PAPER SUBMISSION AND PUBLICATION

Submissions must be original and should not have been presented or published anywhere. Authors of accepted papers must assure that at least one of the authors will attend the conference and present the paper. All submitted research papers in NCEESS 2020 will go through a review process by experts. Authors should follow IEEE format and the maximum length of the paper should not 3500 - 4000 words.The original and quality research papers will be accepted for presentation after reviewing and will be published in conference proceedings after registration. Selected papers will be considered for publication in Marine Engineering Review journal.

Please mail your papers as per the format to nceess20@gmail.com.

IMPORTANT DATES

Submission of Papers	:	**18 March 2020**
Notification of Acceptance	:	**09 April 2020**
Submission with Revision	:	**14 April 2020**
Last Date of Registration	:	**16 April 2020**
Date of e-Conference	:	**21& 22 Dec 2020**

Chief Patron:

Dr.(Mrs). Malini V Shankar I.A.S (Retd)
Vice Chancellor, IMU

Patrons:

Dr. Rajoo Balaji
Director, IMU Chennai Campus

Prof. Dr. K. M. Sivakholundu
Head (CTCE, Academics & Research), IMU

Convener:

Dr. K. Sivasami
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Coordinator:

Dr. S. Thangalakshmi
Faculty, IMU Chennai Campus

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Dr. YVVSN Murthy
Mr. K. Anbazhagan
Mr. C.P. Balaji
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National Level e-Conference on Energy, Environment and Sustainable Shipping (NCEESS 2020)

21 & 22 December 2020

Organized by

School of Marine Engineering and Technology

INDIAN MARITIME UNIVERSITY
(A Central University, Government of India)

In Association with

Institute of Marine Engineers (India)

ABOUTTHE UNIVERSITY

India has had a long maritime tradition and is the 20th largest maritime country in the world. The single largest contributing factor to this glorious tradition is the presence of a strong, dedicated, efficient and reliable reservoir of officers and ratings of the Merchant Navy. The ever-increasing demand of Indian seafarers worldwide is a testament to the quality of education and training disseminated in India.In order to encourage private sector participation in maritime training, the Government of India had announced liberalized guidelines in 1997 and as a result, around 125 Maritime Training Institutes (MTIs) came up in the government and private sector, which impart both Pre Sea and Post Sea training.

The Indian Maritime University (IMU), established through an Act of Parliament (Act 22) in November 2008 as a Central University, is poised to play a key role in the development of human resources for the maritime sector. The impact of technological developments is very much visible in the maritime industry in the recent years. The shipping industry is effectively the facilitator for the global economy and shipping will continue to have an impact on the lives of more and more people.Hence, the vision of the IMU is, to provide quality education and training, to undertake research of international standards, to become an institution of excellence, providing advice, extending support to the Government and to provide guidance, support and supervision to the various training institutions and to act as an umbrella to all maritime institutions in the country. The programmes offered will groom the youngsters as well as the practicing maritime personnel to excel in their area of duties in all disciplines of maritime sector viz. navigational, marine engineering, port management, maritime commerce, maritime law, marine science, ship handling, inland water transportation etc. Globalization of education and the international nature of the maritime industry will drive the University to address the issue of effective quality assurance beyond complying with the needs of the industry, stakeholders and the requirements of the nation.

SCHOOL OF MARINE ENGINEERING & TECHNOLOGY (SMET)

The role of a Marine Engineer is constantly changing with new challenges being regularly thrown up from steam to diesel engines and computer controlled machineries. School of Marine Engineering and Technology is committed to provide systematic and contemporary training in the field of Marine Engineering. In Chennai Campus, B. Tech in Marine engineering is offered, which is a 4 years course. Further, Scholars are also engaged in research under the Ph.D programme offered by the school.

SCOPE OFTHE CONFERENCE

The objective of this Conference is to gather the scholars to present the current developments/ innovations in the domain of Energy, Environment and Sustainable Shipping by exchanging new and valuable information and innovative ideas. This conference includes invited keynote lectures by industrial and academic experts. This would help as a platform for sharing quality research in the domain and knowledge dissemination.

CONFERENCETHEME

The conference includes the following topics but not limited to:

- Clean and Green Energy
- Zero Emission vehicles
- Artificial Intelligence and Robotics
- Novel Materials for Energy Conservation and Environmental Protection
- Port Security Management
- Remote Crewing
- Ship Cybersecurity
- Occupational Health Hazards
- Ship Recycling
- Alternate Fuels
- Power Electronic Converters for Ship Propulsion
- Energy Demands, Future Developments and its Environmental Impacts



NATIONAL LEVEL e-CONFERENCE

ON

ENERGY, ENVIRONMENT AND SUSTAINABLE SHIPPING (NCEESS 2020)

ORGANIZED BY

SCHOOL OF MARINE ENGINEERING AND TECHNOLOGY

21 & 22 DECEMBER 2020

INDIAN MARITIME UNIVERSITY
CHENNAI CAMPUS
&
INSTITUTE OF MARINE ENGINEERS (INDIA)

Day 1: 21.12.2020 (Monday)

Welcome address

Dr. Rajoo Balaji

Director, IMU Chennai Campus.

Presidential Address &
Conference Inauguration

Dr. (Mrs.) Malini V Shankar
I.A.S (Retd)

Vice Chancellor
Indian Maritime University, Chennai

Keynote Address

Shri. Uday Purohit

President,
Institute of Marine Engineers (India)
Mumbai.

Day 1: 21.12.2020 (Monday)

Session (I) Chair

Dr. (Capt.) S. Bhardwaj

Resident Director & Principal
MASSA Maritime Academy, Chennai.

Session (II) Chair

Dr. N. Vedachalam

Project Director & HRD Incharge
National Institute of Ocean Technology (NIOT), Chennai.

Day 2: 22.12.2020 (Tuesday)

Session (III) Chair

Dr. S. Mohamed Ali

Professor, Mechanical Engineering Department
Pondicherry Engineering College

Keynote address

Capt. V. Ramadass

Director, QHSE
Synergy Maritime Pvt. Ltd., Chennai.

Session (IV) Chair

Shri. Pawan Kapoor.

Managing Director - ISF Maritime Services Pvt. Ltd.
CEO - ISF Group International Pte. Ltd., Mumbai.

Valedictory address

Dr. K.M. Sivakholundu

Head – (CTCE & Academics, Consultancy & Research)
Indan Maritime University, Chennai.

Day 1 :- https://meet.google.com/snv-xwdc-suo
Day 2 :- https://meet.google.com/ohm-fcag-zcb

INDIAN MARITIME UNIVERSITY
CHENNAI CAMPUS
&
INSTITUTE OF MARINE ENGINEERS
(INDIA)

Session (I) Papers: Marine Energy, Environment & Management

1. A Perspective Study of Ship Breaking in India and the Impact of International Conventions. and Regulations - **Gopikrishna Chockalingam**, **Dr. K. Sivasami.**
2. New Regulations – Impact of Implementation of Sulphur 2020 Regulation on Seafarers - **Ramadass Venkatarao, Dr. Aprajita Bhardwaj.**
3. Hybrid Energy System and Its Impact On Environment as Clean & Green Energy - Manisha Tikader, **Dr. Geeta Singh, S.S.Biswas.**
4. Studies of Impact On Environment Due to E-Waste and Refrigeration Waste During Ship Recycling Process in India - A Way Out – **Krishnendu Das**, **Dr. K. Sivasami, Dr. N. Das, Dr. S. Majumder.**
5. Air Bubble Lubrication for Hull - **C.P. Balaji**, **Dr. K. Sivasami.**
6. Port Security Management System with Respect to Indian Ports - **B. Uma.**
7. Port Security Management - **Shashwat Dev, Mrinal Nigam.**

Session (II) Papers: **Electrical, Electronics, Control & Automation**

1. Study On Simulation of Fuzzy Compensator for Better Dynamic Response – **Sitangshu Sekhar, Biswas, Arijit Pattra, Rajendra Kumar.**
2. Proof of Concept Model for Demonstrating IoT Based Vessel Control and Monitoring - **Zia Ur Rahman, Anshul Kumar Rai, E. Deepak Cheran, U. S. Ramesh.**
3. Estimation of Forced Cooling Flow to Maintain the Dissimilar Junction Temperature of Xenon Arc Lamp for High Illumination Application **- S.S.Biswas, Arun Kumar Verma, Bipin Kumar P.**
4. Modification in Braking Technology of Ships - **Ritbik Kumar, Sourin Karmakar, Wamiq Asrar.**
5. Energy Storage Systems - Possible Impacts on Maritime Applications - **Dr. S. Thangalakshmi, V. Ganeshram.**
6. Optimizing the Size and Allocation for Distributed Generation with Immune Algorithm - **Dr. S.Thangalakshmi, Dr. K. Sivasami.**

Session (III) Papers: Mechanical and Materials

1. Design and Simulation of Fins for Frozen Seal Valve Using Buoyancy – **Sitanghsu Sekhar Biswas , Venkatesh Rahul , V Vignesh, Akash P, Aswin Harish.**

2. Investigation and Optimization of Turning Parameters on Surface Roughness in Machining of Magnesium Alloy - **Ramesh S, Viswanathan R, K Sivasami.**

3. Design and Fabrication of Savonius Wind Turbine for Electricity Generation – **S S Biswas, Dr. C.S. Boopathi, Saravanan P.**

4. Comparative Study on Stress Intensity Factor of Al7075-T651 Plate with Part Through Elliptical Crack Using Fem and New Man Raju Equation - **A.Sivasubramanian.**

5. Additive Manufacturing for Maritime Industry - **D. Rahul.**

6. A Review On Modern Advancements in Eco-Friendly Anti-Biofouling in Marine Industry – **Anirban Bhattacharjee, Saptak Biswas, Sadananda Chakraborty.**

7. Alternate Fuels - **Anuj Kumar Chouhan, Rahul Singh.**

Session (IV) Papers: Sustainable Shipping

1. Artificial Intelligence and Robotics in Maritime Field - **T. Mohan.**

2. Development of Spinel using Solution Combustion Route and Its Characterization: Potential Material for Abrasion and Chemical Resistance for Marine Structure - **Soumya Mukherjee.**

3. Climate Forcing due to Aerosol and Air Pollution Over South Indian Coast - **Nandhakumar.S.K, Dr Arul Aram I, Dr Sivasami K.**

4. Enhancing Cyber Security Awareness in Marine Industry - **Mihir Chandra.**

5. Alternate Fuels - An Overview - **Hare Ram Hare.**

6. Heat Transfer Correlations for Combustion Modelling for Diesel Engine with Dual Injection of Water Saturated MTBE Solution and Palm Kernel Biodiesel Blends - **N.S.C. Chaitanya, Y.V.V.S.N. Murthy, Surajith Ghosh, Merigala Ramesh.**

7. Recycling - Challenges and Effects in Shipping Industry - **Akshay Raj, Gagandeep Singh.**

PROCEEDINGS

Volume I, 2020

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Proceedings of NCEESS 2020

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School of Marine Engineering and Technology

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Organizing Committee

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Mr. K. Anbazhagan
Mr. C.P. Balaji

Organized by

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Institute of Marine Engineers (India)

I am happy to see that the National Level Conference on Energy, Environment and Sustainable Shipping has attracted a number of worthy papers. I hope that the interested professionals find this collection useful.

I am given to understand that this event was to take place in the early part of the year but could not happen due to the pandemic.

I congratulate the team from the School of Marine Engineering and Technology of IMU, Chennai Campus for organising the event within this year.

I am sure that this enthusiasm will take IMU forward and to greater heights.

Dr. (Mrs.) Malini V Shankar I.A.S. (Retd.)

Vice Chancellor,
Indian Maritime University,
Chennai Campus

It is heartening to see the effort of The School of Marine Engineering and Technology of IMU in organising this National Level eConference. I am told that this is the maiden venture of the SMET, Chennai campus.

Though the pandemic had pushed the plans for the physical event, which was scheduled in April, the Team has worked hard to make it happen through the online mode within this calendar year.

IMU is poised for growth by leaps and such forums fit into the scheme of things. By sharing ideas on contemporary issues of Energy, Environment and Sustainability, the eConference should bring benefit to the students and the professionals. On that note, I am glad that SMET has associated itself with the Institute of Marine Engineers (India). My congratulations to the SMET Team!

I wish success for this event and all other efforts.

Dr Rajoo Balaji

Director,
Indian Maritime University,
Chennai Campus

Conference Schedule

Day 1: 21.12.2020 (Monday)

1000 Hrs:	Invocation
1005 Hrs:	Lighting of Lamp
1010 Hrs:	Introductory Address Dr. K. Sivasami Convener - NCEESS 2020 Head - SMET, IMU Chennai Campus.
1015 Hrs:	Welcome Address Dr. Rajoo Balaji Director, IMU Chennai Campus.
1020 Hrs:	Presidential Address & Conference Inauguration Dr. (Mrs.) Malini V Shankar I.A.S. (Retd.) Vice Chancellor Indian Maritime University, Chennai.
1025 Hrs:	Keynote Address Shri. Uday Purohit President, Institute of Marine Engineers (India) Mumbai.
1030 Hrs:	Start of Session – I (Marine Energy, Environment & Management) Dr. (Capt.) S. Bhardwaj Resident Director & Principal MASSA Maritime Academy, Chennai. (Former Vice Chancellor, AMET, Chennai)
1100 Hrs:	Intermission
1130 Hrs:	Start of Session – II (Electrical, Electronics, Control & Automation) Dr. N. Vedachalam Scientist-F/ Project Director & HRD Incharge National Institute of Ocean Technology (NIOT), Chennai.
1230 Hrs:	End of Session (Day 1)

Conference Schedule

Day 2: 22.12.2020 (Tuesday)

1000 Hrs:	Start of Session – III (Mechanical and Materials) Dr. S. Mohamed Ali Professor, Mechanical Engineering Department Pondicherry Engineering College Pondicherry.
1100 Hrs:	Intermission
1110 Hrs:	Keynote Address Capt. V. Ramadass Director, QHSE Synergy Maritime Pvt. Ltd., Chennai.
1140 Hrs:	Start of Session – IV (Sustainable Shipping) Shri. Pawan Kapoor Managing Director - ISF Maritime Services Pvt. Ltd. CEO - ISF Group International Pte. Ltd., Mumbai.
1210 Hrs:	Valedictory Address Prof. Dr. K.M. Sivakholundu Head – (CTCE & Academics, Consultancy & Research) Indian Maritime University, Chennai.
1220 Hrs:	Vote of Thanks Dr. S.Thangalakshmi Co-ordinator - NCEESS 2020
1225 Hrs:	National Anthem

Session Details

S.No.	Date	Time	Session No.	Title	Paper ID	No. of Papers
1	21.12.2020	1030 Hrs	I	Marine Energy, Environment & Management	EESS-02 EESS-04 EESS-05 EESS-07 EESS-20 EESS-21 EESS-24	7
2	21.12.2020	1130 Hrs	II	Electrical, Electronics, Control & Automation	EESS-01 EESS-08 EESS-09 EESS-11 EESS-26 EESS-27	6
3	22.12.2020	1000 Hrs	III	Mechanical and Materials	EESS-03 EESS-10 EESS-13 EESS-17 EESS-14 EESS-19 EESS-23	7
4	22.12.2020	1140 Hrs	IV	Sustainable Shipping	EESS-06 EESS-12 EESS-18 EESS-15 EESS-16 EESS-22 EESS-25	7

Paper Details

S.No.	Name	Title of the Paper	Paper ID	Session No.
1	1. Ritbik Kumar 2. Sourin Karmakar 3. Wamiq Asrar	Modification in braking technology of ships	EESS-01	II
2	B. Uma	Port Security Management System with Respect to Indian Ports.	EESS-02	I
3	D. Rahul	Additive Manufacturing for Maritime Industry	EESS-03	III
4	1. Shashwat Dev 2. Mrinal Nigam	Port Security Management	EESS-04	I
5	1. C.P. Balaji 2. Dr. K. Sivasami	Air Bubble Lubrication for Hull	EESS-05	I
6	1. Akshay raj 2. Gagandeep Singh	Waste-to-Energy: Current scenario in India and in the global shipping industry	EESS-06	IV
7	Gopikrishna Chockalingam	A Perspective Study of Ship breaking in India and The Impact of International Conventions and Regulations	EESS-07	I
8	1. Sitangshu Sekhar Biswas 2. Arijit Pattra 3. Rajendra Kumar	Study on Simulation of Fuzzy Compensator for Better Dynamic Response	EESS-08	II
9	1. Zia Ur Rahman 2. Anshul Kumar Rai 3. E. Deepak Cheran 4. U. S. Ramesh	Proof of Concept Model For Demonstrating IoT Based Vessel Control And Monitoring	EESS-09	II
10	1. Anirban Bhattacharjee 2. Saptak Biswas 3. Sadananda Chakraborty	A review on modern advancements in Eco-friendly Anti-Biofouling in Marine Industry	EESS-10	III

Paper Details

S.No.	Name	Title of the Paper	Paper ID	Session No.
11	1. S.S.Biswas 2. Arun Kumar Verma 3. Bipin Kumar P 4. Mohanakrishnan V 5. Raaj Vignaes S	Estimation of forced cooling flow to maintain the dissimilar junction temperature of xenon arc lamp for high illumination application	EESS-11	II
12	Capt. Mihir Chandra	Enhancing Cyber Security Awareness in Marine Industry	EESS-12	IV
13	A.Sivasubramanian	Comparative study on Stress Intensity factor of Al7075-T651 plate with Part through Elliptical Crack using FEM and New Man Raju Equation	EESS-13	III
14	1. Anuj Kumar Chouhan 2. Rahul Singh	Alternate Fuels	EESS-14	III
15	T. Mohan	Artificial Intelligence and Robotics in Maritime Field	EESS-15	IV
16	Soumya Mukherjee	Development of Spinel using solution combustion route and its characterization: Potential material for abrasion and chemical resistance for marine structure	EESS-16	IV

Paper Details

S.No.	Name	Title of the Paper	Paper ID	Session No.
17	1. Ramesh S 2. Viswanathan R 3. K Sivasami	Investigation and Optimization of Turning Parameters on Surface Roughness in Machining of Magnesium Alloy	EESS-17	III
18	Hare Ram Hare	Alternate Fuels	EESS-18	IV
19	1. S S Biswas 2. Dr. C.S. Boopathi 3. Saravanan P	Design and Fabrication of Savonius Wind Turbine for Electricity Generation	EESS-19	III
20	1. Ramadass Venkatarao 2. Dr. Aprajita Bhardwaj	New Regulations – Impact of Implementation of Sulphur 2020 Regulation on Seafarers	EESS-20	I
21	1. Manisha Tikader 2. Dr. Geeta Singh 3. S.S.Biswas	Hybrid Energy System and Its Impact On Environment as Clean & Green Energy	EESS-21	I
22	1. N.S.C. Chaitanya 2.Y.VV.S.N. Murthy 3. Surajith Ghosh 4. Merigala Ramesh	Heat Transfer Correlations for Combustion Modelling for Diesel Engine with Dual Injection of Water Saturated MTBE Solution and Palm Kernel Biodiesel Blends	EESS-22	IV

Paper Details

S.No.	Name	Title of the Paper	Paper ID	Session No.
23	1. Sitanghsu Sekhar Biswas 2. Venkatesh Rahul 3. V Vignesh 4. Akash P 5. Aswin Harish	Design and Simulation of Fins for Frozen Seal Valve using Buoyancy Approximation of Extended Surface Heat Transfer	EESS-23	III
24	1. Krishnendu Das 2. Dr. K. Sivasami 3. Dr. N. Das 4. Dr. S. Majumder	Studies of Impact On Environment Due to E-Waste and Refrigeration Waste During Ship Recycling Process in India- A Way Out	EESS-24	I
25	1. Nandhakumar.S.K 2. Dr Arul Aram I 3. Dr Sivasami K	Climate forcing due Aerosol and Air pollution over South Indian Coast	EESS-25	IV
26	1. Dr. S. Thangalakshmi 2. V. Ganeshram	Energy Storage Systems - Possible Impacts on Maritime Applications	EESS-26	II
27	1. Dr. S. Thangalakshmi 2. Dr. K. Sivasami	Optimizing the Size and Allocation for Distributed Generation with Immune Algorithm	EESS-27	II

Proceedings of National Conference on Energy, Environment and Sustainable Shipping
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Modification in braking technology of ships

1st Ritbik Kumar
Marine engineering
Indian Maritime Univerisity
Kolkata, India

2nd Sourin Karmakar
Marine engineering
Indian Maritime Univerisity
Kolkata, India

3rd Wamiq Asrar
Marine engineering
Indian Maritime Univerisity
Kolkata, India

***Abstract*—change is required for everything in terms of evolution, similarly mode of transport also have progression the vast oceanic area, thousands of vessels, millions metric tons of cargoes, oil, gas et cetera, holding worth of 700 billion$ and millions of seafarers sailing around the globe makes it the most vital mode of transport and is more exposed to accidents. To an industry like this, safety plays the most pivotal role.**

Keywords— transport, shipping, accidents

I. INTRODUCTION

Any mode of transport is bound to have accidents. When it comes to shipping industry; Though safety aboard has significantly increased in the last decade as claimed by various maritime organizations but the statistics show scary figures. Due to one reason or the other merchant ships have continued to involve in accidents.

The accidents have not only resulted in financial loss but have also taken lives of officers and crew aboard. Moreover, the accidents at sea also damages seabed, sea depth, marine traffic, sea surface and habitat and harm the marine ecosystem& flora and fauna. Ultimately, it also impacts the weather and livelihood of the people. Our idea deals upon the idea to counter the major number of accidents on cargo ships by suggesting a design of a system 'ECDS AND EBP System' for improved deceleration of the ships to avoid collisions at sea.

II. STATISTICS

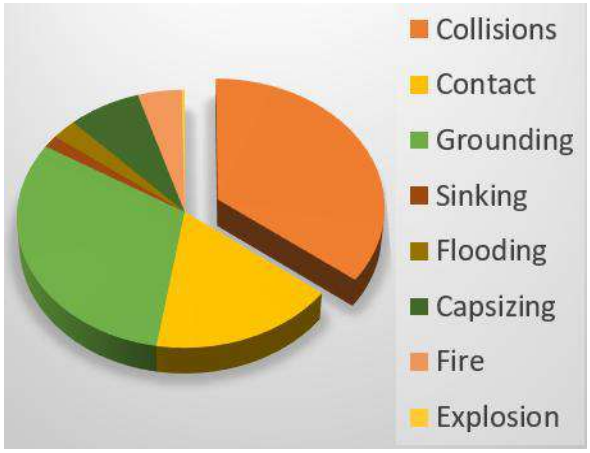


Fig. 1. Statistics of collisions, contact and grounding

Though many preventive measures are taken and many are worked upon, we get big numbers when we go through the analysis of accidents. There were reasons such as the poor maintenance, lack of proper training, equipment failure, natural calamities and primarily collisions. It was reported that approximately 21325 ships involved in accidents leading to 25000 deaths and 8000 injuries in the period (2007-2020). If we do the accident analysis, we find that collisions contribute 36% of the mishaps while contact doing 17% of the damage. Summing them up, we get a huge figure of 53%. So if we focus on avoiding collisions and contact, we would prevent more than half of maritime disasters.

While going through data, we find that 20-25% of vessels involved in maritime accidents are cargo vessels.

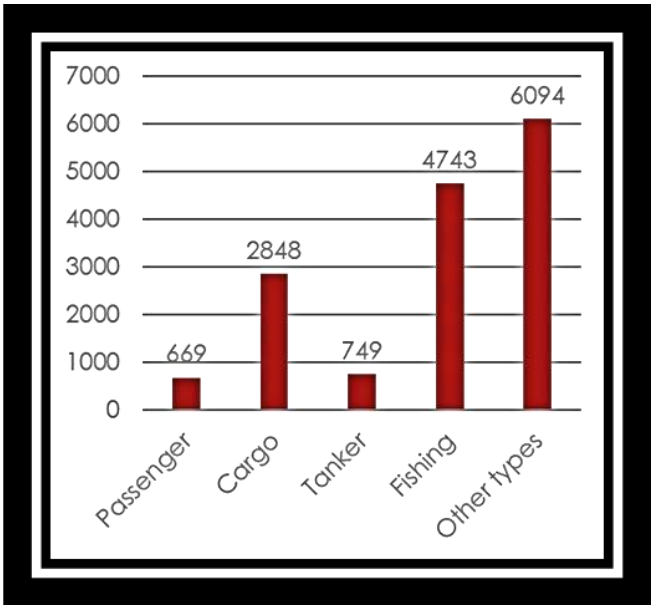


Fig. 2. Statistics of passenger, cargo and tanker

Out of 15,103 ships involved in accidents during (2007-2020) 2848 were cargo vessels as shown by the graph. Our idea focuses to reduce the collisions & contact type accidents on cargo containers ships by reducing the time to stop or decelerate a vessel.

On an average, the length of such ship is 200-300 meters and the average speed is 20-30 knots and the average time taken to bring such a ship to rest, it takes about 25-30 minutes. Here, the major problem occurs. Ships collide with other ships, periphery of ports and icebergs.

III. PRINCIPLE INVOLVED IN DECELERATION / BRAKING OF SHIPS

The reason behind the collisions that is major part of accidents at sea is the slow deceleration of ship. When we look into the functioning of a ship, the ships are brought to rest with the help of propellers and varying function of engine. There are specifically two types of propellers:-

1) Fixed pitch propellers: In this case firstly the RPM is lowered, then it is brought to no thrust position and ultimately the propeller is rotated in reverse direction to acquire reversal or resistive thrust.

2) Controllable pitch propellers: In this case the propeller is brought to no thrust position by bringing the blades at parallel orientation and here the reversal thrust is acquired by reversing the angle of the blades.

The main concept behind the deceleration of ship is countering the forward thrust by the resistance of the ship.When a ship moves in water, there is a viscous drag generated between the submerged hull surface and water particles in contact with the hull. This drag is generated due to the viscosity of water and is directly proportional to the wetted surface area of the ship and varies to the square of velocity of ship.

$$\text{Viscous Drag} \propto (p)(S)(v^2)$$

Where, p= density of water, S= wetted surface area, v= velocity of ship.

Therefore the primary aim of breaking any moving object, is to increase the drag force experienced by the body. This can be done primarily in two ways:

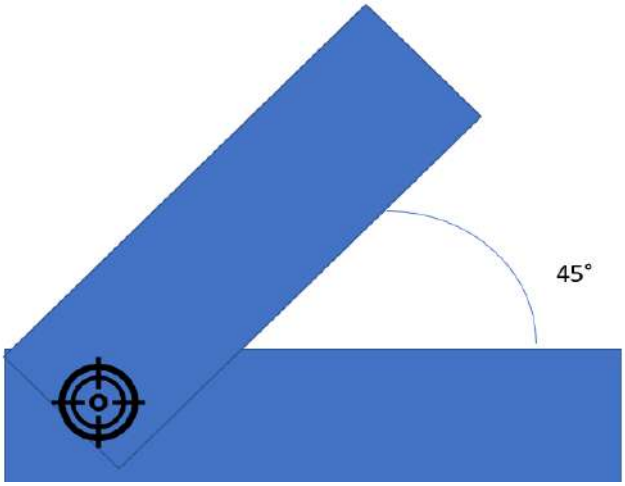
1) Increasing the wetted surface area of ship.
2) Decrease the magnitude or change the direction of thrust on ship.

Our idea focuses on executing both the ways. As a solution to the emergency deceleration problems, we give you the

1. ECDS (Emergency Cargo Drop Stop) and
2. EBP (Emergency Braking Propellers).

A. EMERGENCY CARGO DROP STOP

This system suggests some part of cargoes on ship (10-15%) to be kept in specially designed boxes that would be ferromagnetic in nature or coated with ferromagnetic substances with the ability to be water repellent. These boxes would be kept on a sliding platform in the hold hanged with ropes operated on free fall or hydraulic power system. The boxes would be designed such as that when hanged, these boxes would open into two halves making 45-degree angle between them, this would increase the exposed area and when allowed to touch the sea-bed (when length is approachable) could act as POOL type anchor.



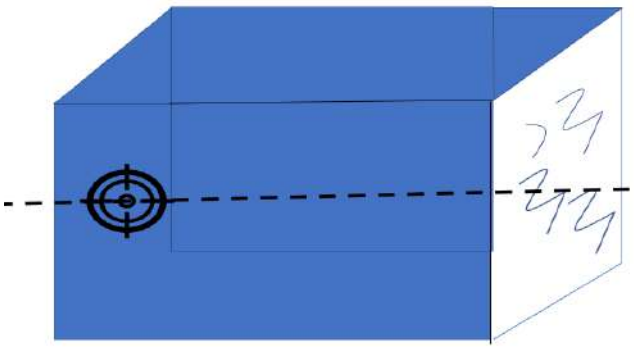


Fig.3. This illustrates the way ECDS containers would be hinged.

Fig.4. This is the 2 D view how the ECDS containers would open up into two parts. Black circle symbolizes the hinge point in both figures 1 & 2.

This system also suggests the incorporation of the thick electromagnetic strips running across the hull below the water line. The strip will activate when the ECDS containers are dropped off through strings or any rope in the sea water, precisely it will activate as soon as the ECDS system starts acting.

When situation suggest a condition of extreme emergency and urgency to decelerate the ship, the boxes with the

platform would slide outwards the hull depicting fin like structures and the platforms would fall and stick to the hull and the boxes will be dropped. As soon as the boxes are made to drop into the water, the electromagnets running across the hull will be activated and the boxes would be made to stick to the electromagnetic strips. The boxes would enhance the amount of the area exposed to the water exponentially adding up the drag force, ultimately increasing the resistive force. When the ship's speed is lowered as per the need, the electromagnets will be deactivated and the cargoes will be heaved up thereafter.

The specially designed ECDS boxes can also be dropped under free fall to the sea bed when the sea bed is approachable distance and they can act as anchors.

This ECDS system would come into function with the help of gear box (installation of this should be near the tail shaft of propeller as per our idea) which will be designed in such a way that the translational motion of the platform with ECDS containers starts as soon as the propeller's RPM is set for lowering(in the case of fixed pitch) or when the blades start orienting themselves in parallel direction(in case of controllable pitch).

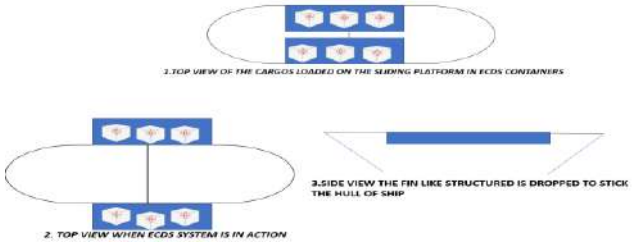


Fig.5. shows the mechanism of the sliding platform that would be used to keep and dispose ECDS containers in the sea as per our design.

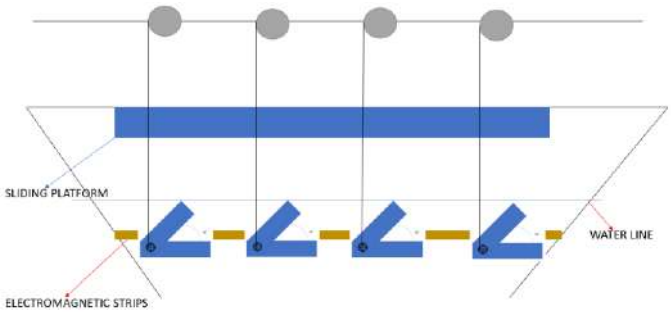


Fig.6. Shows how operated ECDS system would look like. Brown strip symbolizes *the electromagnetic strip while the grey structure could be either some pulley operated system, any mechanic load lifting or lowering device or some hydraulic crane type machinery*.

B. EMERGENCY BRAKING PROPELLERS

The second part of our solution suggests installation of add-ons propellers to the already existing propellers but these propellers will be placed in the front region of the ships. These will completely fit into the ship's side walls maintaining the streamline shape of ships and will only come out when EBP button is pressed. They will then drop into sea to the level of stern propeller and will start to operate in a direction so as to oppose the motion of ship. This will increase the resistance offered to the ship's motion. The stern's propellers' rpm will be then reduced and direction reversed so that it reaches no thrust position. The speed of stern propellers will be then increased in opposite direction so that it matches the speed of EBP and both the propellers end up having the same RPM thus maintaining the stability of ship. After the successful deceleration, these EBP can be retracted back to their original position.

We also suggest the use of these add on propellers for steering ships for sharp turns that are dealing with angular motion but our team still needs to work upon this part.

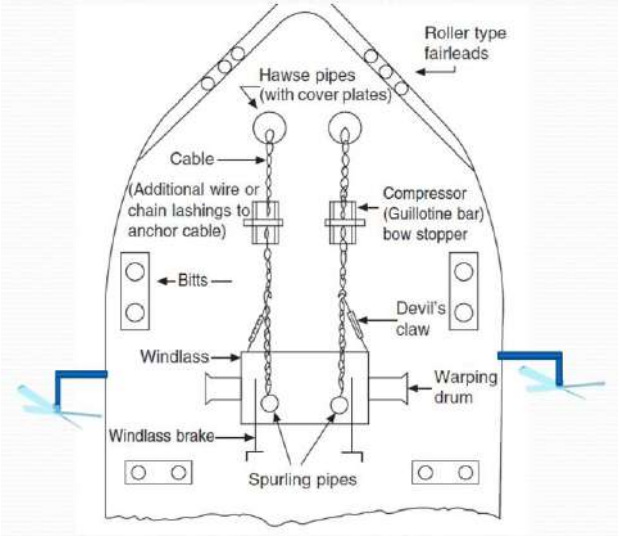


Fig.5. Shows the suggested installation of add on propellers.

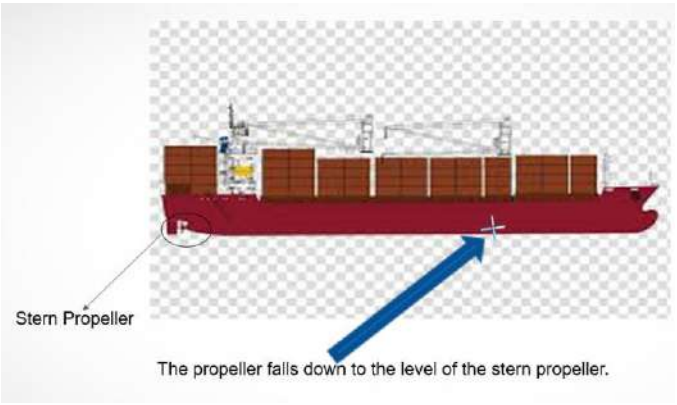


Fig.7.shows the mechanism of Emergency Braking Propellers System.

IV. ADVANTAGES

- Avoid collisions by fast deceleration.
- These ideas can prove to be crucial in life threatening situations. Safety of officers aboard is the primary concern in this industry
- Reduced number of collisions implying greater profits for the owners. Though it might result in damaging some part of cargoes which are stored in ECDS contained but would save the vessel with major part of cargo from wreckage.
- Effective even in extreme weather conditions.
- Quick and effective braking system with low initiation time.

V. DISADVANTAGES

- Might result in the damage of cargo stored in ECDS containers.
- Gear box installation near the tail shaft of the propeller might disturb the primary movement.
- Heaving dropped ECDS containers might be a problem sometimes.

VI. CONCLUSION:

This system as per our design can be very promising in very dangerous situation of collisions and could be helpful in developing an effective and more efficient crash maneuvering. Though installation of such system might cost a huge amount (we have not worked upon the expenditure to set up this project), the primary concern and motive of this project is to deliver safer conditions to a situation which is life threatening.

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Port Security Management System In Indian Ports

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***Abstract*— The maritime security aim is to assess the level of security within and across the maritime network. Regulatory assessment models are wont to assess risk levels and examine the impact of policy options. Usually in terms of the prices and benefits of a regulatory proposal. This paper reviews the event, application and adequacy of existing risk assessment and management models to maritime and port security. In particularly, we had observed the problems with security perception, value and impact, Discussing the restrictions of the present regulatory framework in providing an integrated and effective approach to maritime security risk assessment and management, including for supply chain security.**

Keywords— security, maritime, port, management

I. INTRODUCTION

Throughout the last two decades, the focus of port policies in India has been on restructuring the port industry and reinforcing the quality of provided services (i.e. by integrating ports in supply chains).Ultimately, the port security planning process must develop and implement measures to scale back port vulnerabilities. It also refers to the measures employed to determine that the treaties entered into with other countries are also enforced appropriately. Additionally, port security also deals with maritime security – security of the marine commercial areas, coast lines, and beaches.As a part of the maritime security, comes under the purview of the International Maritime Organization (IMO) and the International Ship and Port Facility Security Code that was introduced in the year 2002 as a part of the Safety of Life At Sea (SOLAS) convention Apart from these two organizations, a lot of port security measures are also incorporated from India's own marine security enforcement agenda.

It is vital because marine transport is a very thriving and extensively used form of conveyance, especially for cargo transportation. Since the cargo containers could be used inappropriately, it becomes important that proper monitoring and inspection of the transferred cargo is carried out. this presentation provides an summary of the essential aspects of port security and identifies many of the challenges facing ports. It's also intended to supply local governments and the commercial maritime industry with a standard basis upon which to determine port security standards and the outcomes expected from meeting those standards.

This can enhance the power of port security managers to execute their risk management responsibilities and to live the impact and effectiveness of the safety measures implemented within the port.

II. INTERNATIONAL REGULATIONS

The important regulations regarding security in trade and transport have been undertaken by IMO. The maritime security-related emphasis of the IMO work became evident early in 2002. By the end of the same year, IMO had adopted a major security-related amendment to the Convention of Safety of Life at Sea (SOLAS).

A. SOLAS and Maritime Security

On 1 July 2004 a new maritime security regulatory regime was adopted into the International Convention for the Safety of Life at Sea (SOLAS), 1974 as amended, namely chapter XI-2 on Special measures to enhance maritime security, which includes the International Ship and Port Facility Security (ISPS) Code. The ISPS Code entered into force a mere 18 months after its adoption by the SOLAS Conference in December 2002.

It was adopted in response to the devastating terrorist acts of September 11 (2001) in the United States, following which, the international community recognized the need to protect the international maritime transport sector against the threat of terrorism..

B. International Ships and Port facility

The ISPS Code has two parts. Part A is mandatory for all the contracted countries, while Part B contains recommended actions. Some countries, including the US, have adopted the optional provisions of the second part as mandatory. The ISPS Code established three security levels denoting the need for normal (level 1), heightened (level 2), and exceptional (level 3), security measures, respectively.

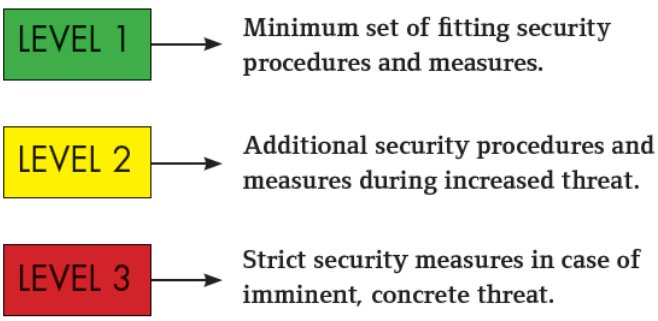

Fig. 1. Level of security

The implementation of the Code's requirements and the respective certification of vessels and shipping companies is the responsibility of the flag state, while ports' national authorities are responsible for inspecting and certifying proper implementation. These provisions cover all types of ships that are bigger than 500 grt, mobile offshore drilling units and port facilities serving ships, which are involved in international voyages.

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The amended SOLAS introduced a new technological security measure for ships. This is the automatic identification system which enables ships to transmit a unique identification signal in order for the shore operational centers to observe the ship's route. Ships are also required to have on board a security alert system transmitting a security alert to a designated competent authority when activated in emergency situations, and the continuous synopsis record (CSR) that contains details of the ship (including: name, flag, port of registry, IMO number, and owner information).

III. THE MAIN PROVISIONS

The development of a port's security policy statement by the signatory states; the establishment of a port security assessment. The identification and evaluation of the critical assets and infrastructures that are important to protect; The development of a port security plan, compatible with the ISPS Code for a port facility security plan; and the increased security awareness of personnel training.

IV, Developing and Implementing a Security Plan

Ports are busy areas and are spread over a very large area. This would mean that certain areas of the ports can be inaccessible all the time as far as patrolling is concerned and therefore could lead to stealing of cargo from the cargo containers.

It could also involve the smuggling of weapons and arsenal into a country and issues of stowage and illegal immigration. Port security helps to solve these problems of inaccessibility and thereby reduces the cargo pilferage that takes place

. Fig. 2. Modern navigation facilities

Oil cargo is carried extensively in the oceanic areas. If attacks from pirates and terrorists cause oil spill or even worse, light up the entire oil tanker, it could cause a major disaster with respect to the environment, resources, and security of countries. Maritime security attempts to block any such activities that could be carried out.

The Coast Guard along with a number of other government agencies helps to enforce port security in respective countries. This is because the Coast Guard is responsible primarily for enforcing marine security.

The requirement of maritime security has increased in recent times. Since terrorists and pirates have started using the marine route to cause greater levels of damage to the society, it becomes necessary that the countries try and incorporate a systematic law that will help to preserve the security of ports and overall marine areas.

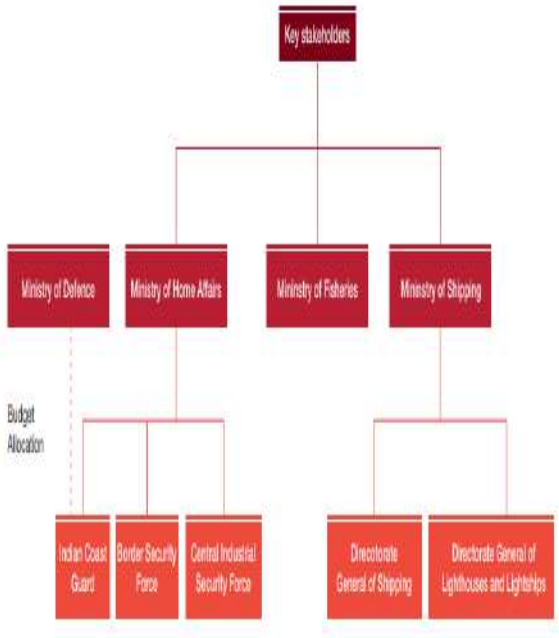

Fig. 3. Stakeholder distribution

A. Port Security and Risk Assessment: Threat –Based Decision Making

- Security vs. Access: Measures to be taken in order to restrict use of waterways and port facilities.
- Measures may restrict access to information.
- Security vs Commerce: Measures may entitle direct and indirect capital costs.
- Security vs. Port Environment: Measures may require that more capital resources be devoted to security vs. commercial use.(eg, staging areas, screening points, buffer zones, protected zones).

B. Maritime Safety Committee

The Maritime Safety Committee (MSC) associated with maritime safety and maritime security associated with the scope of IMO, covering both passenger ships and every one sorts of cargo ships. It includes updating the SOLAS Convention and related codes, like those covering dangerous goods, life-saving appliances and fire safety systems. The MSC concerned with human element issues, including amendments to the STCW Convention on training and certification of seafarers. The key responsibility of MSC is a a vast selection of issues including goal-based standards, autonomous vessels, piracy and heist against ships, cyber security, e-navigation and also the modernization of the worldwide Maritime Distress and Safety System.

C. Industry/Government Partnership

Cooperation of industry and government is necessary to address the complex issue of maritime security. To achieve cooperation, the security departments of seaports must develop partnerships with law enforcement and the transportation industry's shippers, carriers, and insurers. Profitable port business and trade relationships are dependent upon the security of the trade corridors through which a port's business is conducted.

D. Port Security Goals and Principles:

In the process of developing a security program, the emphasis should be placed on deterring, preventing, detecting, and reducing the losses attributed to criminal activities. In order to achieve, the port security operations must be proactive rather than merely reactive. This requires intelligence and investigative coordination with law enforcement agencies and the security departments of the maritime industry companies utilizing a ports facilities.

E. Port Management and Security Planning

Port operations management and security at a marine terminal involve extensive and detailed planning considerations that has got to be coordinated with the ports security program. A level of consistency between a ports operational policies and procedures and its security programs. Effective port security scheme is achieved by integrating port planning and operations functions with port security.

F. Port Security Planning Cycle:

Essential to port security planning is that the ability to document and measure evidence of security threats, vulnerabilities, loss control, and therefore the success of security measures implemented. The security planning cycle is both strategic and tactical in nature. It should be in a dynamic process subject to adjustment as operational circumstances demand. It requires intelligence inputs to research security threat conditions, also as an assessment of vulnerabilities and an evaluation of the suitability of security countermeasures being implemented.

In developing the plan for implementing port security operations, the subsequent criteria should be considered: (a) the port's vulnerability to potential threats, (b) the effect of security measures on the port's efficiency and operations, (c) availability of funds, (d) alternative measures available, and (f) evaluation of all available security capabilities, internal and external.

The elements of a port security plan should be carried out in coordination with such entities as the Nations coast guard, customs service, port authority, local law enforcement authorities, harbor master, marine terminal operators, etc.

G. Implementation of the Port Security Plan

Three keys are very important in the implementation of Port Security Plan are as follows.

1. To a successful implementation of any port security program is support of senior management.

2. The commitment of port personnel. Port personnel will generally be more curious about the successful implementation of a security plan if senior management has authorized and supports its development.

3. Integration of security into the ports overall management, planning, and operations.

H. Physical Access Control

The importance of controlling the physical access to the port facility, its installations, and cargo is paramount. Once physical access has been achieved by criminals, cargo can be stolen or subjected to various forms of exploitation.

In addition to exploiting cargo, other illicit activities can occur within the port. These activities may include smuggling of weapons, drugs, currency, contraband goods, and stowaways, or even the placement of an explosive device within a containerized shipment.

Further, breaches in security that allow criminals electronic access to cargo documentation makes criminal exploitation easier, particularly with the collusion of seemingly legitimate companies fronting for criminal enterprises.

Port security operations may necessitate the ability to take up positions at all entry points, open storage areas, and warehouses throughout the port and inspect the identification papers of arriving workers.

It may also include being capable of controlling the movements of trucks transporting cargo through the port, and

searching containers, warehouses, and ships in port as well as in the anchorage awaiting a berth.

I. INFORMATION SECURITY

Port security must be prepared to counter not only threats posed by physical access to a port but also access to information. Unauthorized access to information used by a port in the conduct of its business can be exploited just as effectively as access to the port itself.

Access to information, such as the contents of containers, is a growing problem in the area of maritime security. Port security programs must address methods and procedures for ensuring information security.

J. Port Security Training

Becoming effective in implementing port security measures and procedures requires competent training. Training of the port security force and supervision of daily security operations are two of the most important responsibilities of port security management.

Port security departments should seek the establishment of regional port security training centers with cooperation of national and international organizations, where port officials, law enforcement, and customs personnel can receive training.

Fig.4. Security Training for Seafarers with Designated Security Duties:

II. OBJECTIVES

- Establishing a framework to identify security threats and take preventive measures against security incidents affecting the ship.
- Implementing roles and responsibilities for ensuring security
- To make ensure the early and efficient collection and exchange of security-related information.
- To provide a strategy for security assessments so on have in situation plans and procedures to react to changing security levels.
- It must employ all sorts of intelligence, promote awareness within the port community, conduct training, practice preparedness, and exercise security plans.

Fig.5. Security Challenges Ports and Dockyards for Guarding:

Ports and dockyards are active zones with constant activity cover a really large area. Thus security of the vast area having containers and other equipment provides protect criminals and miscreants. Cargo containers with high value goods are the attractive targets for criminals. Criminal gangs at ports and dockyards are specializing in pilferage of products.

There's a bigger vulnerability of theft, cargo pilferage, smuggling then on at the ports. Additionally there's also a priority over movement of illegal immigrants in and out of the country through smaller ports which can get on the charge of PSA within the near future. While much of the world is roofed by surveillance there are an outsized number of gaps which require physical coverage by patrols particularly in the dark. At dockyards sabotage of specialized shipping equipment also as ships is additionally a serious concern.

Guards would need to be deployed in small detachments and never but a buddy pair given threat perceived as criminals are going to be frequently armed. There are restrictions on carriage of arms at ports and dockyards, thus armed guards where necessary will need to conform to an equivalent and can be approved by the PFSP

Communications will need to be provided to guards also as guarding detachments given the massive area to be covered. Independent audit is suggested from time to time to make sure effective and efficient guarding.

Provision of ancillary services like firefighting and disaster management can also be considered by PSA by creating additional capabilities.

Fig.6. Safety kid PSA on Vessel

Responsibilities of ship security officer (SSO) are:

- The main duties of the ship security officer (SSO) include implementation and maintenance of a ship security plan along with the port security officer (PSO).
- As per the ISPS code, every ship must have a ship security officer, who holds the key responsibility of the ship's security.
- Execute and maintain the ship security plan (SSP)

- Security inspections are to be done at regular intervals to ensure that proper security steps are taken.
- Modifications to the ship security plan by considering various aspects of the ship .
- Help in ship security assessment (SSA)
- Ensure that the ship's crew is correctly trained to take care of a high ship security level
- Enhance security awareness and vigilance on board ship
- Guide ship's crew by teaching ways to reinforce ship's security
- Report all security incidents to the corporate and therefore the ship's master
- Taking view and suggestions of the corporate security officer and therefore the port facility security officer into consideration while making amendments to the ship security plan

The Designated Person Ashore (DPA) is the 'keystone' to provide the structure and support for an efficient and effective Safety Management System onboard a vessel. Required by ISM Code for all commercial vessels over 500gt, the DPA is especially designated to ensure a reliable connection between the company and the crew and to supervise the safe operation of the vessel.

The Key responsibilities of Designated Person Ashore

(1) Ensure the safe operation of each vessel,

(2) Monitor the safety and pollution-prevention aspects of the operation of the vessel and ensuring that adequate resources and shore-based support are applied, and

(3) Provide a link between the Managing Company and those on board, with direct access to the highest level of management.

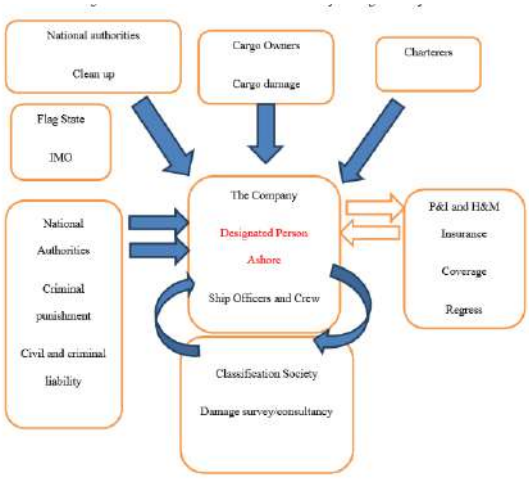

Fig.5. parties involved in an effective safety management

III. MARITIME SECURITY REGULATIONS:

The marine police force created under the Coastal Security Scheme (CSS) that was launched in 2005. The intention of the CSS is to strengthen infrastructure for patrolling and the surveillance of the shallow areas close to the coastal region. The concept of a marine police force was not new in India as Tamil Nadu was one of the first states to establish a separate division in the police force to oversee the maritime dimension of security.

The Coastal Security Police (CSP) established in 1999 in the State of Karnataka due to rising incidents of smuggling and concerns about terrorist through its coasts.

Fig.7. Security Coastal Security Police

The personnel of the Central Industrial Security Force (CISF), coordinated in the joint operations with the Coast Guard, the Indian Navy and the marine police to face threats from the seafront. They are deployed to ensure the security of the major ports in India. All the main ports in India are International Ship and Port Facility Security (ISPS) compliant and possess a security plan, security personnel, and equipment.

The major ports and few non-major ports has Vessel Traffic Management Systems (VTMS) for monitoring and regulating vessel traffic, identifying potentially dangerous vessels. The community of fishermen also plays a vital role in the surveillance architecture by gathering intelligence information and strengthening coastal security.

The Government of India (GoI) also launched the coastal surveillance network project for the protection of the nation's coastline from undetected intruding vessels.

The coastal radar chain, the automatic identification system and VTMS together comprise the coastal surveillance network.

The national automatic identification system ; network supplements the coastal radar chain by installing 84 electro-optic sensors on lighthouses to track and monitor maritime vessels by receiving feeds from AIS transponders installed in these vessels.

The above discussion reveals that there are different ministries associated with the major maritime legislations. The Indian Ports Act, 1908; the Major Port Trusts Act 1963; and the Merchant Shipping Act, 1958 are under the purview of the Ministry of Shipping.

The Ministry of Defense authority for the implementation of the Coast Guard Act, 1978; and the Indian Maritime Zones Act, 1976.

IV. NATIONAL AUTOMATIC IDENTIFICATION SYSTEM:

The DGLL lays the foundation of national AIS network by establishing 74 shore stations on existing lighthouses along the Indian coast for facilitating marine navigation and tracking of SOLAS vessels. The AIS network intent to track all SOLAS compatible vessels and also those carrying transponders as per the Directorate General of Shipping's notices.

This will come up with an overall image of AIS-compliant vessels along the Indian coastline. Thus, apart from management, the AIS network will aid the navigation and creation of maritime domain awareness along the coastal region.

Biometric ID cards for coastal fishermen

The scheme is being operated with the following components:

- Reinforcement to coastal states/UTs for data collection and authentication
- Personalization and creation of biometric ID cards
- Key management system Establishment of central servers

Objectives of the scheme are:

- To entitle every Indian coastal fisherman through the issuance of application-oriented bio metric ID cards.

- To establish a National Marine Fishers Database (NMFD) which may be accessed by all authorized agencies, both at the Central and state/UT levels.
- Reinforcement coastal security and reduce threats from sea routes.

- Issuance of national biometric ID cards/Marine Fishers Identity Cards (MFIDs) to eliminate duplication of cards presently issued to fishermen by different agencies/states –In Maharashtra almost 72,000 cards are distributed @ Andhra Pradesh: 13,000 distributed.

a. Coastal Surveillance Network

- The Coastal Surveillance Network has been found out by the ICG to enhance the coastal security mechanism within the country.
- This network comprises a sequence of static sensors having radars, AIS, day/night cameras and met sensors at 46 locations along the coastline and islands.

b. Vessel traffic service

The scheme of VTS is to strengthen the security and efficiency of navigation, make life in safe, and defend the marine environment, work sites and offshore installations from possible adverse effects of maritime traffic.

This objective is achieved by integrating variety of sensors like radar, receiver (DF), GPS, directional GPS (DGPS), and hydrological and meteorological sensors, which give an overall geographical picture of the world to reinforce maritime domain awareness.

c. RFID in shipping Industry:

In the world of shipping, RFID offers quite just protection against theft and fraud. It aid business people in track damage, loss, error, expiration, slow delivery, and more. Shipping crates and containers are the foremost popular thanks to ship cargo round the world. "Active RFID Tags are often wont to track containers in real-time in yards and docks. Ultra-high frequency

RFID has long identification distance and accelerates identification." briefly, RFID:

- Offers Visibility of Real-Time Cargo Movement
- Helps Accelerate the Speed of Delivery
- Increases Accuracy
- Improves Efficiency

In addition to shipping crates and containers, RFID tags could also be incorporated into heavy duty wood box designs, part specific boxes, light duty boxes, and far more. If RFID seems like a winner for your company's packaging and shipping needs, Valley Box can help.

d. Community interaction program

The ICG has been involved in training the fishermen communities within the coastal regions to assist them keep off threats from the ocean as they function the primary line formation in India's coastal security architecture.

Coastal security awareness drives/campaigns are conducted by the Indian Navy and ICG altogether coastal districts of the country so as to raised prepare the fishermen and coastal communities and to function the 'eyes and ears' of the Indian coastal security mechanism

e. Budget Analysis:

Today, priority is being given on the coastal security infrastructure in India; however, the threats to coastal security are different and highly complicated.

The remoteness of the vast coastline makes coastal areas susceptible as boats can land backstairs without being detected. The gulf areas of Gujarat likely Sunderbans are particularly susceptible to clandestine activities as they're interconnected through small islands where mangroves and

sandbars provide shelter. Dhows (large wooden boats), which are extensively used for trade, are often involved in illicit trade and smuggling.
The fortification of land borders has increased infiltration through sea routes.
Discovery of vast hydrocarbons within the Indian EEZ has complicated things.

f. Some Suggestions are given below:

- Effective usages of Maritime surveillance system is a combination of both various software and hardware modules which together provides the surveillance inputs. Micro satellites, Pico satellites, SAR technology, radar satellites, Inmarsat etc. have to be improvised with updated technologies space based surveillance.

- Adopting innovative ideas & research and development programs has to be carried out periodically.

- Professional Training programs has to be implemented irrespective of any departments.

- Like, Professional Port managers Program, Port, Ship & Maritime Security Training programs , Port Security Management workshops, CPE-Certified Port Executive Program, Online Sea port Security Training System , Port Security & EXIM etc

- Giving adequate training and operational knowledge of using satellite phone and VHF radio to all fisher mans ,coast guards and other protective guards like CISF ,Marine Police etc

- These skill development programs provides training and risk management solutions to meet the vulnerability from coast to coast. Cost-effective and timely training programs which help to meet the objective of remaining abreast of regulatory changes, best practices in the industry, and changing technology and security requirements.

V. CONCLUSION:

In conclusion, Mutual cooperation between different stakeholders is very important when improving maritime security management. Situational awareness and teamwork both nationally and internationally would be regarded as good and well developed maritime security measures.
A viable maritime security program is sweet business. While the implementation of a security program will entail the expenditure of funds, that expenditure are often quite offset by the savings security can provide.
The value to a port of losing a shipping company's business due to inadequate port security must be considered. We must begin to think beyond the short-term cost and appearance at the future benefits like increased cargo operations which cause increased port revenues.

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Additive Manufacturing for Maritime Industry

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***Abstract*— Shipbuilding has always been a complex and time consuming process with the amount of delays in manufacturing and testing. Thus to speed up the process it is recommended that we bring in Additive Manufacturing (AM) also known as 3D Printing. AM technologies have found an industry in which they can bring great innovations for development. As in other fields, the maritime sector is increasing the use of 3D printing technologies and renewing itself according to different needs. This study presents the marine applications of 3D printers which has a wide range of working field. In addition, the latest technologies, projects and applications of 3D printer technology in the maritime industry is examined.**

Keywords—additive-manufacturing (AM), cost-saving, eco-friendly, ship-repair

I. INTRODUCTION

The benefits of AM are not unique to these two industries. The potential to lower marginal cost, reduced material usage, save weight and time, and develop highly complex designs are compelling advantages of AM technology across industry sectors. 3D printing, known industrially as Additive Manufacturing (AM) has rapidly revolutionized production processes and products within a great range of industries in the last few years. This is caused by specific added values such as weight reduction, free complexity, localized production and many more which is possible because of the AM process. AM is defined as the 'process of joining materials to make parts from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing and formative manufacturing methodologies.', ISO/ASTM (2015).

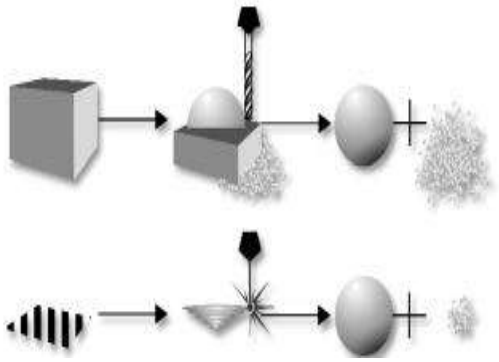

Fig.1. The differences between AM and the traditionally used subtractive manufacturing technologies are schematically shown.

Examples of these are drilling, CNC milling, bending, etc. which are common within the maritime construction sector.
AM has many opportunities and challenges that require introduction before using this technology. There is a set of technological challenges for AM that are inherent to the process. AM does not benefit from economies of scale, since the costs per product do not decrease with increasing numbers. This makes it more suited for one-offs or small series than mass production. The material integrity, which has a connection with surface finish and post-processing is also a challenge; since AM uses layers to build up the material, properties vary along the direction perpendicular to the layers. The layers also result in a surface alike stairs in this direction. These two effect usually result in the need for postprocessing in the form of heat treatment and/or machining. AM will always be a trade-off between speed and accuracy and will always be built up in layers with the resulting effects. However, there is still a lot of research to be done on these subjects to be able to quantify and reduce these challenges. The second set of challenges result from the fact that AM is a relatively new technology and can be (partially) considered temporary. To rise to these challenges, close collaboration of maritime construction sector, AM machine manufacturers and regulatory bodies is required. Only then can new regulations be made on which new research and cases can be based. Standards can follow from these rules and with standards, training becomes relevant as experience is valid over time. Intellectual property also requires close cooperation between engineering and production as well as new laws for property and liability. On top of that, to enable this collaboration and standardisation, the technological challenges need to be clear, within the previous decade:

• Costs have decreased a hundred times for the most inexpensive 3D printers
• Speed has increased more than a hundred times for the most professional 3D printers
• Revenue on printer hardware has increased ten times We are now entering a decade of commercial 3D print mass production.

3D printers still have some serious limitations but the 3D printer industry is dealing with that. The new technologies will disrupt the present ones. Professional 3D printers will mature from the handmade machines of today to mass production and maybe even 3D printing.

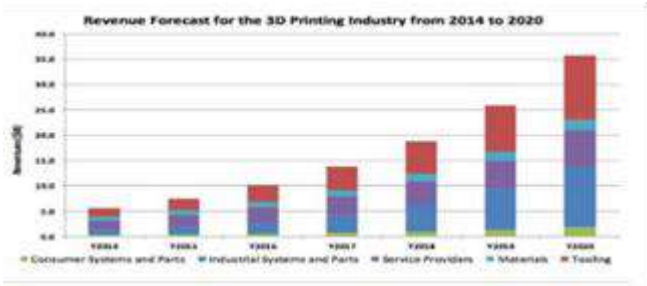

Fig .2. Revene forecast for 3D printing.

The present 3D technology is only available for production of auxiliary components for ships and particularly components and spare parts for pumps, valves, heat exchangers, engines, propellers and catalysers. The photo shows the first 3D print jet engine that actually works. 3D print is competitive when the part printed is characterized by:

- High degree of customization
- Complex design
- High kg price of the component
- Leveraging value due to improved performance
- Urgency of delivery
- Consolidating many components into one

II. BENEFITS

2.1 Saving weight and materials

In case of a propeller the better you get at designing cavities, the more weight and material you save. This is particularly interesting if :

- The material is expensive
- Weight savings enable functionality
- Saving weight saves energy

Look for processes where weight is important. Maybe you can substitute aluminium with a 3D printed hollow steel part. Imagine cavities within the propeller reducing the specific density enough to make it weightless in sea water. In that case you could switch propellers without dry-docking,

2.2 Single piece machinery parts

You can save a lot of leaks and trouble if you 3D print one component instead of assembling a device from several components. This is particularly interesting if the device works with hydraulics, water or gasses under high pressure Single piece devices also save assembly and processes justifying the extra cost of 3D print. Heat exchangers and catalysers are good examples of devices which would benefit from 3D printing.

2.3 Complex Geometry

3D print is a tool for complex geometries. You would never choose 3D printing if you want geometries you can extrude – like plates, cylinders, pipes, beams etc. or order from a shop. 3D printing is superior to milling for complex geometries where the volume of the finished component is small compared to the volume to be milled

- Shells
- Lattices
- Mesh and sieves
- Curved, wavy, hilly shapes that are stronger and more efficient than flat smooth surfaces.

2.4 Accurate Cavity Moulds

Molds reverse the relation between volume kept and volume removed, so 3D printed moulds can often compete with milling. Sand-printing molds is actually one of the few technologies used for mass production with 3D printers. Addition of multiple moulds could be the way to bridge the gap between the size of 3D printers and the size of ships.

2.5 Just in time spare parts

It is of course easier to 3D print from digital files than from 3D scanning, so we expect to see an entreprise 3D scanning all spare parts to a 3D data base to be used by the 3D printer on board. 3D printing spare parts on board has several advantages:

- No inventory of spare parts on board
- No waiting for vital spare parts delaying the ship.

2.6 Instant Repairs

Spray 3D printers can add material on the surface of existing components. This way existing components can:

- Be repaired
- Have new harder and more wearresistant surfaces
- Have surfaces and coatings otherwise impossible to manufacture. Spray printers are expected on the market this year. A spray 3D printer can be a valuable tool in the workshop on board.

2.7 Faster Product Development

BMW, Audi and Airbus use 3D printing as a way to speed up the development process. The entire prototype car can be made from 3D printed parts. It is much faster than producing handmade prototypes and the parts are much more like “the real thing”. Late-ordered or delayed parts from subcontractors can be 3D printed tto meet deadlines. These prototype 3D prints can later be substituted by mass produced traditional components.

III. CURRENT SCENARIO

Maritime industry is characterized by heavy utilization of equipment and machinery and by really specific operating conditions. Ships work in a very unique operational context, and that makes the requirements of reliability and safety particularly critical (Nenni & Schiraldi, 2013). The type and quantity of the spare parts that must be on board a ship is imposed by the authorities for its safety, or suggested by the original equipment manufacturer (OEM) in order to avoid unexpected breakdowns and ship downtime, or even by experience. Spare parts inventory is necessary, but it costs (mainly in capital, and in some cases in available

space). Various optimization techniques are used. Nenni & Schiraldi, (2013) propose an approach to calculate the optimum level of inventory for spare parts of ship equipment. Eruguz, Tan, & van Houtum, (2015) consider an integrated maintenance and spare part optimization problem for a single critical component of a moving asset for which the degradation level is observable. We conducted interviews (semi structured) with people working in the maritime industry, in order to get an understanding of the supply chain of the spare parts of the ships, and get an idea of how this can be changed with the introduction of additive manufacturing. The need for a replacement may occur either because the predetermined stock has fallen below the threshold, or before a predetermined maintenance or because of an extraordinary damage. If the replacement is not in stock at the ship, then a request is send to the land office (usually by the chief engineer). In the land office, after approval from the technical department, the request passes it to the procurement department. The purchasing process is pretty much typical (Purchase Order, Request Quotations, Receive Quotations, Select the supplier, Order, Receive order, Invoice). In this simplified diagram (fig. 3), one must note that the ship is away from the base and changes location. The spare must be timely delivered at the next port that the ship will reach. There is also an option to purchase an imitation of the spare part, or order it at a local workshop. If the requested spare part is out of stock in the chosen supplier's inventory, that must be requested from the regional warehouse, the peripheral warehouse, or finally at the OEM. If it is out of stock at the OEM, then it will be manufactured (as soon as there is economic batch). The spare part made by the AM is comparable with the part made by the traditional method as much stronger and long lasting. Only concern was the cost of the AM machine, and the cost to build the part.

IV. CONCLUSION

3D print is a competitive alternative to traditional production methods when the product or part is characterized a high degree of customization and low production volumes. In order to benefit from the distinct advantages that 3D print allows for, such as complex structures or lightweigth, the object requires re-thinking and re-design. This requires specific competences and an in depth understanding of 3D print. Although 3D print technology is constrained by size limitations at the moment and the maritime industry per definition deals with large objects, there is no reason to believe that the technology is irrelevant. We do, however, need to explore the current limitations. By applying a collaborative approach and engage with print technology providers and experts, the maritime industry can take part in the technological development, to their benefit. The technology is still in its infancy, but the pace of development, suggests that we need to engage now, if we are to succeed. Danish stakeholders have, traditionally, been on the forefront of global maritime development. It is only natural, that we continue to be, by curiously exploring new technologies and their possible to predict the specific impact of 3D print in maritime. That in itself is a reason to continue the exploration. 3D print is one increasingly.

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Port Security Management

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***Abstract*—This document aims at analyzing facts and figures relating to the various security measures that are currently being under taken and could be taken in order to improve the efficiency and maintain the security of the ports**

Keywords— Computer Stimulation, port security management, nuclear detention technologies, quick reaction team, automated locomotives, microchip installed identification card, cyber security.

I. INTRODUCTION

It is imperative for any country that wishes to extend its economic influence to protect its maritime interests. Ports play a vital role in the development of a nation, as it is here where most of the economic activity takes place. The growing maritime traffic and ever enlargement of demands only adds to the stress.

The money involved in the activity increase the potential threats to the ports. Hence, security and proper management can aid to preventing any disruption in the smooth growth of a nation. The threats that ports face can range from a disaster due to minor human error, to a well-planned terrorist attack. Ports just like airports can act a gate for the entry of an epidemic into a country. With the plethora of container and various resources it all comes down to efficiency in managing and security of the port.

The numbers of people that work on a port also add to the risks. Effete practices are something that is very characteristic of a human and depends upon an individual's moral values. Security management can be made more efficient by reducing human presence and increasing the process of integration of technology to various port related activities. Building of a complex relation between technology and humans can ensure security of the port to a great extent.

II. TRADES

A. Selecting a Template (Heading 2)

In this contemporary world, 90% of the international cargo is transported through ships. Every year the port traffic is increasing by the rate of 6 to 8%. Developing countries like India and China are major drivers for port development due to their high economic growth rates. India is having large growth in international trade (about 25% during 2003 to 2009).

B. Maintaining the Integrity of the Specifications

Different ports in India plays vital role in the economy of the country. Some major ports like Mumbai port, Ahmedabad port etc. exports tonnes of carriages. The capacity of 13 major ports in India is likely to increase to 1459.53 million tonnes by 2020 while it was 616.73 million tonnes in 2009 to 2010.

Although 200 minor ports are playing their vital role as well. Current scenario in shipping industry is giving overwhelming results. Some of them are mentioned below: -

a) 118 maritime projects requiring $ 7.7 billion investments have been approved in the last four years

b) Major ports recorded highest ever capacity addition of 100.4 MMTPA in 2016-17.

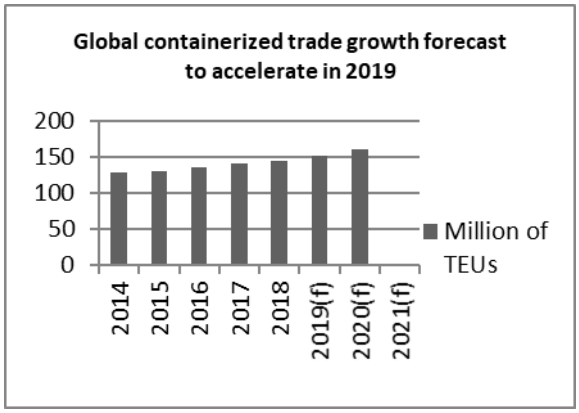

Fig.1. Total world container volume with year over year change

III. TRAFFIC

Traffic management in ports help in improving the efficiency of port's security. The global traffic at the ports is in increasing every year. Countries like China, Singapore, South Korea, United States of America etc are among the top world container ports. Handling millions of TEU traffic per year also increases the amount of global money that is at stake. With so much at stake a gradual increase in the port handling capacity is also imperative..

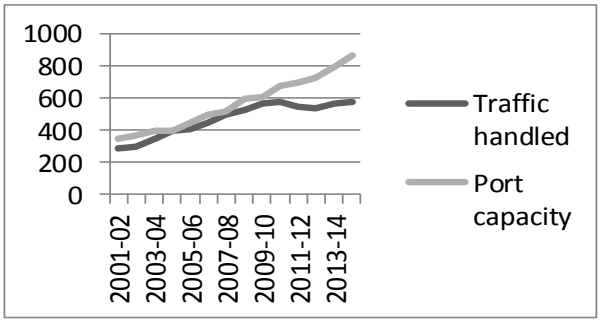

Fig. 2. Port capacity and traffic handled in Indian ports, 2001-02 to 2014-15..

Technology has and its improvement will help in the steady management of port activities and also its security. The increase in maritime traffic is vital for global economy but, increasing in the number of vehicles and humans on ports can make port security management difficult.

In order to make sure that the security of the port is intact, proper investigation of port capacity is important. Technology can aid to this approach through computer stimulation. It helps in evaluating the performance of a container terminal in relation to its handling techniques and their impact on the capacity of terminal.

Automation of activities that are otherwise handled manually can increase the efficiency and reduce risk to the port. The ever growing traffic needs to be managed by an ever evolving port management system.

IV. POTENTIAL TERROR THREATS

After 9/11, the world changed drastically and has been in a state of exceptionally heightened security ever since. The attacks left the authorities that govern the world bewildered. It forced them to re-access the arrangements and threats that a new group possessed.

Terrorism is something that brings almost every country on one page. While assessing the potential of these groups, one is forced to look into the possible loss to the economy that an attack on any port could cause.

The global economy grew by 30% in 2019 compared to the previous year. This means approximately 87 trillion dollar worth of economics was undertaken by the world.

Now, in such a sensitive world where a minor dispute between two nations can bring the entire world economy at halt; one can only imagine the disaster that would unleash if the security of a port was compromised.

The possibility that terrorists could compromise the maritime transportation has caused several agencies to pursue initiatives to manage the risk. Surveillance on ports has increased; better co-ordination between agencies has led to efficient reaction to any unfortunate happenings.

The ISPS (International ships and port facility security code) is an amendment to the SOLAS (Safety of Life at Sea) convention on minimum security arrangements for ships, ports and government agencies. Having come into force in 2004, it prescribes responsibilities to government shipping companies, shipboard personnel and port/facility personnel to detect security threats and take preventive measures against security incidents affecting ships or port facilities used in international trade.

IMO has released a code of practices on security in ports in its Tripartite Meeting of experts on security, safety, and health in ports, Geneva, 2003.

It contains guidelines on port security assessment (PSA) such as:-

i. Identification, selection and prioritization of measures and procedural changes and their level of acceptance in reducing vulnerability.

ii. Identification of the ports perimeter and where appropriate, the identification of measures to control access to the port at various security levels.

iii. Identification of the nature of the expected traffic into or out of the port.

iv. Identification of threats to assets and infrastructure in order to establish and prioritize security measures.

It also contains guidelines on Port Security Plan (PSP):-

The port security plan should be base on the PSA and include-

a) Details of the security organization of the port.

b) Details of the security levels, measures, both operational and physical that will be in place.

c) Identification of restricted areas and measures to protect them at different security levels.

d) Procedures for the verification of identity documents.

e) The PSP should be protected from unauthorized access or disclosure.

Smuggling is yet another problem that threatens port security. Concerns about terrorists smuggling nuclear bombs into the US in container freight have led to demands for 100% inspection at either US or foreign ports. Under some circumstances, it may be possible to deter nuclear smuggling attempts with less than 100% inspection.

Based on a publicly available data, a game theoretic model can be quantified of terrorist decision making to understand the role of nuclear detention technologies in deterring nuclear terrorism. The results suggest that unless the defender imposes high retaliation costs on the attacker. When defender can credibly threaten the attacker with costly retaliation, partial inspection may be sufficient to deter nuclear smuggling attempts.not be listed in columns nor group by affiliation.

V. CYBER ATTACK

With the introduction of technology in port management, the scope of it being compromised also increases. Cyber attack is always a concern for any field that deals with technological aids. In terms of cyber security, the maritime industry has a range of characteristics that makes it difficult to implement solid cyber defenses.

When a container is moved from point A to point B, the information related to this movement may pass through between 10 and 50 different systems, each being controlled by different entities such as ports, custom offices; trucking companies etc. any breach in this system could lead to loss of hundreds of thousands of dollars.

A incident reported by cyber keel based on a forensic analysis performed by clearsky, a cyber-intelligence company (cyberkeel, 2014). A number of maritime companies- principally shipping lines and bunker fuel supplies- were infiltrated with a remote access tool. This remote access was used to monitor email communication and subsequently spoof the communication resulting in a change of bank account information pertaining to large payments. This type of incidents is also known in other industries but, was first reported in maritime sector in late 2014.

Therefore with introduction of technology it is highly suggestive to develop independent systems that are not a part of any network. Information should be predefined in a system as long as it does not depend on real time decision making system. Cyber aid can increase efficiency in multifold but, their breach can jeopardize a complex system worth billions of dollars.

Cargo handling is at the heart of port operations, but the system travelling cargo is not the only port system that is subject to cyber attack. Today, ports rely much on computer network as on lifting and hauling of goods. Special network control system control the loading and unloading of cargo. All kinds of devices such as cranes now use technologies such as optical recognition to manage port operations, including locating cargo, transporting it, inspecting it, etc. containers are automatically placed and moved using GPS. Trucks that have cargo away from port are also dependent on GPS. This modern port operating system makes the entire port vulnerable. Indeed, easily available GPS jammers could potentially close down the entire port, from cargo handling to truck to crane movements. The cost of shutting down a port for one day has been estimated to be on the order of somewhere between 1 billion and 2 billion dollars a day. At least one instance of GPS description having a major impact on port operations has been reported. Sometimes in 2014, two cranes at a major US east coast port were idled for 7 hours when they were unable receive GPS signals.

The cyber threats to the maritime domain we have described are serious and they are not well known. In November 2011, the European Network and Information Agency (ENISA) reported that, “the awareness on cyber security needs in the maritime sector is currently low to non-existent”..

VI. THE WAY AHEAD

In order to keep the multibillion dollar industry safe and to keep the interests of nations safe it is imperative to adopt new changes. These changes shall not be drastic but just an upgrade to what has been the norm. Ports face potential threats from human activities, thus, restricting the number of people on port is important. Proper knowledge of the identity of every person is suggestive

Proper identity disclosure enables quick tracking and complete knowledge of the condition of the worker. No blind zone in any corner of the port is also essential to enable complete control over the security. Since, the installation of CCTV’s has its own limits due to the installation location use of drones and other means of vigilance is important.

Prohibited entry of unauthorized person is the primary level of maintaining security. Because of the adoption of effete practices by authorized officials, a breach in security is possible. An insider that could help plan out an attack is the last thing one would want. The location of every person working on the port should be known at all times. Every person that enters the premises of the port should be given a microchip installed identification card that will track them throughout their visit. The chip shall enable real time data of every person and their location. This increases the efficiency and helps security forces track every movement. Suspicious activities can be monitored easily and sudden disappearances of beacon can raise alarm.

Another step towards ensuring the safety of port can be the establishment of a Quick Reaction Team (QRT). QRT can be kept at standby for carrying out operations in a hostile situation. Drones can also act as an aid in such cases and can prove to be very handy to the QRT for carrying out operations.

The most important part of a port is the cargo. Finding a way for the smooth movement of cargo to and from the port can only add to the effectiveness. Hassle free and smooth cargo transport can decrease chances of error. It is perhaps another sector where technological influence can come to the rescue.

The path to achieve automated handling of cargo is to build automated locomotives that move around the port handling cargos. The data of the consignment is fed from a office central system that in turn specifies the path of the locomotive using GPS. This system will also look into real time traffic on ports to make sure serious accidents are curtailed. The locomotive reaches the section of the port from where the cargo is transferred with the help of cranes. In all of this process the movements of trucks within the cargo holding area will be restricted. The cargo will therefore be delivered to the outer campus of the port through the same locomotive. This is where the trucks come in; the cargo is then transferred to the trucks.

This method shall enhance efficiency and the process is already underway in the northern Chinese city of Caofeidian. Caofeidian was set to become the world’s first fully autonomous harbor by the end of the year 2018. The US – Chinese startup TuSimple, a specialist in developing self driving trucks will replace human- driven terminal tractor or trucks with 20 self driving models.

The potential for effectiveness has many ports interested in automation. This system allows the terminal to operate in complete darkness and have reduced labour costs by 70% while increasing the efficiency by 30%. The number of workers required to unload the cargo ship has also gone from 60 to 9 in some cases.

The system primarily uses cameras to gather data about its surroundings. It uses currently ten cameras including

forward facing, backward – facing and wide lens. They produce 360 degree view of the vehicle surroundings. The cameras can further be used as an additional surveillance method to maintain and carry out port security operations.

This lays out a clear blueprint of how the integration of technology and automation of daily port operations can aid to increased efficiency and ensure better security.

VII. CONCLUSION

Ports are an essential establishment that helps the global economy function. The security of the ports is akin to that of the global economy. After the 9/11 incident, heightened movements among radical groups caused the world to realize how un – secure and un – prepared it was. Managing port security effectively in this era is possible with the intervention of state of the art technology and proper simulation. The cost of closing a port for a day can be enormous and no nation would take the risk of its vulnerability of its assets, especially in today's world of closely linked complex form of global economy. With the introduction of technology stimulated on a network, the threat of a cyber attack comes handy. Therefore, a new type of cyber threat is the next concern the world is and in the near future will be facing in its improved form. Thus, the process of port security is a never ending one and requires a periodic update and there could be no better time than now to ignite the process.

VIII. ACKNOWLEDGEMENT

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Air Bubble Lubrication For Hull

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***Abstract*— The reduction of resistance and the increase of propulsive efficiency are the major drivers for ship designer both for economic reasons and increasingly for reducing the ship's environmental footprint. Ship hull optimization has been utilized commonly to reduce the frictional resistance component of the ship. Reducing the frictional resistance by air injection below the ship in combination with special coatings is an active area of research. Air lubrication can be utilized by utilization of techniques such as air-cavity, microbubbles, and air film formation. This paper reviews about the hull modification for air bubble lubrication in the improvement of ship's energy utilization.**

Keywords*— *frictional resistance, air bubble lubrication

I. INTRODUCTION (*HEADING 1*)

This template, modified in MS Word 2007 and saved as a " A ship is the most energy saving transporter among others. The steep rise in prices of raw materials such as crude oil is predicted to continue for the foreseeable future, in conjunction with the economic growth of developing countries. In the situation surrounding the marine transportation business, expectations for the development of energy-saving technologies for shipping are high, with the international need to address shipping costs and environmental issues such as CO2 emissions. The air lubrication method is a technology to reduce skin friction resistance working on a hull by sending air to the bottom of the hull to create a layer of air bubbles between the hull and sea water. Three distinct approaches are identified: the injection of bubbles, air films, and air cavity ships. These three approaches are very useful in reducing the frictional resistance in hull. Since the proportion of skin friction resistance to total resistance is high, especially on large low-speed blunt ships, the air lubrication method has been focused on for quite some time as an effective measure to reduce skin friction resistance.

II. AIR BUBBLE LUBRICATION

A. Microbubbles using Hydrofoil air pump

A research area for drag reduction of ship with microbubbles has been active in recent years because of the energy saving potential and of the environmental safety for the marine pollution.

The injection of air microbubbles into a turbulent boundary layer over the ship hull modifies the boundary layer and reduces its skin friction. Although recent applications of drag reduction technology with microbubbles to the ship reduce about 10-15% of the energy regarding the skin friction in the turbulent boundary layer, the energy necessary for the injection of air bubbles by using conventional bubble generators, which is about 5-10%, is generally ignored. So a power-saving device which reduces the energy for the bubble injection has been produced. The new facility called WAIP (Winged Air Induction Pipe) which has an angled hydrofoil with an air introducer.

This device utilizes a low-pressure region produced above the hydrofoil as the ship moves forward, which drives the atmospheric air into the deep water.

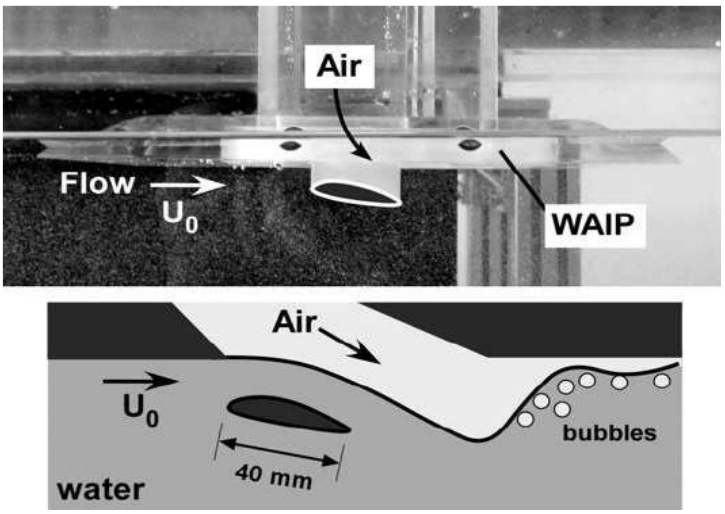

Fig. 1. Side view of WAIP

B. WAIP (Winged Air Induction Pipe) technology:

WAIP technology is proven to be highly effective in reducing the frictional resistance caused by ship's propulsion. It was conceived for the purpose of lessening the amount of energy required for generating micro air-bubbles and also to reduce the size of generated micro-bubbles resulting in reduced buoyancy of the bubble. It turned out that the size of the ultra fine micro-bubbles generated by WAIP was in the vicinity of 10 microns which was 1/100 of the size of the air-bubbles generated by the conventional air compressor method.

Unlike the bubbles generated by compressed air, the micro air-bubble generated by WAIP tends to stay within the water flow around the hull and effectively covers a large area of the hull surface from bow to stern. Installation of WAIP units on the hull reduces the ship's frictional resistance by around 15 % to 20%, contributing to reduction of main

engine power and fuel consumption. Interestingly, the size of microbubbles does not change once ejected into the water.

The WAIP unit is installed on the hull surface and consists of a wing-like blade attached to an air induction pipe connected to the atmospheric air intake. When underway, the vessel's forward movement through the water generates a suction force under the WAIP unit, thus the micro-bubbles are continuously pulled out of the WAIP unit. This air-bubble generating sequence occurs when the ship's draught is below a certain level and is sailing above a certain speed.

Fig. 2. WAIP installation process in dry dock and Cast iron WAIP fitting

When the air and water boundary is located at the upper part of the air induction pipe, such as when the draught is high and the vessel's speed is below the critical level, the boundary level needs to be pushed down to just above the blade of the WAIP unit to be able to generate the

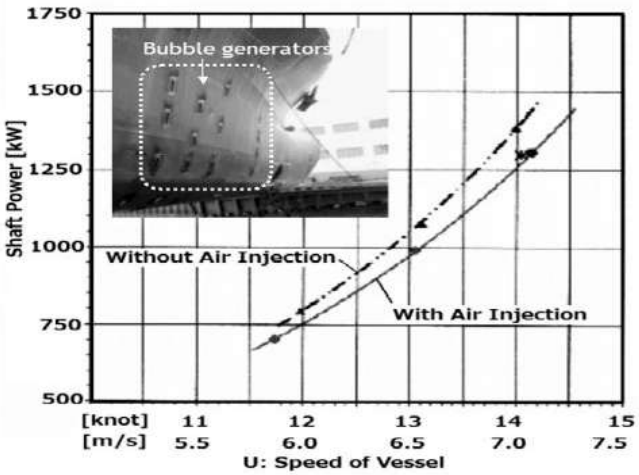

Fig. 3. shows Shaft power with and without air injection by WAIP

microbubbles. To achieve this, a small-size air compressor will be used to lower the boundary to the level above the wing of the WAIP unit. This application of WAIP assisted by compressor is called WAIP air compressor and will enable any ship, whatever its draught or speed, to benefit from WAIP.

III. Air Cavity System

Air cavity system is an air lubrication technology for reducing the frictional resistance of the hull surface.

Fig. 4. shows an image of an air lubrication method.

Air discharged from the air blow-off portion mounted on the bottom of the hull turns into air bubbles because of the tearing-off forces of the surrounding flows and then runs to the direction of the stern with air bubbles covering the bottom of the hull. In approaches toward putting the air lubrication method into practical use, researchers have recently measured total resistance and local skin-friction resistance working on a model hull i.e. a flat plate hull having a total length of fifty meters and have confirmed that these resistances decrease. Among the several actual hull experiments on the air lubrication method that have so far been carried out, the roughly five-percent energy-saving documented by researchers on an actual hull experiment using a cement carrier has attracted interest in the effectiveness of actual hull experiments on an air lubrication method.

IV. Mock-up Model

Air discharged from blowers is temporarily stored in a head tank and fifteen air supply branch pipes connected to the head tank are piped to the air supply portion mounted on the bottom of the hull. One air supply branch pipe is connected to one chamber (air chamber). All of the chambers are housed in a recess. In the test, the recess and chambers of the mock-up model were fabricated and the air blow-off conditions were observed. The test was conducted in a sea keeping tank at MHI's Nagasaki Research & Development Center.

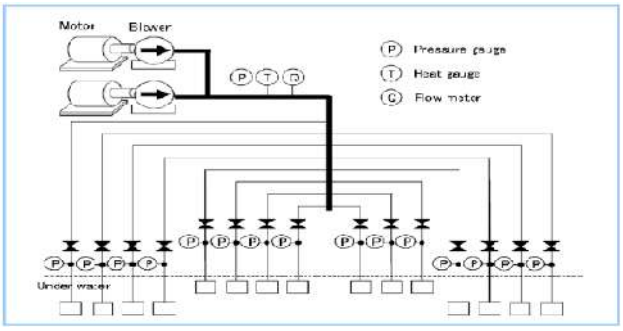

Fig. 5. shows the piping diagram.

A communicating pipe connected to the air supply pipe is attached to the top portion of the chamber, where its attached point is offset by 200 mm away from the center of the

chamber. On the bottom portion of the chamber are installed sixteen small apertures from which air is blown off.

Fig. 6. shows an overview photograph of the chamber

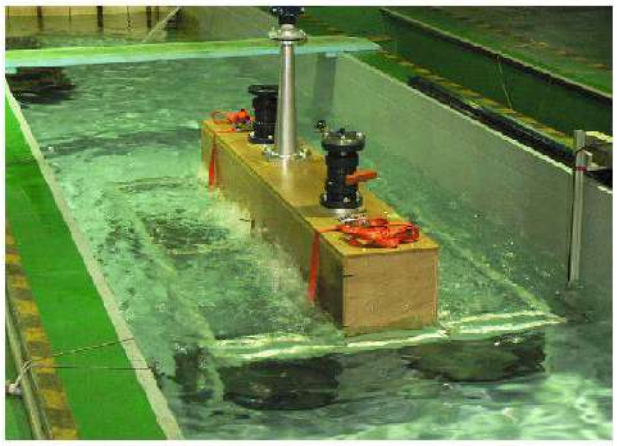

Fig. 4. Air blow-off conditions (underwater)

A picture of the air blow-off conditions, with the chamber placed underwater.

V. Air layers

The air layer concept can be seen as a combination of micro bubbles technique and air cavity ships. An air stream is injected into the bottom region of a ship and an air film forms. This air layer is subjected to influences as turbulence and the natural instabilities that occur on any fluid-liquid interface. With an air film of half a millimeter thick, a drag reduction of 90% was obtained although no Reynolds effects were taken into account. Researchers carried out experiments with air film lubrication on a flat plate and for model ships, all without a water-repellent coating. They managed to obtain drag reduction, but had difficulties in obtaining a stable air film, especially at higher flow Reynolds numbers. They noted that the air layer can increase the frictional drag when the liquid-gas interface become instable, resulting in breaking up the layer in larger sized bubbles that also may reduce frictional drag.

VI. Conclusion

There are many technical levers to save fuel and thus emissions for ships. The best option for improving the power consumption on ships is to evaluate and optimize the design systematically with regards to the underwater and propulsive efficiency in calm water and in a seaway. Various concepts for hull flow smoothing may give valuable improvement in individual cases but requires systematic evaluation in each case.

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Recycling - Challenges and Effects in Shipping Industry

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Abstract - Energy drives everything in the world and so the shipping industry. There are many innovative methods of producing energy but it is much appreciated if the energy could be consistently derived from the ship waste. The waste disposal is an arduous task in shipping industry and hence many researches are in place for effectively disposing the waste. According to the statutory bodies, India has huge source of industrial as well as urban organic waste. The shipping industry demands enormous energy like any other industry. Starting from small crafts to ultra large vessels, there exist huge quantity of waste on daily basis (aerobic as well as anaerobic). Therefore, there is a large potential of harvesting energy from these waste and the problem of waste disposal as well as depletion of conventional energy sources can be effectively resolved simultaneously. This paper analyses the several methods of producing energy from waste. In addition, the present scenario of Waste-to-Energy (WTE) in our country and world is also deliberated.

Keywords – Waste disposal, energy harvest, energy demand, aerobic wasteIntroduction (*Heading 1*)

Introduction

Waste disposal is a major challenge being faced by the world today. Research is being undertaken the world over to find new and effective ways of handling and recycling waste. New methods of converting organic and inorganic waste into useful alternatives are also being developed. One of the best ways to overcome this problem of waste management is to adopt waste-to-energy (WTE) initiatives. This in turn addresses another pressing issue, that of finding alternative energy sources. Research has already found a number of ways of converting waste to energy, but the applications on the field, particularly in India, are very limited. There is huge untapped potential in the waste-to-energy sector and the maritime industry can be an eminent contributor in this.

Waste-to-Energy in India - Current scenario

India is a large sub-continent with a population of nearly 1.38 billion, as of 2020 [1]. The country generates on an average 450 gm per capita per day of municipal solid waste (MSW) [2]. As of 2017, the gross generation was nearly 1,33,760 tonnes of MSW per day [3], out of which about 91,152 tonnes was collected and only 25, 884 tonnes was treated. According to the Annual Report on Implementation of Solid Waste Management Rules for 2018-19, published by the Central Pollution Control Board, the MSW collection efficiency lies at 98.4% of generated waste [4]. The report, however, also mentions that most of the waste processing facilities in the majority of the States are not in working conditions. A huge portion of this collected waste is lying around in open dumpsites and landfills, unsegregated, posing environmental and health hazards. Not to mention, they have rendered large stretches of land barren and useless. As part of India's WTE efforts, the first large scale MSW incinerator was built at Timarpur, New Delhi in 1987 [3]. It had a capacity to process 300 tonnes of waste per day and cost Rs. 250 million. This project, however, failed due to a number of reasons such as poor waste segregation, seasonal variations in waste composition, lack of appropriate technology and operational and maintenance issues. After the Timarpur plant, 14 other WTE plants with a total capacity of 130 MW have been installed in the country but 7 of these have already become non-functional, that is a loss of nearly 66 MW. Currently only 7 plants remain functional with a combined capacity of approximately 69.2 MW [8]. Most of these projects have faced criticism and resistance from residents and environmentalists for causing pollution and posing health risks.

As of 2018, India had a total capacity of 9.54 GW of grid-connected bio-power installed, which includes 8.73 GW from bagasse cogeneration, 0.68 GW from non-bagasse cogeneration and 0.13 GW from waste to energy [6]. Another 84.3 MW of WTE is said to be under construction [8].

Though the amount of energy being generated from waste in India is very nominal currently, the future of waste-to-energy looks promising for the country. The Ministry of New and Renewable Energy has shown notable interest in the field of waste-to-energy and bio-energy and has revised the guidelines of its waste-to-energy programme to create a more conducive environment for sustaining the WTE plants. Under this revised scheme, the government aims to provide financial assistance in the form of capital subsidy and Grants-in-Aid for installations of a number of waste-to-energy and bio-energy plants as well as for expanding capacity of existing plants [7].

However, some of the major challenges in the generation of energy from waste in India still remain. The first major concern in this regard is the composition of waste. In countries like Sweden and Norway where WTE is a major source of power generation today, the quality of the waste

generated is very different from what we find in India. While the calorific value of the waste generated in these countries ranges from 1,900-3800 kcal/kg, the waste in India has a calorific value of only about 1,411–2,150 kcal/kg [8]. This makes it unsuitable for burning and even when burnt, the energy obtained is very low. This is mostly because the majority of the waste generated in India is organic waste having very high moisture content. Secondly, WTE is more expensive as compared to conventional sources of power despite the subsidies offered by the government. As compared to Rs. 3 to 4 per kWh for coal or solar based plants, electricity generated from WTE plants costs users approximately Rs. 7 per kWh [8].

India's potential in the waste-to-energy sector

The MSW generated in urban areas of India has potential to produce approximately 500 MW of power, which is expected to increase to 1,075 MW by 2031 and to nearly 2,780 MW by 2050 [2]. However, to be able to reach full potential, the authorities have to enforce stricter measures to ensure that the ongoing and future projects are able to sustain. According to the Solid Waste Management Rules 2016 [7], only segregated, non-recyclable, high calorific waste must be sent to WTE plants. This means that of the total MSW generated in urban areas, only 30,000 tonnes per day can be sent to the WTE plants, which have a gross capacity of 37,000 tonnes per day [8]. Moreover, stringent emission control rules have to be in place to monitor the operations of WTE plants so that environmental pollution from these plants can be kept check.

Waste-to-Energy technologies

Incineration

Incineration is the most common thermal treatment based WTE technology in use currently. In the incineration process, the waste is fed into the incinerator kiln where it undergoes combustion at high temperatures, >850℃, with sufficient supply of air [9]. The waste is allowed to burn completely to prevent the formation of dioxins or carbon monoxide. The heat of combustion, in the form of flue gases, is used for energy recovery for generating steam in boilers. This high temperature steam can then be used for space heating, electricity generation and other applications. Incineration is best suited for high calorific value wastes [10]. However, incineration does not work well with waste having high moisture content. Also particulate emissions and toxic metal content in the bottom ash, which may be later sent to landfills, are some major concerns with this method.

Gasification

Another common method for thermal treatment of solid waste is gasification. It is the process of converting carbonaceous substances into carbon dioxide, carbon monoxide and some amount of hydrogen. This is also a high temperature process, but the waste is not allowed to undergo combustion in this method. The temperature range in gasification is generally between 760℃ to 1300℃ [11]. The gas produced by this process is known as syngas and can be used as fuel for burning. This fuel is also used for generation of electricity and production of steam among multiple other uses. Gasification is better for controlling environmental pollution as compared to incineration as particulate emission here is much less. However, the amount of energy recovered depends largely on the type of waste used.

Pyrolysis

Pyrolysis is another high temperature procedure in which carbon-based waste matter is made to undergo thermal decomposition in an oxygen deficient, inert environment. The pyrolysis of biomass leads to the production of pyrolysis vapours, which can be condensed into biofuel, and biochar.

Landfill gas recovery

Landfill gas recovery is a thermo-chemical process of waste treatment. Landfill gas is generated as a result of thermal, chemical and microbial processes taking place on the waste matter. This gas is produced as a result of anaerobic decomposition of organic waste in landfills. The gas is composed mainly of methane and carbon dioxide along with small quantities of other organic compounds. In the initial stages of waste deposited in a landfill, aerobic decomposition takes place which generates small amounts of methane. Over time, anaerobic conditions are created and methane-producing bacteria begin to decompose the organic matter to generate large amounts of methane and CO2. This gas can be collected and treated to be used for various applications, as cooking gas, vehicle fuel and even in power generation.

Anaerobic digestion

Anaerobic digestion is a process similar to landfill gas generation. Here the organic content in waste is allowed to be broken down by microorganisms in the absence of oxygen, producing biogas that can be used in multiple applications. The biggest advantage of this method is that it can be done both on a small scale as well as on a large scale.

Renewable energy options and WTE on-board ships

Shipping, as an energy intensive sector, is certainly in need of more renewable energy options. Renewable energy application on ships can provide sustainable solutions for hybrid, auxiliary or even primary propulsion as well as on board energy requirements.

The shipping industry is already taking up new innovative measures to incorporate renewable energy in the existing fleet and into new shipbuilding and design globally.

The current focus on renewable energy measures in shipping is on a few areas such as wind and solar energy based design modifications. Attempts are being made to tap wind energy by means of specially designed soft-sails, fixed sails and kite sails [12]. Wind turbines have also been tested but there have been no successful prototypes yet. Solar photovoltaic cells, hybrid with other energy sources, are being used on small ships. Biofuels are also finding their way into shipping, with the Meri cargo ship claiming to be the first of its size to run on 100% biofuel.

However, waste-to-energy is still a less explored technology in shipping. Large cruise ships produce enormous amounts of waste. This itself presents a huge potential for WTE as a means of producing renewable energy on board ships. There

are very few manufacturers who are venturing into the WTE sector to create energy from waste generated on ships. Scanship, a Norwegian waste management systems manufacturer for ships, has developed a system that converts carbon-based waste generated on ships into biofuels by microwave-assisted pyrolysis. The system can convert waste material like food, paper, plastic and oils into flammable gas, bio-oil and charcoal [13]. Another Norwegian manufacturer, TECO TECH, has developed a waste management system that uses gasification of waste to achieve heat

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recovery through proprietary sodium heat pipe economizers [14].

These are some of the pioneers in the application of WTE systems in shipping. Yet waste management on ships can improve by leaps and bounds with the use of WTE. Currently, most of the food waste from ships is discharged at sea, where permitted under MARPOL Annex V, plastics are not being incinerated, sewage is being discharged to the sea under MARPOL Annex V [15].

Processes like gasification, pyrolysis and incineration technologies have already been implemented on board ships. With further advancements in these systems through research and development the shipping industry could become a self-sustaining industry, in terms of energy generation and usage.

Conclusion

WTE is still an emerging sector in India and so far the country hasn't seen much success in this field. However, with new measures being taken and increased interest of the government and MNRE in waste management and WTE, major developments can be expected in the near future. After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

In the shipping industry as well, WTE is more or less a novel concept. Countries like Norway, that are successfully running WTE plants on land, are gradually transferring the technology on board and leading the way for others. With more measures like these, the waste let out into the sea from ships can be drastically reduced, creating a more balanced ecosystem for all life forms.

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A Perspective Study of Ship breaking in India and The Impact of International Conventions and Regulations

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***Abstract*— Recycling is the most efficient and sustainable way of disposal towards the end of useful life of a ship. However, presently it is not carried out in a safe, environmental friendly manner in the beaching method of ship breaking carried out in the beaches of South Asian Countries such as Bangladesh, India and Pakistan causing frequent accidents, loss of life and environmental degradation. To address the above issues, International conventions such as Hong Kong Convention, EU Ship Recycling, regulations and guidelines have been adopted. This article analyses the ship breaking in global and Indian perspective, the existing legal frame work, the issues in the Indian ship breaking yards and the impact of the International conventions and regulations in Ship breaking in India with a conclusion towards the necessity for implementation of the above conventions.**

Keywords— Hongkong Convention, IMO, EU Ship Recycling Regulation, Ship breaking, Sustainable ship recycling, Training.

I. INTRODUCTION

Maritime transport is the cheapest mode of transport and remains the backbone of the globalized trade and the manufacturing supply chain which constitutes about more than four fifths of world merchandise trade by volume which is carried by sea. The entry into force of the several global environmental mandatory instruments and the voluntary standards being adopted in the shipping sector is having a huge impact on the ship building yards and ship owners due to the fact that they are mostly responsible for incorporating the new standards into the design features and construction of new ships adhering to the existing rules and regulations. In addition, there is enormous pressure from the global shipping regulators on the ship owners and shipping industry towards usage of cleaner fuels and energy efficient vessels towards addressing the issues related to the global warming and climate change. This scenario has resulted in huge expenditures and consequently lower profits to the shipping companies resulting in many of the ships being prematurely sent for demolition to the ship breaking industry to end their life. This scenario has a huge impact both in the shipping industry as well as in the ship recycling industry. On one hand, demolition of old ships helps the renewal of the global fleet of ships, balance the demand and supply of ships in the freight market; on the other hand, it recycles millions of tons of scrap material and contributes to non-depletion of the existing resources and thereby the sustainability of the resources for the future. It is estimated that scrapping of less fuel-efficient vessels in the form of older ships is on an increase, with an estimated projection of 26 million dwt equivalent in 2019 and 44 million dwt equivalent in 2020, thereby reducing the growth in the world fleet by 0.8 per cent in 2020, notably 1.1 per cent across the bulker fleet, 0.8 percent across the tanker fleet, and 0.7 percent across the container ship fleet .

Ship recycling is considered as a best practice to reuse the components, recycle the material due to which a high proportion of utilization of steel is achieved from the recycled ships for the other domestic manufacturing sector which reduces the load on the steel manufacturing industry. However, the manner at which the work process in the ship recycling industry takes place is of a serious concern. The unsafe work practices, accident prone living and working conditions of the workers, loss of life, violation of labour rights, manual work process, poor downstream waste management, health hazard to the workers and the coastal community in the area and environmental degradation are the serious issues at present facing the ship recycling industry. The presence of hazardous material such as asbestos, polychlorinated biphenyls (PCBs), mercury, glass fibre, solid foam in the ship construction as well as the remnants of banned anti fouling substances, paints used in the hull coating and ship generated wastes such as waste oil and oily residues are also few factors towards the accidents as well as health hazard in this industry, considering the worker's lack of awareness and lack of training in handling the hazardous material. In the global arena, to address the above issues, the member nations of the BASEL Convention of the United Nations, the International Maritime Organization, International Labour Organization has jointly come out and adopted the Hongkong Convention. The European union has also enacted its own Ship recycling regulations which is much more stringent than the Hongkong Convention (HKC). The Hong Kong Convention is yet to come in to force. This article analyses the key issues of concern in the ship recycling and the relevance of early as well as strict implementation of Hong Kong Convention.

II. GLOBAL PERSPECTIVE

The shipbreaking industry has been around since ages, as long as the birth of the ships but over the past half-century it has gravitated to certain regions in the world where the ship breaking industry offers inexpensive land, cheap labour and where there is no or less stringent environmental regulations. Prior to World War II, the yards in Europe, USA

and Japan handled the most shipbreaking, with the renowned Ward yards in the United Kingdom gaining public attention by breaking up some of Britain's well known ocean liners and naval vessels. After the end of the World war-II, Taiwan and Kaohsiung became a major destination for vessels at the end of their economic lifespans. In Europe, Spain and Turkey competed with Asian ship breakers, however mostly for the smaller ships. Pakistan's government noted the value of shipbreaking as an employment provider and by the late 1970s declared the activities as "legal" for importing purpose. Due to the high productivity, the shipbreaking business was at a high in the Kaohsiung yards in the 1980's. In the early 1980s, the mudflats of Pakistan, India and Bangladesh rose to prominence by offering cheaper labour as well as lax environmental regulations and low taxes. New yards for ship demolition were established in Pakistan, India, Bangladesh and China. The sands of Pakistan's Gadani beach rose to the prominence, followed closely by the yards established in 1983 at Alang in India, and in Chittagong in Bangladesh using the same beaching techniques. Today most shipbreaking continues to be handled in the South Asian countries such as, Bangladesh, India and Pakistan but the profits have declined due to the very reason that China has flooded the market with cheap steel. With Europe and the United States totally curtailing the environmentally harmful ship breaking has made the ship breaking growing in a faster rate in the yards of the South Asian countries besides Turkey. Ships were acquired on the world market through either independent brokers or by a purchasing cooperative formed by the ship breakers themselves. The price was largely determined by a vessel's light displacement tonnage, type and market demand, paper work, import duties, business licenses obtained and various harbour fees paid.

The decorative furnishings, the brass items and the operational equipment of the scrapped ships were sold just after dismantling. Most of the old steel used in the construction were melted down and re-cast into steel ingots. Similar to shipping and shipbuilding industry, ship recycling industry is also driven by industry cycles.

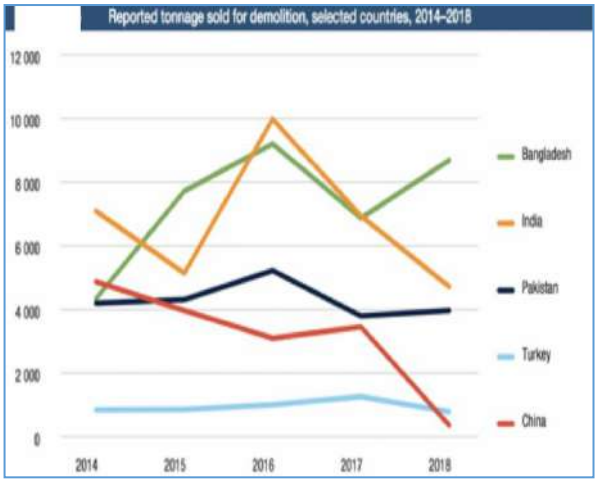

Fig1:UNCTAD Based on data of Clarkson's Research from Maritime Transport,

Reported tonnage sold for demolition by major vessel type and country of demolition, 2018
(Thousand gross tons)

	Bangladesh	India	Pakistan	Turkey	China	World total	Percentage
Oil tankers	5 989	1 946	2 824	66	14	10 884	59.5
Bulk carriers	1 115	465	829	18	53	2 495	13.6
General cargo ships	127	149	57	65	5	405	2.2
Container ships	620	402	38	54	152	1 284	7.0
Gas carriers	347	455	48	3	97	951	5.2
Chemical tankers	43	167	28	28	2	268	1.5
Offshore vessels	181	581	72	143	30	1 156	6.3
Ferries and passenger ships	..	171	..	14	..	185	1.0
Other	210	353	47	29	5	673	3.7
Total	8 632	4 690	3 943	418	359	18 300.9	100.0
Percentage	47.2	25.6	21.5	2.3	2.0	100	

As shown in the Figure 1, the recent trend in the period from 2014 to 2018 indicates that the demolition rate is in a steep increase in Bangladesh, marginal increase in Pakistan whereas the other countries in the top league (of five leading countries) have shown a drop in the demolition tonnage. This is due to the very fact that India is presently in the process of promoting a safe ship recycling industry by way of acceding to Hong Kong Convention and also due to the fact that China has imposed a ban on the entry of foreign ships to their yards for recycling as one of the wide range of measures aimed at controlling the environmental pollution in their country.

Fig 2: Clarkson's Research-2019

As shown in Fig 2, Bangladesh has emerged clearly as a leader as per the reported tonnage sold for demolition by major vessel type. Accidents and pollution issues continue to increase in the shipbreaking industry where in the beaching method of ship breaking is involved. Presently about 50,000 ships are in the World fleet, with a carrying capacity of 2 billion tonnes DWT and about 1000 ships are sent for scrapping every year to the Ship recycling industry of which as per the statistics of 2018, 92 percent of the ship scrapping is carried out only between Bangladesh, India and Pakistan.

III. LEGAL FRAMEWORK

As legal frame work towards the safe ship recycling, the following are the major international conventions, regulations and treaties that are in place.

I. Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal of 1989

II. The International Labour Organization (ILO) guidelines of 2003, which outlines the detailed provisions for the safety and health of workers in ship-breaking industries

III. The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009

IV. The EU Ship Recycling regulations enacted in 2013

The Hong Kong Convention (HKC) with guidelines for safe and environmental friendly recycling is yet to enter in to force. It adapts a " Cradle to Grave " approach. The provisions for entry into force of the convention are that the convention will come in to force, 24 months after fulfilling the following three conditions: (i) Ratification by at least 15 member states (ii) The combined merchant fleets of the States that have already signed the convention should represent at least 40% or more of the gross tonnage of the global merchant shipping volume and (iii) The combined maximum annual ship-recycling volume of the States that have already signed the Convention should constitute at least 3% or more of the gross tonnage of the combined merchant shipping of the same States during the preceding 10 years.

Presently, with ratification of India, a major ship recycling state, the first condition has already been met, while the second and third conditions are yet to be complied.Compliance to the second condition is very close, however, the third condition requires a ratification from any one of the top five ship recycling nations other than India and Turkey who have already ratified the convention. It means any one of the following countries such as

I. Bangladesh with a present capacity of 9.9 million GT

II. Pakistan with a present capacity of 5.7 million GT

III. China with a present capacity of 8.2 million GT.

It is worthwhile to note that the rest of the world barring these top five league ship recycling nations contributes only a meagre 0.6 million GT altogether. This shows the magnitude of the concentration of the ship recycling activities happening in the South Asian countries. The modern industries responsible for dismantling of ships for recycling are required to adhere to the principles of recycling as per the Hong Kong International convention. The Hong Kong Convention establishes control and enforcement instruments related to ship recycling, determining the control rights of Port States and the obligations of Flag States, Parties and recycling facilities under its jurisdiction. The Convention also controls the communication and exchange of information procedures, establishes a reporting system to be used upon the completion of recycling, and outlines an auditing system for detecting violations.

Meanwhile, the European Union has enacted its own Ship Recycling Regulations at the end of 2013. The EU Ship recycling regulations (EUSRR) 1257/2013, do not agree with the beaching method of recycling which is carried out in high tide zones in the muddy flats of the South Asian countries. Unlike the HKC regulations, the EU Ship Recycling Regulations (EU SRR) controls the downstream waste management to control the waste generated during the Ship recycling. The EU SRR seeks to regulate not only the EU flagged ships and EU recycling facilities but also the ships sailing other flags through the control of inventory of hazardous materials (IHM) and facilities outside the EU through the declaration of EU list of approved facilities. The EU SRR also mandates that European flagged ships must be recycled only in yards that are in the European List of approved yards. The EU regulation on ship recycling also mandates all EU/EEA Flag vessels above 500 GT and other flag vessels visiting EU/EEA ports and anchorages must carry an inventory of hazardous materials as of 31st December 2020. The new build vessels built after 31st December 2018 must be in compliance to the above requirement. On board examination and verification towards compliance to the above requirement is expected to commence from the year 2021. Both HKC as well as EU SR regulations mandate that the inventory of hazardous material must be carried throughout the life of the vessel and the same are to be updated whenever there is any subsequent modification of the ship or any addition of material. The IHM will facilitate the ship recycling yards to plan for appropriate handling of hazardous materials which is one of the main reasons for the accident and hazardous occurrence.

The cost of ship recycling at European ship recycling yards are more expensive and therefore presently not an ideal destination for the EU Ship owners. There exists certain loop holes in the EU regulations using which many of the ship owners from EU countries circumvent the regulations by changing ownership, flag and name of the vessel before their end of life, prior heading off to the ship demolition and thereafter reaches the ship breaking yards of the South Asian Countries for the final demolition through the cash buyers. It is to be noted that the most popular end-of- life flags exclusively used by cash buyers at the end of life of a vessel towards scrapping are Panama, Comoros, St Kitts and Nevis, Palau, Liberia and Togo. Presently the EU is planning to start a recycling incentive to compensate the EU ship owners who operate the vessels in EU flag and opts to recycle the vessels as per EU SRR in EU approved list of ship breaking yards. With growing movement and stepping up of the pressure on shipowners to disclose their approaches to ship recycling, this incentive, will motivate more ship owners and shipping companies to opt an environmental friendly ship recycling in EU approved ship breaking yards without circumventing the EU regulations. Presently about 43 yards including 34 facilities located in 12 EU Member States and in Norway, 8 facilities in Turkey and 1 facility in the United States of America are in the European list of approved yards. This recycling capacity will not suffice the requirement of the current ship breaking need. Therefore it is required to add more capacity by adding more ship breaking yards to the existing list of EU approved yards.

Most countries around the globe are presently, actively engaged with ship breakers to improve the workers safety and decrease yard pollution however without adequate academics. The expanded adherence to the Hong Kong Convention and EUSRR may bring about a more responsible ship breaking industry with more concern for worker's safety and clean environment.

IV.INDIAN PERSPECTIVE

In India, Ship breaking industry started officially in the early of the 19th century in 1910 in Mumbai and Kolkata port, however Indian ship breaking yards became an international destination only in the early 1980's. Presently, ship breaking is being carried out in India at various

locations such as Alang Soshiya belt and Sachana in Gujarat, Dharukhana near Mumbai, Tadri and Maipe in Karnataka, Baypore in Kerala, Vishakhapatnam in Andhra Pradesh and Valinokkam in Tamil Nadu .

The world's largest ship breaking yard is presently in Alang in Gujarat, India located on the Gulf of Khambat, started in the year 1982-83 with a meagre 5 ships and 0.24lakh LDT, presently has a mammoth capacity to break at least 450 ships annually. In the year 2011-12, the industry dismantled a record highest 415 ships and 3.85 MLDT handled. Presently about 153 plots developed on 10 kms long coast, oversees the ship dismantling of almost 50% of the world's different types and sizes of vessels, provides employment of about 35000 to 40,000 employees directly and about 4,00,000 workers employed indirectly with an annual turnover of about 6000 crores. It is reported that over 6,900 vessels have been dismantled in these yards during the last three decades.

The Ship breaking Code -2013 was adopted in 07th March 2013 and in effect in pursuance of the Supreme Court of India order dated 06th September 2017 which is very comprehensive and in line with many of the requirement of HKC regulations. The responsibilities of the various Government authorities, Ship recycling facilities, Ships, and other related stake holders are clearly defined in the ship breaking code. The requirement for the accommodation, sanitary facilities, health care, Insurance, primary amenities such as community centers and labour welfare centers for the workers and other training requirements towards hazardous material and waste handling are also defined. However, due to lack of implementation and enforcement of the code requirements, as reported, still there is a practice of carrying out work without impermeable work surfaces, poor downstream waste management, poor working conditions, low per day wages of the labour in comparison with other labour wages in other industries. The ship breaking facilities in Alang Soshiya belt do not have adequate accommodation and sanitary facilities for the workers employed. Adding to the poor working and living conditions, there are less health and insurance facilities available for the workers. Occupational diseases to the workers such as respiratory diseases, cancer and other skin diseases are not appropriately recorded. Adequate training on safety and hazardous material handling are not provided; safe working practices are not strictly followed. Accidents are very common, remains a serious matter of concern and during the period from 1983 to 2013 spanning a period of 30 years around 470 workers have lost their life in various accidents in the Alang Ship breaking yards .The frequency of accidents are high owing to the hazardous nature of activities and due to the fact that the labour employed are mostly unskilled, uneducated and untrained. In the last two years, about 16 workers have lost their life. This includes two separate incidents where in two workers have lost their lives in two different yards who have applied for EU Certification.

Ship recycling volume from 1996 to 2003 remained in the range of 600 ships a year and varied between 18 million DWT to 30 million DWT. The period from the year 2004 to 2008 witnessed a low activity in the ship recycling sector due to the robust economy and buoyant freight rate in the global market and therefore less ships got recycled. Majority of the ships that were recycled in India are cargo ships. This has been evident that the number of ships recycled in India has a higher share compared to DWT. India continues to maintain more than 30% share of the global ship recycling volume by dead weight (DWT) and more than 40% share by numbers. In terms of DWT, India recycled 33% ships in 2012, followed by Bangladesh's 24%, China's 20%, Pakistan's 16% and others 7%. By number of ships, India's share was 40%, followed by China's 18%, Bangladesh's 17% and others 17%. India recycled ships equivalent to 18 million DWT corresponding to close to 500 ships.

Fig 3: Source: Gujarat Maritime Board Care Ratings

Fig 3: Source: Gujarat Maritime Board ,Care Ratings

However, as shown in the figure 3, in the year 2018-19, vessels recycled or sent to Alang ship recycling yard hit a very low in the 11 year period. Going forward, there is a need to restrict the falling market share and increase the dominance of the Indian ship recycling industry and to gain a larger share. In order to recapture the losing market share in the global ship recycling sector, India needs to review the Ship recycling industry and have to upgrade its work process. India has already enacted a wide range of regulatory instruments. Nearly about 50 central and state statutes directly or indirectly exists for the protection and improvement of the working and living conditions of workers in the hazardous industries. However, it is reported that the same has not been strictly adhered in case of the ship recycling industries. Lack of coordination between different enforcement agencies has been reported as one of the major lacunae in the effective implementation of labour and environment laws.

Presently, India has acceded to Hong Kong International Convention for Safe and Environmentally Sound Recycling of Ships, 2009 on 28th November, 2019. The Recycling of Ships Bill, 2019 has become an act after receiving the ascent of the President of India on 13th December, 2019. The Government has decided to bring this Act to provide regulation of recycling of ships by setting certain international standards by laying down the statutory mechanism for enforcement of such standards. It is expected that the enactment of the ship recycling act, 2019 and compliance will bring more business to the Indian ship recycling yards. As a major step, on 15th October 2020, the Government of India, has notified the Directorate General of Shipping (DGS) as National Authority for Recycling of Ships under the section 3 of the Recycling of Ships Act, 2019 and also has authorized DGS as an apex body, to administer, supervise and monitor all activities relating to Ship Recycling. Accordingly DGS will look after the sustainable development of the Ship Recycling industry, monitoring the compliance to environment-friendly norms, safety and health measures for the stakeholders working in

the ship recycling industry and will be the final authority for the various approvals required by the Ship-Recycling yard owners and the State Governments.

Presently few IACS classification societies are issuing Statement of Compliance to several ship recycling yards in Alang for compliance to Hong Kong Convention and are also making recommendations to EU as an 'Independent Verifier' in accordance with the requirements of European Union Ship Recycling Regulation. With the Basel Ban Amendment, adopted by the Parties to the Basel Convention on the Control of the Transboundary Movement of Hazardous and Their Disposal in 1995, coming as international law on December 5, 2019, the mounting pressure from NGOs and the financial institutions showing keen interest for the responsible approach of Ship recycling by the EU Ship owners, there is a need for the demonstration by the EU ship owners who own about 40 percent of the World fleet.

With HKC not coming in to force immediately, this could end up in a chance for the acceptance of EU Ship recycling regulations by the EU ship owners and recycling in the EU list of yards, which may severely impact the Indian ship recycling industry in a big way unless they are included in the EU list of approved Ship recycling yards considering a jaw-dropping 84% of all European end-of-life ships in 2017 ended up in South Asian countries in either India, Pakistan or Bangladesh and therefore a huge loss of business opportunity for Indian Ship recycling industry.

. V.CONCLUSION

It is very necessary that the Hongkong international convention comes early in to force towards a safe, sustainable and environmental friendly global ship recycling. Presently, without the ratification from anyone of the major three ship recycling countries such as Bangladesh, China and Pakistan, the Hong Kong convention cannot enter into force unless a diplomatic conference is convened by IMO to agree for a different entry criteria through a Protocol.

As far as India is concerned, India has ratified the Hong Kong Convention, the age old unregulated ship breaking units are on the preparation to come under the regulations of Hong Kong Convention. The Government of India intends to improve the living and working conditions of the workers in the Ship breaking yards in association with the Industry. In order to improve the conditions, it is paramount to have appropriate formal education and training prior to employment for the employees in the ship breaking and recycling industry as most of the accident occurrence that has taken place is either due to unsafe work practices, not wearing appropriate PPE and poor knowledge of the hazardous material involved in ship building. Presently training is being imparted in the Ship recycling yards by few of the IACS class members. However, still there is no uniform formal training or academics for the employees across the Ship recycling industry. The yards are also to be modernized and mechanized to avoid hard manual labour. Presently almost half of the recycling yards in Alang have invested in infrastructural and procedural improvements and have obtained a "Hong-Kong Convention Statement of Compliance" from IACS Classification Societies. However, the NGOs in the sector have raised serious concern that there is no adequate transparency in the certification process. An effective adherence to HKC regulations will set a safe working atmosphere free from occupational health hazards as well as safeguard the environment. A change in the face of ship recycling industry as a safe work place will invite/facilitate the entry of more and more investment as well as youngsters with adequate qualification in the field which will also assist ease up the unemployment issues in the country. It is very much essential that the gap between the regulations in the Hongkong convention and the European Union Ship recycling regulations are to be identified and must be bridged towards wider acceptance. Options must also be explored towards the possibility for an upgradation or shift in the beaching method of recycling to other environmental friendly methods of recycling such as the use of dry dock, jetty/pier ship breaking .

Considering the above, there is a need for the related Governmental organizations and agencies to combine with the other stake holders in the ship recycling industry, academia towards more research activities and development in the area to formulate the training needs, improvement of the Ship recycling facilities and strict implementation of the same. The above measures will not only facilitate the implementation of safety in the ship breaking yards towards reducing accident occurrences but also prevent the environmental degradation and thereby help effectively implement the HKC regulations in ship breaking industry in India. This in turn will also enable to keep high the prospects of India as a true market leader in Ship recycling and as a sustainable, safe and environmental friendly ship recycling industry as envisaged by the Government of India.

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STUDY ON SIMULATION OF FUZZY COMPENSATOR FOR BETTER DYNAMIC RESPONSE

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I. INTRODUCTION

When we need a very tight control over the output then definitely open loop control system is not sufficient enough to serve the purpose. So basically, we want to take the feedback from the system or plant then it is to be compared with a comparator which will generate the error signal and the error will be modulated based on the requirement to produce a controlled excitation to the plant so that we can maintain a desired output. So, when we are using a compensator, as per the classical control system which may be Proportional Integral(PI),Proportional Derivative(PD), Proportional(P), Proportional Integral Derivative(PID) or it may be single term, two term or three term controllers, but when we are introducing any compensators with the control systems, then the order of the closed loop transfer functions is also getting increased which may create some instability or non-linearity in the system which is very difficult to control. So first of all, to tune a P,PD,PI,PID regulator we need to linearize the entire system otherwise we cannot tune the controller properly to exhibit a high performance dynamic response. So, to avoid this problem, if any non-linearity exists in the system, we need to have some model free adaptive control so that at every instant it will identify the system and based on that the compensator will regulate the excitation. So this is not possible in classical P,PD,PI,PID regulators for which the fuzzy compensator or controller will be the best alternatives. If we introduce that, definitely we will be able the enhance the overall performance of the system.

II. II BASIC CONCEPT AND EXPLANATION

In this paper, a fuzzy logic based controller is developped with a given transfer fuction and the response is compared with a classical PI regulator.

Fuzzy logic is a form of many valued logic in which the truth values of variables may be any real number between 0 and 1 both inclusive. It is employed to handle the concept of partial truth, where the truth value may range between completely true and completely false. By contrast, in Boolean logic, the truth values of variables may only be the integer values 0 or 1.

Fuzzy logic is based on the observation that people make decisions based on imprecise and non-numerical information. Fuzzy models or sets are mathematical means of representing vagueness and imprecise information (hence the term fuzzy). These models have the capability of recognising, representing, manipulating, interpreting, and utilising data and information that are vague and lack certainty.

Let us see what is main problem happening in the case of PI,P,PID,PD regulator. We will see only the case of the PI regulator.
PI regulator stands for the proportional integral regulator. For integral control action the actuating signal consists of proportional error signal added with integral of the error signal. Therefore, the actuating signal for the integral control action is given by

$$e_c(t) = k_p e(t) + k_i \int e(t)dt$$

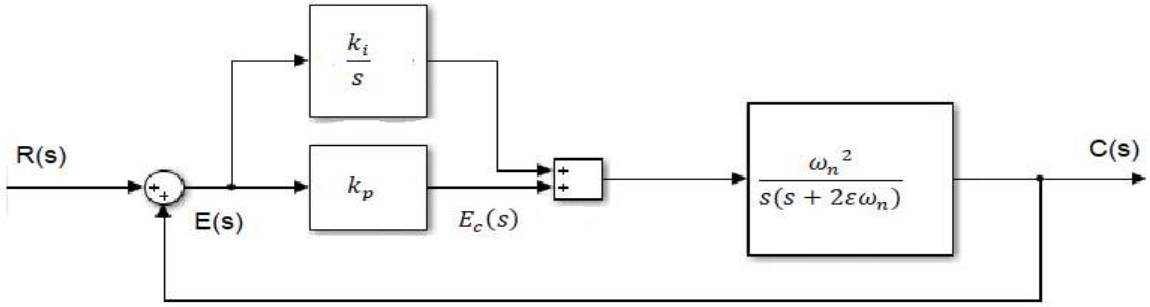
Where e(t) is the error signal, k_p is the proportional constant and k_i is the integral constant.
The Laplace transform of the actuating signal incorporating integral constant is

$$E_c(s) = k_p E(s) + k_i \frac{E(s)}{s}$$

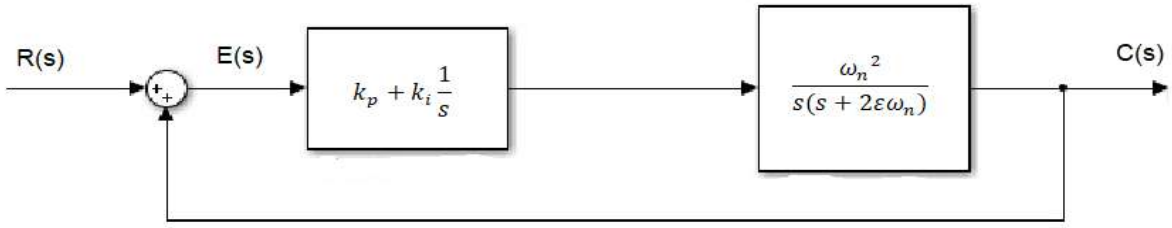
Therefore, the transfer function of the actuating signal is given by

$$H_c(t) = \frac{E_c(s)}{E(s)} = k_p + k_i \frac{1}{s}$$

So, for a second order unity feedback control system the block diagram representation using integral control action is shown in figure.



This block can be simplified as follows



From the block diagram the transfer function of a closed loop second order control system using the integral control is determined below:

$$\frac{C(s)}{R(s)} = \frac{\left(k_p + k_i\frac{1}{s}\right)\left[\frac{\omega_n{}^2}{s(s+2\varepsilon\omega_n}\right]}{1+\left(k_p + k_i\frac{1}{s}\right)\left[\frac{\omega_n{}^2}{s(s+2\varepsilon\omega_n}\right]}$$

This can be further simplified as

$$\frac{C(s)}{R(s)} = \frac{(s+k_i)\omega^2{}_n}{s^3+2\varepsilon\omega_n s^2+\omega^2{}_n s+ k_i\omega^2{}_n}$$ considering

$$k_p = 1$$

The characteristic equation of the above or overall transfer function becomes

$$s^3 + 2\varepsilon\omega_n s^2 + \omega^2{}_n s + k_i$$

=0

The characteristic equation is of the third order and by Routh Hurwitz Criterion we can find the stability of the system using the characteristic equation.

Now we see that as we need to set the value of k_p that is the proportional constant and k_i that is the integral constant to get a high performance dynamic response of the system for which we need to tune the system and also in the case where non linearity is considered it is very difficult to linearize the plant or system as the gains present are constant and are linear. So it is required to maintain nonlinear gains, PI regulator is not a suitable one to perform that.

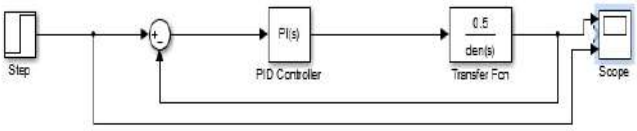
So, we need a compensator which has variable nonlinear gain where the fuzzy logic comes to rescue considering the fuzzy logic controller.

In this paper we are going to design a fuzzy controller using fuzzy logic in MATLAB and show how its response is better than the response of PI regulator.

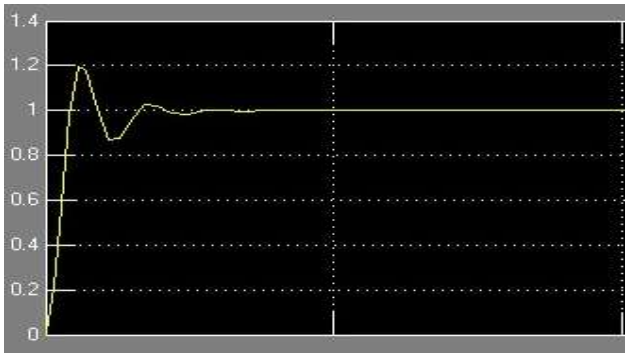
We are going to use 'mandani' method for designing this compensator.

So let us consider that a system has a transfer function as **T.F.(s)=** $\frac{0.5}{0.002s^2+0.05s+0.625}$ and determine the system response. So we are first considering the PI regulator and determining its system response. The block diagram of the model is given as:

Here we had used a PI controller which is already tuned which is able to take linear gains and the system transfer



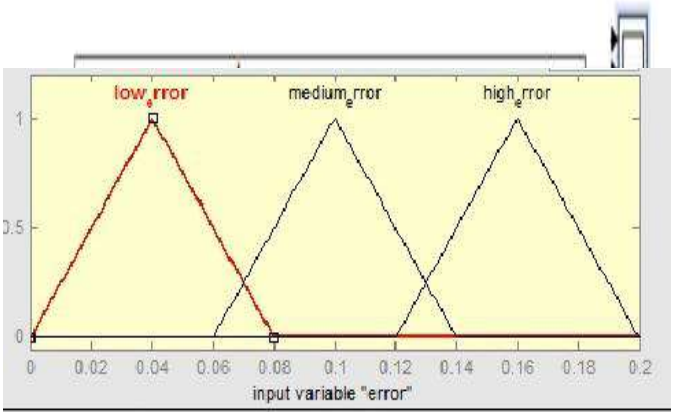
function is provided. A step input is provided and a corresponding feedback is considered from the output which generates the error signal.

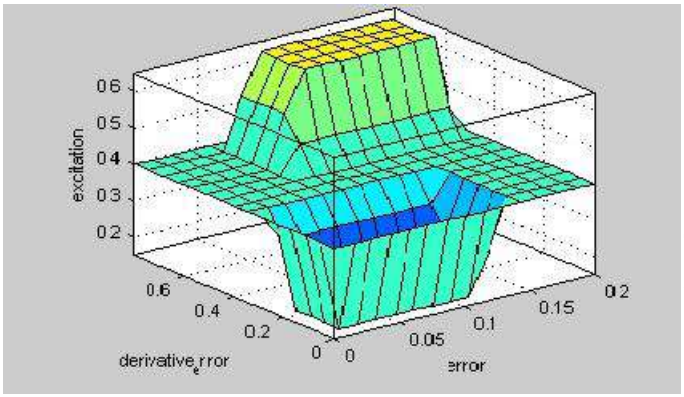


Here we find that the system has an overshoot of around 20% which is the maximum overshoot and it reaches the steady state after a long duration of time having 2 overshoot and 1 undershoot.

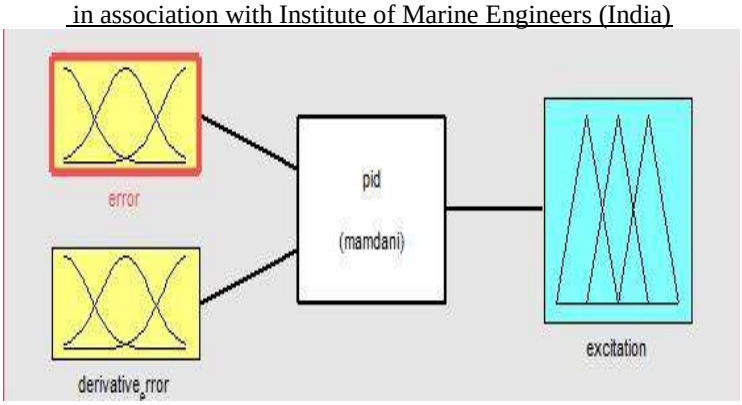
Now let us consider the fuzzy controller and determining its system response. The block diagram of the controller is given as:-

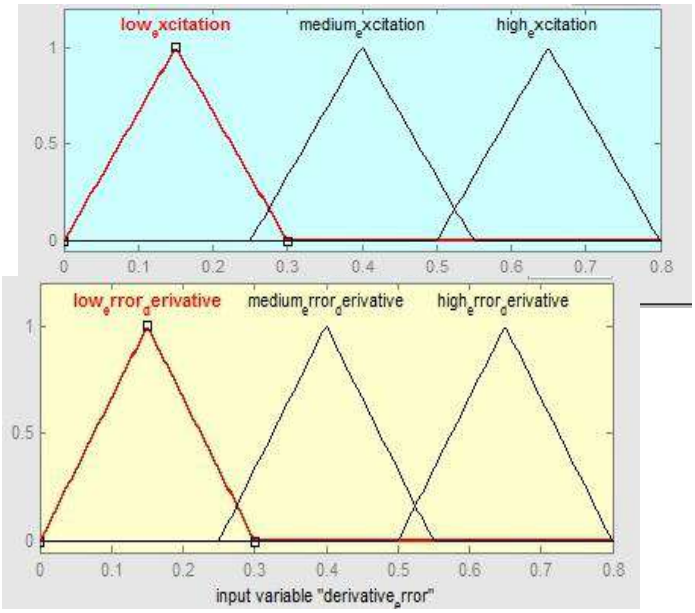
Here we had considered fuzzy controller which is able to take nonlinear gains. The fuzzy logic considered here is as follows: -





The first input to the logic is error which is ranging from 0 to 0.2 and the entire interval is divided into three parts which the first part is the low_error ranging from 0 to 0.08, second part is the medium_error ranging from 0.06 to 0.14 and the third part is the high_error ranging from 0.12 to 0.2. The diagram is as follows: -



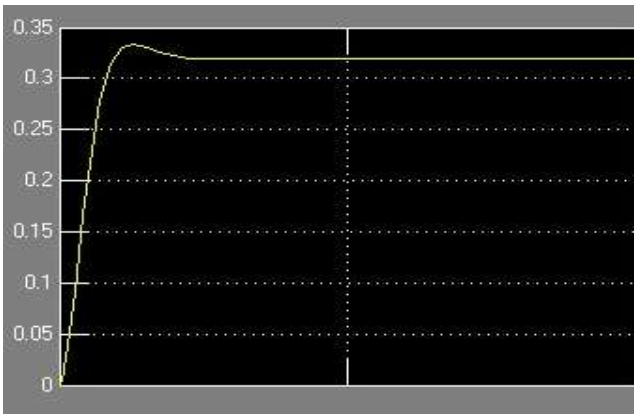


The second input to the logic is the derivative of the error ranging from 0 to 0.8 and the entire interval is divided into three parts which the low_error_derivative is 0 to 0.3, second part is the medium_error_derivative ranging from 0.25 to 0.55 and the third part is the high_error_derivative ranging from 0.5 to 0.8. The diagram is as follows: -

The corresponding excitation is again divided into three parts ranging from 0 to 0.8, the first part is the low_excitation ranging from 0 to 0.3, second part is the medium_excitation ranging from 0.25 to 0.55 and third part is the high_excitation ranging from 0.5 to 0.8. The diagram is as follows:-

Now let us consider surface plot of the corresponding fuzzy logic which is given as follows:

This total logic in incorporated in a ".fis file" shown in the block diagram with the help of the fuzzy logic controller block. The rules table we had used here is as follows: -



The first input that is represented by '1' in the block diagram or the error input gets integrated as it is get summed inside the fuzzy logic controller acting as the integrated part as in the PI regulator and the second input that is represented by '2' in the block diagram or the derivative of the error input gets integrated as it gets summed inside the fuzzy logic controller acting as the proportional part as in the PI regulator.

Rest of the block diagram is similar to the block diagram of the Pi regulator. The output response of the corresponding system is as follows:-

SL. No.	Rules
1	If the error is low_error and the derivative error is low_error_derivative then the excitation is low_excitation.
2	If the error is low_error and the derivative error is medium_error_derivative then the excitation is medium_excitation.
3	If the error is low_error and the derivative error is high_error_derivative then the excitation is medium_excitation.
4	If the error is medium_error and the derivative error is low_error_derivative then the excitation is low_excitation.
5	If the error is medium_error and the derivative error is medium_error_derivative then the excitation is medium_excitation.
6	If the error is medium_error and the derivative error is high_error_derivative then the excitation is high_excitation.
7	If the error is high_error and the derivative error is low_error_derivative then the excitation is medium_excitation.
8	If the error is high_error and the derivative error is medium_error_derivative then the excitation is medium_excitation.
9	If the error is high_error and the derivative error is high_error_derivative then the excitation is high_excitation.

The corresponding output response of the fuzzy controller has a dynamic response where we can see that maximum overshoot is very low and the time taken to reach the steady state is less compared to the response of the PI regulator.

III. CONCLUSION:-

Comparing the dynamic response of the PI regulator which is able to take only linear gains and the fuzzy logic controller which is able to take both linear and non linear gains. The corresponding dynamic response of the PI regulator has a undershoot and overshoot response and the fuzzy logic compensator has a overshoot response. We find that the dynamic response of the system based on the PI regulator has a higher overshoot and a delay in reaching the steady state response compared with the dynamic response of the fuzzy logic controller which has the lower overshoot and it reaches the steady state before the case of PI regulator. So we can conclude that designing a fuzzy controller using fuzzy logic gives a better dynamic response compared to any other controller like PID,PI,P,PD controllers.

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Proof Of Concept Model For Demonstrating IoT Based Vessel Control And Monitoring

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***Abstract*— The internet of things has proved to be one of the most influential technologies affecting almost every other field, be it for remote control, monitoring or regulatory supervision. Similarly, maritime operation and management have the potential to be greatly influenced by IoT, making certain control and monitoring activities highly efficient and easy. This paper proposes a proof of concept design for controlling and monitoring the propulsion systems of an electric twin-screw vessel over the internet.**

The idea is to have Wi-Fi connectivity node modules at the control units to receive and send information about the states of the electro-mechanical units to be controlled or monitored. It is a prerequisite that the vessel should have reliable and persistent internet connectivity for the setup to efficiently function in coherence with the onboard machinery.

Wi-fi node receives data from the cloud using TCP/IP protocol and MQTT library function formats are used to push and pull the information, to and from cloud servers. The Wi-Fi modules are connected to a locally established network of programmable microcontrollers via I2C protocol connection. The embedded controller in the Wi-Fi node decides the action based on the received information and instructs the PMCs accordingly. At the delivery end, PMCs control actuators and relays based on the received instructions, resulting in the change of state of machinery.

Machinery attributes like motor RPM and thermal state can be detected and published to thingspeak in real time through http post requests using another connectivity module. Thingspeak is an IoT service from Mathworks to record, display, publish real time data from various IoT devices. Data can be exported to Matlab for tasks involving computations and the results can be sent back to devices through TalkBack service.

I. INTRODUCTION

A. Introduction to Internet of Things

Information and data have always been counted as valuable entities by humans since antiquity. But the type of data and methods of gathering it underwent a revolution after the invention of information technology during the latter half of the twentieth century. In today's scenario, a major part of the income for IT giants like Google and Facebook is generated from the ads they run on their electronic media platforms that are targeted based on the data, collected from users. Data is collected by many corporations through various digital impressions of users like search queries, likes, comments, preferences, and purchases. Highly comprehensive analytical tools like artificial intelligence, machine learning, and deep learning are used to boost the significance of such data by generating valuable insights that assist analysts to decide on customer interests and marketing strategies. The fact that data can be collected only through digital impressions generated while using electronic gadgets like cell phones and computers limits many possibilities of extended applications. Humans interact with various physical entities daily, these interactions, if at all are documented as digital data can help us to reveal marvelous insights about human-object interactions. Thus Page | 4 facilitating research, development, and optimization of current systems resulting in better products and services for mankind. IOT is one of the possible ways to collect data from daily life interactions. Since various electrical and non-electrical objects of regular use are connected to the internet as a result of the Internet of Things, they generate huge amounts of valuable data related to daily life activities.

B. A Brief Description of IoT Integration with Existing Products

Primarily the data to be gathered is categorized based on continuity, periodicity, and amplitude of the output signal. The device from which data will be collected is defined. The data formats are settled based on the requirements and abilities of the system in use. The basic need to accomplish this is the need to have a reliable and secure internet connection. Up next, an intermediate connectivity system is required to connect devices to the internet. Usually, this is accomplished by using connectivity modules like ESP8266, HC05 in combination with development boards from Arduino, raspberry pi, and Texas Instruments. These modules help us convert the data into digital formats and

send it to the cloud servers via the internet. Further up, many systems support bidirectional communication, allowing us to control and manage a number of things wirelessly, making things more interactive and user-friendly. All the data collected from the devices is stored on cloud platforms and can be made available for public use or kept personal. A lot of these cloud services facilitate cross-platform usage and provide computational services but at the cost of the privacy of data at most. Most of the IT companies now host IOT web services, which are mostly free for individual use and paid for corporate use, like Amazon Web Services, Things Speak, and Google Firebase to name few. These technical leaps will entirely revolutionize the way people interact with their daily life commodities alongside while they gather huge amounts of useful data. This techno-economic real-life data gathering methodology can be very well implemented in the maritime industry. This will gather data generated by the operations of shipping vessels, utility systems, and port operations. Data can then be used to train machine learning models, AIs and will act as a provision for research analytics. Machinery maintenance is an important aspect to be sure about before vessels leave to score through the vast isolating blue oceans. IOT can effectively enhance the easy to condition-based maintenance to monitor the state of machines onboard and simultaneously contribute to real-time machine data content, which can help gain insightful results to improve the design and amend service methodology. Further, these results can assist regulatory authorities in drafting rules and setting standards. These applications promise a great deal of innovation and development in the near future but currently, the cons of this technology hold a seriously precarious reputation due to inappropriate security features.

C. Introduction to IoT in Shipping Industry

Just like any other industry, the maritime industry, extensively uses information services to collectively carry out various operations involved in efficiently maintaining the balance of marine transport and off-shore services. Thus, it is an undeniable fact that the shipping industry has plenty of room for a revolutionary innovation like IOT. Page | 5 Introduction of IOT in ships will lead to the achievement of a certain level of automation in terms of the process control systems. Further, the shift of controls from the control room to the controller's mobile device will drastically reduce the space requirement for the control room while making the control interface easier and remotely accessible. Ships are relatively large floating structures that are in fact sometimes referred to as floating cities sailing in the vast blues. All the data that these ships would generate will be immense in quantitative as well as qualitative terms. This data can be used in many ways like training optimization models, building more autopilot systems and getting insights into the challenges involved in the practical implementation of complete autonomous vessels which in a broader sense has never been done before.

II. DESCRIPTION OF PROOF OF CONCEPT MODEL

The model intends to prove the concept of implementing IoT in the remote and autonomous control of ships. It specifically focuses on propulsion control of a twin-screw vessel with the screws being rotated independently and in synchronization with each other. This setup allows the user to rotate the screws at variable rotations and directions as the need comes. The propeller action can be manually operated or set for automatic action based on predefined triggers in the Arduino script using any terminal connected to the internet with an adafruit.io compatible browser.

III. BRIEF ON MODEL HARDWARE AND SOFTWARE

Propulsion and Powering

Propulsion consists of two fixed pitch propellers powered by two 12V DC motors and connected via a shaft of 6mm diameter and universal couplings. starboard propeller is a right-hand screw and port propeller is a left-hand screw. Power source for the propulsion consists of a 12v,2200mAh LiPo battery powering an L298N dc motor driver module. propulsion motors are connected to the PWM enabled bi-directional motor driver outputs.

Connectivity and Control Module

ESP32 system-on-chip (SOC) microcontroller with built-in Wi-Fi module is used for IoT connectivity module for obtaining internet connectivity over Wi-Fi and controlling the L298N for direction and speed control using pulse width modulation (PWM). ESP32 is powered by a 5v, 1.1amp, 10000mAh battery pack through a male-male USB to micro USB cable. The terminal here is an android device running android7 or above connected to the internet and has a browser installed which supports adafruit.io web application.

ESP32 Firmware and Software

ESP32 is flashed with Arduino firmware to run Arduino code. It runs an Arduino code to connect to Wi-Fi hotspot, subscribe to MQTT server from adafruit and control L298N using GPIO pins. The complete code is given in the appendix.

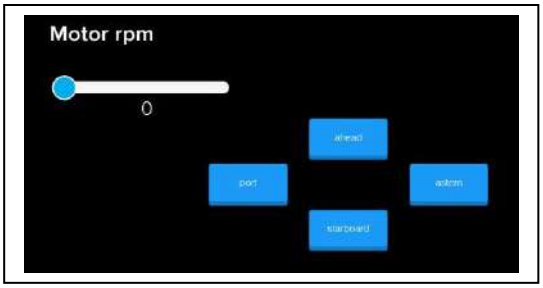
The Code is Structured as Follows

- Include the required libraries
- Define the GPIO pins, state variables, WIFI credentials, MQTT credentials and MQTT connect function..
- Setup section consists of WIFI connect built-in function, assigning the in-out pins and subscribing data from the MQTT server.
- Void loop consists of converting the characters received from MQTT into integers and control loops are used to decide the pin state outputs.

IV. WEB APPLICATION FOR REMOTE CONTROL

Adafruit has a graphic user interface web application for publishing and subscribing data from terminals. The UI has a variety of customizable data publishing and subscribing

tools like virtual monitors, virtual plotters, buttons, sliders etc. The data feeds can be connected to different display and control entities on the dashboard as it is convenient, depending on the purpose. Every user on adafruit is assigned a unique username and 32 bit authentication key. Device connects to the io.adafruit.com through port:1883 using the username and auth-key. The data is subscribed and published in character format.



V. VOICE AUTOMATION WITH GOOGLE ASSISTANT

Trigger based publishing feature from adafruit is utilized to publish data using a third party cloud platform IFTTT which can receive data from google assistant for specific predefined voice commands and activate the corresponding triggers to publish the associated data on adafruit.io. For this to work all three platforms adafruit, IFTTT and google assistant must be using the same google account. IFTTT can be used to configure google assistant to respond accordingly to certain voice commands. We have set up four distinct commands for forward, reverse, port and starboard motion. Generally a delay of 1-2 seconds from giving the command to getting the response in the dc motors.

SECURITY CONCERNS

> "If security were all that mattered, computers would never be turned on, let alone hooked into a network with literally millions of potential intruders" ― Dan Farmer

Anything hooked up to the internet, wired or wireless is at a potential risk of being hacked. But that doesn't stop us from using the technology.

Network security

Networks need to be secured from external penetration by employing firewalls to restrict, from and to communication passing through the network. Ports need to be actively monitored to limit unintended network intrusion. Potentially harmful web resource locations must be restricted from access. All data must be re-routed through a proxy network like socks5 proxy to hide the IP address so as not allow outsiders to digitally document network activity.

Software security

Firmware and program on the IoT modules need to be updated regularly to keep it safe from vulnerabilities and bugs. Updates contain patches for codes, libraries and built-in functions diagnosed with vulnerabilities which can be exploited by hackers to partially or fully take over the system or network at stake. The update files need to be verified using digital signatures to confirm the originality of content and source. Further use of good antivirus software with up to date virus and malware repositories help to keep the system safe from trojans, viruses, malware and ransomware attacks. All data needs to have a reliable backup strategy in case of a possible attack or mishap leading to partial or complete loss of data.

Web security

The web-communication can be secured with SSL encryption, using a secure web browser, blocking malicious scripts and having it tested by penetration testers. Offensive security techniques help in keeping the network, communication and system safe from external attacks.

VI. CURRENT SECURITY SCENARIO

A number of leaked documents and emails on WikiLeaks related to the secretive gatherings in Silicon Valley to discuss various issues regarding security of IoT-smart devices lead us to infer that improper security features of the IoT devices put forward some legitimate concerns that need to be met with before implementing them on relatively larger scales. One of the newly emerged problems is that hackers can use the hacked IoT devices to send automated emails without the consent of the owner. This loophole can be exploited to imitate the situation of distributed denial of services and cause harm to large corporations by bringing down their stock rates and profits. There have been reports of government agencies and other corporations spying on commoners by hacking their cell phones and computers. Considering the vulnerability of IoT devices, one can easily predict the massive advantage these entities will have, to exploit the privacy of large masses without any noticeable offense. IoT is a multimillion dollar industry which has sought interests from big players of IT-industry like Google and Amazon. Thus it will definitely grow into a much larger business by the end of this decade, possessing a potential to impact humanity in an unpredictably substantial manner.

VII. CONCLUSION

As intended initially we have successfully developed a twin screw vessel with IoT enabled propulsion control and tested its working in a well-connected space. The voice automation utility has also been successfully configured and tested with fairly satisfying results.

Appendix

Important terms

```
#include <ESP32Servo.h>

#include <WiFi.h>
#include "Adafruit_MQTT.h"
#include "Adafruit_MQTT_Client.h"


static const int servoPin1=2;
static const int servoPin2=4;
int in1 = 12;
int in2 = 13;
int in3 = 14;
int in4 = 27;

Servo servoObj1;
Servo servoObj2;

#define WLAN_SSID       [illegible]          // Your SSID
#define WLAN_PASS       [illegible]          // Your password

/************************** Adafruit.io Setup ******************************/

#define AIO_SERVER      "io.adafruit.com" //Adafruit Server
#define AIO_SERVERPORT  1883
#define IO_USERNAME     [illegible]          // Username
#define IO_KEY          [illegible]          // Auth Key
[illegible]

  WiFi.begin(WLAN_SSID, WLAN_PASS);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println();

  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());

  mqtt.subscribe(&Servo1);
  mqtt.subscribe(&Servo2);
  mqtt.subscribe(&Motor1);
}

void loop() {

  MQTT_connect();
//Input Check
int bs1,bs2,bs3,bs4=0;


  Adafruit_MQTT_Subscribe *subscription;
  while ((subscription = mqtt.readSubscription(20000))) {
    if(subscription == &Servo1) {
      Serial.print(F("Got: "));

      digitalWrite(in4, HIGH);
      Serial.println(in1);
      }
      else if (motorState1==20){
        digitalWrite(in1, HIGH);
      digitalWrite(in2, LOW);
      digitalWrite(in3, HIGH);
      digitalWrite(in4, LOW);
      }
      else if (motorState1==30){
        digitalWrite(in1, LOW);
      digitalWrite(in2, HIGH);
      digitalWrite(in3, HIGH);
      digitalWrite(in4, LOW);
      }
      else if (motorState1==40){
        digitalWrite(in1, LOW);
      digitalWrite(in2, HIGH);
      digitalWrite(in3, LOW);
      digitalWrite(in4, HIGH);
      }
      delay (20);

      }
  }

  }


      int servoState1 = atoi((char *)Servo1.lastread);
      servoObj1.write(servoState1);

    }
    if(subscription == &Servo2){
      Serial.print(F("Got: "));
      Serial.println((char *)Servo2.lastread);
      int servoState2 = atoi((char *)Servo2.lastread);
      servoObj2.write(servoState2);

    }
    if(subscription == &Motor1){
      Serial.print(F("Got: "));
      Serial.println((char *)Motor1.lastread);
      int motorState1 = atoi((char *)Motor1.lastread);
      Serial.println(motorState1);
      if(motorState1==0){
        digitalWrite(in1, LOW);
      digitalWrite(in2, LOW);
      digitalWrite(in3, LOW);
      digitalWrite(in4, LOW);
      }
      else if (motorState1==10){
        digitalWrite(in1, HIGH);
      digitalWrite(in2, LOW);
      digitalWrite(in3, LOW);
      digitalWrite(in4, HIGH);
      Serial.println(in1);
```

MQTT

MQTT is a machine-to-machine (M2M)/"Internet of Things" connectivity protocol. It was designed as an extremely lightweight publish/subscribe messaging transport. It is useful for connections with remote locations where a small code footprint is required and/or network bandwidth is at a premium. For example, it has been used in sensors communicating to a broker via satellite link, over occasional dial-up connections with healthcare providers, and in a range of home automation and small device scenarios.

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects.

Adafruit IO

Adafruit IO is a platform designed (by us!) to display, respond, and interact with your project's data. We also keep your data private (data feeds are private by default) and secure (we will never sell or give this data away to another company) for you. It's the internet of things - for everyone!

IFTTT

IFTTT is the free way to get all your apps and devices talking to each other. Not everything on the internet plays nice, so we're on a mission to build a more connected world.

Arduino Code Excerpts

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A review on modern advancements in Eco-friendly Anti-Biofouling in Marine Industry

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Abstract:

Biofouling is undesirable accumulation of implants on the surface of submerged objects, obstructing sustainable production. It is relevant in the growing global marine industry to refurbish research to pave the way for future research endeavours. Biofouling causes 50% downgrade in speed of vessel, increasing cost of fuel consumption. Here, the authors propose to come up with eco-friendly alternatives for antifouling from shellfish, finfish and barnacle aquaculture. Implementation of tin free self-polishing co-polymers is essential. The performance of anti-foulant releasing coatings has been improved due to the modified self-polishing co-polymers and the recently invented degradable co-polymers. The bilge of a vessel is usually made up of stainless steel on which corrosion is realistic but researchers have found several methods to significant reduction by electrodepositing polyaniline films on stainless steel which thereby reduces corrosion resistance of different conducting polymers. The integration and synergistic action of separate materials and technologies will be a path breaking direction in marine anti-corrosion and anti-fouling in future. Deeper analysis of the biology of organisms involved particularly with regard to larval settlement and metamorphosis along with the properties of adhesion and adhesives. New findings with regard to using barnacle adhesives adopted to improve the overall performance of the vessel. The main idea is to create a microscopically thin and ultra-smooth (friction free) immobilized sea of lubricant that would have mushroom like minute pores in them to stop accumulation of barnacles and other sea organisms, and injecting chemicals through those pores at regular intervals to completely resist the accumulations.

Keywords - Eco-friendly, Anti-Biofouling, Aquaculture, Copolymer, Self-Polishing, Polyaniline Films, Metamorphosis

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Estimation of forced cooling flow to maintain the dissimilar junction temperature of xenon arc lamp for high illumination application

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***Abstract*—**

The xenon arc lamp reaches it's maximum temperature during the operation for which it may fail, so to avoid failure of lamp, we analyze different rate of air flow to reduce the junction temperature of the lamp.

Keywords— cooling flow, xenon lamp, temperature

I. INTRODUCTION

Direct inspection of Nuclear reactor vessel is impossible due to its high temperature and radiation effect. It needs to inspect during shutdown condition while the temperature will be lesser. So we can use xenon arc lamp which is connected with the periscope and the same arrangement can be used in marine application too. The xenon arc lamp which is of 300W may get damaged if the temperature reaches to its maximum value as recommended by the manufacturer.

By using FEM we are going to analysis the flow rate from the air blower to xenon arc lamp assembly inlet of which is connected at the center of the two longitudinal circular fins.

II. XENON ARC LAMP

The xenon arc lamp is made of two materials, one is ceramic and another is metal alloy with different thermal expansion coefficient. When the bulb powered to 300W the temperature of the bulb increases up to its maximum, due to this the both material can expand in different extent and get crack at the junction of two metals.

Due to this crack, the xenon gas inside the bulb get leaked to atmosphere, the oxygen get entered into the bulb and react with tungsten to produce oxide and tungsten get damaged.

III. FORCED CONVECTION

Forced convection is a mechanism, or type of heat transport in which fluid motion is generated by an external source.

In xenon arc lamp, the temperature is reduced by forced convection method. It is done by blowing the cold air to bulb fin assembly by the air blower.

When we used the forced convection method, the size of heat sink will be reduced compared to natural convection heat sink, so we used the forced convection method.

IV. COMPONENTS

1. Air Blower :

   The Air Blower is used to blow the atmospheric air to the lamp at various flow rate to reduce the temperature of the lamp.

2. Variable frequency drive :

   A variable-frequency drive (VFD) is a type of adjustable-speed drive used in rotating electrical machine to control AC motor speed and torque by varying motor input frequency and voltage.

3. Resistance temperature detector :

   Resistance temperature detectors, are sensors used to measure temperature. Many RTD elements consist of a length of fine wire wrapped around a ceramic or glass core but other constructions are also used. The RTD wire is a pure conductor, typically platinum, nickel, or copper.

4. Power supply :

   It consists of high voltage convertor, flyback transformer.The power supply of the lamp produces 23kV pulse as ignition pulse to breakdown the gas inside the bulb tube and once breakdown occurs, it required 2-20V to glow the bulb. This a high current converter.

V. CONSTRUCTION

It consists of Air Blower and it is controlled by variable frequency drive, the blower pump discharge and lamp is connected through flexible hose, the flow meter is connected at the outlet of the pump.

Resistance temperature detector is connected to the lamp. It consists of a power supply unit which has flyback transformer, high voltage converter and it is connected to the lamp.

VI. WORKING

The atmospheric air is sucked by the pump at the suction area and it is fixed with resistance temperature detector to measure the atmosphere air temperature, and the air is delivered through the outlet of the pump where flow meter is present it will show the air flow rate.

After that the air is delivered to the lamp through the flexible hose which is connected between the outlet of the pump and inlet of the lamp assembly, when it is reaches a stable flow rate, the power supply is made ON to glow the lamp.

In power circuit of the lamp consists flyback transformer, high voltage converter so it will convert 12V to 23KV pulse, so it will be helpful to ignite the lamp and lamp is maintained at constant temperature by varying the forced cooling air flow through the variable frequency drive and the surface temperature is measured by using resistance temperature detector. To knowthe temperature of lamp we use temperature indicator which is connected with resistance indicator detector.

VII. SIMULATION

Case I (Flow rate-18m^3/hr)

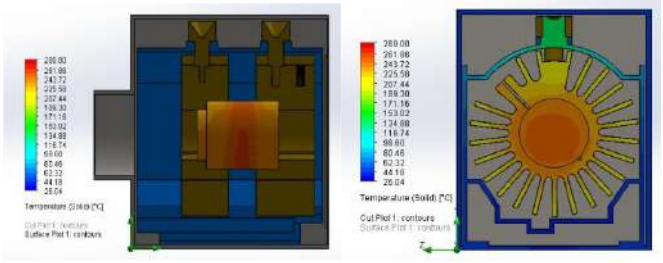


*Fig. 1*Surface temperature in 3D & Cut plot temperature in 3D

Case -II (Flow rate = 45.2 m^3/hr)

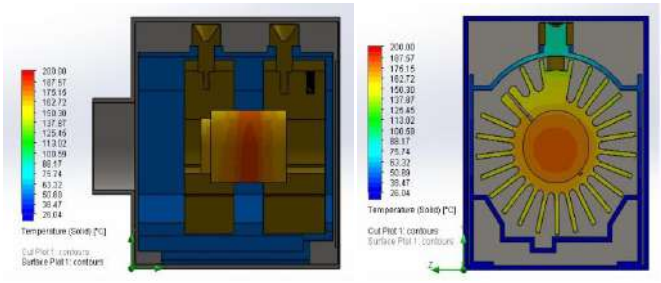


*Fig. 2*Surface temperature in 3D & Cut plot temperature in 3D

Case -III (Flow rate = 54 m^3/hr)

Fig.3. Surface temperature in 3D & Cut plot temperature in 3D

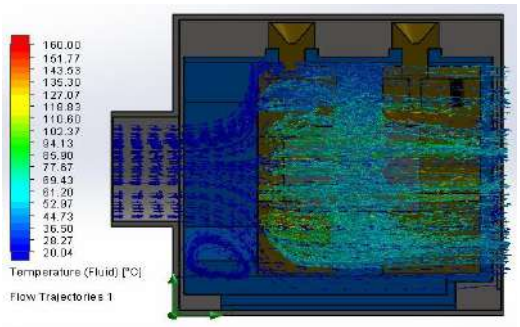
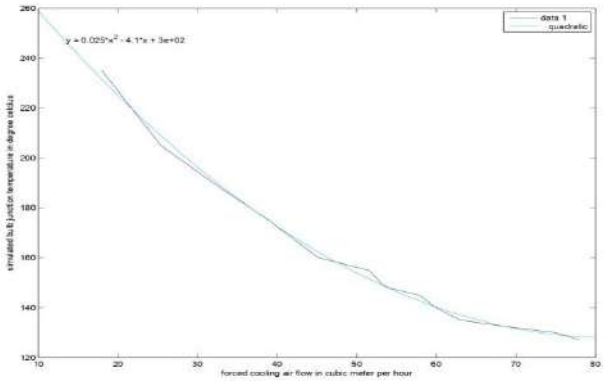


Fig.4 FLOW TRAJECTORY



. Fig.4 Temperature Vs Flow Rate

TABLE I. EXPERIMENTAL RESULT

Case I	**Case II**	**Case III**
Flow rate =18m^3/hr	Flow rate= 45.2m^3/hr	Flow rate = 54m^3/hr
Min temp = 230℃ Max temp = 255	Min temp = 160℃ Max temp = 185	Min temp = 148℃ Max temp = 160

VIII. RESULT

A CFD Model of xenon arc lamp is done for various flow rate to reduce the temperature of the lamp as conjugate heat transfer problem. At the flow rate of 54m^3/hr the temperature of xenon arc lamp is restricted to 150°C.

As per the manufacture's recommendation, the temperature of lamp up to 150°C is allowed, so it is concluded to maintain a flow rate of 54m^3/hr to cool the lamp and for it trouble free operation

IX. CONCLUSION

The CFD analysis of xenon arc lamp is done for various flow rateto get the estimated temperature 150°C, so the life span of the lamp could be increased.

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ENHANCING CYBER SECURITY AWARENESS IN MARINE INDUSTRY

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Abstract— **Cyber security is the combination of stakeholders, policies, processes and technologies to protect cyber assets of any industry. It is optimized to levels that help shipping personnel define, balance resources required with usability/manageability and the amount of risk offset. The aim of this paper is to develop understanding and awareness of key aspects of cyber security – identify threats, identify vulnerabilities, assess risk exposure, develop protection & detection measures & establish contingency plans. Furthermore, establish guidelines for operators on how to assess their ship's operations & put in place necessary procedures and actions to maintain the security of cyber systems for marine industry. The integration of technology in shipping operations is being enabled by the integration of Information Technology and the Operation Technology on board ships. This has enhanced the threats of unauthorised access or malicious interventions to ship's systems and networks. The measures to guard against cyber threats should include, (i) quantification and type of risks to security, environment and commerce if no cyber security measures are in place, (ii) due protection to IT and OT infrastructure and its networked equipment,**

(iii) management of access (iv) protecting data related with its sensitivity. With emerging technologies, there is a direct applicability of trends like Artificial Intelligence to enhance security and fraud prevention. Extending the use of Security Analytics for understanding and detecting risk level of vulnerabilities, improving the performance of own security policy by removal of unnecessary data, feature extraction and selection, data cut off, parallel processing, machine learning and deep learning algorithms – are some examples for the use of advanced technologies for improving Cybersecurity.

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Keywords— *IT- Information Technology, OT- Operation Technology*

I. INTRODUCTION

On average, hackers attack 2244 times a day (University of Maryland).
It's a known fact that cybercriminals can hack any network in the world- all thanks to the technology of digitalization. And Ships, when exposed to interference from one of the many electronic navigation devices, such as the Global Positioning System as the crash rate increases to 70%,or if bugged with viruses in cargo work/ in sensitive and seamless documentation, and /or in the propulsion units of engine room or in machines , any or all can cause serious trouble to the ship owners .And on the blocks now are Autonomous ships and block chain technology for activities of marine logistics and support systems for end to end functions

This template, modified in MS Word 2007 and saved as a "Word 97-2003 Document" for the PC, provides authors with most of the formatting specifications needed for preparing electronic versions of their papers. All standard paper components have been specified for three reasons: (1) ease of use when formatting individual papers, (2) automatic compliance to electronic requirements that facilitate the concurrent or later production of electronic products, and (3) conformity of style throughout a conference proceedings. Margins, column widths, line spacing, and type styles are built-in; examples of the type styles are provided throughout this document and are identified in italic type, within parentheses, following the example. Some components, such as multi-leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow. In cyber security terms, risk is the potential for a threat (a person or thing that is likely to cause damage) to exploit a vulnerability (a flaw, feature or user error) that may result in some form of negative impact (National cyber security centerUK,NCSC). The integration of technology in shipping operations is being greatly enabled by the networking of Information Technology (IT) and the Operation Technology (OT) onboard ships over the worldwide web and Internet of things (IOT) is a common happening. Growing use of big data, smart ships, and IOT, is now increasing and therefore the amount of information are getting accessed by attackers of cyberspace. Hence the threats of unauthorised access or malicious attacks to ships systems and networks get greatly heightened. There could also be risks arising from the inadvertent introduction of malware from say removable media by untrained or unaware personnel and compromising the systems and data. Cyber threats are thus a reality and there is need to be aware of how this could work making the systems vulnerable to its attacks.

It becomes imperative that ship-owners and operators regularly assess their operations and develop resilient approaches to safeguard the security of cyber systems onboard of their ships.

56% of IT decision makers believe phishing attacks are

their top security threats. 32% of the breaches involved phishing. So phishing awareness and education are some of the best ways to decrease risk. The most common cyber-attack methods include phishing/spear phishing/vishing (voice phishing), rootkit, SQL injection attacks, DDoS attacks and malware like Trojan horse, adware and spyware.

Who might be attacking you?Geo political trade interests, Ship-manning agencies, Chartering and shipbrokers' agencies and cross-border intel-agencies, interested in gaining an economic advantage for the host companies or flag-states. They are Hackers who find interfering with computer systems an enjoyable challenge. Hacktivists who wish to attack companies for political or ideological motives. Employees, or those who have legitimate access, either by accidental or deliberate misuse.

II. OBJECTIVE

To find out the factors which become a part for awareness and mitigation drive of cyber risk, threat, vulnerabilities in hindsight, at hand and as a foresight to be prepared for treading in uncharted terrains of new possibilities in shipping industry

III. DISCUSSION

The cyber risks usually are specific not only to the company and the ship depending on the technology usage, but also its area of operation and the trade they are in. The challenge here becomes manifold due to the fact that no historic data or evidence can be relied upon to get any definitive information on the imminent incident or its impact, unlike the traditional areas of concern on safety or maritime security. The motivation for cyber-attack could range from operation disruption to damaging the reputation to financial or political gain or even plain espionage. The threats could emanate from internal sources like disgruntled employee or outsiders like criminals, opportunists, terrorists or just activists.

There are mainly two types of cyber-attacks – untargeted and targeted. Untargeted attacks happen over taking advantage of the openness of the internet without bothering so much about who the victim is. While targeted attacks are when organizations are singled out for a specific interest and can be more dangerous.

Untargeted Attacks: In un-targeted attacks, attackers indiscriminately target as many devices, services or users as possible. They do not care about who the victim is as there will be a number of machines or services with vulnerabilities. To do this, they use techniques that take advantage of the openness of the Internet, which include:

phishing - sending emails to large numbers of people asking for sensitive information (such as bank details) or encouraging them to visit a fake website

water holing - setting up a fake website or compromising a legitimate one in order to exploit visiting user

ransomware - which could include disseminating disk encrypting extortion malware

scanning - attacking wide swathes of the Internet at random

For ships, untargeted attacks are one where a company or ship's system and data are one of many potential targets.

Targeted Attacks: In a targeted attack, your organization is singled out because the attacker has a specific interest in your business, or has been paid to target you. The groundwork for the attack could take months so that they can find the best route to deliver their exploit directly to your systems (or users). A targeted attack is often more damaging than an un-targeted one because it has been specifically tailored to attack your systems, processes or personnel, in the office and sometimes at home. For ships targeted attacks are like the system or data being intended targets.

Targeted attacks may include:

spear-phishing - sending emails to targeted individuals that could contain an attachment with malicious software, or a link that downloads malicious software deploying a botnet - to deliver a DDOS (Distributed Denial of Service) attack subverting the supply chain - to attack equipment or software being delivered to the organization

Vishing- voice phishing by adversial AI.

Water ingress alarm system

Ballast water system

Gas liquefaction

ODMCS-GPS interdependency-compatibility

Various documents –E-bill of lading, E-logs, E-oil record books (forthcoming MEPC resolutions for MARPOL-to be enforce)

PASSENGER SERVICES

i. Property management system
ii. Medical records
iii. Passenger embarkation access control
iv. User authentication and authorization system
v. Passenger or seafarer boarding with own device [BYOD]
vi. Passenger Wi-Fi /-LAN internet access
vii. Entertainment system
viii. Communication

ADMINISTRATIVE AND CREW WELFARE SYSTEM

- Certificates in digital format, Seamen-identity document for example
- Quarantine digital reports
- Other activities related to shore-side are also as below:

Berthing /Unberthing activities
VTS-Pseudo VTS
Port related documentation-FAL Convention
C and F agencies
Port access control

Tanker and Gas terminals—safety, security, pollution related access, operation, spoofing.

Regardless of whether an attack is targeted or un-targeted, or the attacker is using commodity or bespoke tools, cyber-attacks have a number of stages in common. Some of these will meet their goal whilst others may be blocked.

STAGES OF AN ATTACK

An attack, particularly if it is carried out by a persistent adversary, may consist of repeated stages. The attacker is effectively probing your defenses for weaknesses that, if exploitable, will take them closer to their ultimate goal. Understanding these stages willhelp you to better defend yourself. A number of attack models describe the stages of a cyber-attack. We have adopted a simplified model in this paper that describes the four main stages present in most cyber-attacks:

- Survey - investigating and analyzing available information about the target in order to identify potential vulnerabilities
- Delivery - getting to the point in a system where a vulnerability can be exploited
- Breach - exploiting the vulnerability/vulnerabilities to gain some form of unauthorised access
- Affect -carrying out activities within a system that achieve the attacker'sgoal

IV. LITERATURE REVIEW

- Marine Security professionals have additional resources to defend vulnerable networks and data from cyber attackers - combine the strength of artificial intelligence (AI) with cybersecurity. The use of AI yields automated processes - including continuous risk assessments, autonomous incident response, configuration monitoring, and automatic remediation and integration of security solutions and data. There is a significant reduction in response time to cyber-attacks. According to a report published by Capgemini, about 42% of the companies studied had seen a rise in security incidents through time-sensitive applications. However, the use of Artificial Intelligence in addressing areas of cybersecurity can be a considerable threat to ships, apart from being potential solutions[11] (double-edged sword)
- Study from Varonis[9] suggests that 21% of files are not protected and so it suggests for a paradigm shift in cost versus security processes.
- Digital ship newsletter and 'gcaptain' article of 11th March 2020 has shown through Digital container shipping association's publication named as DCSA cyber security implementation guide, the best practices –manageable task based approach towards meeting IMO resolution[1] MSC.428(98) implementation schedule for January 2021.
- An article by H.A. Boyes[10] suggests that 37% of data breaches were attributed to malicious and criminal acts. The remainder were split between system glitches (29%) and human factors (error/negligence) at 35%.
- Incidents of vessels[10] 'Royal Majesty' highlights the GPS/Autopilot problems, whereas vessel ANNABELLA' suggests of loading software glitches.
- Indian news agencies have reported on 10th March about Data theft of about 3 Lac or more people from Australia from Facebook account by a firm.
- International Maritime Organisation has instructed that by January 2021 all member states to take measures to mitigate cyber threats and adopt policies in safety and security related endeavours to create a sort of preventive mechanism of cyber security.
- In 2017, on June 27, AP Moller-Maersk[8] confirmed that the group was hit as part of global cyber-attack named 'PETYA', affecting multiple sites and select business units. The cost to company for recovery was about 200 to 300 million USD.
- Press trust of India reported that at Jawaharlal Nehru port trust Shewa, Panvel, Maharashtra APM MAERSK faced disruption in operation due to cyber-attack.
- Antwerp Port faced cyber -attacks with respect to containerised cargo getting stolen during 2011-2013 by organised cyber- crime by breach to IT system.
- A survey by IHS fair play in 2017 shows that out of 300 industry responders 65 had been attacked through cyber space. Malware apparently found to be of main attack nature.
- In July 2013 a test was done by research scholars of University of Texas, Austin, for GPS spoofing to a sailing yacht and it was achieved successfully by creating false civil GPS signal

- July 2015, South Korea reported of GPS jamming which paralysed all navigation and auxiliary systems on board. It was intentional interference of Geo-political nature.
- A report by Hugh Mcdowell [7] in 'Quantitative assessment' shows that the risk of cyber-attack is excluded from Insurance cover by ''Institute cyber-attack exclusion clause' [CL380] ,10November 2013. Though P&I CLUB has pooling facility with limit of 30 million USD per ship, provided attack is not an act of war or terrorism.
- With the literature survey done, it is observed that a specific network architecture should be in place for assessing the systems as it is demand of the day with threat perceptions looming larger by every passing day when autonomous ships will be plying across waters and their function will depend mostly on, Information communication technology, ICT, high integration of systems and their connectivity with shore system and internet. A contingency plan to be ready to Identify, Detect, Respond, Recover processes[12]for cyber attacks.

IV. Conclusion

Shipping industry is a unique but complex organization wherein different stakes are existing for different vendors having long life periods, systems, and vessels which are almost different to each other in network topology. This industry had plenty of case studies of damages, loss of life and claims of cargo losses in past and analysis of yore shows the human element for the failures and resulted error chain dynamics, but now it is at hand to deal with human element act from remote to do intentional, unintentional, targeted or untargeted attacks without being with the machine on board. STCW, ISM, ISPS codes did deal with filling the gaps of KSA – by having KPIs. Now the need is to train the manpower of industry with essential security tools, paradigm realignment with cutting edge technologies

With the shipping industry's increasing reliance on technology and remote monitoring, maritime cyber security is no longer optional, but is business-critical. It is imperative that companies are ready to tackle the cyber challenge and remain resilient. Whilst the risk is real, it can be mitigated, and how quickly and robustly a company can respond to this challenge will depend on how ready and determined they are, and on whether they are planning to invest in cyber preparedness. Artificial intelligence, though is double edged sword; it is still need of the hour in this industry to cap the human element body as integrated with. Ship operators need to be confident that their procedures can deal with ever bigger and more sophisticated cyber-attacks and that that they are developing a safe, dependable, cyber capability in shipping by inculcating disciplined appropriate systems, training and resources in place to effectively hone the skill and knowledge to use Artificial intelligence cyber security solutions and by employing the 'White hat hackers' system of Artificial intelligence's neural networks and also to raise the cyber defenses. At length it is summarized as to have tough international digital legislation, to have commonly managed appliances and last but the most important of all to impart cyber related education to user as Human being the weakest link in the length of this Shackle and needless to add a shackle length of cable is as strong as to every link.

V. Disclaimer

This paper is not intended to be a standalone or exhaustive guide to cyber risk management. Users to ensure about specific guidelines for specific need of ship-types.

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Comparative study on Stress Intensity factor of Al7075-T651 plate with Part through Elliptical Crack using FEM and New Man Raju Equation

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***Abstract*—This paper deals with stress intensity factor of plane stress condition of Al7075-T651 plate with part through elliptical crack using Ansys and compared with New man Raju equation. It also helps in studying the effectiveness of the result obtained through Ansys along with New man Raju Equation. The plate is modelled and analyzed for loading conditions of 25 Mpa and 50 Mpa and result is compared with the calculation obtained by New man Raju equation and found to have a maximum of 2.5% of variation..**

Keywords—Stress Intensity Factor, New Man Raju Equation, Elliptical Crack, Ansys.

I. INTRODUCTION

The technological advancements in study of new materials have paved way for lot of research in the field of materials and also applications of those materials in all major industrial and Havoc environment.Materials used in Engineering are considered to be flawless and long lasting to its usage. The materials when used fail before its estimated life due to its small defects such as blow holes, cracks, which have major impacts under loading condition and environment. These defect under continuous usage create serious problems. To avoid such problems the study on fracture mechanics have a greater scope and impact. The material Al 7075 T61 is used for study by designing a plate of standard dimension and effect of stress intensity factor under different loading condition is analyzed [1]

II. PLATE DESIGN

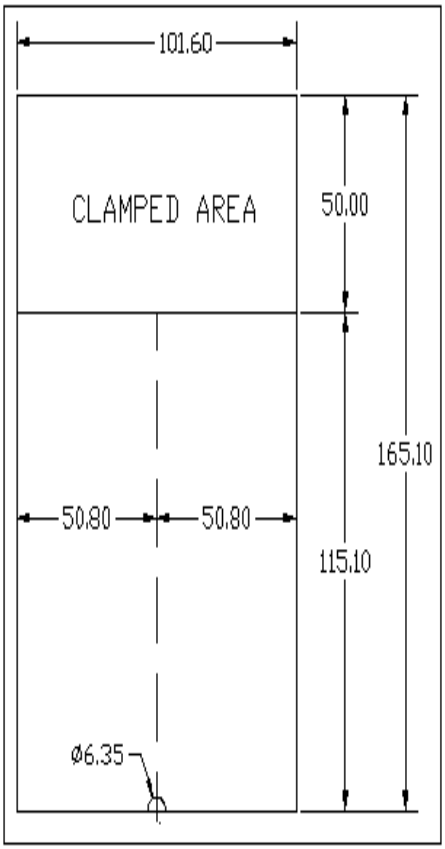
A. Plate Design Specification

The Stress Intensity Factor of Plane Stress condition derived from the ANSYS FEM software is compared with the NEWMAN-RAJU calculation to determine the deviation in the value. In order to prove the effectiveness of the results, the test model considered in the NEWMAN –RAJU analysis is used as a base model and the crack is introduced into the model. The overall dimension of the plate is maintained the same. The crack specifications used in the previous analysis are used in this model. The NEWMAN –RAJU has derived equations for the plate model symmetric about the center of the horizontal axis with a hole at the center of the plate. Equations are derived from the symmetric crack at the ends of the hole in the horizontal plane. The plate is applied a uniform tensile load at the remote end[2]. The plate is modelled similar to the above analysis and is shown in Figure. The model is meshed with singularity element at the crack tip of the elliptical crack. The non-linear material properties are provided with the model. The tensile load is applied at the distal end of the plate and stress intensity factor results are obtained[3]. The analysis determines the deviation in the results of the model in comparison the Newman Raju Equations.

TABLE 1: DIMENSION OF PART THROUGH ELLIPTICAL CRACK

a/t		*0.1*
a/c		*0.5*
Thickness t	*mm*	*6.35*
Crack Depth a	*mm*	*0.635*
Crack Length c	*mm*	*1.27*

Fig1 : Dimension of Plate (Front View)



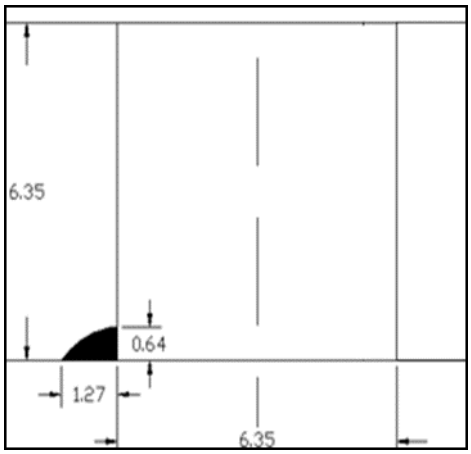
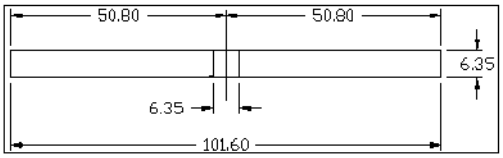


Fig 2: Dimension of The Plate (Section Along Center)



B. Ansys Test Case Analysis

Fig 3: Elements o f Test Case Model

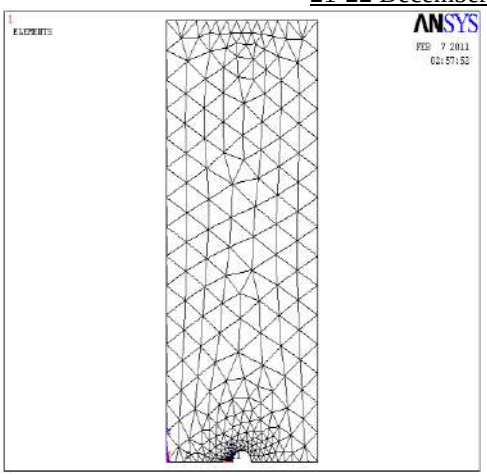


Fig 4:Three Dimensional view

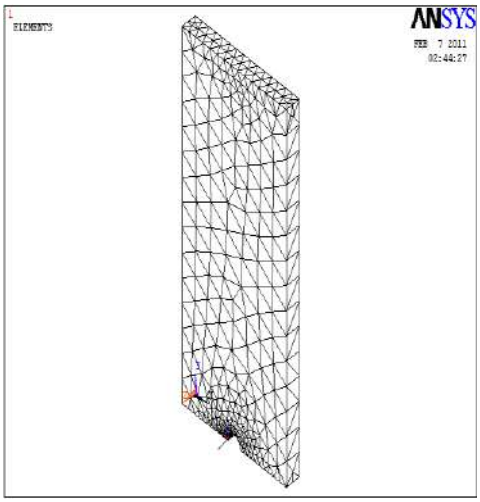


Fig 5: *View of Part Through Elliptical Crack for Test Case Model*

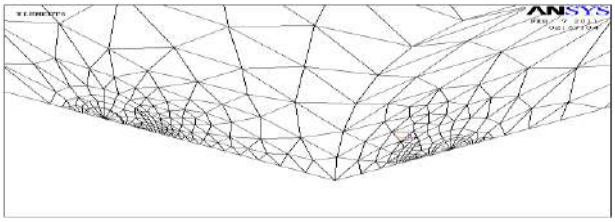


TABLE 2 STRESS INTENSITY FACTOR VALUES FOR CASE 1 AND 2

S No	*Nodal Path*			*Local Co-Ordinate System*			*Case 1*	*Case 2*
1	1169	1149	1136	1169	1149	2333	42.146	84.283
2	1171	1148	1134	1171	1148	2608	40.646	81.302
3	1173	1147	1132	1173	1147	2883	40.834	81.67
4	1175	1146	1130	1175	1146	3158	41.953	83.909
5	1177	1145	1128	1177	1145	3433	43.691	87.384
6	1179	1144	1126	1179	1144	3708	45.498	90.998
7	2022	1143	1124	2022	1143	3983	47.591	95.184

8	**2024**	**1142**	**1122**	**2024**	**1142**	**4258**	**50.001**	**100**
9	**2026**	**1141**	**1120**	**2026**	**1141**	**4533**	**51.93**	**103.86**
10	**2028**	**1140**	**1118**	**2028**	**1140**	**4808**	**54.227**	**108.46**
11	**2030**	**1139**	**1116**	**2030**	**1139**	**5083**	**56.614**	**113.24**
12	**2032**	**1138**	**1114**	**2032**	**1138**	**5358**	**58.688**	**117.39**
13	**1167**	**2019**	**2017**	**1167**	**2019**	**443**	**62.73**	**123.49**
14	**5896**	**5876**	**5873**	**5896**	**5873**	**6152**	**67.68**	**135.43**

III NEWMAN RAJU CALCULATION

The stress intensity factor is obtained using the equations derived by Newman-Raju for the standard case of finite plate with a hole at the center and symmetric cracks on both ends of the hole in horizontal plane. The equations are derived from the curve fit equations analyzed by Newman-Raju.[4]

The equation is formed with the remote bending stress applied to the model at the ends of the plate. In this analysis, the bending load is eliminated and the analysis is carried out for the tensile load applied at the ends of the plate

$$K = (S_t + H_{CH}S_b)\sqrt{\frac{\pi a}{Q}}F_{CH}\left(\frac{a}{c},\frac{a}{t},\frac{r}{t},\frac{r}{b},\frac{c}{b},\emptyset\right)$$

K	Stress Intensity Factor
S_t	Remote Uniform Tensile Stress
S_{ib}	Remote Uniform Bending Stress on the outer fiber
H_{ch}	Bending Multiplier for center crack at a hole in a plate
A	Crack Depth
Q	Shape factor for elliptical crack
F_{ch}	Boundary correction factor for corner crack at a hole in a plate under tension

Inorder to determine the Stress intensity factor using Newman-Raju equation, the model should satisfy the following condition given. Once the conditions are satisfied the equations are solved using the input values of the model

$0.2<a/c<2$; $a/t<1$; $0.5<r/t<2$;$((r+c))/b<0.5$;$0<\phi<\pi/2$

The Newman-Raju equation gives more emphasis on the geometry and the dimension of the crack [5]. The equation does not focus on the geometry of the plate, the number of holes and the material properties of the plate. The results are same for the linear and non-linear material property model. The equations were derived for ***a/t < 1*** part through elliptical crack embedded into the hole in a plate. The results of the Newman-Raju equation is used to compare the Stress intensity factor values of Case1 and Case2 obtained using ANSYS. The equation is same for all the cases since the equation does not focus on the location of the crack along the horizontal axis of the plate.[6],[7]

TABLE 3 COMPARISON OF ANSYS RESULTS WITH THE NEWMAN RAJU 25 Mpa

2φ/π	ANSYS RESULT	NEWMAN-RAJU CALC
0	56.05	39.301
0.063	42.146	38.928
0.125	40.646	39.202
0.188	40.834	40.011
0.250	41.953	41.235
0.313	43.691	42.773
0.375	45.498	44.562
0.438	47.591	46.563
0.500	50.001	48.767
0.563	51.93	51.178
0.625	54.227	53.814
0.688	56.614	56.702
0.750	58.688	59.875
0.813	62.73	63.373
0.875	67.68	67.243

Fig 7 Comparison of Ansys Results and Newman-Raju Equation For 25mpa Tensile Load

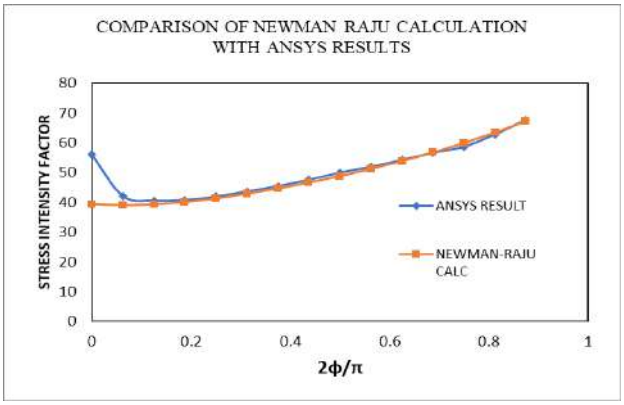
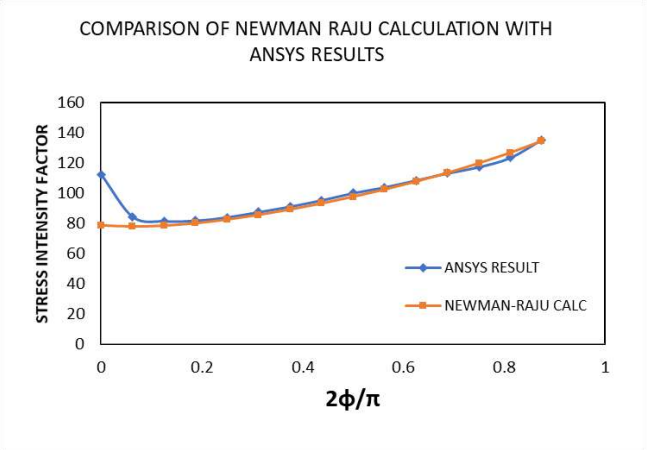


TABLE 4 *COMPARISON OF ANSYS RESULTS AND NEWMAN-RAJU EQUATION FOR 50MPa TENSILE LOAD*

2φ/π	ANSYS RESULT	NEWMAN-RAJU CALC
0	112.48	78.601
0.063	84.283	77.856
0.125	81.302	78.405
0.188	81.67	80.023
0.250	83.909	82.469
0.313	87.384	85.547
0.375	90.998	89.123
0.438	95.184	93.127
0.500	100.00	97.535

0.563	103.86	102.357
0.625	108.46	107.629
0.688	113.24	113.404
0.750	117.39	119.750
0.813	123.49	126.747
0.875	135.43	134.486

Fig8 Comparison of Ansys Results and Newman-Raju Equation For 50 Mpa Tensile Load



IV RESULT AND DISCUSSION

The plot of stress intensity factor obtained from ANSYS and Newman-Raju equation shows similar profile of the value along the parametric angle. The deviation in the value of Stress intensity factor is high initially and it subsides as seen with the change in the parametric angle. The Stress intensity factor is almost similar with a deviation of less than 2.5%. The curve formed with the ANSYS results is not smooth as compared to the calculated value which is mainly due to mesh deformation at the edges of the model. The comparison of the results in both the cases is similar and the deviation in the value is less than 3% overall

The stress intensity factor start to deviate between the two cases with the increase in the tensile load applied to the model. The tensile load has a larger impact with respect to the location of the crack in a plate

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ALERNATE FUEL

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***Abstract*— The world is facing a huge problem of high fuel prices, air pollution and a lot of climatic changes. Alternate Fuels play an essential role in the present scenario in Internal Combustion Engines as the mineral fuels are depleting. This paper presents the maneuver and origin of the use of alternative fuels in internal combustion ignition engines. Analysing the literature, this article shows various alternative fuels utilized in India and all over the world.**

This review paper covers potential alternative fuels for automotive engine application for both spark ignition (SI) and compression ignition (CI) engines. It also includes applications of alternative fuels in advanced combustion research applications. The representative alternative fuels for SI engines include compressed natural gas (CNG), hydrogen (H2) liquefied petroleum gas (LPG), and alcohol fuels (methanol and ethanol); while for CI engines, they include biodiesel, di-methyl ether (DME), and jet propellent-8 (JP-8). Naphtha is introduced as an alternative fuel for advanced combustion in premixed charge compression ignition. The production, storage, and the supply chain of each alternative fuel are briefly summarized, and are followed by discussions on the main research motivations for such alternative fuels. Literatures surveys are presented that investigate the relative advantages and disadvantages of these alternative fuels for application to engine combustion.

Keywords*— *Alcohol fuels, Ammonia, Carbon neutral negative fuel, Hydrogen, Natural gas- LPG and CNG)

I. INTRODUCTION

Alternative fuels research has been on-going for well over many years at a number of institutions. Driven by oil price and consumption, engine emissions and climate change, along with the lack of sustainable fossil fuels, transportation sector has generated an interest in alternative, renewable sources of fuel for internal combustion engines. The focus has ranged from feed stock optimization to engine-out emissions, performance and durability. Biofuels for transportation sector, including alcohols (ethanol, methanol...etc.), biodiesel, and other liquid and gaseous fuels such as methane and hydrogen, have the potential to displace a considerable amount of petroleum-based fuels around the world. The second-generation biofuels are still in the development stage. Combining higher energy yields, lower requirements for fertilizer and land, and the absence of competition with food, second generation biofuels, when available at prices equivalent to petroleum derived products, offer a truly sustainable alternative for transportation fuels. There are main four issues related to alternative fuels: production, transportation, storage, handling and usage. This chapter presents a review of recent literature related to the alternative fuels usage and the impact of these fuels on fuel injection systems, and fuel atomization and sprays for both spark-ignition and compression-ignition engines.

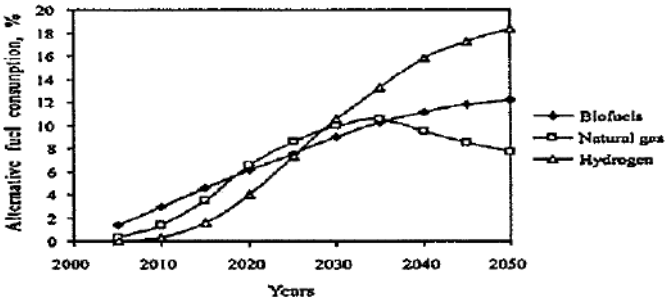


Fig .1. Alternative fuel consumption by world

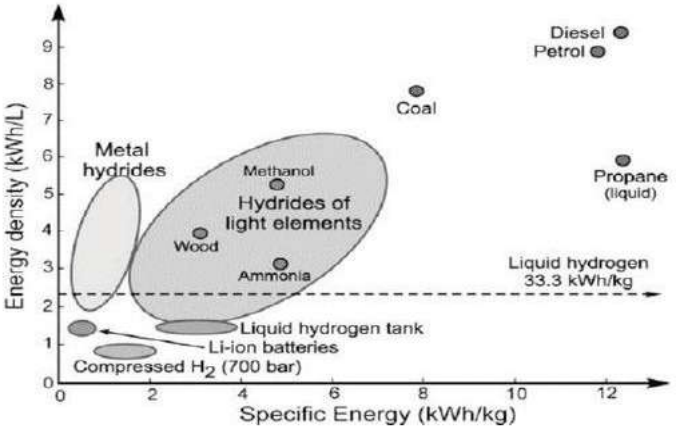


Fig.2. Energy densities of fuel

Properties	Acetylene	Hydrogen	CNG	Ethanol	Gasoline	Diesel
Formula	C_2H_2	H_2	CH_4	C_2H_5OH	C_4–C_{12}	C_8–C_{25}
Density (1 atm, 20°C (kg/m³))	1.092	0.08	0.65	809.9	720–780	820–860
Auto ignition temperature (°C)	305	572	540	363	257	254
Stoichiometric ratio (kg/kg)	13.2	34.3	17.2	9	14.7	14.5
Motor octane number	45–50	130	105	89.7	95–97	–
Flammability limits in air (%Vol.)	2.5–81	4–74.5	5.3–15	3–19	1.4–7.6	0.6–5.5
Adiabatic flame temperature (K)	2500	2400	2320	2193	2300	2200
Min. quenching diameter (mm)	0.85	0.9	3.53	2.97	2.97	–
Min. ignition energy (MJ)	0.019	0.02	0.29	0.23	0.23	–
Maximum flame speed (m/s)	1.5	3.5	0.42	0.61	0.5	0.3
Lower heating value (kJ/kg)	48.225	120.000	49.950	26.700	43.000	42.500

Fig.3. Properties of different fuels

II. ALCOHOL FUELS

Methanol and ethanol fuel are primary sources of energy; they are convenient fuels for storing and transporting energy. These alcohols can be used in internal combustion engines as alternative fuels. Butane has another advantage: it is the only alcohol-based motor fuel that can be transported readily by existing petroleum-product pipeline networks, instead of only by tanker trucks and railroad cars.

Fuels	Resource	Expended energy [MJ/M] fuel]	Greenhouse emissions [g CO_2/MJ]
Gasoline	Crude oil	0.18	13.8
Diesel	Crude oil	0.20	15.4
Natural gas	EU-mix NG	0.17	13.0
	Imported NG 7000 km	0.29	22.6
	Imported NG 4000 km	0.21	16.1
	LNG*	0.28	19.9
	Shale gas	0.10	7.8
	Synthetic from wind electricity	1.05	3.3
Ethanol	Sugar*	1.20	28.4
	Wheat*	1.31	55.6
	Other*	1.66	41.4
Hydrogen	Natural Gas*	1.10	118
	Coal*	1.45	237
	Biomass*	1.05	14.6
	Electricity*	3.11	190

Greenhouse emissions of different fuels

III. BIO-DIESELS

Bio-diesel is made from animal fats or vegetable oils, renewable resources that come from plants such as atrophy, soybean, sunflowers, corn, olive, peanut, palm, coconut, safflower, canola, sesame, cottonseed, etc. Once these fats or oils are filtered from their hydrocarbons and then combined with alcohol like methanol, diesel is brought to lifefrom this chemical reaction. These raw materials can either be mixed with pure diesel to make various proportions or used alone. Despite one's mixture preference, bio-diesel will release a smaller number of pollutants (carbon monoxide particulates and hydrocarbons) than conventional diesel, because bio-diesel burns both cleanly and more efficiently. Even with regular diesel's reduced quantity of sulphur from the LSD (ultra-low sulphur diesel) invention, bio-diesel exceeds those levels because it is sulphur-free.

Property	Value	Test Method
Density @ 15°C, kg/L	0.8801	ASTM D-1298
Copper Strip Corrosion	1A	ASTM D-130
Sulfur, %wt	0.0010	ASTM D-4294
Flash Point, °C	> 110	ASTM D-93
Kin. Viscosity @ 40°C, cSt	4.70	ASTM D-445
CFPP, °C	–6	IP-309
Cloud Point, °C	–2.0	ASTM D-2500
Pour Point, °C	–3	ASTM D-97
Cetane Number	61	DIN 51773
Water, mg/kg	243	ASTM D-1744
Carbon Residue, %wt	0.22	ISO 10370
Net Heating Value, kcal/kg	8906	ASTM D-2015

-BIODIESEL PROPERTIES

Fig.4. Bio-diesel properties

IV. CARBON-NEUTRAL AND NEGATIVE FUELS

Carbon neutral fuel is synthetic fuel—such as methane, gasoline, diesel fuel or produced from renewable or nuclear energy used to hydrogenate waste carbon dioxide recycled from power plant flueexhaust gas or derived from carbolic acid in seawater. Such fuels are potentially carbon neutral because they do not result in a net increase in atmospheric greenhouse gases. To the extent that carbon neutral fuels displace fossil fuels, or if they are produced from waste carbon or seawater carboxylic acid, and their combustion is subject to carbon capture at the flue or exhaust pipe, they result in negative carbon dioxide emission and net carbon dioxide removal from the atmosphere, and thus constitute a form of greenhouse gas remediation. Such carbon neutral and negative fuels can be produced by the electrolysis of

water to make hydrogen used in the Sabbatical reaction to produce methane which may then be stored to be burned later in power plants as synthetic natural gas, transported by pipeline, truck, or tanker ship, or be used in gas to liquids processes such as the Fischer–Troopship process to make traditional transportation or heating fuels.

V.HYDROGEN

Hydrogen is an emission less fuel. The by-product of hydrogen burning is water, although some mono-nitrogen oxides NOx are produced when hydrogen is burned with air.

Hydrogen in the gas phase is about 14 times lighter than the air. Moreover, it is the cleanest fuel in the world. On the other hand because of its high ignition limit (4–75%), low ignition energy, needs special design to use as pure hydrogen in internal combustion engines. It is proved that hydrogen improves the combustion, emissions and performance, when is added as 20% to fuels.

CR	H_2 (%)	$\lambda = 1.0$	$\lambda = 1.15$
9.6	0	2000	3620
	5	2100	3825
	10	1710	4185
	20	1535	4225
12.5	0	2040	4410
	5	1940	4200
	10	2260	4520
	20	2210	4695
15	0	2045	4465
	5	2570	4700
	10	2660	4565
	20	3030	4350

*(CR= compressed ratio)
NOx(nitrogen oxide) value (ppm) for λ=1.0 & λ=1.15
Fig.5. NOx(nitrogen oxide) value

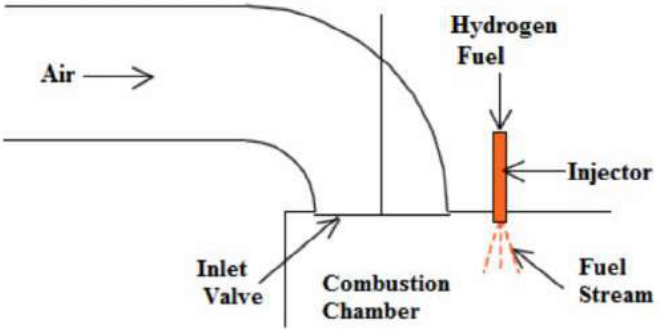


Fig.6. Hydrogen induction mechanism

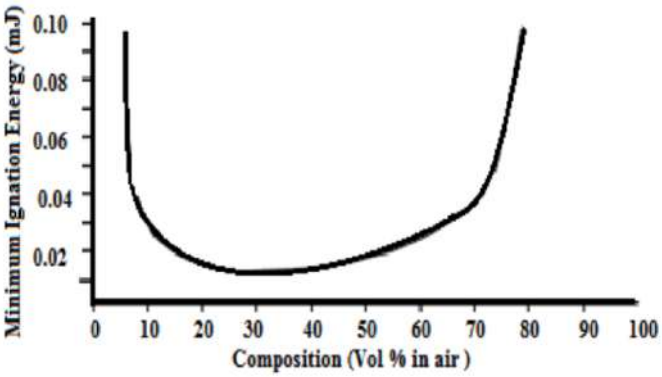


Fig.7. Minimum ignition energy of hydrogen in air

VI. NATURAL GAS - LNG & CNG

Natural gas is a mixture of hydrocarbons- mainly methane (CH4) and is produced either from gas wells or in conjunction with crude oil Production. Due to its low energy density for use as a vehicular fuel, it is compressed to a pressure of 200-250 bars to facilitate storage in cylinders mounted in vehicle and so it is called compressed natural gas (CNG). Low noise, low exhaust emissions, less maintenance, not prone to adulteration, driver's comfort, etc. Aresome of the attractive features of CNG as an
Automotive fuel. It can be stored on a vehicle either in a compressed gaseous state (CNG) or in a liquefied state (LNG).

Composition of LPG & CNG

% composition	CNG	LPG
Methane	93.20	-
Ethane	4.27	0.2
Propane	01.38	57.3
Butane	0.58	41.1
Pentane	00.07	1.4

Fig.8.Composition of CNG and LPG

Composition of CNG.

Constituents	% Volume
Methane	93.20
Ethane	04.27
Propane	01.38
i-Butane	00.18
n-Butane	00.20
i-Pentane	00.04
n-pentane	00.03
Carbon dioxide	00.27
Nitrogen	00.43
Moisture content	2.0 ppm

Fig.9.Composition of CNG

Comparative Emissions from CNG & Diesel

Fuel	Emissions in g/km				PM emissions relative to CNG
	CO	NMVOC	NOx	PM	
Low Sulphur diesel (500 ppm)	1.32	0.50	14.72	0.22	340% higher
ULSD (50 ppm)	1.41	0.52	14.32	0.16	220% higher
CNG	0.66	2.75	9.87	0.05	-

Source: Tom Beer et al 2000, Lifecycle emission analysis of alternate fuels CSIRO report to Australian Greenhouse Office March, mimeo

Fig.10. Comparative emission from CNG & Diesel

VII. P-SERIES

P-series fuels are a family of renewable, non-petroleum, liquid fuels that can substitute for gasoline. The blend of methyl tetrahydrofuran (MTHF), ethanol, and hydrocarbon constitute the P-series fuel.

They are a blend of 25 or so domestically produced ingredients. About 35% of P-Series comes from liquid by-products, known as "C5+" or "pentanes-plus", which are left over when natural gas is processed for transport and marketing. Ethanol, fermented from corn, comprises about 45%, and the remaining 22% is MeTHF, an ether derived from lignocelullosic biomass -- paper sludge, wastepaper, food waste, yard and wood waste, agricultural waste, and so on.

VERIFIED NON-PETROLEUM ENERGY CONTENT OF THE P-SERIES FUELS

Constituent	Regular	Premium	Cold weather (percent)
Pentanes plus	36.2	33.3	19.1
MTHF	37.7	22.1	32.3
ethanol	26.1	44.6	37.5
normal butane	0.0	0.0	11.2
Non-petroleum (excluding pentanes plus, butane).	63.8	66.7	69.8

Fig.11. Positive: P-Series fuels can be used alone or mixed with gasoline in any ratio by simply adding it to the tank.*Negative*: Manufacturers are not making flexible fuel vehicles

P-Series fuels were officially designated as an alternative fuel by the U.S. Department of Energy (DOE) in 1999. The Since P-Series is not derived from petroleum, the DOE concluded that P-Series fuels would effectively help replace petroleum imports. DOE also found P-Series to have environmental benefits because of the reductions in hydrocarbon and CO emissions, toxics, and greenhouse gases.

Much like gasoline, P-Series fuels range from 89-93 octane (mid-grade to premium) and can be formulated specifically for winter or summer use. Refuelling with P-Series is as quick and familiar as with gasoline. But P-Series is not gasoline and cannot be used in a regular gasoline engine. The basic capability for utilizing P-Series in vehicles has already been incorporated into methanol/ethanol flexible-fuel vehicles (FFV's). FFV's are designed to operate on alcohol, on gasoline, or on any mixture of the two. Nearly three million FFV's have been manufactured since 1996.

P-Series is a relatively new alternative fuel. It is a blend of natural gas liquids, ethanol, and biomass extracts. It has significant emissions benefits over gasoline, the greenhouse emissions are about 50% lower than that of gasoline. The use of P-Series would also reduce fossil fuel energy use by 49%-57%, as well petroleum use by 80%. P-Series comes almost completely from domestic renewable sources. Already major companies such as Dodge and Ford have begun making models that support P-Series as an alternative fuel. P-Series was first added to the list of alternative fuels in 1999. This is actually its major weakness. Since it is so new, not everything is known about it yet. Also, since it is so new, we have not yet seen any sort of widespread use of P-Series. So although it seems as if it has a lot of potential, we need to wait until we see more of the facts.

As engine fuels, the most popular alternative fuels are bioethanol, biodiesel, and hydrogen. Recently, in addition to these, there are intensive researches on methyl-, and ethyl alcohols, natural gas, liquefied petroleum gas, P-series, electricity, and solar fuels. Alternative fuels for diesel engines are becoming increasingly important due to diminishing petroleum reserves and the environmental consequences of exhaust gases from petroleum-fuelled engines.These fuels are inexpensive fuels generated by municipal and agricultural wastes. The National Renewal Energy Laboratory (NREL) showed that P-series would be 96% derived from domestic resources and reduce petroleum use by 80% as compared to gasoline. Use of P-series fuels also greatly reduces toxic emissions. P-fuels are economically competitive with gasoline.

Pros and Cons of P-Series fuels

One of the advantages of P-series is that they are very easy to use. There is no need for any special fuel management because gasoline and P-series can be freely intermixed in any proportion with fuel that is already in the vehicle's fuel tank. So, even if P-series is not available at a particular location, simply fill up with gasoline.

Using P-Series fuels has several benefits. It decreases the amount of petroleum used to power vehicles. It makes use of waste that would otherwise have to be placed in a landfill, incinerated, or transported to some other location. P-Series fuels are easy to use. Fuelling an FFV with P-Series fuel is identical to fuelling a vehicle with gasoline.

If consumers begin buying these fuels, however, they could be a good substitute for gasoline.

But P-Series fuels cannot be used in vehicles designed to burn gasoline only. FFVs designed to burn methanol or ethanol can burn it, but ordinary vehicles cannot. P-Series fuels are slightly more efficient than gasoline, but in

practice, mileage for vehicles using P-Series fuels is about 10 percent less per gallon than those using gasoline.
The feedstock used to make MeTHF is chemically digested by the process of making it; as a result, the raw material is completely consumed and no emissions enter the air. Burning P-Series fuels in vehicles releases many fewer emissions than burning fossil fuels.

VIII. NAPHTHA

Naphtha is a term used to refer to a group of volatile, flammable mixtures of liquidhydrocarbons, that are used mainly as solvents, diluents, or raw materials for gasoline conversion. It is a lightweight petrochemical feedstock that is separated from crude oil in the fractional distillation process along with kerosene and jet fuel.[3]

There are many specific types of naphtha that vary in the amounts and types of hydrocarbons contained in their unique blend. Refineries can produce various forms of naphtha, and each has specific guidelines in how it should be handled and stored. Generally speaking, the flammability and volatility of naphtha should be taken into consideration as they are significant safety hazards.

Component	Units	Composition
Butane	% mole	0.11
Iso-pentane	% mole	11.69
N-pentane	% mole	13.3
Cyclo-pentane (CP)	% mole	1.95
2,2-Di-methyle-butane (2,2 DMB)	% mole	0.49
2,3-Di-methyle-butane (2,3 DMB)	% mole	1.66
2-Methyl-pentane (2 MP)	% mole	10.4
3-Methyl-pentane (3 MP)	% mole	9.37
N-hexane	% mole	30.72
Methyl-cyclo-pentane (MCP)	% mole	8.69
Cyclo-hexane (CH)	% mole	5.84
Benzene	% mole	3.18
Heptanes	% mole	2.6
Copper	Ppb*	20
Lead	Ppb	10
Arsenic	Ppb	1
Fluorides	Ppb	0.1
Mercury	Ppb	< 1
HCl	Ppm**	0.5
Sulphur	Ppm	0.5
Nitrogen	Ppm	0.5

* Part per billion.
** Part per million.

Fig.12. Component of Naphtha

Physical properties	
Specific gravity (g/cm^3)	0.655
Initial boiling point (°C)	60.7
Final boiling point (°C)	120.3

Chemical composition (wt%)				
Carbon no.	n-Paraffin	i-Paraffin	Naphthene	Aromatics
C_4	2.16	0.12	0	0
C_5	27.34	21.38	3.58	0
C_6	10.19	12.29	3.84	1.58
C_7	3.29	3.82	4.34	1.57
C_8	1.04	1.2	0.92	0.55
C_9	0.26	0.5	0	0.03
Sum	44.28	39.31	12.68	3.73

Properties and composition of naphtha

Fig.13. Properties and composition of Naphtha

Composition (V%)	Reforming topped light naphtha	Hydrocracking light naphtha	Boiling point (°C)	Octane number RON	MON	BRON
n-butane	9.36	2.8	−0.50	93.6	93.1	–
2-methyl butane	15.4	26.5	28	92.3	90.3	–
n-pentane	15.7	12.0	36	61.7	61.9	–
2,2-dimethyl butane	9.0	12.0	50	91.8	93.4	–
2-methyl pentane	12.8	5.4	60	73.4	73.5	–
3-methyl pentane	7.2	22.5	63	74.5	74.3	–
n-hexane	13.2	11.5	69	24.8	26.0	–
3-methyl hexane	3.36	–	90.1	42.4	46.4	–
n-heptane	2.88	–	98.4	0	0	–
2,2-dimethyl pentane	–	10.8	79.6	93	96	89
Methyl-cyclopentane	6.2	6.5	71.8	91	80	107
Cyclohexane	8.6	0.9	80.8	83	77	110
1,2-Dimethyl-cyclopentane	2.8	–	99.4	95	–	95
Methyl-cyclohexane	1.4	–	100.8	104	71	104
Toluene	2.9	–	110.5	115	104	124

MON: motor octane number; RON: research octane number; BRON: blend research octane number.

Fig.14. Properties and composition of light Naphtha from hydro-cracking and reforming process

Uses and Safety

As mentioned above, naphtha is commonly used as a solvent. It is used in hydrocarbon cracking, laundry soaps, and cleaning fluids. Naphtha is also used to make varnishes, and sometimes is used as a fuel for camp stoves and as a solvent (diluent) for paint.

Highly volatile and flammable, naphtha finds use in many human industries as a solvent, as a fuel, and for industrial purposes. Humans discovered it before the first century A.D. The term naphtha refers to a broad category of chemicals, each a potentially dangerous solution of hydrocarbons. Coal tar, shale and petroleum make up three distinct forms of naphtha, each formed under different conditions and used for different purposes for their chemical properties. In modern production, naphtha often comes from crude oil distillation.

Naphtha has several other names including Enerade ED-6202, high-flash aromatic naphtha, light aromatic solvent naphtha and petroleum naphtha, although these terms can apply to a specific form of naphtha with an intended use.

Naphtha Safety Concerns

Naphtha chemicals can be harmful to humans in various ways. If a human's skin or eye comes into contact with naphtha, the area can become irritated and begin to swell and feel painful. Flush skin and eyes immediately after contact. Ingesting the substance causes nausea, lung damage, respiratory failure and death in some cases. In the case of ingestion, do not induce vomiting and seek medical attention immediately. As naphtha produces a strong, chemical odor, long-term exposure to it can cause respiratory and mental issues. Some scientists list it as a carcinogen. A toxic chemical, naphtha should not be drained into natural ecosystems. As most naphtha compounds give off intense, chemical aromas, they are often found in mothballs. Naphtha is flammable and can cause unexpected and dangerous fires.

Naphtha as a Fuel

Humans use naphtha to fuel products because it contains a large amount of chemical energy and is volatile. It can create 3.14 mega joules of energy per liter. Many camping goods stores and hardware stores sell it to power stoves, lanterns, heating units, blow torches and cigarette lighters, thanks to its ability to burn relatively cleanly. It also finds use as an additive to other fuels.

Why don't we use Naphtha as fuel for spark ignition engines?

It is difficult to adopt this fuel for the Otto engines, as the cycle dictates the fast burning .which is very difficult to be achieved using the Naphtha.

The S. I. engines need almost homogeneous fuel air mixture, to be introduced at the suction stroke. Therefore, a special arrangement and modification are needed to carry out this preparation process, it might include preheating, atomization of the fuel, ...hot compressed air...

Naphtha has very low octane number (RON of 70 or less). Modern SI engines cannot be run on such low octane fuels because of knock.

According to a piece of research on using Naphtha in SI engine.researcher found that adding 7 vol.% of methanol to Naphtha enhances the engine performance and reducing emissions even better than using gasoline as fuel. Also, researcher measured the noise of the engine and found that at this percentage the noise is lower than the noise generated when using Gasoline.

But according to others researcherIt depends on what the specification of the engine was. What was the compression ratio? Adding methanol increases the fuel octane number and will allow you to run the engine on higher load if the engine is knock-limited- noise reduction might also be related to better knock resistance. As for emissions - there might be slight reduction in HC and CO but an increase in knock. As for the other answer above - naphtha is in the gasoline boiling range and mixture preparation should be no different from gasoline.The burning velocity would also be similar.

As for emissions - there might be slight reduction in HC and CO but an increase in knock. The last word here should be NOx not knock

Even few researchers said that they did not measure the NOx but they think it will be lower due to the high heat required to evaporate the methanol which makes the temperature lower than of gasoline case.

However, do you think it is better to use this blend instead of gasoline if this blend has (almost) the same properties of gasoline?

So we think naphtha is cheaper than gasoline and we do not need to other processes to convert naphtha into gasoline which means lower CO2 emission and low power consumption.

Yes. Naphtha is less processed than gasoline and hence "easier to make. Then it depends on the availability and ease of manufacture of methanol. You also have to remember that methanol has a very low volumetric energy content (km/liter will go down) and has materials compatibility problems.

It is also toxic and this raises handling issues for market deployment.

But some researchers disagree with it. Addition 7% methanol to naphtha improve the fuel quality, combustion process and will decrease the fuel consumption. Regarding methanol toxicity, we think the advantages gained outweigh this disadvantage.

IX. JP-8

Fueltype	JP-8	Method
Density(gr/ml,15°C)	0.7950	ASTMD1298
Viscosity(cSt,)20°C)	3.87	ASTMD445
Freezingpoint(°C)	)48.5	ASTMD2386
Flashpoint(°C)	41	ASTMD93
Conductivity(pS/m)	375	ASTMD2624
Sulfur(wt.%)	0.23	ASTMD4294
Nitrogen(ppm)	14	
Aromatics(vol.%)	15.3	ASTMD1319
Olefins(vol.%)	0.3	ASTMD1319
Water(ppm)	23	ASTM1744-83
Copperstripcor.	1¾	ASTMD130
Lubricity		CECF-06-A-96
Initialmeasurement(lm)	754	
Repeatedmeasurement(lm)	758	
Distillation(°C)	145	ASTMD86
IBP	174	
10%	181	
20%	200	
50%	233	
90%	250	
FBP	251	

JP-8, or JP8 (for "Jet Propellant 8") is a jet fuel, specified and used widely by the US military. A kerosene-based fuel, JP-8 is projected to remain in use at least until 2025.

Fig.15. Property of JP-8

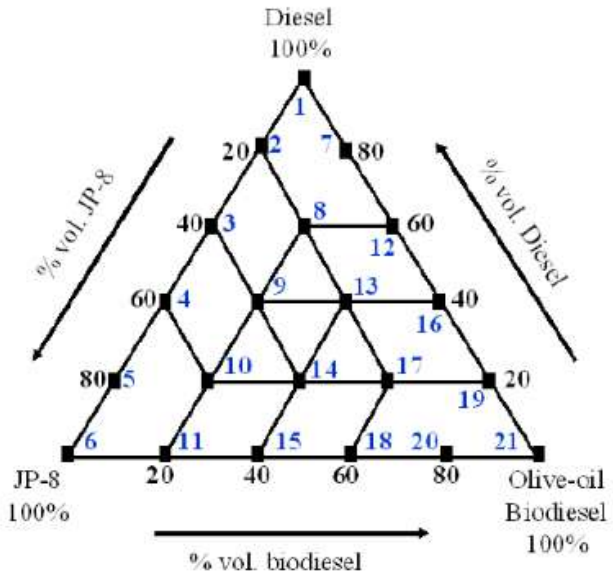
	0.1HP	1.25HP	2.5HP	3.75HP	5HP
NO emissions of JP8 base fuel (ppm)					
Mean value	180	326	352	360	423
Std deviation	2.4	6.7	7.8	3.5	7
NO_x emissions of JP8 base fuel (ppm)					
Mean value	209	351	377	378	433
Std deviation	2.0	2.9	9.4	5.5	5.8
PM emissions of JP8 base fuel (mg/m^3)					
Mean value	4.2	3.2	6.6	6.2	13.5
Std deviation	0.9	0.8	1.7	1.0	2.8

Fig.16. Emission measurement from the stationary petter engine, when JP-8 was used (base fuel measurement)

In order to make this type of fuel compatible with direct injection compression engines, the Fuels and Lubricants Laboratory of the National Technical University of Athens, used a stationary Diesel engine fueled with fuel blends containing two different types of biodiesel, at proportions up to 50%. In this paper, fuel consumption and exhaust emission measurements from a single cylinder, stationary, Diesel engine are described. The two types of biodiesel appeared to have equal performance, and irrespective of the raw material used for their production, their addition to the JP-8 aviation fuel improved the particulate matter emissions.

The research evaluates the effect of using JP-8 fuel in a heavy-duty diesel engine on fuel injection, combustion, performance, and emissions, and subsequently utilizes the obtained insight to propose changes to the engine calibration to mitigate the impact of the trade-offs. Experiments were carried out on a Detroit Diesel Corporation (DDC) S60 engine outfitted with exhaust gas recirculation (EGR). The results indicate that torque and fuel economy of diesel fuel can be matched, without smoke or NO_x penalty, by increasing the duration of injection to compensate for the lower fuel density. The lower cetane number of JP-8 caused an increased ignition delay and increased premixed combustion, and their cumulative effect led to relatively unchanged combustion phasing.

Under almost all conditions, JP-8 led to lower NO_x and particulate matter (PM) emissions and shifted the NO_x-PM trade-off favourably.



Mixing mode for the Base Fuels.

Property	Automotive Diesel	JP-8	Test Method
Density @ 15°C, kg/L	0.8334	0.8001	ASTM D-1298
Distillation, °C			ASTM D-86
10% Rec. Temperature	218	151	
50% Rec. Temperature	283	200	
90% Rec. Temperature	348	238	
Sulfur Content, % wt	0.033	0.2532	ASTM D-4294
Copper Strip Corrosion	1A	1A	ASTM D-130
Flash Point	65	44.5 (D-56)	ASTM D-93
Kin. Viscosity @ 40°C, cSt	.92 (40°C)	4.05 (-20 °C)	ASTM D-445
Cetane Index	57	53	ASTM D-4737
Cetane Number	55	51	FuelTech IQT
CFPP	-7	n/a	IP-309
Freezing Point	n/a	-48	ASTM D-2386
WSD, µm	455	720	CEC F-06-A-96
Conductivity (pS/m)	n/a	420	ASTM D-2624

Fig.17. Comparison between automotive diesel and JP-8

Can JP8 Be Used On Cars that Use Gasoline?

When used in highly supercharged diesel engines with the corresponding low compression ratio of about only 14:1 or below, JP-8 cause's troubles during cold start and idling due to low compression temperatures and subsequent ignition can delay.Modern common-rail diesel engines can experience wear problems in high-pressure fuel pumps and injectors.

Workers have complained of smelling and tasting JP-8 for hours after exposure. As JP-8 is less volatile than standard

diesel fuel, it remains on the contaminated surfaces for longer time, increasing the risk of exposure

Comparison between combustion, performance and emission characteristics of jp8 and ultra-low sulphur diesel fuel in a single cylinder diesel engine

JP-8 is an aviation turbine engine fuel recently introduced for use in military ground vehicle applications and generators which are mostly powered by diesel engines. Many of these engines are designed and developed for commercial use and need to be adapted for military applications. This requires more understanding of the auto-ignition and combustion characteristics of JP-8 under different engine operating conditions. This paper presents the results of a comparative analysis of an engine operation using JP-8 and ultra-lowsulphur diesel fuel (ULSD). Experiments were conducted on 0.42 litter single cylinder, high speed direct injection (HSDI) diesel engine equipped with a common rail injection system. The results indicate that the distillation properties of fuel have an effect on its vaporization rate. JP-8 evaporated faster and had shorter ignition delay as compared to ULSD. The fuel economy with JP-8 was better than ULSD. The gaseous emission components such as unburned Hydrocarbons (HC), Carbon monoxide (CO) reduced with JP-8 suggesting improved combustion quality. A slight reduction in NOx was recorded with JP-8, whereas Nano particle emissions increased compared to ULSD.

X. CONCLUSION

P-series fuels are inexpensive fuels generated by municipal and agricultural wastes. Use of P-series fuels also greatly reduces toxic emissions. P-fuels are economically competitive with gasoline.
There is no need for any special fuel management in P-series fuel because gasoline and P-series can be freely intermixed in any proportion with fuel.
If consumers begin buying these fuels, however, they could be a good substitute for gasoline.
P-Series fuels are slightly more efficient than gasoline, but in practice, mileage for vehicles using P-Series fuels is about 10 percent less per gallon than those using gasoline.

Burning P-Series fuels in vehicles releases many fewer emissions than burning fossil fuels.

Naphtha chemicals can be harmful to humans in various ways. If a human's skin or eye comes into contact with naphtha, the area can become irritated and begin to swell and feel painful. Flush skin and eyes immediately after contact. Ingesting the substance causes nausea, lung damage, respiratory failure and death in some cases.

It is difficult to adopt naphtha for the Otto engines, as the cycle dictates the fast burning, which is very difficult to be achieved using the Naphtha.

The S. I. engines need almost homogeneous fuel air mixture, to be introduced at the suction stroke. Therefore, a special arrangement and modification are needed to carry out this preparation process, it might include preheating, atomization of the fuel, ...hot compressed air...

Naphtha has very low octane number (RON of 70 or less). Modern SI engines cannot be run on such low octane fuels because of knock.According to a piece of research on using Naphtha in SI engine.researcher found that adding 7 vol.% of methanol to Naphtha enhances the engine performance and reducing emissions even better than using gasoline as fuel.

Adding methanol increases the fuel octane number and will allow you to run the engine on higher load if the engine is knock-limited- noise reduction might also be related to better knock resistance

In order to make this JP-8 fuel compatible with direct injection compression engines, for this they used a stationary Diesel engine fueled with fuel blends containing two different types of biodiesel, at proportions up to 50%. Fuel consumption and exhaust emission measurements from a single cylinder, stationary, Diesel engine are described. The two types of biodiesel appeared to have equal performance, and irrespective of the raw material used for their production, their addition to the JP-8 aviation fuel improved the particulate matter emissions.

The research evaluates the effect of using JP-8 fuel in a heavy-duty diesel engine on fuel injection, combustion, performance, and emissions, and subsequently utilizes the obtained insight to propose changes to the engine calibration to mitigate the impact of the trade-offs.

When JP-8 used in highly supercharged diesel engines with the corresponding low compression ratio of about only 14:1 or below, JP-8 cause’s troubles during cold start and idling due to low compression temperatures and subsequent ignition can delay. Modern common-rail diesel engines can experience wear problems in high-pressure fuel pumps and injectors.

JP-8 evaporated faster and had shorter ignition delay as compared to ultra-low sulphur diesel fuel(ULSD). The fuel economy with JP-8 was better than ULSD. The gaseous emission components such as unburned Hydrocarbons (HC), Carbon monoxide (CO) reduced with JP-8 suggesting improved combustion quality. A slight reduction in NOx was recorded with JP-8, whereas Nano particle emissions increased compared to ULSD.

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ARTIFICIAL INTELLIGENCE AND ROBOTICS IN MARITIME FIELD

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Abstract— **Artificial intelligence (AI) is becoming increasingly inevitable for the maritime industry and is going to play an important role in the near future. The influence of automation in the maritime activities along with the demand for more autonomous shipping has led to an increase in the demand for AI. Predictive maintenance, intelligent scheduling, and real-time analytics, will drive AI along with Machine Learning & Robotics to play a more important role in Maritime Field.**

Keywords*— *Machine Learning, Artificial Neural Networks, Internet of Things, Cognitive analytics, Digital Twins, Predictive maintenance, Robotics

Introduction

The jargon of modern times in industry and business is Artificial Intelligence. This AI technology is vital to the digital transformation happening today as organizations are trying to capitalize on the exponentially growing amount of data that being generated and collected. This vast ocean of data has necessitated intense research into the means this data can be processed, analyzed and utilized for further action.

Maritime applications

With more and more new sensors and internet of things (IOT) devices on ships, more data being generated but only little of that data is actually being put to good use. According to surveys very little of all shipboard generated data are analyzed in a meaningful way. Ship owners, Regulatory entities and machinery manufacturers are increasingly interested in harnessing the value of data being collected on board ships. The possibilities are detection of mechanical anomalies in real time, categorizing these anomalies into minor, intermediate or serious, showing these anomalies in 3D displaying which component inside the machine is causing the anomaly and the automated model building can predict when failure might occur. Classification societies can create a notation for the ships using these technologies and grant considerable extension of time for survey.

Machine learning and cognitive analytics tools provide all of these capabilities, detecting anomalies in machine operations and predicting failure with high degree of accuracy. Machine learning will be a game-changer for the maritime sector. The ability to apply machine learning tools to shipboard generated data is now more widely available. The progression of analytics from descriptive (what happened?) to diagnostic (why did it happen?) to predictive & prescriptive (when is it likely to happen and what can be done to prevent it?) is changing the way the industry can harness the value of machine learning tools in data analysis.

Additionally, machine learning empowers fleet managers to reduce unplanned out-of-service time, protect against malicious threats, and provide cognitive query of relevant vessel-operating information from a variety of sources. This further allows for savings in maintenance and capital cost replacements, extending the life of critical shipboard assets. Operators in the maritime space are increasingly interested in this new technology for following reasons:

(i) Cognitive analytics provide the capability to ingest the terabytes of data that are already being generated, and find the insights contained within to save money and reduce off-hire

(ii) Cognitive analytics allow more intelligent planning of major maintenance periods such as special surveys and dry-dock periods, spare parts and consumables inventories, and support to seagoing staff in assessing whether maintenance needs to be performed in-voyage, in a port turnaround, or over a longer period of time

(iii) Ship-owners and operators find value in developing a deeper understanding of shipboard machines rather than leaving it to yard periods or warranty and insurance claims.

For an industry that has used some of the same systems for years, artificial intelligence and machine learning offer an opportunity for revolution in shipping. The commercial shipping industry runs on a lot of data; every ship has a manifest, every container has an identification number, every box has a packing slip. AI advancements in gathering and analyzing that data could allow the shipping industry to plan further out and more accurately, particularly for busy times of the year that are known to be a challenge. The result could be not just greater efficiency for the industry, but significant cost savings.

Machine Learning

Artificial Intelligence is a concept of building machines which are capable of thinking like humans using the digital binary logic of computers. The field of research which has been more fruitful in recent years is what has become known as "machine learning". The concept of machine learning is that rather than have to be taught to do everything step by step, machines, if they can be programmed to think like humans can learn to work by observing, classifying and learning from its mistakes.

Given data, a machine learning algorithm can recognize patterns and learn from data to make predictions about new data, all through the use of clever statistics. In short, if you have data and a pattern in the data, your machine can learn. As in much of engineering, however, there is obviously more to machine learning than that simple explanation when it comes to execution and delivery. Within the field, there are three types of machine learning algorithms: supervised learning, unsupervised learning and reinforcement learning. Supervised and unsupervised are currently the most popular learning methods. They differ as follows:

- **Supervised learning:** In this method, the algorithms are trained by entering an input and a desired outcome to create labeled examples. The machine is able to find errors by comparing the actual outcome with the outcome that it knows should be correct based on the information originally entered. An example would be an algorithm for identifying credit card fraud. The machine can spot unusual charges by comparing them to the expected transactions.
- **Unsupervised learning:** As opposed to supervised learning, unsupervised learning does not have "right" answers – or historical labels – to compare the information to. Rather, the algorithm must look at the information provided and draw its own conclusions. This method is helpful for finding attributes by which to sort groups, such as identifying what consumers can be targeted by the same marketing campaign.
- **Reinforcement learning:** While not as popular as the previous two methods, reinforcement learning is an important part of the field. As opposed to supervised and unsupervised learning, this algorithm learns through trial and error, ultimately learning how to choose the option that will result in the greatest reward. This method is common in robotics, navigation, gaming etc.

Machine learning is growing in popularity and importance in large part because companies and government agencies have large quantities of data that

need to be sorted, analyzed and leveraged to ensure a boosted return on investment. The data that is used in these algorithms can include everything from customer spreadsheets, past buyer information, loaner information, census information, survey information, website visiting rates and much more. Machine learning can not only reveal trends about this information, but can also give insight toward predicting things about future behavior.

While machine learning is related to the broader field of artificial intelligence, these terms are not synonyms. AI is a branch of computer science that is primarily focused on creating machines that are capable of intelligent thought. However, this is hard to accomplish without the contributions of machine learning.

AI is basically the intelligence – how we make machines intelligent, while machine learning is the implementation of the compute methods that support it. AI is the science and machine learning is the algorithms that make the machines smarter, "So the enabler for AI is machine learning."

Though the idea of a machine making decisions on its own and thinking independently may sound almost like a work of fiction, machine learning is actually more common than many people may expect. The general public can find elements of it in many areas of daily life. For instance services provided by websites, such as the way that Amazon.com recommends items that consumer might be interested in based on his browsing history and previous purchases. While these are very useful applications of machine learning for the average person, the field is much more than shopping and entertainment.

Artificial Neural Networks (ANN)

The application of neuroscience to IT system architecture has lead to the development of Artificial Neural Networks (ANN). Although this field was evolving quite some time it is only recently that computers with adequate power have been made available to make the task a reality. Neural networks take a different approach to problem solving than that of conventional computers. Conventional computers use an algorithmic approach i.e. the computer follows a set of instructions in order to solve a problem. Unless the specific steps that the computer needs to follow are known the computer cannot solve the problem. That restricts the problem solving capability of conventional computers to problems that we already understand and know how to solve.

But computers would be so much more useful if they could do things that we don't exactly know how to do. Neural networks process information in a similar way the human brain does. The network is composed of a large number of highly interconnected processing elements (neurons) working in parallel to solve a specific problem. Neural networks learn by example. They cannot be programmed to perform a specific task. The examples must be selected carefully otherwise useful time is wasted or even worse the network might be functioning incorrectly. The disadvantage is that because the network finds out how to solve the problem by itself, its operation can be unpredictable.

On the other hand, conventional computers use a cognitive approach to problem solving; the way the problem is to be solved must be known and stated in small unambiguous instructions. These instructions are then converted to a high level language program and then into machine code that the computer can understand. These machines are totally predictable; if anything goes wrong is due to a software or hardware fault.

Neural networks and conventional algorithmic computers are not in competition but complement each other. There are tasks that are more suited to an algorithmic approach like arithmetic operations and tasks that are more suited to neural networks. Even more, a large number of tasks, require systems that use a combination of the two approaches (normally a conventional computer is used to supervise the neural network) in order to perform at maximum efficiency.

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well.

An artificial neuron is a device with many inputs and one output (Figure 1). The neuron has two modes of operation; the training mode and the using mode. In the training mode, the neuron can be trained to fire (or not), for particular input patterns. In the using mode, when a taught input pattern is detected at the input, its associated output becomes the current output. If the input pattern does not belong in the taught list of input patterns, the firing rule is used to determine whether to fire or not.

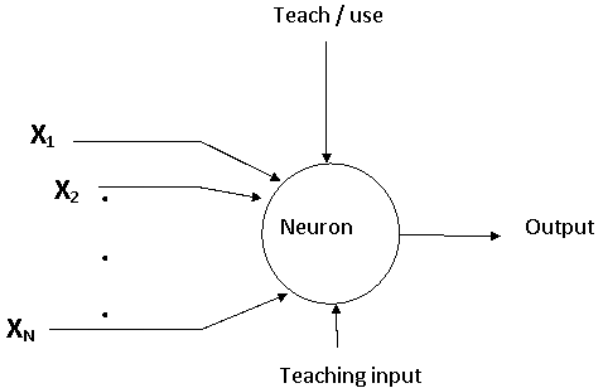

Figure 1

An important application of neural networks is pattern recognition. Pattern recognition can be implemented by using a feed-forward (Figure2) neural network that has been trained accordingly. During training, the network is trained to associate outputs with input patterns. When the network is used, it identifies the input pattern and tries to output the associated output pattern. The power of neural networks comes to life when a pattern that has no output associated with it, is given as an input. In this case, the network gives the output that corresponds to a taught input pattern that is least different from the given pattern.

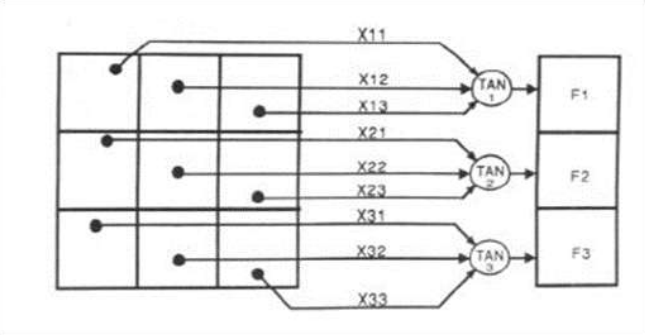

Figure 2

For example the network of (Figure 3) is trained to recognize the patterns T and H. The associated patterns are all black and all white respectively as shown below.

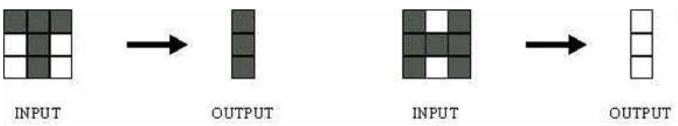

Figure 3

A more sophisticated neuron (Figure 4) is that the inputs are 'weighted'; the effect that each input has at decision making is dependent on the weight of the particular input. The weight of an input is a number which when multiplied with the input gives the weighted input. These weighted inputs are then added

together and if they exceed a pre-set threshold value, the neuron fires. In any other case the neuron does not fire.

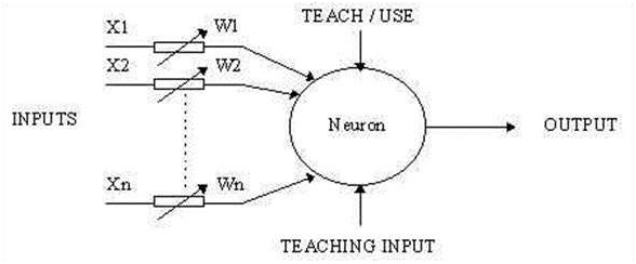

Figure 4

In mathematical terms, the neuron fires if and only if;

$$X1W1 + X2W2 + X3W3 + ... > T$$

The addition of input weights and of the threshold makes this neuron a very flexible and powerful one. Various algorithms exist that cause the neuron to 'adapt'; the most used ones are the Delta rule and the back error propagation. The former is used in feed-forward networks and the latter in feedback networks.

The commonest type of artificial neural network consists of three groups, or layers, of units: a layer of "input" units is connected to a layer of "hidden" units, which is connected to a layer of "output" units. (See Figure 5)

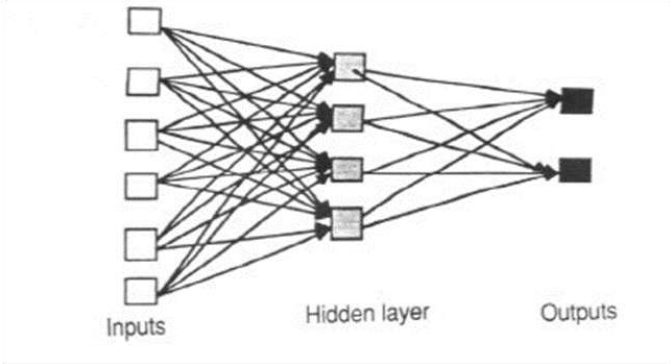

Figure 5

The activity of the input units represents the raw information that is fed into the network. The activity of each hidden unit is determined by the activities of the input units and the weights on the connections between the input and the hidden units. The behavior of the output units depends on the activity of the hidden units and the weights between the hidden and output units. Feedback networks are very powerful and can get extremely complicated. Feedback networks are dynamic; their 'state' is changing continuously until they reach an equilibrium point.

Artificial Neural Networks (ANN) is currently a 'hot' research area and the explosion of data availability from things shared on social media and machinery data from industry connected through IOTs (Internet of Things) to help them learn more efficiently and make better decisions.

Predictive Maintenance

Predictive maintenance of equipment and plants promises increased reliability at lower cost, along with the possibility of determining which components and assets need maintenance, and when. Replacements when needed can be called up in advance and stored at the dock for timely installation. Where maintenance isn't needed, despite what an OEM's maintenance schedule says, money simply doesn't need to be spent. The drive for cost savings and efficiency improvements is an important goal to operators in a marine industry that is still reeling from a downturn in the market.

Since the advent of the digital era many have expounded that ship-owners need to invest in digital systems, data analytics and machine learning if they are serious about being key players in the marine industry in the future. There is a range of software solutions coming onto the market that enables more collaboration between departments and moves the industry toward autonomous ships. But digitization and the use of machine learning and artificial intelligence (Al) is not something that will happen overnight. Instead it is a step-by-step process as the industry learns and adapts to working with the new technology.

Machine learning can perform predictive analytics far faster and more accurately than any human can. The potential for marine maintenance is to move completely away from time-based scheduled maintenance, to maintenance that is based on equipment use and true plant condition. The enabling of predictive maintenance through data-driven systems is expected to add further value to the maintenance process. "It's safe to assume that Al could help early failure detection in all types of equipment and machinery on board a vessel."

Through machine learning and better data-driven optimization, AI will not just save costs in maintenance, but also the time spent maintaining vessels. Machine learning is a set of algorithms, tools and techniques that mimic human learning behavior to solve problems. Machine learning algorithms are used to analyze data from currently operational marine equipment and train software models that can recognize unknown patterns in the data and make a prognosis about how that equipment is performing. "If the data we analyze is 'big', then the model can recognize more complex patterns and make more accurate predictions about the state of the marine equipment than any human could." Potentially this means maintenance in the future could be carried out in a more timely and cost-effective way and could further improve the reliability of equipment.

"Since 60-80% of defects have been ascribed to incorrect maintenance, there are good reasons from every angle to perform maintenance only when it is needed."

Digital twins

Another advantage that AI will bring is through the digital twin –a complete digital representation of a physical asset. Having a digital twin provides all the information of that asset through its lifetime by using sensors enabled through the Internet of Things. Future digital twins will be central to all forms of shipping, especially for autonomous and remotely controlled vessels. "With a digital twin, the shore-based control centre and engineers will be able to explore the entire vessel from their desktop or phone and compare both real-time and historic data,". "3D images and virtual reality will enable engineers to familiarize themselves with a task before they go on board. AI models running on a digital twin will identify and prioritize maintenance needs." Further developments to the technology, such as more layers of redundancy and self-healing capabilities, will need to be added before AI systems will truly start to take effect and be trusted by the industry. Autonomous technology in the future may have to integrate with non-autonomous solutions. How they work around and with each other is another point that needs to be considered. "The big challenge is making peace between autonomous and non-autonomous in the future".

Corrosion & Bio-fouling

Ship builders and vessel owners have a common interest in protecting marine vessels against corrosion and bio-fouling. For ship builders, protection involves the application of a paint system incorporating a primer, a binder and a final coat that releases chemicals to deter organisms from attaching themselves to the hull.

To combat corrosion, ship-owners apply coatings that will protect their assets over the long term, without the need for extended maintenance. Owners are also looking for consistent fouling control protection across a full dry dock cycle, accompanied by a minimum drop in vessel performance.

Most coatings are applied when a ship is under construction or during routine dry dockings. Heavy duty coatings are applied to areas of extensive wear and tear, such as near rudders, where surfaces need protection against the cavitations damage caused by the propellers as they churn the water, or complex structures that can be more costly and difficult to repair, such as water ballast tanks.

Visual inspection is an important component of marine and offshore asset management. However, applying artificial intelligence (AI) models to detect levels of corrosion and coating breakdown on ships and offshore structures

can reduce required man hours and may increase the safety of inspection operations.

The ability to identify corrosion from surface images is a first step to achieving this goal. American Bureau of Shipping (ABS) plans to leverage remote inspection technologies (including drones) to perform remote inspections and detect in real-time corroded areas that require additional attention. Furthermore, by capturing the history of corrosion progression, ABS may predict required inspections more precisely by using historical data and prediction modeling.

The data analytics component of a comprehensive inspection system for marine and offshore structures that consists of data collection tools (UAVs, ROVs), a digital model of the asset where collected data is mapped (stored), and tools to analyze the data and make decisions.

Robotics

There are a growing number of remotely operated and autonomous drones available to carry out marine maintenance tasks. An increasing number of companies, from ship operators to offshore developers, are waking up to the potential benefits of using drones to do the marine inspection and maintenance tasks that are dull and dangerous for humans in situ.

Floating drones: The remotely operated robotic inspection devices are small multi-use surface vessels with the ability to collect data autonomously by deploying a range of sensors and cameras. This is achieved through the combination of an autonomous operating system with object detection and avoidance, as well as automated path planning algorithms capable of calculating the optimum time to start missions based on weather forecasts and waterway traffic. The drones analyze the data they collect on board, using interpretation and predictive maintenance models for post-processing. This runs alongside algorithms which calculate the degradation of assets. This information can be used by managers to make strategic decisions about maintenance.

Underwater drones: The device takes the form of self-propelled robotic arms, capable of traveling long distances to carry out inspection, maintenance and repair (IMR) tasks in confined spaces not generally accessible by other underwater vehicles. The robot consists of a chain of joints, thruster modules and payloads, such as tools to provide torque and for cleaning. It is designed to stay permanently underwater on the seabed for up to six months at a time. This enables the robot to be used around the clock, irrespective of the weather.

Aerial drones: The use of Unattended Aerial Vehicle (UAVs) is becoming increasingly accepted by the marine industry, especially for inspections of difficult to reach areas and infrastructure for example, internal inspections of tanks. As part of the external specialist certification procedure, the surveyor can complete all safety and inspection processes required to accept the examination of tanks. Using UAVs for tank inspection reduces the need to use a technique called rafting. This involves filling the tank being inspected with water, allowing the surveyor to use a raft or dinghy to view critical inspection areas of the tank that would otherwise be inaccessible from the tank floor. Rafting creates a large volume of oil-contaminated water that has to be decanted from the vessel at a port. Using a UAV eliminates this and the safety risks associated with rafting. "UAVs are enabling the next generation of marine and offshore surveys and inspections, providing less intrusive, safer and more efficient ways of assessing critical areas,

Crawler drones: Another emerging application of robotic technology for marine maintenance is the use of remotely operated drones for inspecting and cleaning hulls. A prominent example of this type of approach is the underwater drone designed to carry out cleaning and hull inspection activities. The device works by generating vacuum and aspiration force via a central turbine driven by an electric motor, which performs the dual function of keeping the robot attached to the hull and removing any algae that has formed on it.

Conclusion

Dependency on a new technology to understand the behavior of machines is a paradigm shift away from thinking about ships. Lloyd's Register, in its "Global Marine Technology Trends 2030," estimated a 4,300% increase in the annual data generated by ships by 2020, and says that "by 2030, that figure will have increased even further as this is an accelerating trend." Data itself can now be considered a new class of "asset." And if ship-owners look after the asset that is their data, their data will help look after everything else.

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Development of Spinel using solution combustion route and its characterization: Potential material for abrasion and chemical resistance for marine structure

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***Abstract*—Spinel magnesium aluminate was synthesized by solution combustion route. Nitrate salt precursors were used in 2:1 molar ratio while citric acid was used as fuel and reducing agent for preparation. Thermal analysis was carried to determine the crystallization formation of the phase. XRD analysis confirmed the phases developed after proper annealing. Morphology of the synthesized powders were analysed using SEM while M-O coordinations for bond formation was observed from FTIR. EDX analysis confirmed the elements required for phase formation.**

Keywords—Spinel, Phase analysis, M-O coordinations, EDX analysis

I. INTRODUCTION

The synthesis of $MgAl_2O_4$ from industrial waste is a simple and cost-effective method. Magnesium aluminate spinel offers a unique combination of high-temperature properties including a high melting point, excellent resistance against chemical attack, potentially high strength even at high temperatures and very good thermal characteristics. $MgAl_2O_4$ develops high strength at normal as well as elevated temperature and it has no phase transition up to a melting point (2350ºC)[1]. Different sizes of particle and morphological structures were introduced by the varied synthesis conditions. The result materials reveal that the textural properties of the $MgAl_2O_4$ products are fully dependent on the nature and amount of addictive solvent and calcination temperatures [2]. Use of $MgAl_2O_4$ has shown superior as armor materials such as sapphire, AlON, soda-lime silicate glass, and MgF_2 in terms of its excellent performance and affordability [3]. Sol-gel technique is extensively used among all chemical routes because it has the advantage of producing pure, ultrafine powders at low temperatures with high surface area and pore size distribution[4]. From various literature study it is found that $MgAl_2O_4$ spinel can be synthesised using various novel chemical methods including the citrate–nitrate route [5], sol–gel technique [6], Pechini [7] and coprecipitation method [8]. Among the wet chemical routes, solution combustion technique has been regarded as one of the effective and economic methods due to its convenient processing, simple experimental setup and significant time-saving and high purity products [9-12].

In the present article solution combustion route is tried to synthesize spinel Magnesium aluminate using Magnesium nitrate, Al-nitrate precursor solutions and citric acid as fuel and reducing agent.

II. METHODS OF PREPARATION

High purity precursors of Magnesium nitrate, Al nitrate were used in 2:1 molar ratio along citric acid having three different ratios of 1.25, 1.5 and 1.75. Double distilled wate was utilized for preparing the solution. Citric acid was added in three ratios followed by proper stirring and heating at about 80°C for 3-4 hours. After proper drying, calcinations was carried at about 650°C, 800°C for 5hours for 3 different fuel ratios of 1.25, 1.75 and 1.50 respectively. Phase analysis of powders was carried by XRD to determine the formation of phases while FTIR analysis of pellet samples was carried to determine the bond formations of the compounds. Morphology was studied by SEM followed by EDX to confirm the elements present in the sample.

III. RESULTS & DISCUSSION

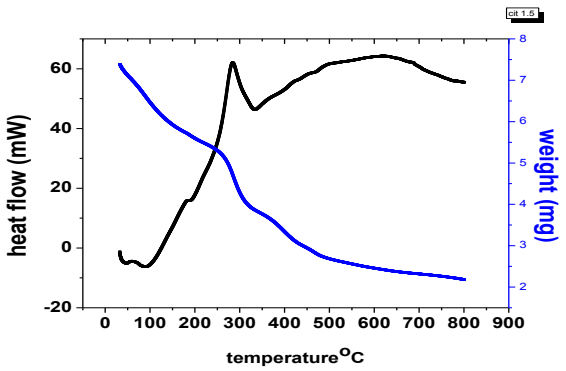

Fig1. DTA-TGA of Mg nitrate:Al nitrate having 2:1 ratio with heating rate of 15°C/min upto 900°C

First weight loss is noted in the temperature range between 100°C to 200°C from the DTA-TGA curve. The curve also exhibits two endothermic peaks one at about 100°C and second one at about 200°C. First endothermic peak suggests removal of physically absorbed water and 2nd one suggests removal of structural water. It is noted that large exothermic peak occurs due to burning or oxidation of organic compounds which is mainly combustion of carbonaceous elements due to citric acid and this corresponds to 2nd weight loss. A small endothermic peak is around 350°C due to formation of γ-alumina. The second endothermic is noted at about 450°C which associated with decomposition of nitrates. After that from 500°C to 700°C there is a weak but broad exothermic peak which corresponds to initiation of crystallization process and records the third weight loss.

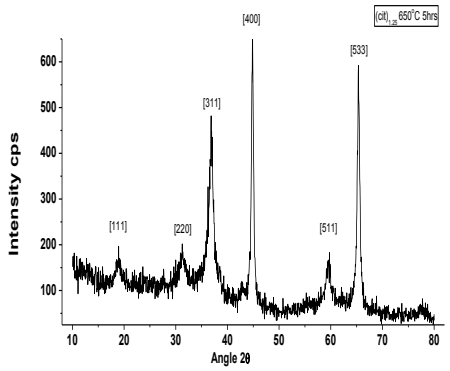

Fig2. XRD of spinel Magnesium aluminate after heating at 650°C for 5 hours using citric acid of 1.25 molar ratio.

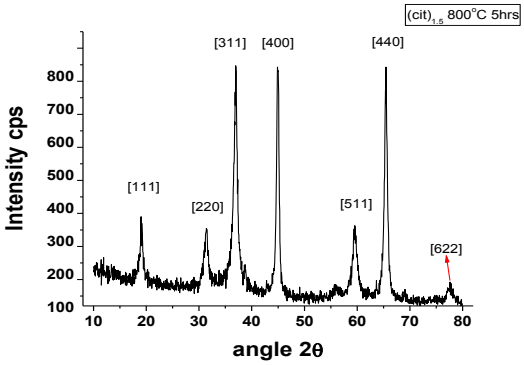

Fig3. XRD of spinel Magnesium aluminate after heating at 800°C for 5 hours using citric acid of 1.50 molar ratio.

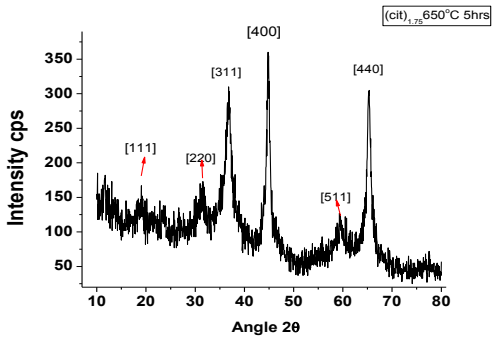

Fig4. XRD of spinel Magnesium aluminate after heating at 650°C for 5 hours using citric acid of 1.75 molar ratio.

XRD spectra of Fig 2 correspond to those peaks which have been indexed with the help of the standard JCPDS library (#01-082-2424, #01-075-1800) and all the peaks are of $MgAl_2O_4$ spinel. 6 planes (111), (220), (311), (400), (511) and (440) indicates that for citric acid of 1.25 molar ratio, 650°C, 5 hours soaking is sufficient for crystallization and phase development of spinel. Crystallite size estimated to be about 24.36nm. For Fig 3 also indicates presence of spinel phase as per JCPDS #01-077-1193, #01-075-1800 with extra plane of growth about (622). Crystallite size is estimated to be about 24.35nm. Fig 4 also indicates spinel phase but crystallization is little poor in compare to previous 2 cases. Thus, with increase in citric acid molar ratio, crystallinity is little inferior in compare to lower citric acid ratio for synthesis. Moreover, crystallite size obtained is about 18.26nm. Thus, higher citric acid ratio indicates better size control than first XRD observation. Among all three, citric acid ratio of 1.5 with higher temperature activation exhibits highest crystallization and sharp peaks. None XRD exhibits presence of other intermediates.

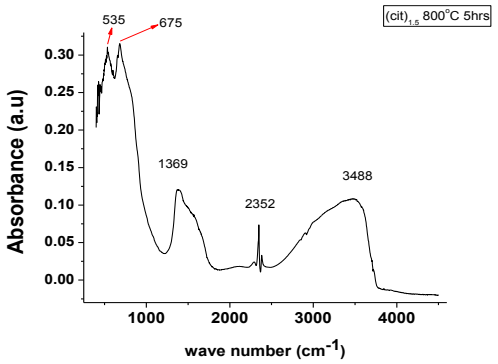

Fig5. FTIR spectra of spinel Magnesium aluminate after heating at 800°C for 5 hours using citric acid of 1.50 molar ratio.

Fig 5 give IR spectra value for Spinel($MgAl_2O_4$) synthesized for the temperature range from 800°C after soaking for 5 hours with 1.5 molar citric acid. Major bonds available is mostly Mg-O, Al-O, Al-O-Mg, O-H stretching at various molecular vibration. In FTIR graph there is presence of Al-O-Mg bond as a major peak which suggests successful synthesis of Spinel($MgAl_2O_4$). FTIR analysis supports the XRD analysis of phase formation.

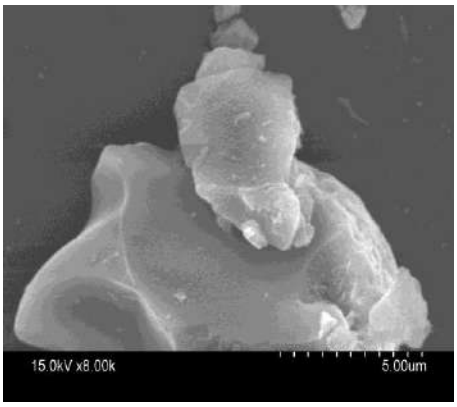

Fig6. SEM morphology of spinel Magnesium aluminate after heating at 800°C for 5 hours using citric acid of 1.50 molar ratio.

The morphology studied using SEM suggests it is an agglomerated chunk. Shape wise it is an irregular polygon shape. One end of this chunk has a cup shaped fracture. From this image it is clear that the top part has a conchoidal depression while the bottom part a blunt edge is observed. The agglomerate is dense in nature with negligible porosity. Individual particulates are also irregular polygon in shape but they have a very sharp corner. Morphology of the agglomerate also have roughness with irregular- depth impressions. The agglomerated chunk has height of more than 18 µm and width is about 9 µm. the individual particle are fallen in between the size of 0.3 µm to 1 µm. Dense structure indicates the possibility of increase in abrasion resistance, impermeability of ions which may cause rupture or chemical action on the substance.

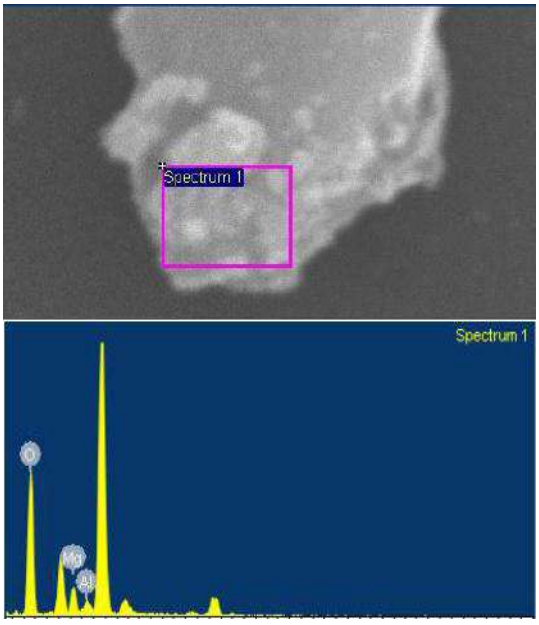

Fig7. EDX analysis of Magnesium Aluminate after heating at 800°C for 5 hours using citric acid of 1.50 molar ratio.

The peaks are O, Mg and Al respectively which satisfies the successful synthesis of spinel ($MgAl_2O_4$) phase. The portion of image analysed for elemental analysis is marked in the figure. Other peaks of K, Si are noted since drop caste of sample solution is made on glass slide which contains oxides of Si and K causing presence of some peak of those elements.

IV Conclusions

Solution combustion route was undergone using Magnesium nitrate, Al-nitrate precursors of 2:1 molar ratio while citric acid as fuel having 1.25, 1.50 and 1.75 molar ratios. Thermal analysis confirmed crystallization formation within 500°C-700°C range. XRD confirms the proper spinel phase as per JCPDS #01-077-1193, #01-082-2424, #01-075-1800. At 800°C, 5 hours annealing was noted to be the best condition for crystallization. M-O co-ordinations confirm the bonding analysis of compound while morphology having agglomerated chunk, conchoidal fracture having irregular polygonal shape was noted. From the above, a simple low cost combustion route was carried to synthesize Spinel which can with stand high temperature and corrosion in adverse conditions. This material can be potentially applied as coating over marine structure to withstand abrasion and corrosion attack.

Acknowledgment

Author is grateful to Department of Metallurgical & Materials Engineering, Jadavpur University for providing the characterization facilities like DTA-TGA, XRD, FTIR and SEM for the synthesized samples.

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INVESTIGATION AND OPTIMIZATION OF TURNING PARAMETERS ON SURFACE ROUGHNESS IN MACHINING OF MAGNESIUM ALLOY

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***Abstract*—Magnesium alloy is one of the lightest materials which has wide applications in the production of aircraft engines, airframes, helicopter components, light trucks, automotive parts and computers parts for its attractive properties. In this paper, a study on the cutting properties of magnesium alloy AZ91 in dry turning with uncoated cemented cutting tools is presented. Design of experiments has been used to study the effect of the main turning parameters such as cutting speed, feed rate and depth of cut on the surface roughness of Mg AZ91 alloy. A mathematical prediction model of the surface roughness has been developed in terms of above parameters. The effect of these parameters on the surface roughness has been investigated by using Taguchi method. It was found that the cutting speed had greatest influence on the surface roughness. Feed rate and depth of cut were found to have lesser influence on performance characteristics in that order**

Keywords— Mg alloy, surface roughness, Turning, Optimization and Taguchi.

I. INTRODUCTION

Magnesium is one of the lightest metallic materials, and as such, it is widely used in industries, such as aeronautics, aerospace, automotive, medicine, sports, and portable devices, in applications where the density to resistance ratio must be low [1–3]. Because the melting temperature of magnesium alloys is higher than its autoignition temperature (650°C and 430°C, respectively), chips can easily auto ignite during machining and create critical problems. If such a fire occurs, water should not be used to extinguish a magnesium fire because water is decomposed by magnesium to form hydrogen gas, which is highly explosive; only dry sand or a suitable extinguisher for fires involving metals should be utilized. For the same reasons, the use of water-based coolants can also be a risk factor. Additionally, the use of lubricants or coolants in the machining process can entail undesirable economic and environmental consequences. Therefore, machining of magnesium should be conducted under dry conditions, not only for safety reasons, but also because of economic and environmental considerations.

The turning operation normally removes stock from the material and produces rough surface. Therefore, surface roughness is another important index to evaluate the cutting performance [4]. The average surface roughness (Ra), which is mostly used in industries, has been considered in this study. The type of material machined and the type of cutting tool used also play important roles in the kind of surface characteristics produced [5].

In turning operation the surface roughness depends on cutting speed, feed rate, depth of cut, tool nose radius, lubrication of the cutting tool, machine vibrations, tool wear and on the mechanical and other properties of the material being machined. Even small changes in any of the mentioned factors may have a significant effect on the produced surface [6].

In machinability studies investigations, statistical design of experiments is used quite extensively. Statistical design of experiments refers to the process of planning the experiments so that the appropriate data can be analysed by statistical methods, resulting in valid and objective conclusions [7]. Design methods such as factorial designs, response surface methodology (RSM) and taguchi methods are now widely use in place of one factor at a time experimental approach which is time consuming and exorbitant in cost [8].

The main objectives of this study were to identify the most important factors and interactions that influence the dry turning of magnesium and subsequently to select the optimal manufacturing conditions that produce minimum surface roughness. To achieve these objectives, the “smaller-the-better” characteristic method was applied to the average roughness Ra.

II. EXPERIMENTAL PROCEDURE.

A. Test Material and its composition

In this study AZ91 magnesium alloy was used as test material with a diameter of 60mm and a length of 300mm.

B. zTest equipments and Experimental Method

The machining was conducted under different cutting conditions using a Kirloskar Turnmaster 35 lathe machine with a capacity of 3HP/2.2 kW power. The tests were carried out in dry condition using uncoated cemented carbide cutting tool at different cutting speeds, depth of cut and feed rate. The levels were specified for each process parameter as given in the Table 1. The parameter levels were chosen within the intervals recommended by the machine tool manufacturer. The experiments were planned using Taguchi's orthogonal array in the design of experiments which help in reducing the number of experiments. The experiments were conducted according to a three level, L9 orthogonal array was selected. After each test, the surface roughness was measured by surftest211, Mitutoyo surface roughness tester.

TABLE I. Factors and their level for experimental design

Factor	**Level 1**	**Level 2**	**Level 3**
Cutting Speed (m/min)	40	60	80
Feed (mm/rev)	0.10	0.20	0.30
Depth of cut (mm)	0. 5	0. 75	1.00

III. RESULT AND DISCUSSIONS

The experimental results from Table 2 were analyzed with analysis of variance (ANOVA), which used for identifying the factors significantly affecting the performance measures.

Optimization of Parameters

Taguchi recommends analyzing the means and S/N ratio using conceptual approach that involves graphical method for studying the effects and visually identifying the factors that appear to be significant. There are three quality characteristics in the analysis of S/N ratios for optimization such as Lower-The-Better (LB), Higher-The-Better (HB) and Nominal-The-Best (NB).

TABLE II. L9 (3^3) Orthogonal Array with Experiment results

Trail No	**Cutting Speed v (m/min)**	**Feed f (mm/rev)**	**Depth of cut d (mm)**	**Average surface roughness Ra (µm)**
1.	40	0.10	0.5	0.25
2.	40	0.20	0.75	0.22
3.	40	0.30	1.00	0.35
4.	60	0.10	0.75	0.30
5.	60	0.20	1.00	0.33
6.	60	0.30	0.5	0.40
7.	80	0.10	1.00	0.33
8.	80	0.20	0.5	0.32
9.	80	0.30	0.75	0.34

In this work, response is minimized to obtain optimal parameter, so smaller the better type S/N ratio is used [9, 10]. The surface roughness is individually analysed using MINITAB 16 software. The mean S/N ratio for each level of the machining parameters was calculated and the results are shown in Table 3.

TABLE III. Response table for Signal to Noise Ratio

Detail	Machining parameters S/N ratio		
	Cutting speed	Feed	Depth of cut
Level 1	11.437	10.709	9.966
Level 2	9.349	10.893	10.993
Level 3	9.632	8.816	9.459
Delta	2.088	2.077	1.534
Rank	1	2	3

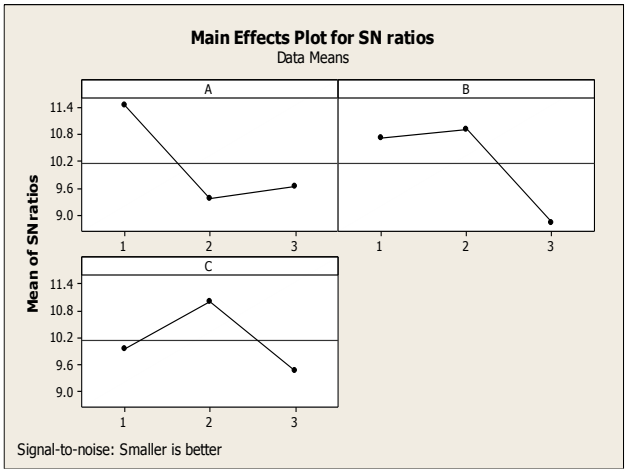

Fig 1. Main effect plot for surface Roughness (ra)

Development of Surface response Model

The mathematical model suitable for predicting suitable value is Quadratics model by considering the Full Quadratics model as shown in equation 3, which the coefficients of factors that affect response value are as shown in Table 5.

TABLE V. Co efficient of Surface Roughness

Term	**Co efficient of Surface Roughness**
Constant	85.7494
v	0.0405
f	-73.7467
d	-3.2840
v * v	-0.0001
f * f	16.6667
d * d	0.6133
v * f	-0.0100
v * d	-0.0013

With the above coefficients of factors that affect response value above, a mathematical model equation can be built as follows;

Mathematical model for forecasting surface roughness

Surface Roughness = 85.7494 + 0.0405v -73.7467 f - 3.2840 d -0.0001 v * v + 16.6667 f * f + 0.6133 d * d - 0.0100 v * f -0.0013 v * d (1)

TABLE VII. The optimized cutting parameters by Taguchi method

Cutting Parameters	**Taguchi method**
Cutting Speed (m/min)	40
Feed (mm/rev)	0.20
Depth of cut (mm)	0.75

CONCLUSION

As the parameter testing of turning work pieces as cutting speed, feed rate and depth of cut as the surface response of surface roughness by Taguchi method as shown in Table 7

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ALTERNATE FUELS

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Abstract

As the world moves towards greener solutions for reduction in pollution by any source, the transportation industry will be greatly affected and hence major changes are taking place throughout. From automobiles, logistics, aviation and each and every machine in the supply chain is looking to cut down the emissions.Shipping contributes to 3% of the world's total manmade carbon emissions. Around the world, air pollution is causing serious health problems and premature death, and local air pollution will be subject to tougher regulations over the coming years.

Reducing emissions to air and introducing new propulsion technologies are key challenges for the worldwide transport sector, including shipping. The world's future fleet will have to rely on a broader range of fuels, propulsion solutions and energy efficiency measures. All alternative fuel options have benefits and challenges. This guidance paper provides an introduction to alternative fuels and technology solutions. It includes an overview of selected alternative ship fuels – LNG, LPG, methanol, biofuel and hydrogen – as well as emerging technologies such as batteries, fuel cell systems and wind-assisted propulsion.

The objectives of the paper are to provide decision support for investment in ships for the upcoming period. The paper focuses on technical parameters and limitations without accounting for local market conditions, considerations and incentive schemes which may have a significant impact on competitiveness and the uptake of alternative fuels and technologies.Marine fuel currently contributes approximately 3 per cent to global man-made CO2 emissions. Most seagoing ships are still using heavy fuel oil (HFO) or marine gas oil (MGO), with a maximum Sulphur limit of 0.5 per cent (mass) in force for HFO and 0.1 per cent (mass) for low-Sulphur MGO w.e.f. 1st Jan 2020

Looking at the future with the IMO 2020 low-Sulphur standards and upcoming CO2 emission regulation regime in mind, the share of conventional oil-based ship fuels will drop and the share of alternative fuels will grow.Prerequisites for introducing a new fuel include availability of sufficient production and distribution facilities as well as an adequate bunkering infrastructure. In addition, new fuels in many cases require extensive on-board modifications and a reversal to a conventional system is complex and costly.

In this paper various aspects of alternate fuels are presented and possibility of further development in this aspect and further challenges narrated.

Key Words

Transportation, logistics, supply chain, carbon emission, air pollution, premature death, propulsion solutions, energy efficiency, alternate fuel, LPG, LNG, Methanol, Bio-Fuel, Hydrogen Cell, Batteries, wind-assisted propulsion, technical parameter, competitiveness, oil-based ship fuels, bunkering infrastructures

I. INTRODUCTION

IMO has made resolution to cut emissions by imposing restrictions on the fuel used. The 2020 Sulphur Cap has limited the use of Sulphur fuels to 0.5% worldwide. Further on recently adopted ambition is to reduce GHG emissions to 50% by 2050. The combined amount of heavy fuel oil (HFO) and marine gas oil (MGO) consumed by ships accounts for no more than 25 per cent of the global diesel fuel and petrol production (2016 figures).

On application of the above restrictions related to Sulphur from 1st January, 2020 70-88% of the fuel consumed onboard will be low Sulphur fuel (0.1-0.5%). Assuming an installed base of about 3,000 scrubbers at that time, no more than 10 to 15 per cent of ship fuel usage will be high-Sulphur fuel. Latest estimates assume that 2,000 to 2,800 scrubber systems installed by early 2020. This development suggests that HFO may only be available at major bunkering locations. It is difficult to predict a price level, but HFO is expected to be available at a significant discount compared to MGO or other compliant fuels.

The restrictions also imply in terms of carbon, nitrogen and particulates. In the advent of the decisions taken the industry is looking for solutions that are economically viable as well as environment friendly so as to form a win-win situation.

LNG-powered vessels have been in operation since 2000. As of 1 December 2018, 137 LNG-fueled ships were in operation and 136 newbuilding orders were confirmed.

Short sea shipping

Due to their relatively low energy demand, these vessels are often ideal candidates for testing new fuels marked by high energy or fuel storage costs. The Norwegian ferry sector is in the process of being electrified, with about 50 battery-electric ferries to be phased in over the next few years. The use of hydrogen is also technically feasible, and the Norwegian national road authorities, supported by DNV GL, are working on the development of hydrogen applications and intend to put a new hydrogen-powered ferry into service by 2021.

Deep sea shipping This includes large, ocean- going vessels covering long routes, often without a regular

schedule. These vessels require fuel that is globally available. The energy source carried on board must have a sufficiently high energy density to maximize the available cargo space. For these vessels, LNG can be a viable option once an adequate bunkering infrastructure is available globally. Sustainable biofuels, methanol and LPG can also be a choice, provided that they can be made available in the required quantities and at an adequate quality level. Based on current technology, batteries are viewed as impractical as a source of main propulsion energy for these vessels in the foreseeable future. Nuclear propulsion is technically feasible for large vessels, but there are political, societal and regulatory barriers to consider.

Alternative Fuels

- LPG
- LNG
- METHANOL
- BIOFUEL
- HYDROGEN
- Newly proposed technologies
- Batteries
- Fuel cell
- Wind assisted propulsion

Fuel cell (FC) systems for ships are under development, but it will take time for them to reach a degree of maturity sufficient for substituting main engines. Battery systems are finding their way into shipping; however, on most seagoing ships their role is limited to efficiency and flexibility enhancement. Batteries cannot store the huge amounts of energy needed to power a large ship. Finally, wind-assisted propulsion, while not a new technology, will require some development work to make a meaningful difference for modern vessels.

The greatest challenges are related to environmental benefits, fuel compatibility, the availability of sufficient fuel for the requirements of shipping, fuel costs and the international rule setting by the IGF Code.

The IMO continues its work on the IGF Code for methanol and low-flashpoint diesel and the rules for FC systems. The other fuels named above are not on the current agenda for the IGF Code.

CO2 Emissions

GHG emissions are measured as CO2 equivalent emissions. Of all relevant fossil fuels, LNG produces the lowest CO2 emissions. However, the release of unburnt methane (so-called methane slip) could reduce the benefit over HFO and MGO because methane (CH4) has 25 to 30 times the greenhouse gas effect compared to CO2. Nevertheless, engine manufacturers claim that the tank-to-propeller (TTP) CO2-equivalent emissions of Otto-cycle dual-fuel (DF) and pure-gas engines are 10 to 20 per cent below the emissions of oil-fueled engines (ref.1).

The comparison between the CO2 emissions from LNG used in Qatar – close to the production site – versus LNG used in Europe reveals that the required transport of LNG does not increase the carbon footprint significantly. The carbon footprints of methanol and hydrogen produced from natural gas are larger than those of HFO and MGO.

The key benefit of fuels produced using renewable energy is clearly a small carbon footprint. Among these fuels, first-generation biodiesel has a relatively low CO2 reduction potential. However, liquefied methane produced from biomass (biogas) has extremely high CO2 reduction potential. It should be noted that the main component of LNG is also methane; therefore, both liquefied gases are equivalent.

The cleanest fuel is hydrogen produced using renewable energy. Liquefied hydrogen could be used in future shipping applications. Because of its very low energy density, its storage volume is large.

NOx Emissions

Diesel-cycle engines must be equipped with exhaust gas treatment systems to comply with the IMO Tier III limits. Only Otto-cycle engines burning LNG or hydrogen have the potential to remain within the Tier III limits without requiring exhaust gas treatment. This means that in most cases a switch of fuel is not sufficient to comply with the Tier III NOX limits. (ref.2)

Overall Emission Behavior

Diesel Cycle (HFO):

- Cost added
- Addition of EGR and Scrubbers

Diesel Cycle (LSHFO/HFO):

- SOx emission compliant
- NOx reduction techniques required

Diesel Cycle (LNG):

- Zero SOx emissions
- EGR/SCR still to be used to reduce NOx emissions
- Zero methane slip achieved in High Pressure Diesel LNG cycle

Otto Cycle (LNG):

- Medium speed and low speed (LNG & DF engines)
- Meets NOx Tier III without additional requirements
- 10-20% reduction in CO2 emission compared to oil-fueled engines.

Fuel Pricing

The price of fuel over the lifetime of the ship, or the desired return on investment over a given period, is often the most relevant factor.

- Market Conditions
- Distribution Facilities

- Ease of availability of fuel
- Source of production (e.g. Hydrogen produced from renewable sources is expensive & cheaper comparatively when produced from LNG)

Fuel Availability

The use of alternative fuels can meet the demands of the shipping industry in the upcoming years but availability of the fuel with ease depends on the demand. A particular fuel may catch attention of the ship owner's but its availability then becomes the deciding factor.

In theory, a switchover of the entire global fleet to LNG would be possible today since the current LNG production is higher than the shipping industry's energy requirement, and the share of LNG in the total gas market is only 10 per cent.

Environmental and price challenges are driving the interest in alternative ship fuels, but the number of realistic candidates is small. LNG, LPG, methanol, biofuel and hydrogen to be the most promising candidates. Among them, LNG has already overcome the hurdles related to international legislation, and methanol and biofuels will follow suit very soon. It will be a while before LPG and hydrogen are covered by appropriate new regulations within the IMO IGF Code, as well.

The existing and upcoming environmental restrictions can be met by all alternative fuels using existing technology. However, the IMO target of 50 per cent GHG emissions reduction within 2050 is ambitious, and will likely call for wide-spread uptake of zero-carbon fuels, in addition to other energy efficiency measures. Fuel cells can use all available alternative fuels and achieve efficiencies comparable to, or better than those of current propulsion systems. However, fuel cell technology for ships is still in its infancy. The most advanced developments to date have been achieved by the projects running under the umbrella of the e4ships lighthouse project in Germany, with Meyer Werft and ThyssenKrupp Marine Systems heading the projects for seagoing ships.

Without taxation or subsidies, renewable fuels will find it difficult to compete with the prices of conventional fossil fuels. LNG and LPG are the only fossil fuels capable of achieving a CO2 reduction. CO2-neutral shipping seems possible only with fuels produced from renewable sources. If the shipping sector resorts to synthetic fuels produced from hydrogen and CO2 using renewable energy, the available alternatives will be liquefied methane (which is very similar to LNG) and diesel-like fuels.

Alternative Fuels

- LNG
- Methanol
- Hydrogen
- LPG
- Batteries
- Fuel cell
- Wind assisted

I The International Code of Safety for Ships using Gases or other Low-Flashpoint Fuels (IGF Code) is the mandatory IMO instrument that applies to all gaseous and other low-flashpoint fuels in shipping, and to all gas-powered ships other than gas carriers. The use of low-flashpoint fuels in gas carriers is covered by the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IMO IGC Code). (ref.2)

The IGF Code was adopted by the IMO in June 2015 (MSC.391 [95]) and came into force on 1 January 2017. It is compulsory for all gaseous and other low-flashpoint-fuel ships and currently has detailed provisions for natural gas in liquid or compressed form (LNG, CNG). Regulations for methanol and low-flashpoint diesel fuels as well as for maritime fuel cells are under development.

The IGF Code contains mandatory provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using low-flashpoint fuels. It addresses all areas that need special consideration for the use of these fuels, taking a goal-based approach, with goals and functional requirements specified for each, the design, construction and operation of ships using this type of fuel.

Technical provisions for low-flashpoint fuels other than natural gas, and other energy arrangements such as fuel cell systems will eventually be added to the code as new chapters. For the time being, ships installing fuel systems designed to operate on other types of low-flash-point fuels will need to demonstrate individually that their design meets the IGF Code's general requirements.

Brief Overview

To assess all fuels or technologies in a comparable manner, the information is categorized as follows

1. Price: Accounts for production process, raw materials, market price and the reasoning behind it, current/foreseeable (five years) price or expected price (beyond five years)

2. Infrastructure: Current/future distribution network, bunkering, availability

3. Regulation: Existing/expected regulations, consequences

4. Scalability: Current/possible future production as related to the requirement in shipping

5. Environmental impact: CO2, NOX, SOX, particulate matter (PM) and others

6. Technology: Availability of current/future technology, foreseeable changes

7. CAPEX: Engines, storage, processing, retrofitting

8. OPEX: Exhaust cleaning, scrubber, additional costs for fuel change

Reference Fuels

HFO & MGO

Price

For decades, the HFO price has been below and the MGO price above the crude oil price. Since global demand for HFO will drop significantly after 2020, its price is assumed to fall as well. However, there might be local variations depending on the actual HFO availability in certain geographical locations. At the same time, the price of MGO and of 0.5 per cent Sulphur fuels is expected to rise significantly, leading to a high initial spread between HFO and compliant fuels, which is expected to close eventually. This spread may temporarily accelerate the uptake of scrubbers, while the high MGO prices may increase interest in alternative fuels

Infrastructure

In A well-developed worldwide MGO and HFO supply infrastructure is in place. Ships are supplied by bunker barges when in port, in most cases during cargo operations (IMO) expects oil-based, fuel-cap-compliant fuels to be available worldwide as of 2020, a notion challenged by other parties. However, it is not clear as yet what fuel products will be available to cover the demand.

Regulations

The IMO Marine Environment Protection Committee (MEPC) limited the Sulphur content of ship fuel to 0.5 per cent from 2020 onward. This regulation applies worldwide.

Emission control areas (ECAs) for SOX were introduced along the North American coasts as well as in the North Sea and Baltic Sea in 2015. In these areas, the Sulphur content of fuel is limited to 0.1 per cent. It is allowed to continue burning HFO and use scrubbers to clean the exhaust gas to achieve an equivalent level of Sulphur emissions.

In 2016, the North American coastlines were additionally declared NOX-restricted areas. This means that ships keel-laid after 31 December 2015 must comply with Tier III NOX requirements. The same restrictions will apply in the North Sea and Baltic Sea from 2021 onward.

Scalability

The reality about the availability of compliant fuels and its potential impact on prices will not be known until the industry starts consuming compliant fuel after the Sulphur cap takes effect.

Environmental Impact

GHG emissions, SOx, NOx and particulates.

Technology

However, the reality about the availability of compliant fuels and its potential impact on prices will not be known until the industry starts consuming compliant fuel after the Sulphur cap takes effect.

Capex

Depending on the size of the engine, the investment costs for scrubbers' range between 150 to 100 USD per kilowatt (40,000 kilowatt and larger engines).

Opex

An exhaust gas cleaning system requires energy to operate the pumps and scrubbing units to remove the SOX from the exhaust gas. This energy use is estimated to be approximately 1 to 2 per cent of the power used by the engine(s) installed on the ship

The operational costs of scrubbers are composed of the cost of maintenance and energy consumption. According to IMO MEPC 70/5/3, these amount to approximately 0.7 per cent of the total fuel costs (ships with more than 25 MW of shaft power).

LNG

The main component of liquefied natural gas (LNG) is methane (CH4), the hydrocarbon fuel with the lowest carbon content and therefore with the highest potential to reduce CO2 emissions (maximum reduction: roughly 26 per cent compared to HFO).

Using LNG as fuel consequently does not produce any SOX emissions. Since the boiling point of LNG is approximately –163°C at 1 bar of absolute pressure, LNG must be stored in insulated tanks.

The energy density per mass (LHV in MJ/kg) is approximately 18 per cent higher than that of HFO, but the volumetric density is only 43 per cent of HFO (kg/m³). This results in roughly twice the volume compared to the same energy stored in the form of HFO.

Price: Natural gas hub prices worldwide (except in certain parts of East Asia) have been below the price of crude oil and HFO for the last ten years.

Compared to other alternative fuels, LNG seems to have reached the most competitive feedstock price level historically among all alternative's fuels. Currently, the price level is competitive with MGO, but direct competition with HFO may be difficult

While still limited, the dedicated LNG bunkering infrastructure for ships is improving quite rapidly. A large share of LNG bunkering as well as LNG distribution to bunkering locations is still taking place by road. Delivery by rail would also be possible but is currently not practiced. In 2017 and 2018, several LNG bunker vessels where delivered for operation in key locations such as the Amsterdam, Rotterdam and Antwerp (ARA) region, the North Sea, the Baltic Sea and at the Florida coast.

LNG is essentially available worldwide (at large-scale import and export terminals), and investments are underway in many of these locations to make LNG available to ships.

In 2016, the global LNG production capacity was approximately 320 m t/a. This figure will increase by almost 40 per cent to about 450 m t/a by 2020 (2017 World LNG report; International Gas Union [IGU]).

Environmental Impact

Natural gas from LNG is the cleanest fossil fuel available today. There are no SOX emissions related to it, particle emissions are very low, the NOX emissions are

lower than those of MGO or HFO, and other emissions such as HC, CO or formaldehyde from gas engines are low and can be mitigated by exhaust gas after-treatment if necessary. Nevertheless, methane release (slip) must be considered when evaluating the CO2 reduction potential of LNG as ship fuel (maximum value is roughly 26 per cent compared to HFO). Low-pressure Otto-cycle gas engines (i.e. all four-stroke as well as all low-pressure two-stroke engines) burning LNG comply with the IMO Tier III NOX limit without requiring exhaust gas treatment.

Opex

Gas-fueled engine systems have about the same efficiency as conventionally-fueled systems. For this reason, the energy consumption of an LNG-fueled ship is roughly the same as that of an oil-fueled ship. Maintenance of a gas-burning engine may be less expensive thanks to cleaner fuel. Currently, the maintenance intervals of conventional and gas-fueled engines are typically the same, but with more operational experience to draw on, they may be extended for gas engines. The maintenance costs for the high-pressure gas supply system on board ships with high-pressure engines should be considered.

Concluding Remarks

The use of alternative fuels can meet the demands of the shipping industry in the upcoming years but availability of the fuel with ease depends on the demand. A particular fuel may catch attention of the ship owner's but its availability then becomes the deciding factor.

In theory, a switchover of the entire global fleet to LNG would be possible today since the current LNG production is higher than the shipping industry's energy requirement, and the share of LNG in the total gas market is only 10 per cent.

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Design and Fabrication of Savonius Wind Turbine for Electricity Generation

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***Abstract*— Wind energy is the most abundantly available clean form of renewable energy in the earth crust. Wind turbines produce electricity by using the power of wind to drive an electric generator. There are two kinds of wind turbines according to the axis of rotation, HAWT and VAWT. VAWT is include both a drag type configuration like Savonius wind turbine and a lift type configuration like Darries wind turbine. Savonius construction is simpler and cheaper. It is independent of the wind direction and has a good starting torque at lower wind speeds. After some research studies was found that the two blades rotor is more efficient than three and four ones. Multi stage rotors have higher performance compared to single stage rotors. The rotor without overlap ratio are better in operation than those with overlap. This paper shows the mathematical modelling of Turbine for the best performance.**

Keywords—VAWT, Wind Energy, Drag Type

I. INTRODUCTION

Even though the first wind turbine was built around 900 A.D. Wind power is today a small addition to the worlds energy demand when compared to coal, nuclear, hydro and oil. However, today there is a global discussion about if the greenhouse effect exists or not and if an oil crisis is waiting to happen. Whether or not this is the case, it is a good idea to investigate more environmentally friendly energy sources. A growing number of installed wind turbines is not the single solution for the world's growing energy demand, but can be a part of a more environmentally friendly solution. To be competitive, wind turbine developers need to reduce the cost per installed kW and the maintenance needs have to be as low as possible to reduce downtime. In a study from 2007, it was stated that failures in gearboxes, pitch and yaw systems together stand for 42.1% of the downtime in Swedish wind turbines. This indicates that a less complex system without these parts has the potential to reduce the downtime and thereby increase the profit of a wind turbine. Vertical axis wind turbines (VAWT) can be built without these parts, but have today a very small part of the wind power market in favour of the horizontal axis wind turbines (HAWT). Drag based Savonius wind turbine was invented by the Finnish engineer Sigurd Johannes Savonius in 1922. However, Europeans had been experimenting with curved blades on vertical wind turbines for many decades before this. The earliest mention is by the Italian Bishop of Czanad, Fausto Veranzio, who was also an engineer. He wrote in his 1616 book *Machinae novae* about several vertical axis wind turbines with curved or V-shaped blades.

II. VERTICAL AXIS WIND TURBINE

It is a type of wind turbine where the main rotor shaft is set transverse to the wind (but not necessarily vertically) while the main components are located at the base of the turbine. This arrangement allows the generator and gearbox to be located close to the ground, facilitating service and repair. VAWTs do not need to be pointed into the wind, which removes the need for wind-sensing and orientation mechanisms. Major drawbacks for the early designs (Savonius, Darrieus and giromill) included the significant torque variation or "ripple" during each revolution, and the large bending moments on the blades. Later designs addressed the torque ripple issue by sweeping the blades helically. There are several types of VAWT. They are H-Rotor, Savonius, Darrieus.

III. LITERATURE REVIEW

In this, several literature reviews are mentioned which gives the suitable and efficient design for our project.

Wenehenubuna et.al states that number of blades will influence the rotation of rotor of wind turbine models. The three blades wind turbine produces higher rotational speed and tip speed ratio than that two and four blades. The highest tip speed ratio is 0.555 for wind speed of 7m/s. x Wind turbine rotor with four blades has high torque compared with two or three blades wind rotor. x Four blades wind turbine has good performance at lower tip speed ratio, but three blades wind turbine has the best performance at higher tip speed ratio.

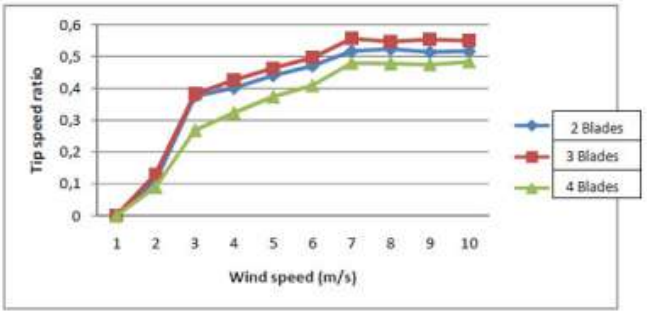

Fig I. Graph explaining tip speed ratio and wind speed

Laxmikant et.al mentions that numerous configurations were adapted for enhancing the performance of Savonius wind turbine. Each configuration of Savonius rotor gives good performance characteristic. In previous studies show that performance of Savonius wind turbine was affected by some parameters like aspect ratio, overlap ratio, number of blades, rotor shapes, Reynolds number, turbulence intensity, shaft interface, influence of stator, direction of wind flow. For predicting performance accuracy experimental and Cfd simulation method was used by many of researchers. These two methods provide good results comparing to each other's. Experimental method is costly and time consuming and other hand Cfd simulation method less costly and time consuming. The functional relationship between coefficient of power and geometric parameter and wind flow parameter,

Cp = f (tip speed ratio, geometric parameter, flow parameter)

T. Letcher states that a combination of common vertical axis wind turbines (VAWT) rotors was designed and tested for optimal performance in low wind speeds. The Savonius rotor creates high torque and is self-starting even at low wind speeds, but is relatively low in efficiency rating. The Savonius rotor is used to start the straight bladed Darrieus rotor. The Darrieus rotor is not a self-starting rotor, but has much higher efficiency than the Savonius rotor. The combination of rotors increases the total power of the turbine in lower wind speeds.

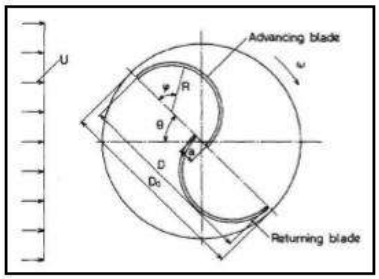

Fig. II Overlapping of rotor

IV. CONCEPT DEVELOPMENT

The concept was developed after having detailed literature survey and based on the procedure adapted for designing a new component. The flow chart showing the working principle of the project.

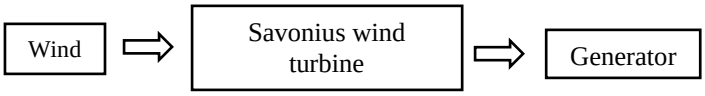

Fig III. Flow diagram of VAWT

From the above fig 3.1 it is clear that the energy from the wind is converted into electric energy by means of Savonius wind turbine.

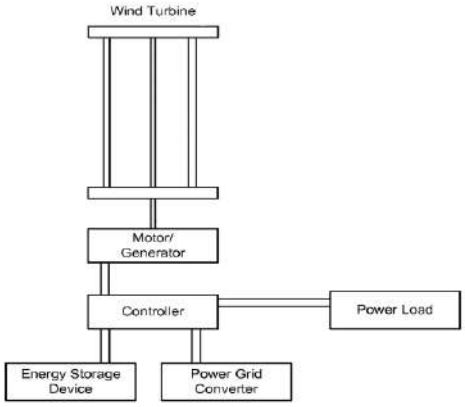

Fig IV. Schematic diagram of VAWT

V. WORKING PRINCIPLES

Savonius turbines are one of the simplest turbines. Aerodynamically, they are drag-type devices, consisting of two or three scoops. Looking down on the rotor from above, a two-scoop machine would look like an "S" shape in cross section. Because of the curvature, the scoops experience less drag when moving against the wind than when moving with the wind. The differential drag causes the Savonius turbine to spin. Because they are drag-type devices, Savonius turbines extract much less of the wind's power than other similarly-sized lift-type turbines. Much of the swept area of a Savonius rotor may be near the ground, if it has a small mount without an extended post, making the overall energy extraction less effective due to the lower wind speeds found at lower heights.

Vertical-axis wind turbines (VAWTs) are a type of wind turbine where the main rotor shaft is set vertically and the main components are located at the base of the turbine. Among the advantages of this arrangement are that generators and gearboxes can be placed close to the ground, which makes these components easier to service and repair, and that VAWTs do not need to be pointed into the wind. Major drawbacks for the early designs (Savonius, Darrieus and giromill) included the pulsatory torque that can be produced during each revolution and the huge bending moments on the blades. Later designs solved the torque issue by using the helical twist of the blades almost similar to Gorlov's water turbines.

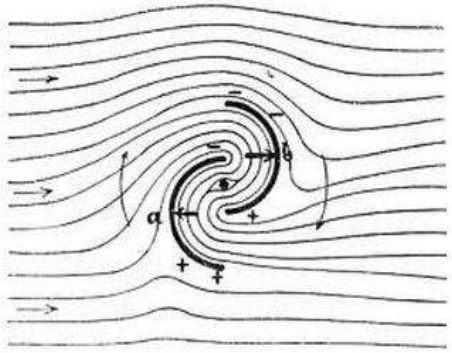

Fig V. Working of Savonius wind turbine

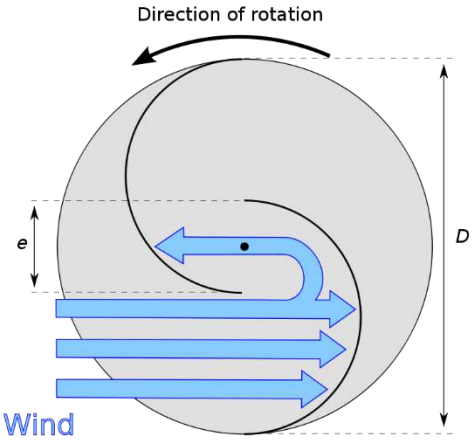

Fig VI. Wind flow in turbine

VI. DESIGN CALCULATION

A. *Betz' law*

According to Betz's law, no turbine can capture more than 16/27 (59.3%) of the kinetic energy in wind. The factor 16/27 (0.593) is known as Betz's coefficient. The maximum power of the rotor is estimated according to Betz's law

$$P_s = \frac{1}{2}.\rho.A.v^3.C_p$$

$\rho = 1.2\ kg/m^3$ is the air density

A = h. D the sweep area of the rotor blade

$C_p = 0.593$ the Betz coefficient

v = velocity of air (m/s)

$$P_s = 0.36.h.D.v^3$$

There are aerodynamic and mechanical losses in the order of 50%. Then rotor shaft power equation becomes

$$P_s = 0.18.h.D.v^3\ [\text{W}]$$

Rotational speed is given by

$$n = \frac{60}{2\pi}.\omega\ [\text{rpm}]$$

$\omega = \lambda.v/r$ [rad/s] is the angular velocity

For Savonius rotor, λ = 0.8

Torque at the rotor shaft is given as $\tau_s = \frac{P_s}{\omega}$ [Nm]

Factors affecting rotor design

- Number of blades
- Number of stages
- Overlap ratio(β)
- Aspect ratio(α)

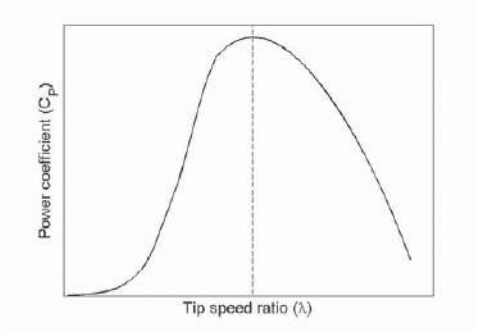

Fig VII. Graph showing Power coefficient and Tip speed ratio

B. *Theoretical Design*

We know that,

$$P_s = 0.18.h.D.v^3$$

Assume P_s = 5w, v = 4m/s

Optimum Conditions, $\alpha = 2.24$ $\beta = 0.162$

h = 0.77D

$$5 = 0.18.\ 2.24D^2.\ 4^3$$

D = 0.28m **h = 0.19m**

β = (e-a)/d = 0.162

D = 4r = 0.56m

r = 0.14m

d = 2r = 0.28m

$$\tau_s = \frac{P_s}{\omega}$$

$$\omega = \lambda.v/r$$

λ = 0.8 (for Savonius rotor)

$$\omega = 0.8\ \text{X}\ \frac{4}{0.28}$$

$\omega = 11.42$ rad/sec

$$\tau_s = \frac{P_s}{\omega}$$

$$\tau_s = \frac{5}{11.42}$$

$\tau_s = 0.437\ Nm$

n = (60/2π). ω

n = 109.05 rpm

Height **H = 0.8m**

Rotor diameter **D = 0.56m**

Blade diameter **d = 0.28m**

Endplate diameter $D_o = 1.1\ \text{X}\ \text{D} = 0.56\text{m}$

Shaft diameter **a = 0.03m**

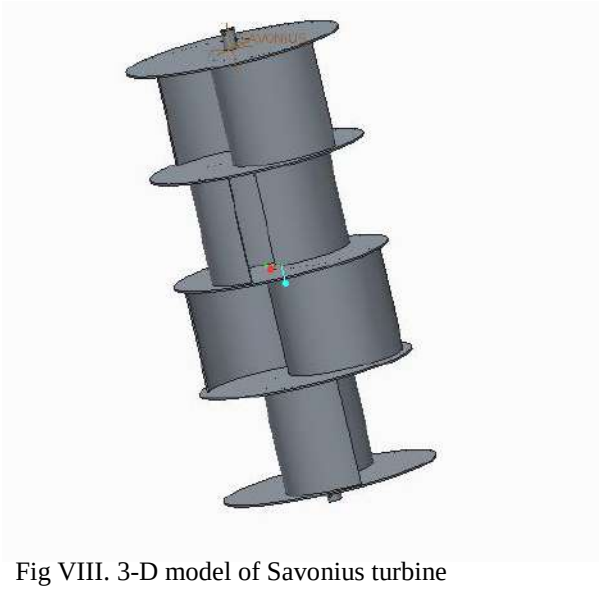

Fig VIII. 3-D model of Savonius turbine

VII. FABRICATION

A. *Introduction*

The fabrication of components which required for our project is explained below. They are

- Rotor
- Shaft
- End plate
- Bearing and bearing housing

B. *Rotor*

'S'- shaped Savonius rotor is designed by making the cylindrical shaped acrylic plastic into two semi-cylindrical rotors. The designed rotor is shown in fig

Fig IX. Photographic view of Rotor

C. Shaft

Here we use a GI pipe of dia 28cm and length 1.2 m because of non-corrosive property it can withstand the atmospheric weather condition for long life time

D. End Plate

End plate is manufactured by cutting the wooden plate of OD 56cm and ID 35cm of 5 pieces. The figure is shown below

Fig X. Photographic view of End Plate connected with Shaft

E. Bearing and Bearing Housing

The shaft support is given by lateral bearing (bearing no. 51106) and guide bearing (bearing no. 6006) which comes under our specifications are used. And the bearing housing is fabricated by Stainless steel (no. 304)

VIII. WORKING AND TESTING

A. Introduction

Savonius wind turbine is working based on the principle of drag force because of concavity and convexity of the rotor blades. When the wind hits the blades the concavity blade exerts more pressure than the convexity part which exhibits the drag force and in turn converts into rotational force. The rotational force is then transmitted to generator connected by chain and sprocket arrangement.

Fig XI. Photographic view of VAWT

B. Testing Methodology

The rotor setup is tested in normal wind velocity of about 3m/s using anemometer. The rotor runs at a speed of 135 rpm.

Table I. Rotor parameters as function of wind

v (m/s)	4	6	8	10	12
N (rpm)	66	98	130	164	195
ω (rad/s)	6.878	10.32	13.75	17.19	20.6
P_s (W)	12	45	107	209	360
τ_s (Nm)	1.745	4.36	7.78	12.15	17

IX. CONCLUSION

The kinetic energy available in the wind is absorbed by Savonius turbines and it converts into rotational force. Due to the self-starting property of the turbine, it does not require any starting and yaw mechanism. Hence it cost will be reduced. By connecting the MPPT, the maximum power point tracker the maximum power can be trapped at instant irrespective of the load and wind speed.

The multi stage turbine plays efficient role in trapping the energy from the wind. As it arranged in the phase angle of $\frac{360}{n+1}$ the blade will face at 360 degree.

In the present mini project prototype of Savonius wind turbine is designed and fabricated. And the parameters like speed, torque, power is determined with respect to the function of wind speed.

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New Regulations – Impact of Implementation of Sulphur 2020 Regulation on Seafarers.

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I. BACKGROUND

International Maritime Organization (IMO), under the objective to control harmful impact of shipping on environment, develops the regulations and guidelines to reduce pollution from ships through "International Convention for Prevention of Marine Pollution from Ships (MARPOL)". After series of studies and discussions, MARPOL Annex VI, which addresses the emissions from ships, was modified vide regulation, 14.1.3 reducing the limit of Sulphur oxide emissions from ships. This new regulation, hereinafter called Sulphur 2020, sets a limit of Sulphur content, in the fuel to not to exceed 0.50% m/m. It was agreed that 01 Jan 2020 as the effective date of implementation.

There had been continuous changes in the regulations limiting the Sulphur content (Sulphur Cap) in the fuel. Sulphur cap is 0.1% m/m when the ships are trading near the coasts of European Union and Unites states of America, commonly known as Sulphur Emission Control Areas and 0.5% m/m in coastal waters of China. Sulphur cap was however set at 3.5% globally, in rest of the areas. The new regulation brought down the cap to 0.5% m/m globally from 01 Jan 2020.

While there are many ways to comply the regulations, the most common approaches are either of the three methods viz, (1) cleaning all the

fuel tanks and commence using of compliant fuel with Sulphur level below 0.5% m/m (VLSFO or LSMGO), (2) installation of scrubbers that would clean the exhaust gas and reduce the Sulphur emission within the stipulated level or (3) using of alternate fuel system complying with the emission requirement.

II. INTRODUCTION

Increased environmental awareness is one of the social trending that forces to simulate changes by means of new regulations. (Robins, SP, Judge T.A, Vohra N, Organizational Behaviour, 2012,). In order to effectively implement the change, extensive guidelines were developed by International Environmental Protection Committee (IEPC) of IMO, Flag States, and other industry bodies such as Classification Societies, OCIMF, Intertanko, etc. for the consistent shipboard implementation plans. (MEPC.1/Cir 878, IMO, Guidance on the Development of Ship Implementation Plan for the Consistent Implementation of 0.5% Sulphur Limit under Marpol Annex VI , 2018) The guidelines covered various factors including risk assessment, mitigation plan, modifications of tanks and cleaning of tanks, segregation capability, procurement of compliant fuel, change over plan, impact on the machinery system, related documentation, and reporting. However, varied levels of difficulties were fore seen prior implementation date such as possible challenges in availability of compliant fuel, unsure about the effective models of scrubbers, lack of shipyards availability and the possible fines by authorities for non-compliance.

Societal and technological change is one of the extra organizational stressors for the people of an organization. (Luthens, 2011). Uncertainty about the possible future threat disturbs the ability to cope and results in anxiety. (Grupe & Nitschke 2013). Whenever there is an external demand. Stress can be defined as a nonspecific response of the body to any demand made on it. (Huffman, 2004,). Whenever there is an external demand there is an internal stress. To cope with this stress, it is essential for the seafarer to become well adapted to the expectations. The earlier regulations such as Maritime Labour Conventions, (2006), lifeboat design modifications have brought similar stresses to the seafarers.

In order to upgrade the safety of the vessels where open lifeboats were used, IMO, through SOLAS (International convention of Safety of Life at Sea), implemented regulations to have fully enclosed life boats and arrangements of hooks that could facilitate the boats being released with all ship complement inside the boat without any external assistance. However, the hook mechanism caused many accidents, and it has been widely believed that lifeboats that were meant to save lives has killed many. Even though many modifications were brought in for safety, there are still cases where the seafarers get injured or killed due to the hook mechanism. (Mora T, et all, 2010)

Many a times policies and regulations meant for the larger good impacts certain sections of the society. On 08th November 2016, Government of India announced demonetization of currencies of denominations 500 and 1000. The aim of the demonetization was to curb black money and terrorism which was widely accepted and agreed by the society. However, the weaker section of

the society, who were relying mainly on the currency transaction suffered a major blow and impacted them economically as well as psychologically. (Mukhta Naik, 2018).

This is also evident that when Government of India enforced lock down to contain the spread of covid19 in March 2020, many migrant workers and the section of the people who live on daily wages had a severe impact.

While at a larger picture, every individual is appreciative of the new regulation (Sulphur 2020) and the importance of environmental impact, the overall implementation models did not adequately identify stressors encountered by the seafarers who are at the sharp end of the implementation.

III. NEED OF THE STUDY

Many administrations announced severe fines and punishments for non-compliance to the new regulation Sulphur 2020. Singapore Government announced prison of 2 years and heavy fines for captains and owners of the ship which would not comply with the requirement. Many countries did not agree to the use of scrubbers within their coastal waters.

All these collectively created extra stress and anxiety amongst the seafarers, managers, operators, and ship owners.

The present study is needed to

1) Know seafarers' understanding of the regulations,
2) See how the seafarer perceive the problems in the implementation of new regulation.
3) Understand how the regulation actually impacted on the seafarer after implementation.
4) Evolve methods by which this can be effectively addressed.

IV. OBJECTIVE OF THE STUDY

Objective of the study is to

1) Highlight concerns perceived by the seafarers when complying with this new regulation and
2) Identify the actual difficulties faced followed by the implementation.

V. Method of Investigation (Methodology)

Research design

This study is exploratory in nature as Sulphur 2020 is a new regulation and therefore the problems encountered would be novel in nature.

The following measures were undertaken for the study

To get a detailed understanding of the regulations, the Research Scholar examined various related regulations and consulted experts in the relevant area.

Based on the discussions, the research scholar developed questionnaire to identify what are the challenges a seafarer would expect in the implementation of program prior implementation of the regulation.

Collect the incidents that happened in relation to the Sulphur 2020 after implementation (1st January 2020) till 15 November 2020.

Analysis and interpretation of the findings.

VI. Data Collection – Sampling

For this study, convenient sampling method was used. Sample size consisted of 148 sailing seafarers who participated in the survey. Mean age of the sample was 35 years with average shipping experience of 12 years and sailing experience (sea time) of 10 years.

Sample distribution is shown below

Details	Engine Officers	Deck Officers	Total
Senior Officers	42	39	81
Junior Officers	25	42	67
Total	67	81	148

Based on the seniority and the department following groups were formed.

1) All participants (All Engine and Deck, Senior and Junior Officers). N =148
2) All Senior Engineers (Chief Engineers and Second Engineers), n=42
3) All Senior Officers (Masters, Chief Engineers, Chief Officers, Second Engineers), n=81
4) All Engineering officers (Chief Engineer, Second Engineer, Third engineer, Fourth Engineer and Electrical officers), n=67.

VII. Tools used for the study

The survey question was prepared by the research scholar who probed about different aspects of implementation of the new regulation and challenges foreseen during implementation.

The questions were generated after interviewing ten senior office superintendents who are well versed with the regulations. While there are multiple ways to implement the regulation, this study is focused only on two popular models, installing scrubber onboard which would clean the exhaust gas to reduce the emission or using compliant fuels such as Very Low Sulphur Fuel oil or Low Sulphur Marine Gas oil.

Since the office senior superintendents were experts in fuels, engine, new regulations and the practical of the implementation, it was important to know which method of the two the preferred and the pros and cons of that system. This information can be sought by simple direct questions which were made the part of the interview. The interview with superintendent consisted of one closed ended question on the preference of system scrubber or compliance fuel and other open ended, the major advantages challenges that are faced in those approaches. The questions asked were

Considering a ten-year-old vessel, which is the best method for implementing the new regulation – Scrubber installation or using compliant fuel?

What are the major challenges you fore see in both above approaches?

Interview with senior superintendents revealed various issues that may be faced by the seafarers because of new regulation which has potential to cause anxiety and stress.

It was identified that following were the various conditions that has the potential to cause anxiety and stress to seafarers

Extra Workload.

Physical and mental fatigue.

Work related incidents.

Penalization / Criminalization due to non-compliance.

Additional procedures and paperwork.

Neglect of other machinery.

Approach by various Port State control authorities.

Level of training provided by the companies.

Additionally, following were considered as the conditions having potential to cause anxiety and stress when using new scrubber installations for compliance

Hazard inside Engine Room due to additional sea water pipes.

Hazard due to passing of scrubbed water pipelines in Engine Room

Machinery related problem within scrubber operations.

Following were considered as additional conditions having potential to cause anxiety and stress when compliance fuel usage is considered for compliance.

Increase in machinery issues due to compliant fuel

Fear of punishment when usage of compliant fuel (especially if fuel was found to be higher in Sulphur content)

Compatibility issue of the fuel

Additional challenges during fuel change over procedures.

With all such inputs questionnaire was made with brief introduction of the regulation and demographic details. Eleven statements of concerns were raised under scrubber installation as the mode of compliance and Twelve statements under using compliant fuel as the mode of compliance.

The statements were to be read and their feeling to be answered using a Likert scale ranging from 1-10 where 1 being low and 10 being high.

Additionally, to understand how the seafarers are prepared to handle the stress and anxiety, seven more questions were asked, which as follows.

Do you think you are fully prepared to handle the new regulation without any issue?

How do intend to handle the additional pressure due to new regulation

Gain More knowledge by attending seminar

Read more materials

Avoid joining vessel until the situation is settled

Face the challenge as it is without any preparation.

Any other feedback – an open-ended question

Willingness to share contact details

If yes, then details of e mail and telephone number.

Final questionnaire was shown to the experts for verifying the content validity.

From a fleet of 221 vessels, a list of various issues was obtained following the implementation of Sulphur 2020 for a period from 01 Jan 2020 to 15 November 2020. A qualitative study was done on the types of issues faced and reviewed against the results obtained prior to the implementation.

Procedures

Final questionnaire was given to the seafarers who were visiting the organization for training program as hard copies. The filled in forms were transferred to a digital code using Microsoft excel. The data was statistically analyzed.

Analysis.

Mean of the scores and standard deviation were calculated for the entire group and sub-groups. T scores were used for comparing groups based on their seniority.

All participants (All Engine and Deck, Senior and Junior Officers). N =148, All Senior Engineers (Chief Engineers and Second Engineers), n=42, All Senior Officers (Masters, Chief Engineers, Chief Officers, Second Engineers), n=81, All Engineering officers (Chief Engineer, Second Engineer, Third engineer, Fourth Engineer and Electrical officers), n=67.

The mean of the data are as follows.

S.No	Statement	Overall		Senior Eng Officers		All seniors		All Engineers	
		Scrubber	Com Fuel	Scrubber	Com Fuel	Scrubber	Com Fuel	Scrubber	Com Fuel
1	Extra workload for ship staff	6.84	4.99	6.92	4.71	7.26	4.98	6.89	4.53
2	Fatigue related problems	6.1	4.5	6.13	4.17	6.51	4.37	6.08	4.13
3	Work related incidents	6.19	4.44	6.58	4.67	6.65	4.49	6.26	4.39
4	Additional Paperwork	6.87	5.28	6.71	4.75	6.95	4.93	6.74	5.05
5	Penalization / Criminalization	6.51	5.07	6.96	4.88	6.95	4.86	6.89	4.79
6	Neglect of other machinery issues	5.91	4.01	5.88	3.96	5.98	3.79	5.66	3.79
7	Anxiety due to PSC approach	7.14	5.84	7.33	5.79	7.47	5.74	7.08	5.61
8	Level of training provided as of now	6.22	5.93	5.54	5.21	5.77	5.67	5.76	5.32
	Additionally for Scrubbers								

1	Additional Hazard due to Pipeline Passing thro	6.34		7		7.07		6.24	
2	Additional hazard due to scrubbed water pass thro	6.28		6.71		6.79		6.39	
3	Machinery problems in scrubber operations	6.41		6.79		6.91		6.37	
	Additionally for Compliant Fuel								
	Machinery problems due to new fuel		4.86		5.38		4.98		5.24
	Fear of punishment while complying compliant fuel		5.69		5.38		5.56		5.29
3	Compatibility issues		5.79		5.71		5.93		5.68
4	Fuel change over procedures		5.68		5.46		5.86		5.24

Additionally, based on analysis many other sub-groups data, interpretations were made by comparison of means.

Seniors, more than juniors, feel that scrubber installation might affect their daily workload, functioning and increase hazards and machinery problems.

There is no difference between seniors and juniors on anxiety and stress level due to regulations change.

There is no significant difference between seniors' and juniors' perception of problem they face due to fuel compliance.

All groups felt that scrubber installation as the option for compliance will create more stressful condition than opting for use of compliant fuel.

The highest level of concern was Anxiety created due to approach taken by various port State control authorities.

Hazards of additional pipelines carrying large quantities of sea water inside the engine room was felt to be the next high concerned condition.

Criminalization of seafarers due to non-compliance was the next high concern followed by extra workload for ship staff and additional procedures and paperwork.

VIII. Review of incidents that happened post implementation onboard the ships.

After implementation of the regulation in 01 Jan 2020, the incidents happened were followed in an organization which was managing about 221 vessels. Out of the 221 vessels, 59 were fitted with scrubber installation to comply with the regulation. Remaining 162 vessels carried out fuel change over procedures and started using compliance fuel.

From 01 Jan 2020, until 15 November 2020, there were about 45 issues reported in relation to the new regulation. Of which 34 issues were related to scrubber and 11 related to use of compliant fuel.

Of the 59 vessels where scrubber was fitted as the means of compliance, 34 issues were reported. This can be categorized as follows

Malfunction of scrubber equipment – 21 Leakage from the scrubbed water system – 6

Leakage from the seawater pipelines for scrubber – 4 Possible penalization due to potential non-compliance – 1 and Work related incidents related to scrubber fittings – 2

Issues reported on the scrubber usage was reviewed against the initial risk assessment to identify the gaps. In one of the vessels, there was a minor fire incident while the installation of scrubber was in progress without any injury to the personnel.

Of the 162 vessels where, compliant fuel was used as the mode of compliance to the regulation, 11 incidents were reported. The categories as follows

Fuel compatibility issues – 3

ISSUES ON MACHINERY DUE TO COMPLIANT FUEL – 6 WORK RELATED INCIDENTS – 2

These incidents were also reviewed against the risk assessment that was prepared prior to the implementation. This was to identify the gaps in identification of hazard, estimated risk and effectiveness of the control measure against the conditions at which incidents occurred at the later stage. For those ships where supply of compliant fuel was planned, management of cleaning of tanks with high Sulphur fuel posed big challenge. The ship crew were not familiar and not having enough equipment and machinery onboard to manage the large volume of sludge from the old fuel which had to be landed ashore. In one of the ships, while landing the sludge using containment boxes, damage occurred during crane handling, causing minor spill on the jetty which resulted in fine.

IX. RESULTS AND FINDINGS

The mean scores of the responses indicated that certain conditions caused more anxiety and stress than others. They are analyzed in the rank order of seriousness.

Scrubber installation as the means of compliance had higher concerns compared to the usage compliance fuel. Scrubber installation on the board the ships for cleaning the exhaust gas is a major project involving high cost. The scrubber installation would need large volume of space in the engine room and funnel deck areas. There would be pipelines carrying sea water from sea chest and pumped up to the higher most deck on the ships. Additionally, the water that scrubbed the exhaust gas would be acidic. The treated water would pass down from higher decks to bottom part of engine room through pipelines. Leaking from these pipes can cause flooding and injury to the seafarer working in the vicinity.

The Compliant fuel usage, on the other hand, does not require major modification or installation of machinery. It requires extensive cleaning of fuel oil tanks that presently carry high Sulphur. The ships are built mostly with machinery designed for running in high Sulphur fuel. Whereas compliant fuel would have varied lubricity and different composition compared to the regular high Sulphur Fuel. Machinery manufacturers and experts suggested adding of chemicals to the

compliant fuel, changes to the setting of the machinery and modifications to the regular maintenance schedule to address the potential issues in the usage.

The highest concern was the anxiousness created due to the **approach by port Authority authorities** who would verify the compliance. This condition scored highest means in both models of compliance. All the regulations are verified for compliance by flag state authorities and by classification societies prior issue of certificates and during periodical inspections. Additionally, the port State Authorities of the country where the vessel calls, would carry out inspections of the vessels and impose fines, issue findings and may detain the vessels for non-compliance. There were many communications in this regard from various port State authorities. Singapore government announced 2 years of imprisonment and fine for the masters and ship owners of the vessels who do not comply. Such communications and their past experiences might have caused anxiousness.

Second highest concern was the **hazard due to sea water pipelines** carrying huge amount of water. There was a video popularly spread through social media of a popular incident, where the leakage from such pipe would be flooding the engine room. Leaks in these pipelines can cause flooding in the engine room as well as injury.

Seafarers are worried about being penalized by the authorities for non-compliance. **Criminalization of seafarers** is the most talked in the maritime industry. Judiciary of the port states invariably establish blame on the crew for accidents where loss of life during any incident and pollution prevention. It has been established at various occasions that are the common occurrences where the seafarers are penalized by the authorities and invariably imprisoned and kept along with criminals. This condition

has scored next high with fear of non-compliance due to any failure.

Next concern raised by the seafarers are the **additional procedures and paperwork**. Every new regulation is bringing additional levels of paperwork and procedures creating huge workload for the seafarers.

X. LIMITATIONS

The study was done on the seafarers working in one organization. Other seafarers from different organizations were not considered. Since regulation being common for all organizations, researcher considered taking information from one organization. Data was only taken from the seafarer who were on leave and visited the organization for training. Sailing seafarers were not considered.

XI. CONCLUSION

Seafarers were able to foresee the problem that might arise in the new regulations. Even though many publications and guidelines were available for the easier transit to the new regulations, the organizations and the seafarers experienced anxiety and stress prior to and during the implementation process. The studies imply that organizations and industry bodies must consider more possible scenarios for the failures and develop related solutions to mitigate same. The studies also imply that many associated studies such as making efficient models of scrubber, alternate means for reducing emission levels, technological solutions to machineries when using compliant fuels etc.

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HYBRID ENERGY SYSTEM AND ITS IMPACT ON ENVIRONMENT AS CLEAN & GREEN ENERGY

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***Abstract*—Energy resources have a major role in the present era. But the treasures of the world's accumulated conventional energy resources will one day end. The prevailing power continues to pollute the world. Standing in this place, we need to increase the use of non-conventional energy. Renewable energy actually helps to keep our environment green and clean, in addition to meeting our energy needs This electronic document is a "live" template and already defines the components of your paper [title, text, heads, etc.] in its style sheet. *CRITICAL: Do Not Use Symbols, Special Characters, Footnotes, or Math in Paper Title or Abstract.* (*Abstract*)**

Keywords—solar energy, Environment

I. INTRODUCTION

All over the world coal plants are being replaced by solar panels and wind turbines. The cost of equipment required for wind power and solar energy is steadily declining. The proportion of our energy generated by sun and wind is expected to increase in next 30 years. In 2050, 2/3 of global electricity will come from renewable sources.

India is blessed with abandoned source of renewable energy in the form of solar and wind. This source of energy has a vital role in the socio-economic development of the country. In the present situation electricity is one of the fundamental needs of human life. In the 21st century 240 millions of Indians are not connected to grid system. Some part of India remains dark at night. We can't provide quality human life without electricity. Energy plays the major role in socio-economic and technological development of a country .Till now 90.8 % of total energy supplied by conventional energy sources. The Era of fossil fuel is going to be ended, so entire world are behind green energy utilization. When the question of green energy comes, sun and wind are the abandoned source of energy. Being a part of society, we need to transform those sources of energy to a usable form. Otherwise it will be an injustice to the society. Sun neither rises at night nor wind blows throughout 24 hours, to meet the huge energy demand we have to set up hybrid energy system, combination of one or more energy sources as a single unit and it must be attached with the grid..

II. ENERGY

A. Solar Energy:

India has a huge potential for solar power generation. We can convert the solar power directly into grid quality electricity. This is done mainly by solar photovoltaic cells (SPV) .Mainly the Thar Desert of Rajasthan, east and west coastal area of India and also the Decan Platue are the most potential for setting up solar power stations. The main advantages of using solar power are that it is environmentally friendly. Because it does not produce carbon content and the cost of maintenance is low, 3 to 4 acres of land is required to generate 1MW electricity. Solar photovoltaic panels can be installed on the roof of the house mainly in urban areas where there is a lack of land. SPV performance depends largely on its tilt angle. The latitude of the site where the tilt angle are decided is minus 15 degree in the summer and plus 15 degree in winter. Realizing the important of solar power, solar power plants have been set up in the states of Karnataka, Rajasthan, Gujrat, Tamilnadu, Andhrapradesh, Madhyapradesh, Telengana, Maharastra etc. National solar mission has been working since January 11 ,2010, with the goal of allowing India to produce 100GW of solar Electricity in the year 2022 .India currently ranks 5th in the world in solar power generation .Indian production has increase 11 times in the last 5 years . In 1914 there were 2.6 GW, in 2019, rising to 30 GW.

TABLE I. GENERATION OF POWER IN INDIA

Region	**Conventional Generation (MU)**	**Non-conventional Generation (MU)**						
India	1249337	Wind	Solar	Biomass	Small Hydro	Bagasse	Others	Total
		62036.38	39268.2	2763.82	8702.75	13562.67	425.28	**126759.09**

TABLE. II YEAR CUMULATIVE SOLAR POWER CAPACITY IN INDIA (MW)

Year	Production
2015-2016	6,763
2016-2017	12,289
2017-2018	21,651
2018-2019	28,181

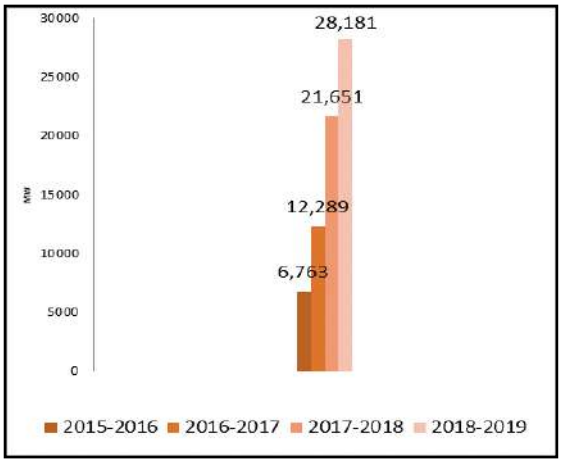

Fig 2. Year cumulative solar power capacity in India (MW)

B. Wind Power:

We first noticed the use of wind mill in the Babylonian civilization .King Hammurabi set up wind mills to improved irrigation in agriculture in the 17th century BCE .The air flows from one place to another for the variation of air pressure on atmosphere. Wind power mills produce electricity with the help of wind .To set up a wind mill it is more important to select the site to built wind power plants where the wind speed is at least 18km/h. availability of land is also a important measure. Wind energy mills energy efficiency is very low only 10% to 20% .Big size wind turbines have many problems such as loud noise, vibration, shadow deflection etc so it is possible to produce small wind turbine in each house to generate electricity through them and store the excess energy by the help of battery. About 1 million homes in the Mongolia, China have such small wind turbines that made the daily needs of their electricity. United States of America is the leading country in the world to generate wind power but India is not far behind. There are variations in climate in India during monsoon most of the parts of India received lower insolation due to cloud cover and are compensated by higher wind energy. So hybrid energy is the solution of energy crisis.

PREPARE YOUR PAPER BEFORE STYLING

Before you begin to format your paper, first write and save the content as a separate text file. Complete all content and organizational editing before formatting. Please note sections A-D below for more information on proofreading.

TABLE III. YEAR CUMULATIVE WIND POWER CAPACITY IN INDIA (MW)

Year	Production
2007-08	8,756
2008-09	10,241
2009-10	11,806
2010-11	14,155
2011-12	17,352
2012-13	19,052
2013-14	21,132
2014-15	23,444
2015-16	26,777
2016-17	32,280

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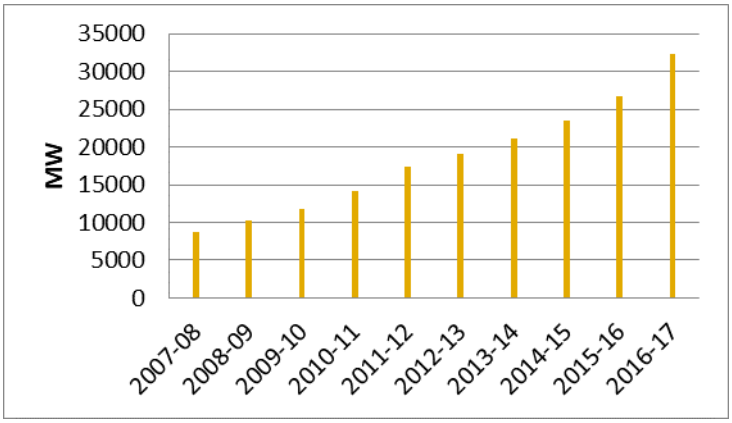


Fig. 3. Year cumulative wind power capacity in India (MW)

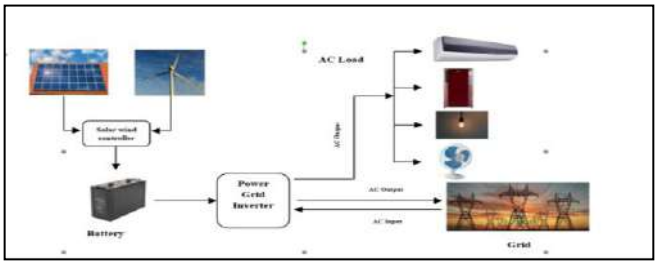
III. OVERVIEW OF A HYBRID POWER PLANT:

Power from the panel transmitted to solar wind controller box, combine the different panel and then one common output. Now the power comes to the battery section and charge the battery .From battery the power transmitted into the power grid inverter .Inverter convert the DC power to the AC usable power, where we can use it in our air-conditioner, refrigerator, light, fan etc.

If the solar panel and wind turbine generate excess power and it do not have load, in the house hold then this hybrid inverter send the excess power to the grid, from there we can earn a good amount of money. In the day time of power outage the hybrid inverter cuts off the grid and stats supplying solar plus wind power directly to our load.

If power break down happen during the night when solar panels are inactive .

Fig.2. Overview of a hybrid power plant



We take the power from wind turbine and also from the battle to fulfill our demand.

Requirement of survey: the selection of site or survey location is an important issue for hybrid energy power station. There are few steps to take

Step 1: Demand of electricity

Areas of electricity demand in the area such as how much electricity is required only in case of basis house hold needs. The amount of light provided by the roads in the area.

Step 2: Which place is suitable for power generation.

The velocity of the wind flow and the type of flow and the continuity of the flow are of particular importance. The angle of inclination of the Sun throughout the day are specially important.

Step 3: The cost of equipment and its replacement .

The cost of Installing electricity is the cost of the equipment and the cost of carrying it and the cost of replacing it, as much as the cost of maintaining it later.

IV. CONCLUSION:

The planet earth has the suitable climate for human inhabitation but the climate of the earth changing rapidly due to the emission of carbon dioxide. The main source of carbon dioxide is coal and mineral oil burned at the power plan. Also combustion of aviation gasoline and petrol adds carbon dioxide to the atmosphere .The rice of this green house gasses is one of the major cause of climate change. so at the point of socio economic development and environmental development we must abandoned this conventional power generation system and switched to non conventional power.

Sun neither rises at night nor wind flows throughout 24hrs.therefore it is not possible to use any one sources of energy to meet the demand. In that case we can use hybrid energy system. Hybrid energy system is where solar power and wind power are used together with the help of the system we can meet the demand for electricity and reduced the grid dependency of electricity.

Currently petrol and diesel cars are being converted to electric vehicles which will reduce carbon dioxide emissions in the environment. We can use non conventional power to charge electric cars ,and this will also reduce green house gas consumption .as a result ,the health of people will be better and the incidence of disease will be reduced .the use of non conventional electricity helps reduce the dependents of mineral oil on other countries .

Still now 90% of the energy supplied by the conventional sources and it damage the environment. To find out the best green energy solution this non conventional energy like Solar, Wind those are the most suitable alternatives. But the problem is the country like India where population density is very high; to install this kind of distributed power sources is very difficult to find the site, because land acquisition is a big problem in India.

We can think some alternative way like-

- Install the plant at the empty area of Air ports.
- Top of the Real Estate property.
- Roof of the stadiums.
- Top of the River

Conservation of river is a big tusk also. Evaporation should be less if we set up solar panel on river. In this way we also save the water.

In that way solar installation can be possible without any political disturbances.

[a.)]

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HEAT TRANSFER CORRELATIONS FOR COMBUSTION MODELLING FOR DIESEL ENGINE WITH DUAL INJECTION OF WATER SATURATED MTBE SOLUTION AND PALM KERNEL BIODIESL BLENDS

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***Abstract*— The biomass resource being alternative fuels and effective use of these fuels is gaining prominence as substitute way to solve the problem of global warming and the green energy crisis. In this work a single cylinder diesel engine was modified to run on secondary water injection equipment which electronically control the precise quantity of water and methyl tertiary butyl ether (MTBE) additive for effective NOx control. Heat transfer models are applied to study the combustion characteristics in the present research work and in-cylinder pressure variations and heat release rate are predicted using these models effectively and presented in this research paper.**

Keywords—component, formatting, style, styling, insert

I. INTRODUCTION

Several works have been reported to improve the performance of engines fuelled by vegetable oils with property modifications by preheating the oil, use of hot surface ignition, blending with the diesel fuel, emulsions with lighter alcohols and by transesterification. Pure vegetable blends can be used in lieu of diesel fuel directly without any engine modification. But increase in the percentage of vegetable oil in the blend creates problems like cocking and gum formation. That is the reason why the diesel fuel cannot be replaced by neat vegetable oil without engine modifications. As many of the problems associated with the use of pure vegetable oil in diesel engines are mainly due to high viscosity, reduction of viscosity of the vegetable oil may help in possible replacement. Reduction of viscosity can be affected by any of the processes like transesterification, mineralization, and pyrolysis. Mineralization consumes more time and pyrolysis brings about irregular molecular break down. Hence transesterification is the only method, which reduces the viscosity of the vegetable oil and paves way for possible replacement to diesel fuel in internal combustion engines. In this work conventional laboratory equipment has been used for the transesterification of Palm Kernel oil to get Palm Kernel methyl ester. Various properties of Palm Kernel methyl ester are tested for comparison with diesel fuel, further the investigations are carried out on a laboratory-based D.I diesel engine with Palm Kernel methyl ester prepared in the laboratory in pure form. A trail was made to evaluate the ester's compatibility with the engine for possible replacement.

Model basis and assumptions

The basis for the majority of the heat-release models is the first law of thermodynamics; the energy conservation equation. For an open system, it can be stated as.

$$dU = dQ - dW + \sum_i h_i dm_i \quad (1)$$

where *dU* is the change in internal energy of the mass in the system, *dQ* is the heat transported to the system, *dW* is the work produced by the system and $\sum_i h_i dm_i$ is the enthalpy flux across the system boundary. Possible mass flows are: 1) flows in and out of the valves; 2) direct injection of fuel into the cylinder; 3) flows in and out of crevice regions; 4) piston ring blow-by The mass flow is positive for a mass flow into the system and hi is the mass specific enthalpy of flow i. Note that hi is evaluated at conditions given by the zone the mass element leaves.

Some commonly made assumptions for the single-zone odels are

- the cylinder contents and the state is uniform throughout the entire chamber
- the combustion is modeled as a release of heat

- the heat released from the combustion occurs uniformly in the chamber
- the gas mixture is an ideal gas

Consider the combustion chamber to be an open system (single zone), with the cylinder head, cylinder wall and piston crown as boundary. Figure 1 shows a schematic of the combustion chamber, where the sign conventions used in pressure and heat-release models are defined. The change in heat dQ consists of the released chemical energy from the fuel dQch which is a heat adding process, and the heat transfer to the chamber walls dQht, which is a heat removing process. So, the heat transport is represented by . Note that the heat transfer cools most of the time, but sometimes heats the air-fuel mixture. The work done by the fluid on the piston Wp is positive, therefore dW=dWp. The first law of thermodynamics (1) can then be rewritten as

$$dQ_{ch} = dU_s + dW_p - \sum_i h_i dm_i + dQ_{ht} \qquad (2)$$

The piston work Wp can also be written as *dWp=pdV*. For an ideal gas, the change in sensible energy dUs is a function of mean charge temperature T only, thus:

$$Us=mcu(T) \qquad (3)$$

- which in its differentiated form becomes:

$$dUs=mccv(T)dT+u(T)dmc \qquad (4)$$

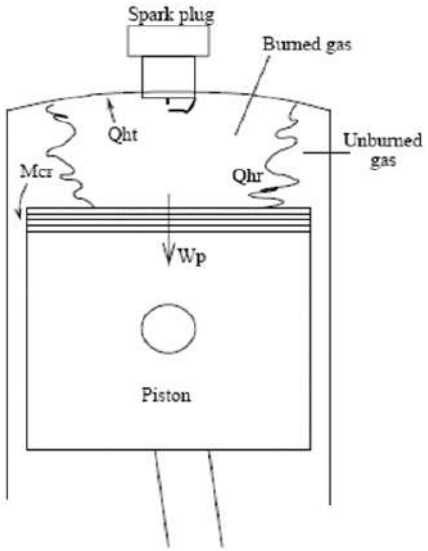


Figure1.0: combustion process in the cylinder

where *dmc* is the charge mass, and $c_v = \left(\frac{\partial u}{\partial T}\right)_V$ is the mass specific heat at constant volume.

The mean temperature is found from the ideal gas law as ,

$$T = \frac{pV}{m_c R}$$

and its differentiated form is

$$dT = \frac{1}{m_c R}\left(Vdp + pdV - RTdm_c\right)$$

(5)

Assuming R to be constant. Equation (2) can now be rewritten as:

$$dQ_{ch} = \frac{c_v}{R}Vdp + \frac{c_v + R}{R}pdV + \left(u - c_v T\right)dm_c - \sum_i h_i dm_i + dQ_{ht}$$

(6)

The specific heat ratio is defined as $\gamma = \frac{c_p}{c_v}$ and assuming an ideal gas the m ass specific gas constant R can be written as *R=cp-cv*, the yielding that the mass specific heat at constant volume is given by Combustion process in the cylinder

$$c_v = \frac{R}{\gamma - 1} \qquad (7)$$

The mass specific heat is the amount of energy that must be added or removed from the mixture to change its temperature by 1 K at a given temperature and pressure. It relates internal energy with the thermodynamic state variables *p* and *T*, and is therefore an important part of the heat release modeling

Inserting (7) into (6) results in

$$dQ_{ch} = \frac{1}{\gamma - 1}Vdp + \frac{\gamma}{\gamma - 1}pdV + \left(u - \frac{RT}{\gamma - 1}\right)dm_c - \sum_i h_i dm_i + dQ_{ht} \qquad (8)$$

Crevice effect model:

Crevices are small, narrow volumes connected to the combustion chamber. During compression some of the charge flows into the crevices, and remain there until the expansion phase, when most of the charge returns to the combustion chamber and some charge stays in the crevices. However, a small part of the charge in the crevices blows by the top ring and ends up in the crank-case, a phenomenon termed blow-by. Since the flame cannot propagate into the crevices, the charge residing in the crevices is not combusted. The temperature in the crevices is assumed to be close to the cylinder wall

temperature, due to that the crevices are narrow [54]. The ideal gas law thus gives

$$pV_{cr} = m_{cr} RT_w \Rightarrow dm_{cr} = \frac{V_{cr}}{RT_w} dp \qquad (9)$$

where it is assumed that *Tw=wall* temperature and *R=specific* gas constant

Mass balance thus yields

$$dm_c = dm_i = -dm_{cr} \qquad (10)$$

Equation (8) can then be rewritten using (9) and (10) as:

$$dQ_{ch} = \frac{1}{\gamma - 1} V dp + \frac{\gamma}{\gamma - 1} p dV + \left(\frac{RT}{\gamma - 1} - u + h'\right) dm_{cr} + dQ_{ch} \qquad (11)$$

The enthalpy is evaluated at cylinder conditions when the mass crevice flow is out of the cylinder , and at crevice conditions otherwise.

$$\begin{aligned} c_v T + h' - u &= c_v T + RT' + u' - u \\ u' - u &= \int_T^{T'} c_v dT = \frac{R}{\gamma - 1}(T' - T) \end{aligned} \qquad (12)$$

Heat transfer model

Engine Heat Transfer

Typically, 20-35 % of the fuel energy is passed on by heat transfer to the engine coolant, the upper limit is reached for low load conditions [55]. Of the total heat transfer, about half comes from in-cylinder heat transfer and the rest from heat transfer in the exhaust port. Exhaust ports are sometimes isolated, which reduces the heat flow to the coolant, reassuring further oxidation of the combustion products due to the higher exhaust gas temperature. This extra energy can also be used by the turbine. Since we are only trying to model the in-cylinder pressure, the heat transfer in the exhaust port is not accounted for.

In-cylinder heat transfer

The in-cylinder heat transfer occurs by both convection and radiation, where convection constitutes the major part. This applies for most forced convection applications [55]. In SI engines, up to approximately 20 %, but usually much less of the in-cylinder heat transfer is due to radiation [56], but this is often included in the correlation for convective heat transfer. For CI engines, the heat transfer originating from radiation can constitute a more significant part (up to 40 % [57]) and has to be accounted for explicitly [58]. Heat transfer by convection is the transfer of energy within the fluid due to the movement of the fluid from one thermal environment, temperature field, to another (solid surface). The magnitude of the rate of energy transfer by convection $\dot{Q}_{ht}$, which occurs in a direction perpendicular to the fluid surface interface, is obtained by use of an expression referred to as Newton's law of cooling:

$$\dot{Q}_{ht} = h_c A \Delta T = h_c A (T - T_w) \qquad (13)$$

where A is the surface area of the body which is in contact with the fluid, ΔT is the appropriate temperature difference, and h_c is the convection heat transfer coefficient. Note that $\dot{Q}_{ht} = \frac{dQ_{ht}}{dt}$, thus when simulating heat transfer in the crank angle domain,

$$\frac{dQ_{ht}}{d\theta} = \frac{dQ_{ht}}{dt}\frac{dt}{d\theta} = \dot{Q}_{ht}\frac{60}{2\pi N} \qquad (14)$$

should be used, where N [rpm] is the engine speed.

Woschni's heat-transfer correlation

The form proposed by Woschni [1967] states that the characteristic speed *v* depends on two terms. One is due to piston motion and is modeled as the mean piston speed u_p [m/s]. The other term is due to swirl originating from the combustion event, which is a function of the pressure rise due to combustion, i.e. p − p_0 where p_0 is the motored pressure. Woschni used the measured motored pressure. The following expression results for the heat transfer coefficient h_c

$$h_c = \frac{0.013 B^{-0.2} p^{0.8} \left(C_1 u_p + \frac{C_2 (p - p_0) T_r V_i}{p_r V_r}\right)^{0.8}}{T^{0.55}} \qquad (15)$$

Where

p	cylinder pressure for firing cycle	[Pa]
p0	cylinder pressure for motored cycle	[Pa]
T	mean gas temperature	[K]
up	mean piston speed [m/s]	
Vi	instantaneous cylinder volume [m3]	
C1	constant	[-]
C2	constant [m/(sK)]	

(pref ,Vref ,Tref) evaluated at any reference condition ref.

Cylinder volume model

The cylinder volume *V* (□, *xoff*) consists of clearance volume *Vc* and instantaneous displacement volume *Vid* (□, *xoff)*

$$V(\theta, x_{off}) = V_c(x_{off}) + V_{id}(\theta, x_{off})$$

The instantaneous displaced volume *Vid* depends on the crank angle □, cylinder bore B, crank radius a, connecting rod length *l*, pin-off *xoff* and is given by

$$V_{id}(\theta, x_{off}) = \frac{\pi B^2}{4}\left(\sqrt{(l+a)^2 - x_{off}^{\ 2}} - a\cos\theta - \sqrt{l^2 - (x_{off} + a\sin\theta)^2}\right) \quad (16)$$

The instantaneous combustion chamber surface area $A(\square)$ through which the heat transfer occurs is computed as

$$A(\theta) = \frac{\pi B^2}{2} + \pi B\left(\sqrt{(l+a)^2 - x_{off}^{\ 2}} - a\cos\theta - \sqrt{l^2 - (x_{off} + a\sin\theta)^2}\right) \quad (17)$$

Net heat-release simulation

Inserting equations (9) to (17) into (8) yields the expression for the released chemical energy:

$$dQ_{ch} = \frac{1}{\gamma - 1}Vdp + \frac{\gamma}{\gamma - 1}pdV + dQ_{ht} + (c_v T + RT'\left(1 + \frac{1}{\gamma - 1}\right))\frac{V_{cr}}{RT_w}dp$$

$$= \frac{1}{\gamma - 1}Vdp + \frac{\gamma}{\gamma - 1}pdV + dQ_{ht} + (\frac{1}{\gamma - 1}T + T'\left(1 + \frac{1}{\gamma - 1}\right))\frac{V_{cr}}{T_w}dp \quad (18)$$

This ordinary differential equation can easily be solved numerically for the net heat-release trace, if a cylinder pressure trace is provided, together with an initial value for the heat release.

EXPERIMENTAL SET UP

The experimental setup consisting of DI diesel engine is arranged in the engine's laboratory of Department of Marine Engineering, Andhra University. Water saturated with Methyl Tertiary Butyl Ether (MTBE, $C_5H_{12}O$) is injected at the suction end at 3 kgf/cm^2. The injection is controlled electronically and it is timed to inject after full suction valve opening. Assuming diesel consumption is 1kg/hr at full load and with respect to this consumption, the water saturated with MTBE is injected. 5%, 10%, 15%, 20%, 25%, 30%, and 40% of water saturated with MTBE is calculated against the 1kg/hr diesel consumption as reference. The corresponding mass flow rates of the above percentages are 13.88mg/sec,27.77mg/sec,41.66mg/sec,69.44mg/sec and 111.11mg/sec. respectively.

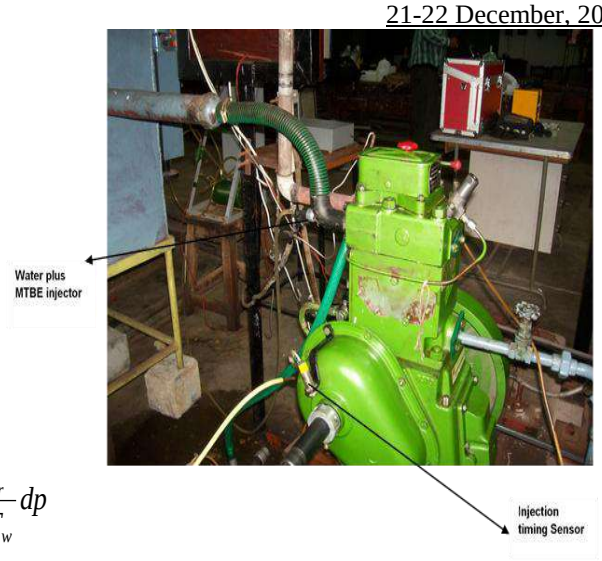


Fig. 2 Secondary Electronic injection equipment outside the Engine.

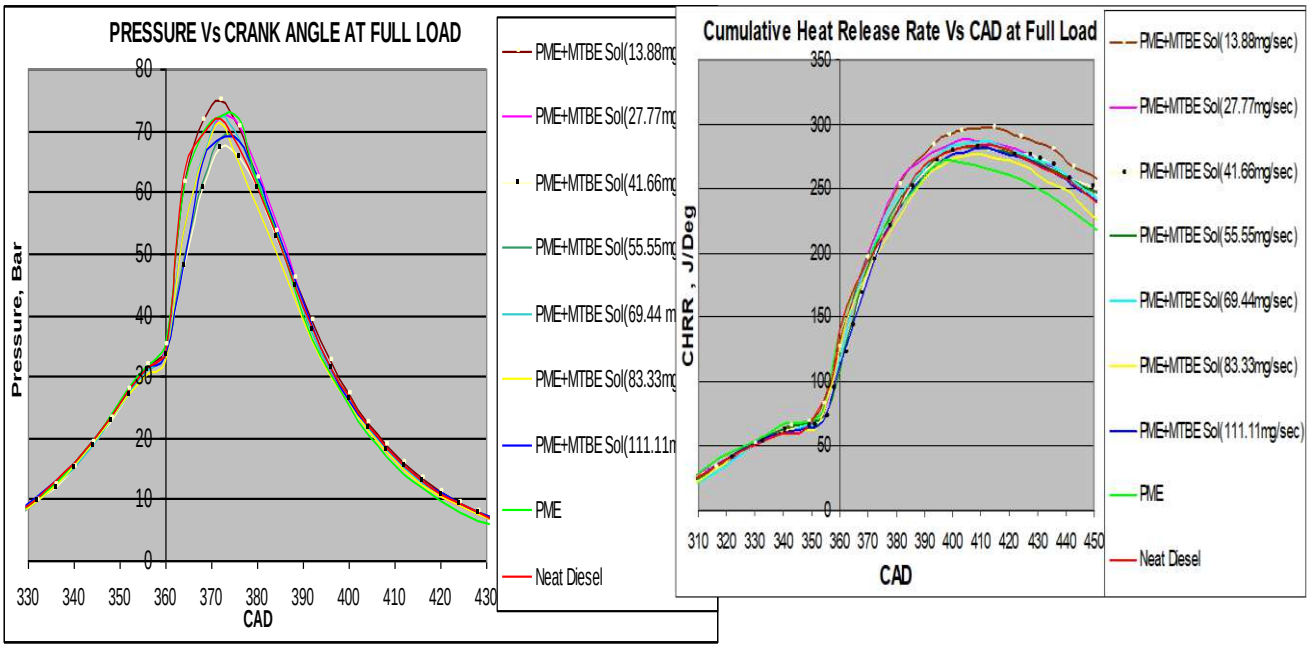


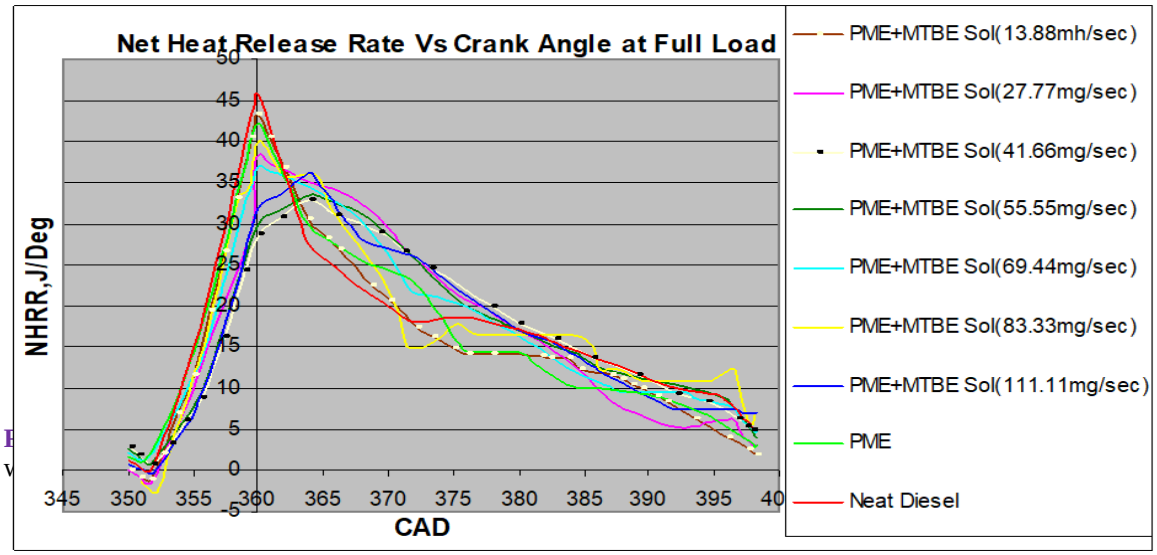
Fig3. Input pressure data signatures obtained with neat Palm methyl ester injection.

Result:

Output : net heat release rate and cumulative heat release rate calculations:

Figure 5: Cumulative heat release trace at Full load in the limited range.

The parameters used in the Gatowski model and their nominal values are summarized in table 1.0.



is successful in predicting the combustion peak pressure variations with the modified engine

Par.	Description	Value	Equation
γ	constant specific heat	1.36	(7)
C_1	ratio [-]	2.28	(14)
C_2	heat transfer parameter [-]	3.24×10^{-3}	(15)
B	heat transfer parameter	80	(15)
S	[$m/(sK)$]	110	(16),
l	cylinder bore diameter	234	(17)
x_{off}	[mm]	1	(16),
N	stroke length [mm]	1500	(17)
T_w	connecting rod length	440	(16),
T	[mm]	600	(17)
V_c	pin-off [mm]	3.5672×10^{-5}	(16),
V_{cr}	engine speed [rpm]		(17)
R	mean wall temperature	3.5672×10^{-7}	(9), (13)
p_0	[K]		(13)
p_{ref}	mean gas temperature [K]	287	(9)
V_{ref}	clearance volume [m^3]	3433.5	(9)
T_{ref}	crevice volume [% V_c]	111.457	(7)
T'	specific gas constant	3.5672×10^{-5}	(15)
	[J/kgK]		(15)
	cylinder pressure for	323	(15)
	motored cycle [kPa]	1200	(15)
	pressure at reference		(12)
	condition [kPa]		
	volume at reference		
	condition [m^3]		
	temperature at reference		
	condition [K]		
	crevice temperature [K]		

Conclusion: The heat transfer models available to study the combustion characteristics of single cylinder diesel engine modified to run with Palm kernel methyl ester biodiesel blends and along with additive Methyl tertiary butyl ether MTBE blended in different proportions as indicated in the combustion graphs and this injection is precisely controlled by electronic fuel injection system developed indigenously as shown in fig2. of and injected as secondary injection in to the inlet manifold and palm kernel biodiesel blends as primary fuel. Water is blended with MTBE and injected in to the engine cylinder by fumigation technique is to provide cooler combustion and reduce the in-cylinder temperature and lower the activation energy to control NO_x emissions. The heat transfer model

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DESIGN AND SIMULATION OF FINS FOR FROZEN SEAL VALVE USING BUOYANCY APPROXIMATION OF EXTENDED SURFACE HEAT TRANSFER

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***Abstract*: Frozen seal valve is a gate valve, used to isolate the heat transfer system or heat exchanger for maintenance purpose in nuclear power plants; The frozen seal valve is a stainless-steel valve and is an external setup where hot liquid secondary sodium comes directly from the nuclear reactor through a strong fixed pipeline to this valve for sodium freezing and heat transfer dissipation. Liquid sodium is used as coolant in primary and secondary systems of nuclear fast breeder reactors and is exothermic to nature; To isolate secondary liquid sodium from steam generator and also to avoid leakage, Frozen seal valves are used. They are called as butterfly valves used for liquid sodium freezing, and horizontal fins are attached to outer surface of valve sheath. Natural convection of air takes place in these cavities which is investigated using CFD analysis for various fin profiles. Experiments have been conducted on a model valve of selected design. The objective is to do modelling of the fins by analytical and simulation method with (COMSOL 5.3) and its optimization to obtain better thermodynamical efficiency.**

Keywords: Natural convection, Open-ended shallow cavity, Frozen seal sodium valve and Computational fluid dynamics.

I. INTRODUCTION (*HEADING 1*)

Fast Breeder Reactor (FBR) programme is the India's second stage nuclear reactor for making more fissile element from fertile element. The FBR contains the three major systems to generate steam from heat generated at the core. The three major systems are primary sodium system, secondary sodium system and steam generator. As liquid sodium is used as coolant in primary and secondary systems of fast reactors due to its large heat transfer coefficient and high boiling point. The large heat transfer coefficient leads to compact layout of components. The high boiling point of sodium leads to low pressure systems with minimum mechanical loads and high thermodynamic efficiency. The main drawback of sodium is its violent exothermic chemical reaction with air. Also, its freezing point is high (98°C), which demands elaborate heating provision in reactor systems to avoid sodium freezing. To overcome the unfavourable chemical property of sodium, its high freezing point is judicially utilized in secondary sodium valves. Sodium valves are used in secondary sodium systems to isolate steam generator units which are faulty. These are frozen seal gate valves. This valve has a disc, perfectly fitting in the valve seat provided in sodium pipes. The disc is attached to a cylindrical stem. The stem is covered by a sheath which itself is attached to the pipeline. There is positive clearance (forming an annular path), between the stem and the sheath. Due to the pressure in the sodium line, sodium rises in this annular path. To avoid sodium leaking though this path, the sodium is forced to freeze in this path. To promote freezing of sodium, heat transfer from the valve sheath has to be enhanced. This is achieved by providing circular fins attached to outer surface of the sheath. These valves are used in the Fast Breeder Reactor (FBR). It is essential to ensure that freezing is achieved solely by natural convection of air. Natural convective cooling of fins is passive and hence is highly reliable without the need to provide blowers, emergency power supply etc. Too large number of fins are uneconomical while too less a number would not lead to sodium freezing. Hence, the number of fins required and the fin spacing are to be determined by an integrated conjugate thermal analysis of the valve assembly. One of the important inputs for this analysis is knowledge of natural convective heat transfer coefficient over fins. As the fins are stacked one over the other, conventional correlations for Nusselt number (Nu) such as, Nu = 0.54 x $Ra^{1/4}$(hot plate facing upwards), Nu = 0.27 x $Ra^{1/4}$(hot plate facing downwards) and Nu = {0.825 + 0.387 x $Ra^{1/6}$/ [1+ $(0.492/Pr)^{9/16}]^{8/27}\}^2$ (vertical hot surface), are not applicable. For the case of stacked fin surfaces, these correlations are invalid, as the surfaces are closely located with significant flow restraints by the fin assembly. The adjacent horizontal fins of sodium valve form open-ended cavities, natural convection of air takes place through these constricted cavities. For these configurations, heat transfer coefficient has to be found by using the Computational Fluid Dynamics (CFD) and Analytical approach.

II. LITERATURE SURVEY

In the present work, detailed survey has been carried out on the various aspects of this field which include various types of fins, fin geometry, fin arrangement, conjugate heat transfer of sodium, thermal analysis of fins and detailed knowledge about the computational fluid dynamics.

- HINOJOSA. P. (2012) STUDIED THE NUMERICAL RESULTS OF TEMPERATURE PROFILES AND FLOW PATTERNS FOR NATURAL CONVECTION IN A TWO-DIMENSIONAL PARTIALLY OPEN TILTED CAVITY.
- POLAT ET.AL STUDIED THE CONJUGATE HEAT TRANSFER IN INCLINED OPEN SHALLOW CAVITIES.
- CHAN AND TIEN (1985) INVESTIGATED LAMINAR STEADY STATE NATURAL CONVECTION IN A SHALLOW OPEN CAVITY AND SQUARE CAVITY WITH HORIZONTAL OPENING.
- VELUSAMY. K. ET.AL DESIGNED AND INVESTIGATED ABOUT THE VARIOUS VALUES OF FIN LENGTH, FIN SPACING AND ROOT TEMPERATURE WITH FUNCTION OF ASPECT RATIO AND RALEIGH NUMBER.

III. SCOPE OF STUDY

The whole investigation is carried out in two stages. In the first stage, detailed two dimensional axis-symmetric CFD analyses of fluid flow and temperature distribution will be carried out using COMSOL 5.3. Fin profile and root temperature will be varied as parameter. From these parametric studies, convective heat transfer coefficient of fins will be found out. And the various fins profiles will be analyzed for effectiveness. In the second stage, the results will be validated by taking experiment measurement of high efficiency fin profile of proposed fin dimension.

IV. METHODOLOGY

In CFD analysis, the circular fin with conical cavity will be analysed for the flow of molten sodium in the annular gap between sheath and stem by the physics of Conjugate heat transfer with buoyancy approximation which provides way to simulate flow and heat transfer simultaneously. So that the result approximation will be reduced and it leads to reduced computational time. The geometry of the fin was created using the pre-processor of COMSOL 5.3. The height of the valve, h is 753 mm, fin length L is 85 mm, inner thickness and outer thickness of fin is 20 mm and 10 mm for case 1 and thickness and height are same i.e., 10 mm and 753 mm for other two cases respectively. The 3D model, 3D axisymmetric model and 2D axisymmetric model of the valve was shown in all cases.

CASE I – CIRCULAR FIN WITH CONICAL CAVITY

- The latent heat from liquid to solid is 26 kJ/kg. The phase change temperature is 371.15 K with transition interval of 10 K.
- The convective heat transfer coefficient was found out as 1.9 w/(m^2K).
- Contour temperature distribution of frozen seal sodium valve and it is clear that the minimum and maximum temperature of valve were 305 K and 429 K respectively with inlet temperature of 429K.

G1 Graph of sheath length and sheath temperature

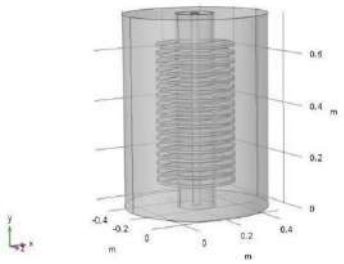
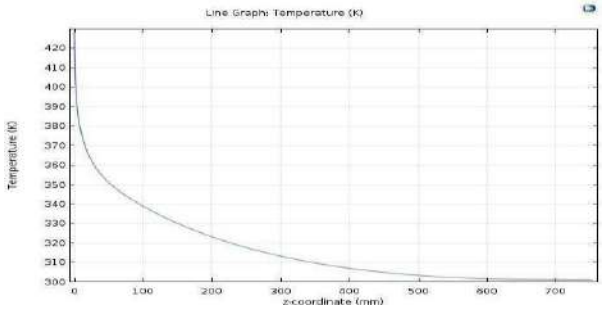


Fig 2. 3D model of conical cavity circular fin

CASE II – CIRCULAR FIN WITH RECTANGULAR CAVITY



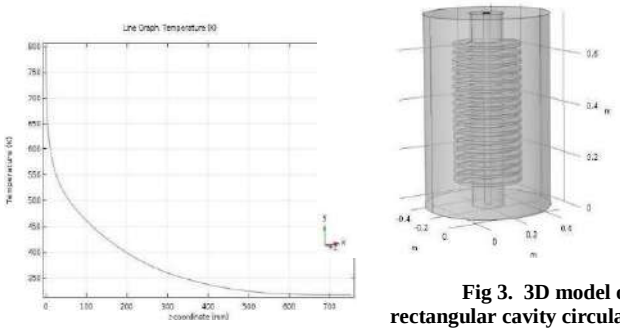
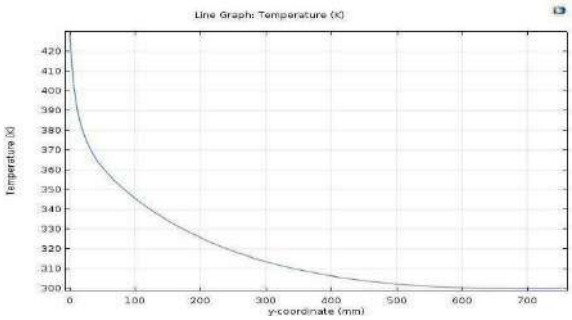


Fig 3. 3D model of rectangular cavity circular fin

G 2. Graph of sheath length and sheath temperature

- The latent heat from liquid to solid is 26 kJ/kg. The phase change temperature is 371.15 K with transition interval of 10 K.
- The convective heat transfer coefficient was found out as 2.4 w/(m^2K).
- Contour temperature distribution of frozen seal sodium valve and it is clear that the minimum and maximum temperature of



valve were 299 K and 429 K respectively with inlet temperature of 429K.

CASE III – SQUARE FIN WITH RECTANGULAR CAVITY

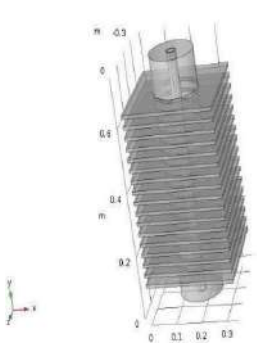


Fig 4. 3D model of rectangular cavity square fin

G 3. Graph of sheath length and sheath temperature

- The convective heat transfer coefficient was found out as 2.35 w/(m^2K).
- Contour temperature distribution of frozen seal sodium valve and it is clear that the minimum and maximum temperature of valve were 299 K and 429 K respectively with inlet temperature of 429K.
- The total computation time taken was 23 min 25 s.

V. EXPERIMENTAL AND SIMULATION RESULTS ANLYSIS OF FROZEN SEAL VALVE

SELECTION OF FIN PROFILE: From table 2, It is clear that case II i.e., circular fin with rectangular cavity has the higher heat transfer coefficient than the other fin profiles. Although the theoretical efficiency of the single stacked conical fin and square fin is high, the valve model of fins one over another form constricted air supply to the fins leads to poor heat transfer coefficient. And when taking the economic factors, the conical and square fin have higher manufacturing restriction which rise the further cost of the valve. So, **the circular fin with rectangular cavity** will be the compatible profile for frozen seal valve. There are totally three cases (case I – circular fin conical cavity, case II circular fin rectangular cavity, case III – square fin rectangular cavity) of fin profiles were taken into consideration. And the temperature distribution of above specified fins was found. From the temperature distribution, the heat transfer coefficient and minimum – maximum temperature of valve was found. From the table 6.1, ***It is clear that circular fin with rectangular cavity and square fin rectangular cavity has almost same heat transfer coefficient, the circular fin with rectangular cavity was taken for the application***. Because it provides advantaged
condition for manufacturing processes. As the valve has a fin arrangement of stacked fins of one over another, the air flow constricted in the cavity.

Case I	**Case II**	**Case III**
Heat transfer coefficient = 1.9 W/m^2K	Heat transfer coefficient = 2.4 W/m^2K	Heat transfer coefficient = 2.35 W/m^2K
Min temp = 305 K Max temp = 429 K	Min temp = 298.85 K Max temp = 429 K	Min temp = 299 K Max temp = 429 K

Table 2. Comparison of Fin Profiles

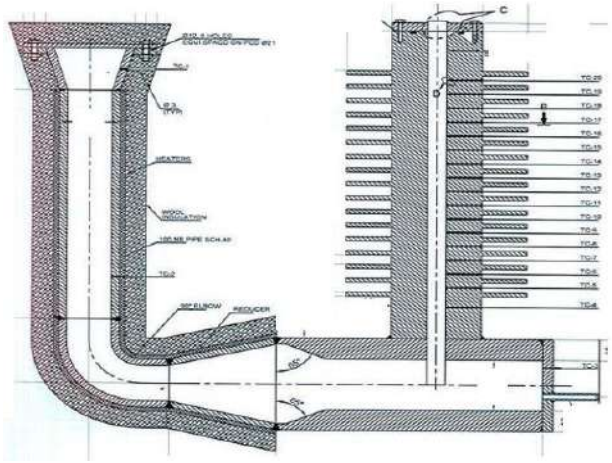
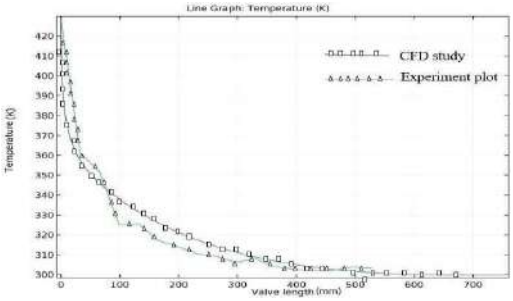


Fig 3. Development of experimental setup

The fin with high transfer coefficient was found out with CFD analysis. The experiment model of frozen seal valve with circular fin with rectangular cavity was manufactured. The temperature was measured for every fin using k-type thermocouple. There were totally 17 fins, so that the 17 thermocouples were connected in the provided holes of sheath.
The compressible oil in the valve was heated by using 2.1 kW N-type heater. The heater was wrapped around the sump of the valve. To avoid the heat loss from valve, the surface except the fin and finned surface were covered with glass woolen insulator. The reading was taken by using the data logger made out of Arduino. The inlet temperature which has given to the oil was 429K. And the experimental plot was validated with CFD analysis as shown in Graph 4.



G 4. Validation of CFD and experimental plot

CONCLUSION

Thermal analysis of frozen seal sodium valve used in secondary sodium lines of FBR has been carried out, to decide the suitable fin profile. Based on this study, the temperature distribution of various fin profiles was determined and circular fin with rectangular cavity which has heat transfer coefficient of 2.4 W/m^2K has taken as opted design experimental analysis. The inlet temperature is given as 429 K and minimum temperature was 301.2 K. Since the temperature is considerably lower than the freezing point of sodium, leakage of sodium would be arrested and hence, this configuration is selected. The minimum and maximum temperature for CFD and experimental was 429 K, 299 K and 429 K, 301.2 K respectively. So, the measured stem temperature distribution is found to compare well with the prediction, validating the results derived from CFD study and thermal analysis methodology.

FUTURE WORK

In future work, the analysis will be carried out by varying the annular path between the sheath and stem parameter. So that the nature of sodium flow and phase change of sodium can be studied. And also, it is ensuring the failure of shear stress of frozen sodium due to flow pressure which when exceeding the shear stress of the frozen sodium at the top of the annular gap.

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STUDIES OF IMPACT ON ENVIRONMENT DUE TO E-WASTE AND REFRIGERATION WASTE DURING SHIP RECYCLING PROCESS IN INDIA- A WAY OUT

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Abstract
In the past few years, it has been observed that the shipbreaking process and its consequences have risenin a huge way. Therefore it is creating a big challenge for the environment as well as to human health. Currently, the ships which are being dismantled, are manufactured or built-in the 80s which is before the time on banning of several harmful materials that are vulnerable for the environment. Hence it has been discovered that if the shipbreaking process has been carried out in a haphazard way by less technical and scientific process and by taking improper health, environment and safety precautions they could be exposed to the broader range of hazards and the ship breaking process would leave disproportionate biggest environment footprints. Thus it is fundamental to carry out the ship dismantling procedure in order to recognize the wastes that have been generated from the ship breaking process. So this paper will show the different effects on the environment because of refrigeration wastes in the ship recycling process in India and systematic way out.

Key Words: CFC, HCFC, HFC, GWP, ODP

1. INTRODUCTION

The ship recycling process is an old procedure and the European Union used to refer to this process as the traditional way of taking the old ship that is teaching. The process is conducted by dismantling the obsolete vessels completely after anchoring down on the shore for recovering the useful components. The shipbreaking process is considered to be the biggest onshore business due to its profitable purpose (Du, Zhang, Zhou, Yuen, and Wong, 2018)[1]. It has been found that India is also in the race in this business. The ship possesses a refrigeration system for carrying loads of goods from one place to another therefore during the time of dismantling the vessel it imparts several refrigeration wastes to the environment.

As per Devault, Beilvert and Winterton (2017) [2], the shipbreaking practices in India are labor-intensive and it is completely based on experienced wise management with no technical organized process. An estimation of around 2 to 8 months is needed for breaking the ship based on the size as well as the type of the vessels. For carrying out this process around 150 to 200 laborers used to employ for the individual ship breaking process in the site. However, it has been also observed that the very less execution of the management guidelines has been followed and also of the occupational as well as environmental measures at the site. Therefore the ship breaking industry in India is far from leading the process by following international standards and environmentally sound practices (Hossain, 2018)[3]. Furthermore, owing to the hazardous wastes that are occurring due to the refrigeration wastes which causing subsequent

environment pollution the ship breaking site at the Alang has been under the close supervision of the national and international authorities. It has been stated by Hossain, Fakhruddin, Chowdhury and Gan (2016) [4] that the activity carried out in the Indian shipbreaking except for Kolkata is the beaching process. The obsolete vessels are sailed onshore or towed by using the tidal range and then it is broken down manually. However, the guidelines for the precautions and safety of the ship breaking process that should be followed have been laid down by the Gujarat Maritime aboard. While dismantling the ship several wastes materials are generated particularly the refrigeration wastes which used to cause an impact on the environment at a high level. It has been found that compounds such as CFC that is chlorofluorocarbon and methane from the refrigeration wastes are affecting the ozone layer of the Earth in a major way.

Fig-1 (Bulletin of information and analysis on ship demolition, Shipbreaking # 56 – August 2019 by Robin Des Bois)

As per Chowdhury, Mili, Akhter and Ahmed(2017) [5], the hazardous wastes also comprise of the polychlorinated biphenyl (PCB), Tributyltin (TBT), polycyclic aromatic hydrocarbons (PAH) and heavy metals. There are also gaseous and solid wastes like CFC, ammonia and the inflammable gases which used to present within the pipeline of the oil tankers and also in the LPG carriers. Therefore, all these wastes make it difficult to handle the process and the locating of these hazardous wastes along with its removal process is tedious because of the complexity of the structure of the vessel.

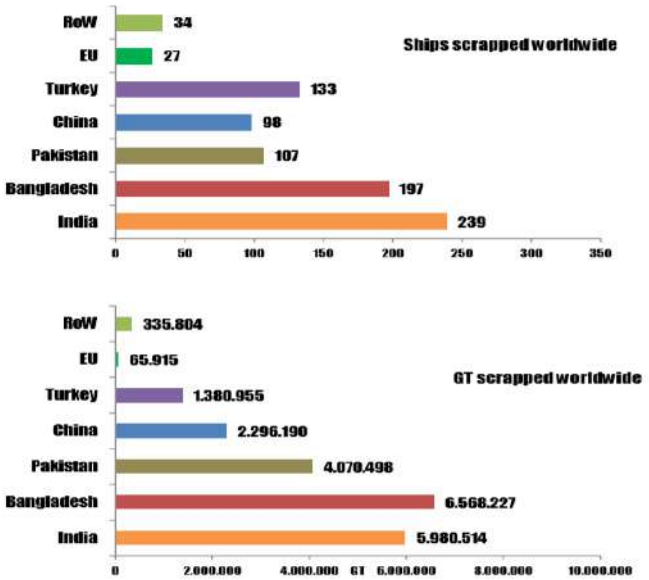

Fig.2, 2017 Ships scrapped worldwide (ref- NGO-Shipbreaking-Platform-Stats-Graphs-2017)

2. STUDY OF SHIP RECYCLINGYARDS

The main aim of this research study is to estimate the cause of the impacts on the environment by the hazardous refrigeration wastes generated by the ship breaking process in India. For conducting this research study both qualitative and quantitative research method has been used. The qualitative data has been collected with the help of gathering resources from different kinds of literature sources that comprise of journals, articles, various reports of ship recycling process, websites and books. The relevant and accurate data has been taken from the selected sources to maintain authenticity in the study. On the other hand, the quantitative data have been obtained with the help of interviewing the personnel involved in shipbreaking process. The valuable information will then be selected and obtained by thoroughly transcribing the records that have been gathered in the interview process to get the relevant information.

With the 2016 inclusion of a global HFC phase-down, the Montreal Protocol now has two regimes to control: the ODP and GWP substances.

Type	Product R- Number	ODP[1]		GWP[2]	
CFC	12	1	High	10900	High
	502	0,33	High	4657	High
HCFC	22	0,055	Medium	1810	Medium
	123	0,060	Medium	77	Low
	401A	0,033	Medium	1182	Medium
	401B	0,036	Medium	1288	Medium
	402A	0,019	Medium	2788	High
	402B	0,030	Medium	2416	Medium
	408A	0,024	Medium	3152	High
	409A	0,046	Medium	1909	Medium

Fig.3

The phase-out schedule for HCFC and the phase-down schedules for HFC can be in Fig.4. Generally average ship's life 30 years and transforms for ship recycling process in shipbreaking yeard. Most of these ships used Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs), Hydrofluorocarbons (HFCs) etc. which have GWP and ODP. During ship recycling process these gases are released into the environment due to uncontrolled way of handling and scrapping of refrigerant units and components. Other than this, the process involved labors with lack of training and environmental awareness in line with supervising and management personnel.

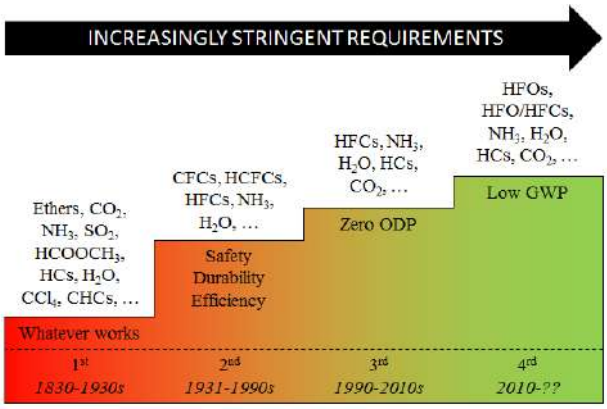

Fig.4

The refrigerants commonly found in refrigeration / AC equipment as well as their approximate charge sizes. Actual equipment charge size varies based on equipment type and model. Generally a household refrigerator typically contains 0.225 kg of refrigerant.

While a building chiller may contain over 450 kg. of refrigerant. Reference Fig.5

Ship has (other than refer ship):

Accommodation AC unit

Provisional refrigeration system

Domestic refrigerators

Example:

Approx. total quantity of refrigerant = 100 kg (minimum side) / ship

Average HFC charge per ship in kg			
Type of vessel	For AC	For Provision	Refrigerator
Passenger	600	120	50
Ro-Ro	200	40	5
Tanker	70	20	5
Bulk	70	20	5

Carrier			
Vital Statistics of Ship Recycling Yards in Alang: About 80% vessel Container Ships, Oil & Chemical Tankers, Bulk Carriers, General cargo Ships. Average CFC, HCFC, HFC per ship= 100 kg			

Fig.5

For carrying out this research study different shipbreaking sites in India have been visited to obtain the desired data and information that would aid in getting the desired outcomes of the research study. The various shipbreaking sites which are present in India have been distributed along the coastline. The prominent among all the shipbreaking sites that are present in India are the Sewri in Mumbai, Kolkata in West Bengal, Maharashtra and Alang which is situated in Gujarat (Zhang, 2016). Apart from this, the Kakinada which is present in Andhra Pradesh, Hutbay and the Rungat port in Andaman has been also considered to be the ship dismantling operation sites. About 80% scrapped ships are Container Ships, Tanker, Chemical Tanker, Bulk Carrier and General Cargo ships Fig.6.

Year		**2020 1st, 2nd and 3rd Quarter Total**	**FY 2019**	**FY 2018**	**FY 2017**	**FY 2016**	**FY 2015**
Total Nos. of Ship Recycled In India		129	214	453	259	249	275
Total Refrigerant Kg (average) CFCs		12900	21400	45300	25900	24900	27500
50% Release Uncontrolled	**Refrigerant Kg**	6450	10700	22650	12950	12450	13750
	GWP (CO2 eq.) Tonne	70305	116630	246885	141155	135705	149875
	ODP	6.54	10.7	22.6	12.95	12.45	13.75
25% Release Uncontrolled	**Refrigerant Kg**	3225	5350	11325	6475	6225	6875
	GWP (CO2 eq.)	35152	58315	123442	70577	67852	74937
	ODP	3.225	5.35	1.23	7.05	6.78	7.49
10% Release Uncontrolled	**Refrigerant Kg**	1290	2140	4530	2590	2490	2750
	GWP (CO2 eq.)	14061	23326	49377	28251	27141	29975
	ODP	1.290	2.140	4.530	2.590	2.490	2.750

Fig.6

Generally average life cycle of a ship may be considered as 25~30 years. Mainly these ships holds CFC, HCFC, HFCs in their refrigerant plants.

Analyzing all the relevant data and information that has been gathered it has been found that the ship recycling process used to create huge pollution in the environment due to uncontrolled emission of refrigerant waste. The refrigeration wastes generate a huge amount of hazardous wastes because of the

improper dismantling procedure. The disposal of this refrigeration wastes is affecting the ozone layer of the Earth and because of that several health issues take place among the individuals due to the exposure of the high ultraviolet rays from the sun (Patel, Singh, Patel, Jain, Amin and Madamwar, 2019)[6]. It has been also found that the improper way of handling of the hazardous refrigeration wastes also leads to soil contamination. The gases which are used in the refrigeration process are flammable in nature. It also includes toxic compounds like the PCBs, TBT, heavy metals like that of cadmium, ammonia, zinc, lead, copper and chromium (Manjunath, Sharma, Tyagi and Kaushik, 2018)[7]. Therefore the toxic smokes get released when the dismantling procedure is carried out and it goes to the air thereby causing air pollution. The CFC and the PCB used to affect the Earth's oxygen layer and cause the greenhouse effect which is the main cause of the rise in temperature. It also causes depletion in the ozone layer thereby further causing serious health disorders to the living organisms such as mutations

3. Result and Discussion

The shipbreaking industry is found to be the most hazardous industry as it causes tones of different types of wastes that are harming the environment in a bad way. Hence the contention is to make the sustainability of the process and the industry. So to carry out this ship recycling industry in an eco-friendly way all the necessary safety guidelines should be followed along with the implementation of the EMP with formulated principles that are provided by the ISO. To reduce the effects of the hazardous substance in the environment the global community must be committed towards sustainable development and also in promoting the eco-friendly process of dismantling the ship in the necessary sites where the operations are carried out. Other than this, locally the policies and regulations should be formulated concerning the ship breaking activities for focusing mainly on the safety of the recycling process. Moreover, the challenges which the ship recycling process is mainly facing nowadays are due to the refrigeration wastes it produces such as CFC, HCFC and other heavy metals. For minimizing the effects of these harmful substances the action plan should be implemented at the global scale to reduce the wastes onboard and also to handle the wastes in a proper way for safeguarding the workers from the occurrence of any kind of casualties. Apart from this, the global, as well as the local safety measures and waste management guidelines, should be followed to reduce the impact of wastes generated at the time of dismantling.

4. CONCLUSION

This research study has been conducted to obtain relevant data and information on the refrigeration wastes that have been produced at the time of the ship recycling activities. It has been recognized that the ship dismantling industry in India is a part of the global ship recycling process. The industry possesses various opportunities and challenges. Furthermore, in India, this ship breaking industry is considered to be the prime economic activity as most of the steel used to obtain through ship dismantling and recycling procedure.

Therefore, maintaining sustainability is needed for this industry. The wastes this industry possesses are high and hence it needed preventive measures to reduce the wastes. The government of India must implement proper guidelines that must be global and local based so that it could be followed to manage and handle the wastes in an effective manner. The government must approach implementing of going green process to handle the bulk wastes which the shipbreaking process used to generate at the site. Proper handling of the refrigeration wastes must be carried out in order to minimize the impact of the air, land and water. It has been found that heavy metals are causing depletion in the marine ecosystem and also causing a high rate of air pollution. Thus it is essential that steps should be taken to reduce the effects of the refrigeration wastes as much as possible in order to prevent the harmful impacts.

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Climate forcing due Aerosol and Air pollution over South Indian Coast

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***Abstract*—An aerosol is a colloid of fine solid particles or liquid droplets, in air or another gas. The excessive range of aerosol in the particular region will affect the health of the living organism and affect the regional climate. So identifying the aerosol in the particular region is very necessary. The emissions of CO_2, NO_X and SO_X from atmospheric pollutant affect cloudiness, and accelerate climate impact 'Radiative Forcing' (RF). Positive RF produces warming and Negative RF produces cooling effect. These also indirectly affect weather through the Cloud Condensation Nuclei (CCN) ability of cloud shows a high impact of gases and particulates. Increase in Sulphur could result in reduced Negative RF.**

Several methods are used for analyzing the range of aerosol like LIDAR, photometer, particulate analyzing method and so on; here we use the particulate analyzer to find out the level of aerosol. In order to find out we kept the particulate counter and analyzer in upper deck of ship and analyzed the aerosol content over the atmosphere of south Indian coast

Keywords— Air pollution, Aerosol, Particulate matter, Emission, coast region, climate forcing

I. INTRODUCTION:

Emission from south Indian coastal region produce major impact in air quality in that emissions share takes place largely near to the shoreline only; in global shipping 70% emissions occurs within 222 NM from the land. Due to ship emissions, air quality problem is significant in coastal areas.

The use of carbonated fuels from the combustion process in coastal region creates anthropogenic carbon emissions. In the transportation sector, emissions from marine transport play a vital role in air pollution and climate forcing.

II. METHODOLOGY

Coastal emission were monitored during on board ship voyage is done for $PM_{2.5}$ and PM_{10} using the air quality analyzer. The amount of SO_x and NO_x emissions is studied using appropriate chemicals. The air quality analysis process undertaken in this study will be implemented later for regular use on board in Sagar Manjusha ships with the help of NIOT-VMC(National Institute of Ocean Technology)

In particulate analyser we have to keep the filter paper,before that the weight of the filter paper is noted and once we set ensure that no water deoplets or dust inside the chamber,when the instrument is started we have to adjust the timer depend user preference,ensure that timer is set and start the instrument after starting the instrument the blower inside the particulate analyzer start sucking the outside air, so the dust particules in the air got deposited in the air quality analyser,after stipulated time the instrument get stopped, ensure the timer get stopped and we have to open the filter paper chamber and take the filter paper carefully with out stiking the dust anywhere else and check the weight of the filter paper, calculate the difference between intial weight and final weight and also see the volume of air get sucked from intial to final and find different, then put the ratio betwen both we get the particluate weight.

III. PM CLASSIFICATION

Particulate matter (PM) is defined as any airborne finely divided solid or liquid material with an aerodynamic diameter smaller than 100µm. Super coarse is dust, dirt, soot, smoke and liquid droplets of size ranges 11-100µm in diameter. Coarse is PM_{10} with aerodynamic diameter of 10µm or less. Fine is $PM_{2.5}$ with AD of 2.5µm or less.

Fig.1: Air quality instrument in upper deck of sagar manjusha

The collected the air quality data of the nearby costal region of Chennai and Pondicherry depends on the factors such as nearby port emission contributors, vehicle's fuel type, engine size, age, condition and power output [3]. With response to the factors the emission range and air quality status of a particular place changes is identified. The use of low quality of fuel and old engines are the major causes of pollution.

The results of these studies showed that $PM_{2.5}$ emissions from shipping are responsible for approximately 60,000 cardiopulmonary and lung cancer deaths annually worldwide, with impacts concentrated in coastal regions on major trade routes. Most of deaths occur near coastlines in Southeast Asia where high populations and high shipping-related $PM_{2.5}$ concentrations coincide [2]

Evaluation of air pollution from ships in ports showed an increasing ecological effectiveness of larger ship operations in ports. Emission forecast scenarios showed a positive effect of MARPOL73/78 Annex-VI. [4]

A. Formula:

$PM_{2.5}$= Vd ／ Va----------1

Vd- volume of dust, Va- volume of air

Vd =(FPfw- FPiw)----------2

FPfw- final weight of filter paper

FPiw- intial volume of filter paper

Va =(Vaas - Vabs)----------3

Vaas- volume of air after stopping, Vabs- volume of air before starting

PM_{10} = Vd ／ (T*FRavg)-------- 4

Vd- Volume of dust, T- time,

FRavg- average flow rate reading

Vd =(FPfw- FPiw)---------- 5

T-(ft-fi)---------- 6

ft -final timing, fi- intial timing.

TABLE.1: Description of equipment for Air Quality Monitoring

Parameter	**PM_{10}**	**$PM_{2.5}$**	**PM_{10} &$PM_{2.5}$**
Equipment	Respirable Dust Sampler (Envirotech, APM 460 NL)	Fine Particulate Sampler (Envirotech, APM 550)	Dust Monitor Model 1.108
Sampling Period	24 hr	24 hr	
Measuring Principle	Filtration of aerodynamic sizes with a size cut by impaction	Filtration of aerodynamic sizes with a size cut by impaction	works based on the principle of 1ight scattering with ±2% accuracy
Flow rate	0.9 -1.15 m^3/min	0.9 -1.15 m^3/min	
Analysis method	Gravimetric	Gravimetric	1ight scattering
Minimum detection limit	1µg/m^3	1 µg/m^3	0.1 µg/m3

Figure 2: sampling location near Chennai coast

The instruments are placed above the ship near to the exhaust manifold to collect ship emission and further particle counter is placed in the deck of the ship to count particles.

TABLE.2: Locationwise coordinates with weather information

station	**GPS**		**WD**	**WS (m/s)**	**Cloud Cover**
ID.	**Lat**	**Long**			
	(Deg)	**(Deg)**			
CH-4	13.137 053N	80.32505E	E	9.9	Scattered Clouds(Clouds passing)
CH-7	13.145 878N	80.361064E	E	7.6	Sunny (With scattered clouds)
CH-6	13.163 311N	80.367631E	E	9.28	Scattered Clouds (Clouds passing)
CH-1	13.191 669N	80.347578E	E	5.98	Scattered Clouds (Clouds passing)
T2D2	13.039N	80.75345E	E	5.701	Cloudy (No Sun)
T2D3	13.038 3N	81.0102E	E	8.12	Cloudy (No Sun)
T3D3	12.576 2N	80.9805E	E	4.21	Overcast (Uniform Clouds)
T5D3	11.563N	81.0001E	E	5.78	Cloudy (No Sun) (Scattered dark grey clouds with clouds passing)
T5D2	11.5672N	80.3687E	E	2.01	Overcast (Dark grey clouds)
T5D1	11.5932N	79.9338E	E	4.03	Sunny Pale Blue
T3D2	12.1414N	80.1457E	E	3.7	(White haze, Sunny)

T3D1	12.427 4N	80.2484E	E	2.94	Cloudy
T2D1	13.0394N	80.3652E	E	2.66	Cloudy

CH-4, CH-1, CH-7, CH-6 are near Chennai coast, T2D2, T2D3, T3D3, T5D3, T5D2, T5D1, T3D2, T3D1, T2D1 Are the station between Pondicherry and Chennai coastal stretch

Fig 3: sampling location between Chennai and Pondicherry coast

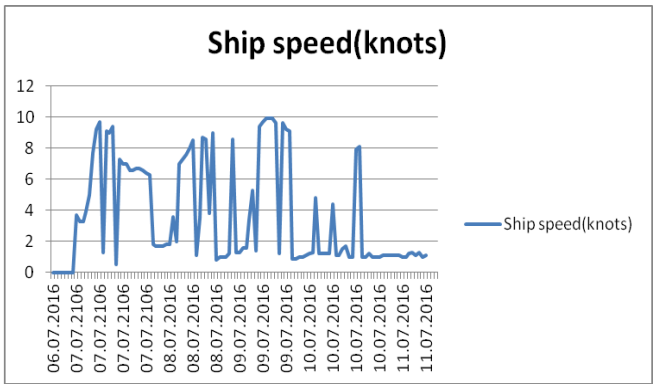


Fig 4: Graphical representation of ship speed during sampling period

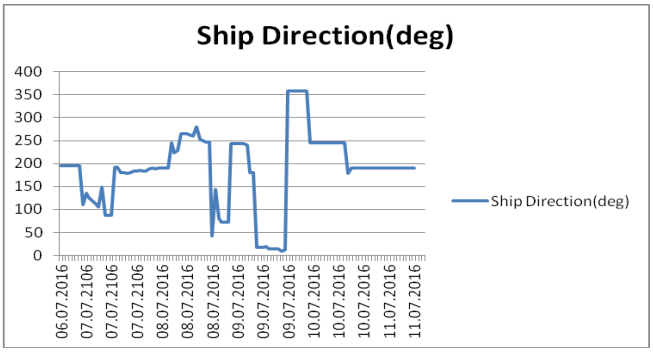


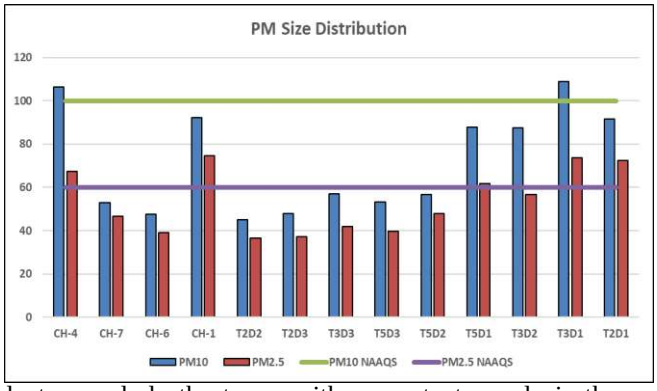
Fig 6: Graphical representation of Ship direction during sampling period

IV. RESULT AND DISCUSION

Ship exhaust has been shown to increase local marine cloud albedo by adding to the available nuclei on which cloud drops form 23±25 [1].

Due to the dispersion of particle with respect to wind direction, wind speed and ship speed was not able to observe the concentration of the particulate properly. therefore, in order to avoid the issue direct connection of exhaust manifold with analyzer was trailed.

But due to the change temperature and humidity particles stick in the external boundary layer. lead to smog formation in the pipe line.in this stage we need a air sea interaction



study to conclude the terms with property to analysis the optical depth of the particles, so further optical studied are required in detail for analysis

During maneuvering particle size are found to be more and nearby coastal region PM_{10} is more and inside coast $PM_{2.5}$ is more due to sea salt deposition.

V. CONCLUSION

In this research we find out the particulate matter over the coast region was found to high, this may because the sea salt deposition over the coast region are very high and this may also depends on the monsoon pattern of the particular region that leads to Air -sea interaction take place in the south Indian coast are found to be more , During the summer season the more haze formation is one of the reason for the formation of sea salt aerosol over the south coast and during winter & spring due the condensation process of the region in interaction with aerosol over the particular area the cloud condensation nuclei over the region is found to be more , this will affect the weather pattern of the particular region.

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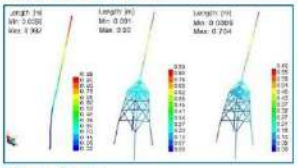

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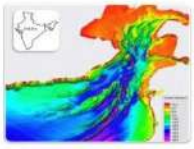

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