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Understanding VFDs

Inside This Issue

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EDITORIAL

The saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom.

- Isaac Asimov

Our knowledge-window of the global happenings is reliant on the media where the data crunching on the pandemic continues. The science communication whets our curiosity about the virus and the communication technology has made the media-reach wider and prompter (include the entertainment in our abodes).

It makes us ponder:

Are we, as a modern human civilisation, using science wisely to build a better society?

Has our society misplaced its values (if not lost), while it is lapping up the pleasures that technology is tempting us with?

Our economic inadequacies, the overburdened public healthcare, the meandering migrants and nearly moonstruck mariners (waiting to sign-off/sign-on) are the paradigms of the science-society mismatches. And again, we seek science to gather knowledge and relieve us with a palliative remedy (at least) from the virulent virus. While science still gathers knowledge, we wait. But are we wiser?

In this issue...

In our February issue, we had carried a study highlighting the merits of VFDs based on a shipboard sea water system. VFD- electronics applications are extending into propulsion systems, cryogenic cargo systems etc. A better understanding of the working of these systems will help in trouble shooting.

Dr. Thangalakshmi unravels the principles of VFD systems with a slow drive through the fundamentals. This educative article should interest any marine engineer and the aspiring ones as well.

Though the year in progress has provided some relief to the atmosphere from emissions, as engines and machines whir back to life, the planet will cough again. The quantity matters.

A prudent model is essential to estimate the maritime emissions and it would not be based on fuel consumption data alone. Dr. Acharya, having been involved in emission-studies, gives an insight into other factors which may affect the emission inventories such as vessel activity, trade route densities etc.

Under Shipping Matters, Neelam Goswami summarises an interesting panel discussion on post-pandemic shipping scenario.

And VRV clarifies the usual misconceptions about Variable Injection Timing under Competency Corner.

We have also added a doubt-clearing tailpiece by Jagbandhu on the DP Cell transmitter write-up we carried in the May issue.

This brings joy as two facts have become apparent:

1. Engineers are reading the MER
2. MER makes the readers to think

May the tribe increase.

The story of ME failure due to 'water ingress through vent head on deck' featured under 'Spanner in the Works' column, could be in the scrap books of many marine engineers. This problem can be sighted in few reports of Classification Societies and is another one of fit-for-all-times problems.

An appeal: The September issue is being planned on the theme of **'Decarbonising Shipping'.** We appeal for contributions based on original studies or reviews with valence points etc., to make the issue meaningful. I have added few more thoughts on contributions to MER under the 'In the Wake' column.

And this year, the International Yoga Day was IYD (In Your Domicile). Making the masks as chain guards, many would have twisted and untwisted their limbs but their breaths would have been deep sighs...

The decades old Uriah Heep hit-song went like this...

'There I was on a July morning... looking for love...
With the strength of a new day dawning...
And the beautiful sun...'

Our deep sighs are because we are all in July looking for love, strength and lifting of lockdowns.

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Maritime Emissions Inventory Management

- Dr. Jai Acharya

ABSTRACT

Emissions from international shipping can be estimated from activity data and also from international fuel statistics data. However, it is observed that the activity-based different ship sizes and types give a better prediction of global fuel consumption and emission factors from international shipping than fuel statistics. This is due to the apparent under-reporting of marine bunker sales.

Considering the different activity-based estimates reported, the lower estimates of fuel consumed by the oceangoing world fleet in 2000 is around 200 Mt, while estimates as great as 290 Mt of marine oils would include all internationally registered ships including fishing vessels, the military fleet and auxiliary engines. This does not account for growth in emissions that may be reflected in estimates for more recent years (Veronica Eyering et al., (2009)). The latter is about 110 Mt higher than the reported total (i.e. sum of IEA categories of Internal Navigation and International marine bunkers) of IEA marine sales (IEA, 2003).

Despite the ongoing scientific debate regarding whether bunker fuel sale statistics are representative while estimating fuel-based emissions and whether input data on engine operational profiles for different ship types and size categories are representative (Corbett and Kohler, 2003, 2004; Endresen et al., 2003, 2004, 2007; Eyring et al., 2005a), these estimates demonstrate some convergence in terms of uncertainty bounds. More importantly, there is agreement among researchers that better input data on ship activity and improved means of allocating activity geospatially will reduce current differences among inventories.

The current methodologies in the Emission Factors Inventory provide a good framework of estimates for standard practice for estimating and reporting the emissions from ships' activities. The main difficulty and uncertainty lies in several factors such as variations in fuel specifications between domestic and international use. Consequently, good methodologies are particularly needed in order to collect relevant and accurate data on domestic fuel used for marine transportation. Uncertainty in the data collection for the emissions of SOx, NOx and PM2.5 are a particular cause of concern and this essay would give an overview of current approaches to estimating emissions.

Southeast Asia is one of the most densely trafficked shipping areas in the world, with some of the major international sea routes for large cargo ships. Domestic and regional traffic has also increased, following the economic growth of the countries in the ASEAN (Association of Southeast Asian Nations). There is a need for better understanding of both emissions and impacts resulting from shipping activity in the ASEAN region. Geographically gridded inventories of emissions (in air) from shipping are required as fundamental inputs to evaluate impacts on the environment, human health and climate and to effectively assess what options are available to mitigate the impacts.

EMISSION INVENTORY

An emissions inventory is an accounting of all significant sources of air emissions within a defined geographical area based on emissions estimates. For example, air emissions inventories exist for Australia, Hong Kong, Canada, and many other regions. An emissions inventory is one important tool in identifying air quality issues, goals and management strategies for an area of interest. Regular updates to these emissions inventories are required to provide an indication of progress towards meeting emission targets.

THE GROWING IMPORTANCE OF SHIPS' EMISSION INVENTORIES

Burning of fossil fuels is often the most important emission source. Emissions from Ships are also increasingly important since the shipping/maritime activities are growing rapidly in Asia. Given the current, rapid rate of economic development in East Asia/South East Asia and the degradation of air quality (as a likely result), it becomes necessary to make use of all the scientific tools available for the management of the atmospheric environment. One of these tools is the air pollutant emission inventory.

What quantities of air pollutants are emitted and where do they come from?

The best way to answer these questions is to prepare an air pollutant emission inventory. Emission inventories are now regarded as indispensable tools for a wide range of environmental measures such as management of chemicals as well as the prevention of air pollution.

GEOGRAPHIC DISTRIBUTION OF SHIP TRAFFIC AND EMISSIONS

Global inventory estimates for fuel use or emissions derived from activity-based bottom-up estimates or from fuel sale statistics are distributed according to a calculated ship traffic intensity. The intensity is identified on a proxy per grid cell, referring to the relative ship reporting frequency or referring to a relative ship reporting frequency weighted by the ship size.

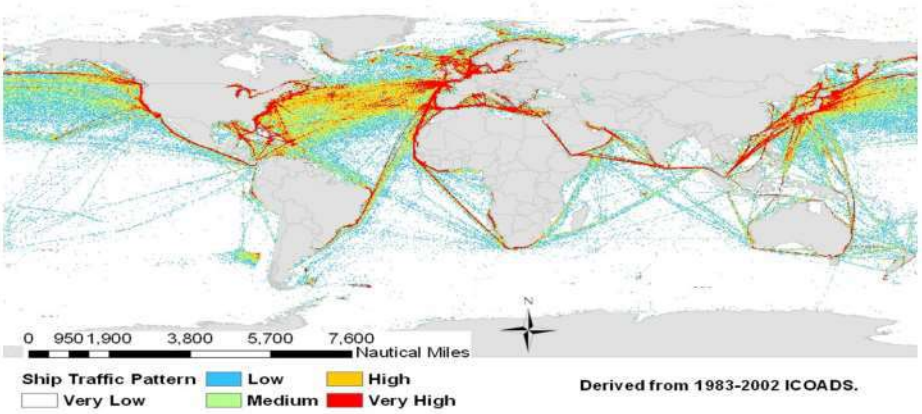


Figure 1A Ship Traffic Patterns based on ICOADS data

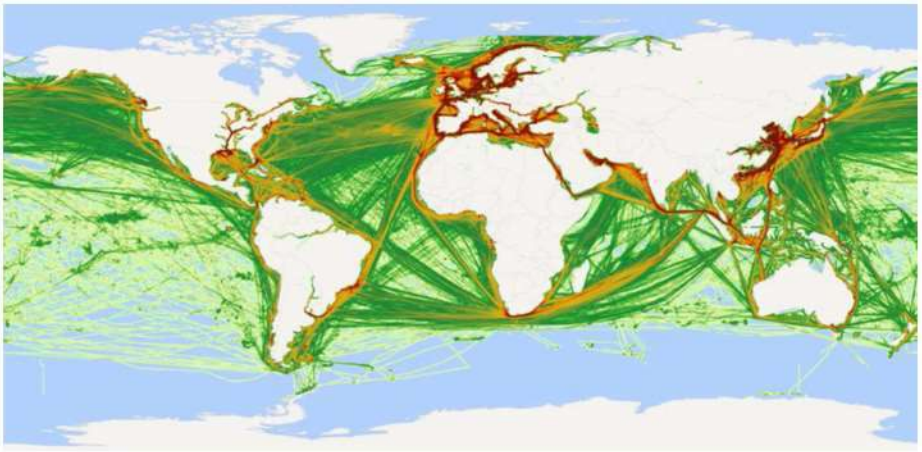


Figure 1B Global Traffic density (April, 2015) [Wu et al., 2017]

Emission inventories are now regarded as indispensable tools for a wide range of environmental measures such as management of chemicals as well as the prevention of air pollution.

The accuracy of the resulting totals is limited by uncertainty in global estimates as discussed above and the representative bias of spatial proxies limits the accuracy of emissions assignment (spatial precision).

SPATIAL PROXIES OF GLOBAL SHIP TRAFFIC

Corbett et al. (1999) produced one of the first global spatial representations of ship emissions using a shipping traffic intensity proxy derived from the Comprehensive Ocean-Atmosphere Data Set (COADS), a data set of voluntarily reported ocean and atmospheric observations with ship locations which is freely available. Endresen et al. (2003) improved the global spatial representation of ship emissions by using ship size (gross tonnage) weighted reporting frequencies from the Automated Mutual Assistance Vessel Rescue system (AMVER) data set. AMVER, sponsored by the United States Coast Guard (USCG), holds detailed voyage information based on daily reports for different ship types. Participation in AMVER was, until very recently, limited to merchant ships over 1000 GT on a voyage for 24 or more hours and the data are strictly confidential. The participation in AMVER is 12 550 ships but only around 7100 ships have actually reported. Endresen et al., (2003) observed that COADS and AMVER lead to very different regional distributions. Wang et al. (2007)

addressed the potential statistical and geographical sampling bias of the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) and AMVER data sets, the two most appropriate global ship traffic intensity proxies and used ICOADS to demonstrate a method to improve global-proxy representativeness by trimming over-reporting vessels that mitigates the sampling bias, augments the sample data set and accounts for ship heterogeneity. Global ship traffic patterns are illustrated in Figure 1a and 1b. From a casual comparison, it can be seen that the intensity and patterns are well defined.

A TYPICAL BREAKDOWN OF EMISSION INVENTORY IN SOUTH EAST ASIA (ASEAN REGION)

Ship emissions in the ASEAN region are calculated by multiplying the AIS-based fuel consumption by emission factors. The AIS based tracking also allow for calculating sailed distance for individual ships and aggregated.

Table 1 presents an overview of emissions by ship types for the ASEAN region. Key findings from the AIS - based emission modelling are:

- CO_2 emissions are around 112 million tonnes, representing about 14% of the global ship emissions.
- Emissions of NO_X and SO_X are 2320 and 1730 Kton, respectively.
- Emissions of PM_{10} and $PM_{2.5}$ are 214 and 194 Kton, respectively.

Figure 2 shows the geographical distribution of modelled ship fuel consumption for the entire ASEAN region. The fuel consumption and associated emissions to air varies within the region, with hot-spots along the main international sea lanes, largest ports and busiest straits and channels (i.e. red colour). [Ref: DNV GL Report No.: 2018-0260, Rev. 1]

Similarly, a typical data on bunker fuel oil analysis is obtained for the vessels operating in this region and type of Marine Diesel Engines (two stroke/four stroke) and the modelling creation on correlation between each. An Emission Inventory can be utilised for the various purposes.

Vessel Type	CO_2 KTons	NO_X KTons	SO_X KTons	PM_{10} KTons	$PM_{2.5}$ KTons
Oil tankers	19 490	340	308	37.0	33.4
Chemical/Prod. Tankers	6510	120	105	12.6	11.4
Gas carriers	9360	200	151	18.1	16.4
Bulk Carriers	4420	790	545	65.4	59.1
General cargo vessels	33 750	80	71	8.6	7.8
Container vessels	29030	630	469	56.4	50.9
Ro-Ro vessels	2150	50	34	4.1	3.7
Reefers	510	10	8	1.0	0.9
Passenger vessels	2800	50	36	4.4	4.0
Offshore vessels	2160	30	1	4.1	3.7
Other vessels incl. Fishing	1750	20	1	2.9	2.7
Total	**111930**	**2320**	**1729**	**214.6**	**194.0**

Table 1 ASEAN SHIP EMISSIONS FOR 2017, [Ref: DNV GL Report No.: 2018-0260, Rev. 1]

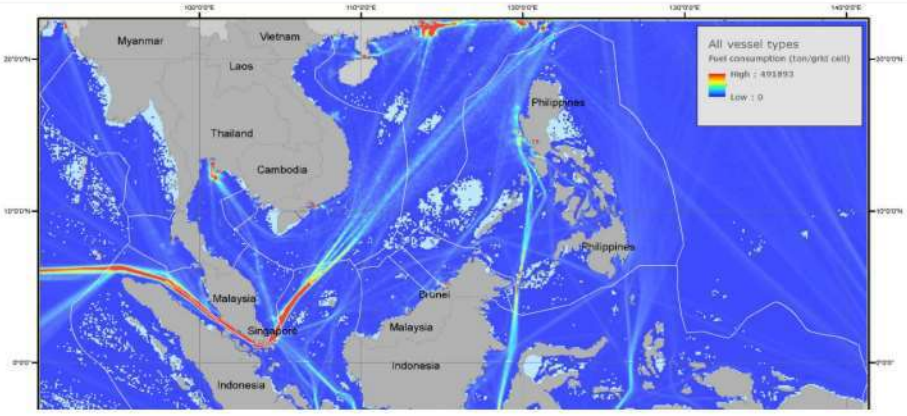


Figure 2 Ships Fuel Consumption in ASEAN

SHIP PM2.5 EMISSIONS AND MORTALITY IN ASIA

QUANTITATIVE UNDERSTANDING OF ACTUAL EMISSIONS [Refer Figure 3]

The quantitative emissions estimates provided by an inventory promote a better understanding of the actual emissions and help to raise the awareness of both policymakers and the general public. Through this process, the major emission sources can be identified, priorities for emission reduction defined and any data gaps requiring further work are revealed.

USE OF MODELLING ACTIVITIES

Emission data allocated geographically and temporarily can be used for atmospheric transport and deposition models. The resulting air concentration and deposition estimates obtained by modelling, after verification with monitoring data on the ground and/or data from satellite observation will be valuable information for air quality management decision making. Further, useful information can be provided by estimates of the likely adverse impacts (to humans, animals, crops and natural ecosystems), which may be assessed from the modelled deposition and concentration of pollutants.

USE OF FUTURE PROJECTIONS AND SETTING TARGETS

A current emission inventory can be used as the basis for estimating future emissions according to projected likely changes in socio-economic indices (e.g. population growth, economic growth, changes in energy use per unit activity), lower emission factors (e.g. by introduction of better control measures), fuel switching and so forth. Estimated future emissions provide important information for setting emission targets.

USE FOR THE CONSIDERATION OF POSSIBLE REDUCTION MEASURES

An emission inventory enables the likely effects of introducing various

prevention and control measures within different source sectors to be assessed and compared, both now and in the future. Combined knowledge of cost of the different options, also enables identification of the most cost-effective emission reduction measures.

USE FOR PLANNING OF POLICY AND MEASURES AND THEIR FOLLOW-UP

Emission inventory data can be regarded as an index to the various indices used for gauging changes in economic activity. The trend of such an index allows us to judge whether we should introduce or reinforce regulations, economic measures or technical measures to control air pollutants.

REGIONAL CO-OPERATION IN PREPARING EMISSION INVENTORIES

Analyses based on emission inventories and atmospheric transport modelling is crucial when dealing with long-range transport of air pollutants. Such analyses would be made easier and more fruitful if the methodologies used were harmonised across all countries in a region. Cooperation in preparing inventories also could promote capacity building in the measurement of emissions, developing emission factors and on the use of inventories and models. The resulting increased capacity will contribute to the development of pollution control strategies in each country leading to a reduction in trans - boundary air pollution.

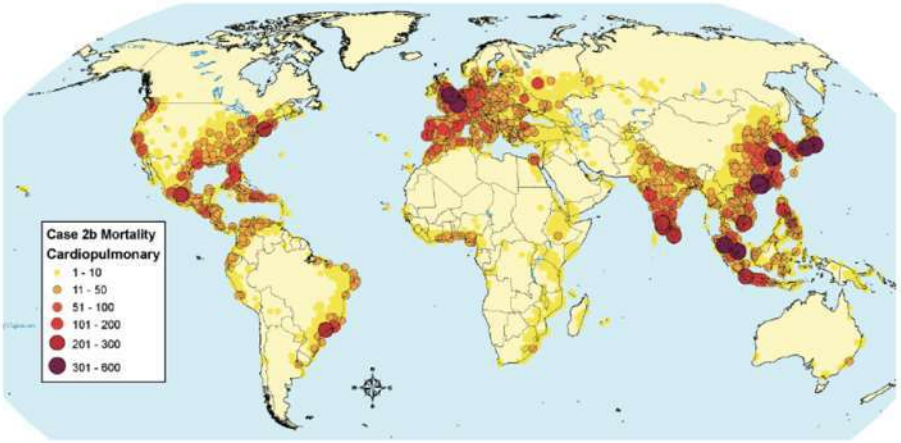
METHOD FOR DEVELOPING INVENTORIES

In general, anthropogenic emissions of air pollutants are estimated by the following basic formula for each source, when it is difficult to measure it directly. (Refer to Figure 4).

Emission = Emission Factor X Activity Data.

Examples:

- SOx emission per the amount of fuel burnt, calculated based on the sulphur content of fuel, the sulphur retained in the ash and the reduction achieved by emission control technology (fuel combustion)
- NOx emission per distance (exhaust gas emissions from ships)
- The amount of fuel burnt (fuel combustion)
- The distance of vessel travelled (exhaust gas emissions from a ship)
- The rates of the production of the commodity (industrial process without combustion)



[Source: Corbett et al (2007) Mortality from ship emissions: A Global Assessment]
Figure 3 Global mortality from ship emissions

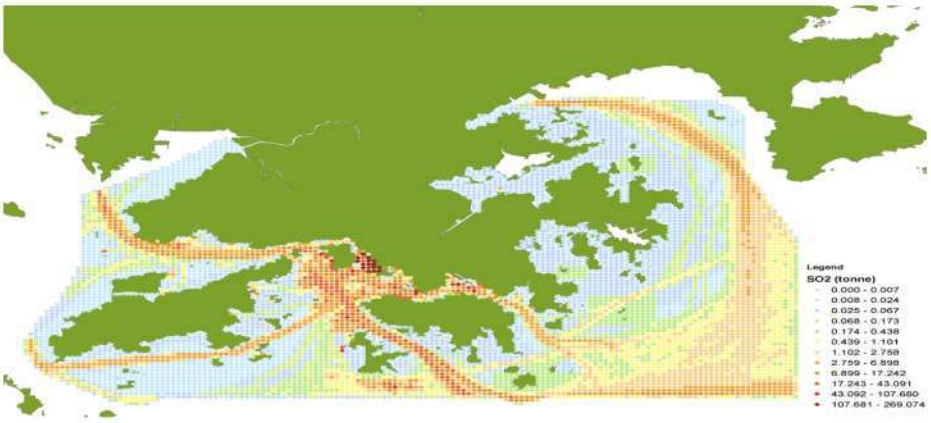


Figure 4 Global Profile: Vessels Emission Inventory
[Source: Ng, et.al (2012) Study on Marine Vessels Emission Inventory: Final Report]

An emission inventory enables the likely effects of introducing various prevention and control measures within different source sectors to be assessed and compared, both now and in the future.

EMISSION FACTORS

Emission factors are the average rate of emission of a pollutant per unit of activity data for a given sector. When there is no emission factor reflecting the actual local situation, default values in manuals are used. However, if the default factor is considered to be inappropriate, it is preferable to obtain an emission factor that reflects the real situation by direct measurement.

The rates of reduction and propagation of technical measures have to be reflected in the factor or the formula, because introduction of countermeasures reduces the emission.

Unlike diesel engines in trucks and land-based equipment, very few ocean-going vessel engines have been tested for the purposes of developing emissions factors. A recent ICF report for the US Environmental Protection Agency (EPA) described emissions factors for OGV (Ocean Going Vessels) as "the weakest link in deep sea vessel

emission inventories".

This is because "emission factors continue to be derived from limited data. Emission testing of OGVs is an expensive and difficult undertaking; and thus, emissions data are relatively rare. In most cases, the power generated is only estimated, leading to inaccuracies in the overall emission factors"

ACTIVITY DATA

Activity data give a measure of the scale of activity causing the emissions. The necessary data basically can be collected from various reliable sources/statistics and surveys. Inventory Manuals of various international agencies, Classification Societies (ABS, Class NK, DNV GL, Lloyds' etc.), marine bunker fuel oil test laboratories and Government bodies would be the main sources of activity data. Currently Available Emission Inventories Database in Asia and the World are through below mentioned agencies.

1. **SPATIAL DISTRIBUTION OF SHIP SO2 EMISSIONS IN HONG KONG, 2007**
2. **EMISSION DATABASE FOR GLOBAL ATMOSPHERIC RESEARCH (EDGAR)**

   This database is developed by the Netherlands National Institute for Public Health and the Environment (RIVM*) to estimate emission of air pollutants and greenhouse gases.

   * Rijks instituut voor Volksgezondheid en Milieu (RIVM)

   EDGAR is a joint project of the European Commission DG JRC and the Netherlands Environmental Assessment Agency (PBL). The link address is: http : / / edgar . jrc . ec . europa.eu /

3. **RAINS-GAINS***

   This database is developed by International Institute for Applied System Analysis (IIASA) to estimate emission of air pollutants including greenhouse gases.

   * The Regional Air Pollution Information and Simulation' (RAINS) Model
   * Greenhouse Gas-Air Pollution Interaction and synergies (GAINS) Model

4. **GEIA (Global Emissions InitiAtive) as part of International Geosphere** - Biosphere Programme (IGBP), GEIA has been developing inventories of global gas and aerosol emissions.
5. **LTP (Projects on Long Range Trans boundary Air Pollutants)** is a joint research program among China, Japan, and Korea. Its purpose is the monitoring/modelling of Air Pollutants to improve of trans-boundary air pollutants in Northeast Asia.
6. **ACESS** is developed by Argonne National Laboratory to support the Aerosol Characterisation Experiments and Transport and Chemical evolution over the Pacific Experiments.
7. **REAS** is developed by Frontier Research Centre for Global Change and National Institute for Environmental Studies to understand the role of trace constituents in the atmosphere.
8. **EA-Grid** is developed by the Ministry of the Environment in Japan to understand trans - boundary air pollutants in Northeast Asia.

Although some countries in East Asia/South East Asia have prepared inventories, the detailed information they contain is difficult to share in the region because:

- They are prepared only for a domestic use,
- The tasks are divided among different departments such as domestic affairs, international cooperation, and human health-related departments and
- There is no reporting system for such inventories.

Substances targeted by inventories are SO_x, NO_x, VOC, PM_{10} / $PM_{2.5}$, CO, CO_2, CH_4 and N_2O.

CONCLUSION

The current methodologies in the Emission Factors Inventory provide an estimated and good framework for standard practice for estimating and reporting the emissions from ships activities. Uncertainty in the data collection for the emissions of SOx, NOx and PM2.5 are in particular cause of concern. However, with new technology evolutions and IMO regulatory compliances, the methodology of the ship emission assessment modelling and inventory management will have minimum uncertainty in data collection and uniformity in estimation of emission factors.

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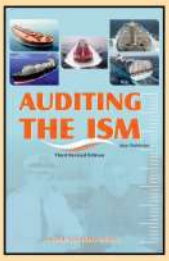

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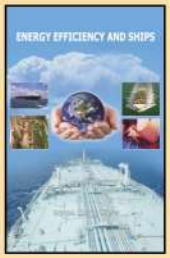

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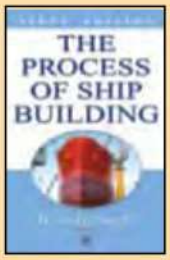

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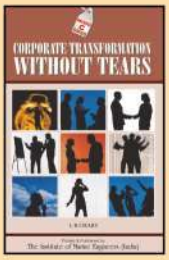

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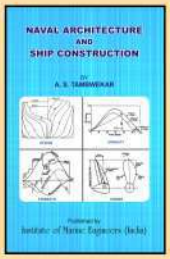

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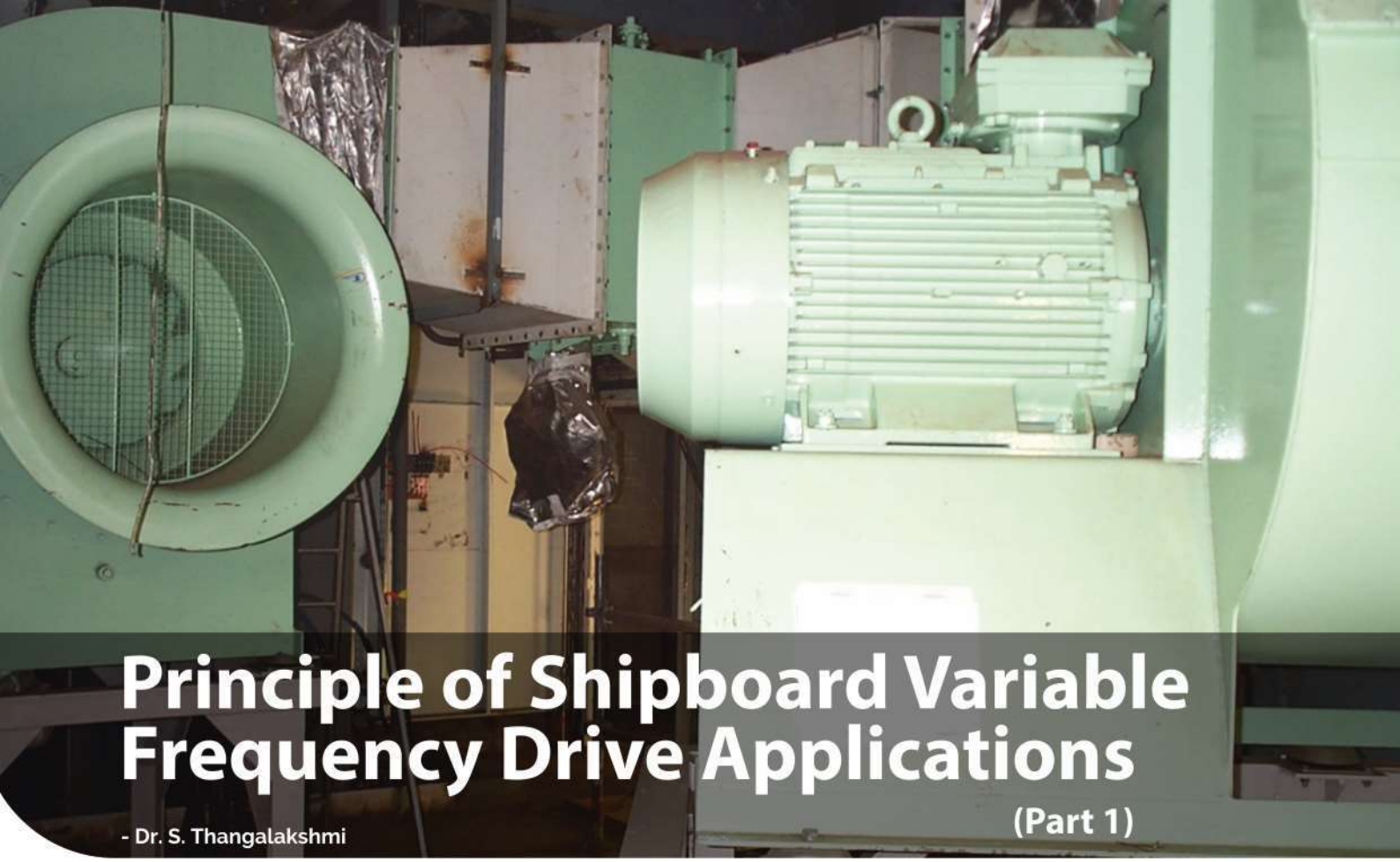

Principle of Shipboard Variable Frequency Drive Applications

(Part 1)

- Dr. S. Thangalakshmi

ABSTRACT : The shipping industry is the major support system for the global economy. While the nation focusses on modernisation of the industry, efforts on energy saving and lowering carbon emissions trail. The Variable Frequency Drive (VFD) used for propulsion would be a better choice to save energy. Propulsion system apart, many of the auxiliary machines can employ the VFD model. This paper highlights on the workings and uses of VFD and the challenges prevailing during operation. The harm of harmonics in the VFD system is explained. The greater objective of energy saving with VFD is emphasised with simple analyses.

KEYWORDS: shipboard electrical systems, energy saving, environment.

INTRODUCTION : In a conventional propulsion system of a ship, the main engine is coupled to the propeller using a shaft. This entire system along with additional vital equipment (e.g., bearings) is referred to as the ship's propulsion system. The category of propulsion scheme employed in a ship is decided by a number of factors viz. speed, power, range and capacity of ship etc. [1-2]. The evolution of propulsion started from basic direct drive propulsion system, which comprises of a propeller coupled to the engine through a shaft. Manoeuvring of the vessel in this method is usually performed with conventional rudders, which are powered independently.

In Controllable Pitch Propeller (CPP) systems, manoeuvring is accomplished by regulating the speed of the core engine and varying the direction of propeller rotation. Higher speed operation is usually not possible by this method [3].

Geared drive propulsion system is an improved method, which can be allied with nearly all varieties of prime movers. Gearing arrangement decreases the number of revolutions from the engine output to meet out highest possible efficiency of propeller [4]. Also, it enables to attach single shaft to dual prime movers or it helps to share power between two shafts or to join a shaft of alternator to the propeller shaft. The reversing is usually accomplished by means of the CPP itself. Yet, gearing can make the job very easier.

Electric propulsion has developed as one of the best competent propulsion method for quite a lot of vessel types over the last decades. This type of propulsion was used widely through the times of Second World War, when the vessels had steam turbines as prime movers, along with electrical drives and large gearboxes. However, the modern use of electric propulsion gained popularity in the 1980s along with the growth of semiconductor switching strategies employed in high power drives (initially the dc drives and later on to ac drives) [5]. This progress cemented the way for complete speed control of propellers and thrusters, thus permitting a simple mechanical configuration.

Conversely, the principal intention for using electric propulsion in commercial ship applications was the prospective of oil/gas savings in comparison to corresponding mechanical means. Though the vessels are designed for larger speed variation, they are rarely operated at full power. This fact helps in fuel saving. The power plant principle is hence well suited in vessel operation because power can be generated as and when

required by operating the prime movers in the optimum range. Similarly, the engine can be switched on and off based on the power requirement for propulsion and other vessel loads [6]. This type of propulsion was mainly introduced in icebreakers and further expanded to cruise and offshore drilling vessels.

An electrical drive is therefore beneficial for a ship having a large non-propulsion electrical load or for a vessel in which the number of propulsion devices are all connected to the line shafting as in the case of dynamically controlled offshore vessel. Further merits include reduced noise and vibration, power for the sporadic use of bow thrusters with the available power source, and smooth functioning even at lower rpms.

All the above discussions pertain to smaller vessel types which may include offshore vessels, Dynamic Positioning vessels (DP), tugs, log pushers, passenger vessels etc. Electric propulsion may be said to have greater suitability for these vessel types, whereas, large vessel propulsion systems have traditionally remained dependant on directly coupled/geared Diesel engine drives.

2 ELECTRIC PROPLUSION DEVICES : Abundant chances to save energy exist, when a motor is used on board. The motor connected to propeller may be a DC motor or AC motor.

2.1 DC Motor Drive : In earlier times, DC motors were engaged with the electrical drives and the ships used to have totally a distinct electrical system for propulsion [7]. Subsequent to the invention of marine type thyristor converters, the ship was able to tie its entire group of devices to one single electrical system, as in the case of an electric power station.

Direct current (DC) motors are essentially adjustable/flexible speed machines. Speed plus torque control is attained by changing the voltage across the armature, the field excitation/current, or both. Conventionally, speed control for a DC motor is done by motor-generator (M-G) set. In such set, an AC motor energises a DC generator to offer adjustable voltage for DC motor functioning. These sets are huge, less effective and necessitate substantial maintenance.

Modern control comprises of microprocessor based rectifier sets, which allow simple and precise control of rpm, improved efficiency and consistency. Still, because of the complications involved (wear and tear at brushes due to its contact with rotor while in operation), cost and maintenance related to a DC motor, they are rarely preferred in new applications. Many existing DC drive applications are being replaced with AC motors and VFDs.

2.2 AC Motor Drive : There are mainly two types of AC motors namely, synchronous motor and asynchronous induction motor. The latter type is preferred for AC drive as the synchronous motor is fundamentally a constant speed motor and is not suitable for variable speed operation [8]. The induction motor works on the principle of mutual induction and torque is produced by the interaction of stator and rotor fluxes. The relative speed between the rotor and the rotating magnetic field produces the necessary torque. Hence, the rotor tries to catch up with the speed of rotating magnetic field and never runs at synchronous speed. Typical AC induction motor speeds are 3600, 1800, 1200, and 900 RPM.

The power plant principle is hence well suited in vessel operation because power can be generated as and when required by operating the prime movers in the optimum range.

The rotor speed (Nr) is related to synchronous speed (the speed at which the magnetic field rotates) as shown through the following expression:

Nr = Ns (1-s); where s is the slip, and Ns is the slip and synchronous speed.

The synchronous speed can be calculated by the formula, Ns= (120f/p).

Here f refers to the supply frequency and p refers to the number of poles.

Alternately, the rotor speed can be formulated as, Nr = (120f/p) (1-s).

It can be inferred from this equation that the speed of the motor can be controlled either by changing the number of poles, the supply frequency or the slip. Changing the number of poles is quite complex and hence changing the frequency can help to achieve desired speed. With the advent of converters/power electronic devices, changing the frequency becomes an efficient way of controlling the speed of AC induction motor [9]. The electronic devices capable of changing the supply frequency connected with AC induction motor along with other accessories and fitted to propeller of the ship is referred to be Variable Frequency Drive (VFD) for the propulsion system of the ship.

2.3 Variable Frequency Drives

VFD is a kind of motor controller that drives an electric motor by varying the frequency and voltage supplied to the electric motor. The other common names used to refer VFD are variable speed drive, adjustable speed drive and adjustable frequency drive. VFD employs a Pulse Width Modulation (PWM) to change the frequency [10]. These drives are invariably preferred to attain variable speed operation because of their economy and reliability. If a particular application does not require full speed operation of an electric motor, the VFD lowers the frequency and the voltage according to the needs of motor load.

These drives may contain a variety of power semiconductor devices such as diode, thyristor, transistor etc. and modern drives use insulated-gate bipolar transistors (IGBT). The required torque and speed can be regulated to match the load request using PWM technique [11]. They change the supply frequency from fixed value to a variable one, which in turn changes the magnitude of the supply voltage. These variable parameters are fed to the induction motor to regulate its speed

according to the need. Wider speed range is possible with VFD (approximately from 10% to 200%) based on the model of VFD.

Exceptionally accurate speed and position control is possible by properly choosing the type of control with VFD. The modern shipping industry opts VFD for the reasons listed below [12]:

a. Energy savings on fan and pump applications

b. Improved process control and regulation

c. Wider range of speed control

d. Improved power factor

e. Protection from overload currents

f. Safe acceleration.

2.3.1 Working of VFD : A variable frequency drive controls the rpm of an AC motor by means of varying the supply frequency given to the motor. Besides, it regulates the voltage at the output as a percentage of output frequency to offer a fairly constant ratio of voltage to frequency (V/Hz), as required by the characteristics of the AC motor to yield satisfactory torque.

There are 3 steps involved in the process of varying the frequency. They are,

1. Rectifying the AC supply voltage into DC voltage (by means of rectifier / converter)
2. Smoothening the ripples of DC voltage by means of capacitor or inductor or by both (This is frequently called as DC bus or DC link)
3. Converting the DC voltage back to AC (by means of power electronic/ IGBT inverter using PWM)

The output voltage is switched on and off at a high frequency, by controlling the on-time period/ pulse-width, so as to obtain a nearly sinusoidal waveform. The whole course is controlled by a microprocessor or a Programmable Logic Controller (PLC). The processor monitors the supply voltage, set-point for rpm, link voltage at DC bus, output current and voltage to make sure that the motor is operated within the recognised limits.

Figure 1 shows the circuit of VFD along with the waveforms at various sections. For the given example, the input is supplied at 480 V (RMS), 60 Hz. The DC bus will have peak of AC output voltage and it should have approximately 680 V (√2 times 480) but due to the ripples at the DC output, it is roughly 650 V.

Through the waveforms, it can be seen that the output of AC-DC converter is pulsated DC after rectification. The ripples are smoothened through the link capacitor and the waveform at the DC bus is pure DC. The DC to AC inverters is represented as switches, which are usually insulated-gate bipolar transistor (IGBT) or bipolar transistors.

The output of the inverter is in the form of rectangular pulses, which more or less resemble a sine wave. The width of these rectangular pulses can be adjusted to get a desired frequency. It is worth mentioning here that the above drive is referred to as 6-pulse VFD drive. In the rectification stage (first step of VFD), six rectifier diodes are used to form three-phase full wave bridge.

If a particular application does not require full speed operation of an electric motor, the VFD lowers the frequency and the voltage according to the needs of motor load.

This converter is named as a 'six-pulse design' as it receives current at six distinct pulses from the AC line. Some drives use more than one full bridge. Accordingly, the VFD is referred to as 12, 18, 24, etc. 'pulse device' (integral multiples of 6).

After closing any one of the switches at the top of the inverter, that particular phase of the motor is connected to the positive DC bus and the voltage of that phase becomes positive. Likewise, connecting any one of the switches at the bottom of inverter section connects the respective phase to negative DC bus assuming negative voltage. Therefore, any phase of the motor can be operated with positive or negative polarity to generate any desired frequency. Note that if the switch is in open position, then the voltage is zero. The pulse width modulation is better depicted in Figure 2.

The pulse width modulation can be understood from Figure 2. If it is desired to lessen the motor frequency to 30 Hz (half of the supply frequency), then the output switches of inverter should be switched on gradually. It refers to adjusting the on-time duration of the switch. This is true even for 10 Hz, 80 V output waveform shown in Figure 2. It is to be noted that the (V/f) or (V/Hz) is maintained as 8 for the example provided. Decreasing the frequency

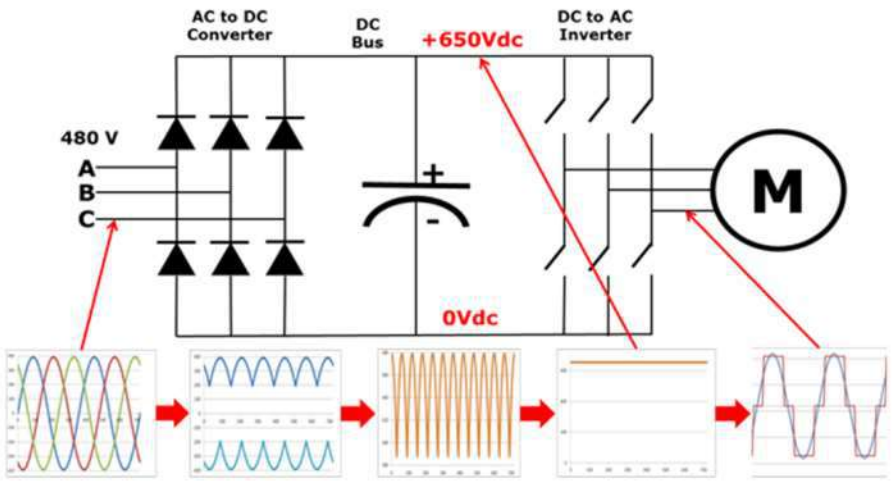

Figure 1 Circuit Diagram of Variable Frequency Drive [13]

decreases the voltage proportionally (240 V for this case) to keep up the V/Hz ratio. This technique can also be explained using the duty cycle. The duty cycle is the ratio of on-time to total time period.

By varying the on-time period of the switches, the duty cycle can be varied, which in turn modulates the width of pulses. Figure 3 shows the duty cycles of pulse width modulation at 500 Hz frequency.

2.3.2 Energy Saving by VFD : VFDs control the rpm of the motors with changing frequency and as a result, the energy consumed is reduced. The energy saving is nearly about 60% of the usual motor consumption. The VFD is best suited to govern the motor speed that is installed in pumps and fans on board ship to satisfy the load demand settings. Pumps and fans form major segments of the electrical load on board a ship. They are intended to work under the most severe conditions of load. Anyhow, most of the times of working life, the vessels usually do not reach these situations.

Strictly, the operation of the vessel at slow and very slow speeds still diminishes the necessity for high loads. Normally, half of the total time of vessel is expended in Port and hence there is no such high power necessity existing in Engine room. The same holds good to blowers, sea water cooling pumps, etc. The dynamic load requirement if fulfilled through VFD, then huge reduction of electrical load can be accomplished in addition to saving money [15]. The energy saving cost is computed using the Equations [Set 1]

From Figure 4 and Figure 5, it is clear that a small percentage reduction in saving reduces the electrical energy consumption drastically. It is a usual practice to quote "one unit of energy saved is two units of energy generated". Hence, the associated emission of carbon dioxide (greenhouse gas) can be reduced.

The energy savings for various control applications with VFD is tabulated in Table 1. It is because of this substantial reduction in consumption of energy

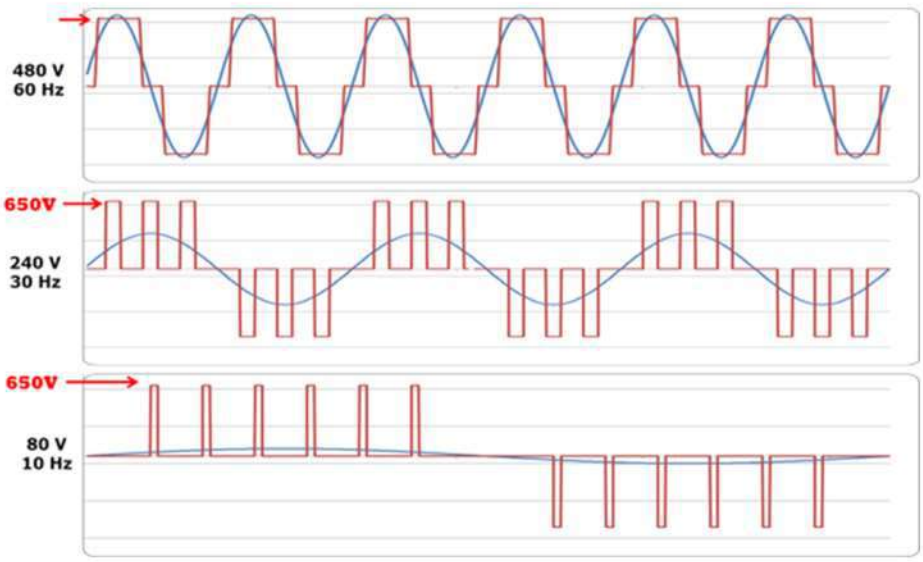

Figure 2 Output of DC-AC Inverter at Various Frequencies [13]

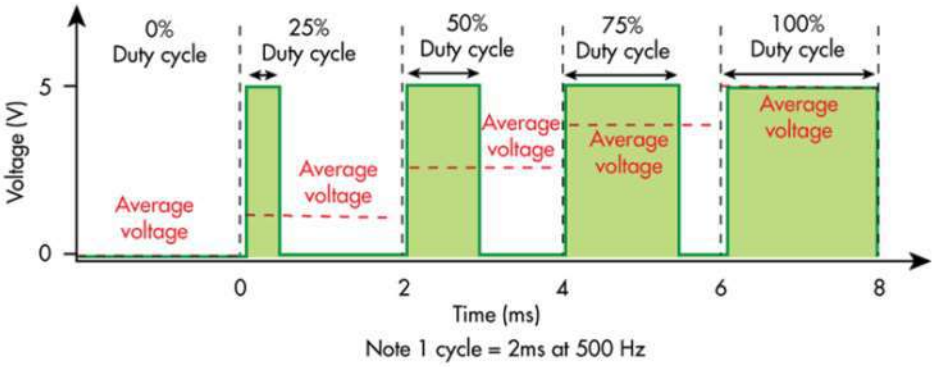

Figure 3 Duty cycles of pulse width modulation [14]

$$ESC = \left(P_m^{rated} - P_m^{inv}\right) * N X RT * \left(\frac{FOR}{OEE}\right) * FOC$$

where,

RT - Duration of lower temperature of sea water (lesser than the set or reference value) in hours

FOR - Fuel oil consumption rate in grams per kilo-watthour

OEE - Oil electricity conversion efficiency in percent

FOC - Unit cost of fuel oil in USD per gram

N - Number of units

P_m^{rated} *– Rated power of motor in kilowatts*

P_m^{inv} *– Power consumption for single VFD- driven sea water cooling pump in kilowatts*

$$P_m^{inv} = \frac{Q_p^{true} * H_{total} * \gamma * C}{\eta_e X 6120}$$

where,

Q_p^{true} *– Actual sea water flow for a single pump in cubic meters per hour*

H_{total} *- Actual pipeline head during pressure drop in meters*

γ *- Seawater gravity*

C *- flow conversion coefficient*

ηe *– overall efficiency of a single pump with VFDs*

Equations [Set 1]

and associated cost cutting, the VFD market is anticipated to reach USD 1,039 million by the year 2024, globally. The carbon dioxide emissions are reduced by employing VFD in engine room fans and sea water pumps. This reduction is estimated to be 470 tons per annum.

2.3.3 Challenges with VFD : The main drawback of VFD is that it is operated at a low power factor and there is a considerable reduction of power factor when it drives the AC motor at lower speed. As a consequence, it injects sizeable harmonic currents back to the supply. All power electronic components inject harmonic currents into the system because of their non-linearity. The current magnitudes are higher than the normal peak currents and their higher magnitudes increases the temperature of the windings of rotating machines, transformers and the connecting cables. All the electrical appliances are designed based on the temperature resistive/handling capacity. This overheating by the harmonics weaken the cables and windings of machines. Moreover, the protective equipment like relays and measuring instruments are designed with higher sensitivity and they unnecessarily operate at this harmonic current, assuming this to be an overload or over current. This leads to the malfunctioning of protective relays [18].

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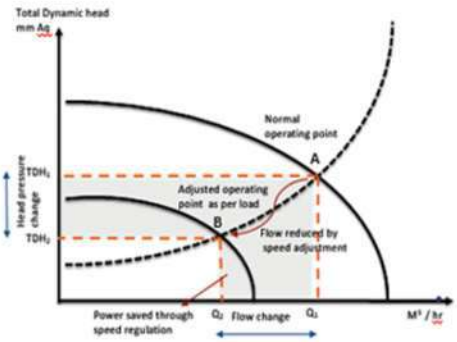

The savings follow what is termed as affinity rules.

- Flow produced by the system is proportional to the motor speed.
  Q_1/Q_2 (m³/min) ∞ N_1/N_2 (rpm)
- Pressure produced by the system is proportional to the motor speed squared.
  $P_{t1}\ P_{t2}\ \infty\ N_1^2\ /\ N_2^2$
- Horsepower required by the system is proportional to the motor speed cubed.
  $HP_1/\ HP_2\ \infty\ N_1^3\ /\ N_2^3$

A reduction of the blower speed by @ 10% will save up to 27% of consumed power

Figure 4 Power Consumption versus Blower Speed [16]

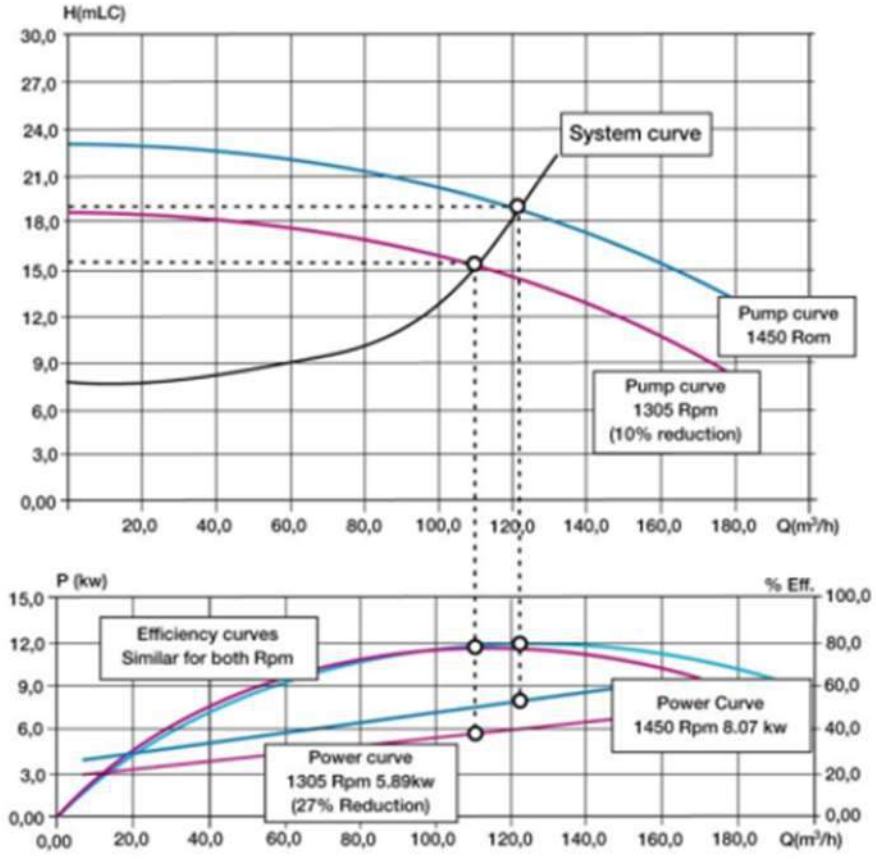

Figure 5 Power Consumption versus Pump Speed [17]

Equipment	Potential for Saving (%)
Fans and Blowers	30 – 35
Feed water Pumps	30 – 40
Sea Water Circulating Pumps	30 – 35

Table 1 Saving Potential with VFD for typical applications

(Part 2 of this article will feature in the next Issue)

Revitalisation of Maritime Sector - Business Outlook Post Covid 19 Pandemic A ShipTek Webinar (9 June, 2020)

The above Session organised by Biz Events Management was moderated by Chris Greenwood, Regional Director of Business Development (MEA), American Bureau of Shipping.

The eminent panellists:

Ca. Gautam Ramaswamy,
Director (Regulatory Affairs),
The Hong Kong Ship-owners Association

Mr. Jagmeet Makkar,
Director, Pastiche Holdings Ltd.;
Co-Founder & Director, SkillPlus

Mr. Shahab Al Jassmi,
Commercial Director of Ports & Terminals,
DP World

Dr. Nawfal Al Jourani,
Former Chief Officer,
Dubai Maritime Cluster Office

Some pertinent questions and responses given by the Panellists.

Q. The impact of Covid on Global Supply Chain could be between -13% and -32% in 2020. What do you think our industry can expect in the short (3 months), medium (6-12 months) and long-term (12 months +)?

A: It could be even worse than the WTO Figure of 32% depending upon the duration of lock down and its negative impact on the economy. However, the figures given by WTO reflect total trade by value. As per the shipping analysts, the reduction in the seaborne trade may be around 5% depending upon the severity of the Covid-19, lockdowns, fiscal stimulus and recovery.

China is on its way to powering up. The sea borne trade is expected to continue improving, albeit with a reasonable high degree of volatility. Regional and positional surprises and shocks cannot be avoided. One example is the unbelievably high charter rates for Supras and Panamaxes on the East Coast of India for destination China. With China looking for iron ore fines and pellets from East Coast, India, there is a sudden high demand for ships in the region. The shortage is created due to lesser number of coal ships coming into India for various reasons including lack of demand and quarantine time.

Imagine ships fixing at $16,000 per day when the index is less than half this number. With time, assuming no major wave of the pandemic resulting in reversal of opening up of global economies, the scenario looks positive.

Q. What measures do you think should be taken at the organizational level and governmental level to minimize this?

A: There are different schools of thoughts on this. We will probably see a relatively quick recovery when (not if) pandemic impact comes under control. Whether, this will be a V-shape, U-Shape or a mid-part-flat bowl shape recovery will depend upon a number of factors, including what people do at the governmental level. Firstly, we need to distinguish between the present situation and the Global Financial Crisis (GFC). This time:

- Banks are not under-capitalised as they were during GFC and with decent liquidity injection through stimulus initiatives and possibly more to come, we are in a better situation.
- Base economy is robust in terms of demand and supply, except for the Covid-19 impact in last few months. So as the economy opens up, in many of the areas, the demand is expected to return.

At the governmental level, the key questions would be the quantum and duration of the extraordinary stimulus and alignment between countries on possibly unconventional fiscal, monetary and trade policy measures. Further, lowering interest rates, managing unemployment and the efforts of unwinding of these unconventional measures would be challenging.

Q. How has COVID 19 impacted your individual business and what strategies have you undertaken to cope up with the current challenges?

A: As a prudent ship-owner you might have taken steps to hedge yourself before the pandemic for decent time charter returns. This may be by way of taking in contracts of affreightment or letting your ships out on period to someone. As we saw in the second half of 2008, the counterparty defaults were serious and the owners (including disponent owners or operators) had to face the low spot market while in their books they were hedged, returning profit. Preparing for such down turns is very important through risk management strategies that can

safeguard against market, execution, operational and counterparty risks.

Q. With easing of restrictions and relative 'normalcy', the virus threat will still exist.

What are the measures which you have taken to ensure the safety of your customers and staff alike?

A: The scenario described in the question is what Hong Kong, its people and industry have been successfully managing since January.

A high degree of civic sense and awareness is seen. Everyone wears masks, uses sanitisers, keeps social distance, puts plans in place in the companies for staff as to who will work from home and who will come to office.

Post Covid is an anomaly, at least for medium term. We will be living with it for some time and we need to take all possible precautions while, cautiously opening the economy to get it going.

Q. What should be done to keep staff morale high in these challenging times. Is Rightsizing the preferred option versus retaining the talent with reduced benefits?

A: We need to be thankful that this pandemic came in the Internet age so that we could use the tools to conduct our business. Challenges we face in the organisations today are -

- getting tech savvy sooner than later
- relooking at the resource requirements especially when the revenues are seriously hurt. Having said that, these should not be short term decisions
- employing the latest tools to conduct the business efficiently
- retaining the talent with reduced benefits, if they agree, is better.

It is a question of time before this pandemic goes away and having the right people will make all the difference because shipping is a PEOPLE'S BUSINESS.

Q. Do you think 'Work from Home' will become a norm in the future?

A: The simplest answer is YES, as much as possible and wherever possible.

Q. Every shipping sector is affected by this pandemic, barring tankers to a certain extent. When do you think the dry bulk sector including BDI's etc. are going to rebound and what measures are needed in short and long term?

A: As mentioned earlier, China is now already on the go. Things have to get better sooner than later. We will, hopefully, continue to see the Cape average index move north. Yes, there are issues with the Brazilian iron ore where 30-40 million tons ex Vale has been affected due to Virus. When Brazil gets better, Capes will get healthier due to three times more tonne miles.

Looking at the medium-term future, Cape spot index was $ 7745 as of 8 June 2020 whereas the 4/6 months' short period rate is $16,750 for delivery Atlantic and $12,000 for delivery Pacific. Similarly, the midpoint of FFA for Q3 and Q4 is $13,775 and $15,125 respectively.

We can be positive about Q3 and more positive for Q4. Going into Q1 of 2021, market usually comes off but that is uncertain.

However, it is difficult to answer the question in terms of both short- and long-term measures. We can only say for long term, please do not order new ships.

A quick snap shot of how the industry has been affected (thanks to MSI):

Iron Ore: Holding up relatively well.

Australia: Broadly unaffected.

Canada & South Africa: Production shutdowns

Brazil: Concerns mounting over Brazilian supply this year.

Grains Trade: Shipping is playing a key role in ensuring food supply across the world despite economic inactivity. Production of the key trading grains is heavily mechanised and broadly continuing uninterrupted. The problem for grains trade is likely to be inland transport networks and ports' throughput.

Coal Trade: This is the major concern, with demand impacted heavily in key regions like India and also Europe. There are pockets of strength such as Vietnam.

Minor Bulks Trade: Another area of concern, particularly construction-related material like steel products and cement.

Q. What is the future of shipbuilding industry past Covid 19? In particular, the big 3, China, Korea & Japan? Which country according to you will rebound and how? How will COVID impact ship-design?

A: The drivers of shipbuilding are: demand for ships, new environmental regulations, availability of suitable technology, automation etc., status of the order book and slippage, available shipbuilding capacity, tonnage replacement requirements and availability of finance and financial regulations (IFRS 16, Poseidon Rules etc.).

Of these, demand cycle, slippage and availability of shipbuilding capacity are possibly affected. We should be mindful that a possible U-shaped recovery may result in explosion in earnings and we may see ship-owners rushing to shipyards to order ships. Hopefully, the finance will keep some control.

The answer to "which country?" would have to be China, Korea and Japan, in that order.

Q. Do you think this pandemic will act as a catalyst for the marine industry to

understand the importance of adopting digital and technological innovations and undergo a radical change?

A: Yes, shipping has been slow to adapt and this pandemic will act as a catalyst to bring about a radical change.

Q. How do you think this pandemic will affect the IMO sustainability goals?

A: Some of the SDGs will be affected more than the others, in a positive way. For example:

1. SDG 1/2: No Poverty/Zero Hunger: The pandemic and lockdown has reminded us of the fragility of food and basic needs supply. Thinking of the migrant labour in some countries and loss of employment in others is a grave concern.
2. SDG 9: More efficient shipping, working in partnership with port sector - the pandemic will result in more mechanisation and last mile connectivity.
3. SDG 11: Sustainable Cities and Communities. This again relates to infrastructure and mechanisation.
4. SDG 13: Climate action: We have seen the impact on earth and nature during the period of lockdown. It is a reminder of how we are damaging the environment. Hopefully, one good thing that will come out of this pandemic is some action-oriented awareness about climate change.

Q. Do you think COVID will be the catalyst for the transition into renewables?

A: It may be that in an effort to get the economy engine started and running, the authorities have compromised investments in renewals. While at the same time, this pandemic has reminded us that going green is the only way for sustainability.

Closing Remarks by Mr. Jagmeet Makkar:

If the countries do not fight this pandemic together and get distracted in geopolitical issues, trade wars, inward looking policies, then the recovery may get seriously, if not severely, affected. For shipping, with low order book, any good news that increases the demand would be most welcome.

(Webinar Discussion Summary: Neelam Goswami, Faculty, IMU Chennai Campus)

Fearnleys Weekly Report

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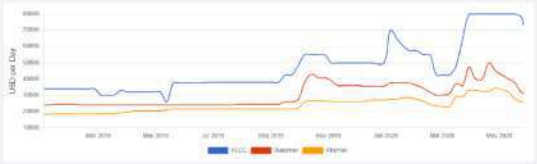
Rates

DIRTY (Spot WS)	Size	This week	Change
MEG/WEST	(280 000)	WS 26.0	-6.5
MEG/Japan	(280 000)	WS 42.5	-16.5
MEG/Singapore	(280 000)	WS 42.5	-17.5
WAF/FEAST	(260 000)	WS 40.0	-19.0
WAF/USAC	(130 000)	WS 37.5	-7.5
Sidi Kerir/W Med	(135 000)	WS 42.5	-2.5
N. Afr/Euromed	(80 000)	WS 60.0	0.0
UK/Cont	(80 000)	WS 75.0	5.0
Caribs/USG	(70 000)	WS 67.5	0.0

1 Year T/C (USD/Day)		
VLCC (Modern)	$60000.0	$0
Suezmax (Modern)	$28000.0	-$1,000
Aframax (Modern)	$20500.0	-$1,00
VLCCs fixed in all areas last week	44	10
VLCCs available in MEG next 30days	144	9



TANKERS

VLCC

The dam has burst, and VLCC rates have taken a - overdue - nosedive. The recent lack of activity, with the June MEG fixture count at an 18-year low, and July has kicked off with a rate slide. MEG/East rates are now realistically in the WS 30's for all classes, and West Africa/East has followed suit. Daily earnings are still in the USD 20's, but with increased bunker prices and further downward potential OPEX levels could come under threat moving forward. By all accounts it's going to be a hot, long summer of discontent.

SUEZMAX

After a busy last week, some owners had a slight hope that the market could have bottomed out, but boy they were wrong. After the VLCC's tanked at the beginning of the week, Suezmaxes were suddenly not the cheapest alternative anymore, and split VLCC cargoes on subs failed. Going forward this will mean more VLCC cargoes and less for Suezmaxes, and with 120+ ships on the 30-day count in West Africa, owners should be happy to get USD 10k/day on their ships. The East is still over-tonnaged, and we could see a couple of more points downside to the MEG/East market.

AFTERMAX

Aframaxes trading in the Nsea and Baltic continues to suffer from the lack of available market cargoes. This is mainly due to the production cuts especially from the strategic crude export terminals in the Baltic. Another main factor is that relets fix a huge portion of the few available cargoes on a private basis, hence leaving very little to fix for other owners. Going forward the market will move sideways around current bottom levels. Much of the same can be said for the Mediterranean and Black Sea where the market has continued to move sideways yet another week. Although little activity from charterers, rates have bottomed out at around WS60 for a straight cross-Med voyages. This gives owners a return of about USD 1,500 pd in TCE. We expect this to continue in the week to come.

Fearnleys Weekly Report

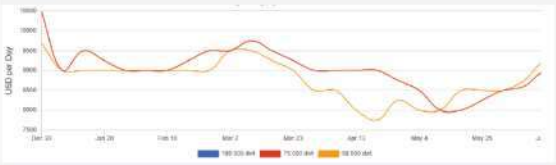
(Published with permission)

DRY BULK

Rates

Cape size (USD/Day, USD/Tonne)	This week	Change
TCE Cont/Far East (180 DWT)	$45,900	$5,075
Australia – China	$9.8	$0.9
Pacific RV	$29,225	$3,808
Panamax (USD/Day, USD/Tonne)		
Transatlantic RV	$11,900	$3,400
TCE Cont/Far East	$18,457	$1,084
TCE Far East/Cont	$2,043	$166
TCE Far East RV	$9,814	$766
Supramax (USD/Day)		
Atlantic RV	$7,475	$410
Pacific RV	$7,350	$129
TCE Cont/Far East	$12,479	$268
1 Year T/C (USD/Day)		
Newcastlemax (208 000 dwt)	$20,000	$250
Capesize (180 000 dwt)	$16,750	$250
Kamsarmax (82 000 dwt)	$10,500	$250
Panamax (75 000 dwt)	$9,250	$250
Ultramax (64 000 dwt)	$10,500	$250
Supramax (58 000 dwt)	$9,250	$0
Baltic Dry Index (BDI)	$1,705	

1 Year T/C Dry Bulk



Capesize

The Capesize rally continues with similar gain in the average rates as previous week, from 19,000 daily last week to close to 29,000 daily today. Iron ore is still the key factor, linked to restocking and increased infrastructure spending in China. Of the key iron ore routes, Australia c5 is up USD 2 to present high 9s pmt, and Brazil's c3 is close to USD 22 from low 19s. The period activity is firm, with short period being the main interest as first quarter 2021 is still valued relatively low, sub USD 10,000.

Panamax

After last week's strong activity and rate hike it has been a slower start to this week. We see less fixing activity in what can be looked at as a standoff between owners and charterers. 12k has been reported done for TA and has been the benchmark for this week's trading. However, mid-week we see a big gap with owners asking excess 14k for same. In the Pacific we see rates hovering in the mid/high 9k's and the period market has regained some activity.

Supermax

Both the Supramax and Ultramax market remained stable but more quiet compared to the previous week, though indexes still climbing up in most routes. In ECSA and USG, transatlantic rates achieved USD 10,000 pd with premium for larger units. USG is still the driving force with charterers paying USD 17-18,000 pd for FH and USD 15,000 pd with grains from Mississippi River to Mediterranean/Continent direction. The Cont and Med markets were lacking "steam", and rates remained unchanged from last week. Ultramax fixed USD 10,000 pd with coal from Baltic to Turkey. Fronthaul rates from Med reported at USD 12,000 pd. Both the India and South Asia market kept slightly better levels, and demand for period was high. Ultramax NB was fixed for 1-year period USD 10,750 pd to a grain house.

LPG Rates

Spot Market (USD/Month)	This week	Change
VLGC (84 000 cbm)	$325,000	-$110,000
LGC (60 000 cbm)	$600,000	$0
MGC (38 000 cbm)	$600,000	$80,000
HDY SR (20-22 000 cbm)	$630,000	$0
HDY ETH (17-22 000 cbm)	$730,000	$0
ETH (8-12 000 cbm)	$390,000	$0
SR (6 500 cbm)	$300,000	$0
COASTER Asia	$250,000	$0
COASTER Europe	$160,000	-$10,000
LGP/FOB Prices (USD/Tonne)	**Propane**	**Butane**
FOB North Sea/ANSI	$248	$0
Saudi Arabia/CP	$350	$0
MT Belvieu (US Gulf)	$269	$7
Sonatrach/Bethioua	$255	$0
Spot Market (USD/Day)	**This week**	**Change**
FOB North Sea/ANSI	$222	$0
Saudi Arabia/CP	$330	$0
MT Belvieu (US Gulf)	$222	-$23
Sonatrach/Bethioua	$245	$0

GAS (CHARTERING)

EAST:

There is not too much to write home about this week for the VLGC market in the East. Activity has been limited to a couple of requirements going into India, while freight remains long with available ships from both the main owners and the traders. We are probably not going to see too many new requirements from Indian majors for rest of July either, as spot demand for LPG into India continues to be slow, and they are still dealing with a big backlog of VLGCs currently waiting to discharge in both East and West coast of India. One international trader did also take a ship on subs at USD 25.50 Baltic for early July load in the Middle East, but this later failed.

WEST:

In contrast to the East, the West has shown the first signs of life this week, with multiple charterers entering the market to fix tonnage. Fundamentally, the market remains the same; arb economics are still just around cancellation territory and worldwide loading figures are lower than this time last year despite multiple newbuild deliveries over the same period. However, on the micro level, the number of players with open vessels ex USGC in July is relatively low; relets seem few and mostly found at the end of the month. At the same time, there are a number of cargoes which should be uncovered. These things together could mean we start to see signs of support with regards to rates.

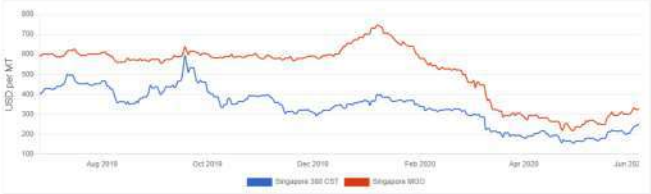
Fearnleys Weekly Report (Published with permission)

New Building Activity Levels

Tankers	Slow	Slow
Dry Bulkers	Slow	Slow
Others	Slow	Slow
Prices		
VLCC	$91.0	$0.0
Suezmax	$61.0	$0.0
Aframax	$49.5	$0.0
Product	$36.0	$0.0
Capesize	$51.0	$0.0
Kamsarmax	$28.0	$0.0
Ultramax	$26.0	$0.0
LNGC (MEGI) (cbm)	$188.5	$0.0
Sale & Purchase, Prices		
Dry 5 Yrs.		
Capesize	$36.5	$0.0
Kamsarmax	$23.5	$0.0
Ultramax	$21.5	$0.0
Dry 10 Yrs.		
Capesize	$22.5	$0.0
Kamsarmax	$15.5	$0.0
Ultramax	$11.0	-$0.5
Wet 5 Yrs.		
VLCC	$77.0	$0.0
Suezmax	$53.0	$0.0
Aframax / LR2	$41.0	$0.0
MR	$29.0	$0.0
Wet 10 Yrs.		
VLCC	$51.5	$0.0
Suezmax	$37.5	$0.0
Aframax / LR2	$29.5	$0.0
MR	$18.0	$0.0

Market Brief

Exchange Rates		
USD/JPY	106.24	-1.01
USD/KRW	1208.75	-5.20
USD/NOK	9.47	-0.06
EUR/USD	1.13	0.01
Interest Rates		
LIBOR USD (6 months)	0.39%	-0.03%
NIBOR NOK (6 months)	0.49%	0.09%
Commodity Prices		
Brent Spot	$42.50	$1.00
Bunkers Prices		
Singapore 380 CST	$260.5	$10.5
Singapore Gasoil	$384.5	$25.5
Rotterdam 380 CST	$265.0	$32.5
Rotterdam Gasoil	$360.5	$19.0



All rates published in this report do not necessarily reflect actual transactions occurring in the market. Certain estimates may be based on prevailing market conditions. In some circumstances, rates for certain vessel types are based on theoretical assumptions of premium or discount for particular vessel versus other vessel types.

Expert decision-making vital for investment and divestment of ships

- Jagmeet Makkar

(Article Courtesy: TradeMaker Magazine; June 2020)

Shipping is an asset-heavy industry, which relies on external finance and is very sensitive to the duration and cost of servicing debt. Companies and ships that have cost-effective finance are able to drive their daily break-even lower, and thus are in a position to better compete in the market, especially when the market environment is challenging. With the changing financial regulations that may adversely affect the off-balance sheet deals, e.g. operating leases, it is important to understand the basics of financing the vessels. Traditionally, shipping companies have been highly reliant on vanilla bank finance, and that too, on non-recourse basis. Over the last few years, the sources of finance have dramatically changed and so have the stringent needs for collateral.

The international nature of shipping leads to the global nature of lending, and is not restricted geographically. For example, an Indian investor in Singapore, in order to purchase a five-year-old Supramax bulk carrier from a Japanese shipowner, may take a loan from a European bank based in Hong Kong, with the funds transfer taking place in Tokyo. This goes to show that a ship investment transaction cuts across national boundaries.

Ship finance, being a major aspect of shipping enterprises, is essential for the entire industry and not just for the people working in financial institutions. The decision-making with regards to investing or divesting in ships requires a good understanding of cash-flow analysis, the market risks involved and discount rates to be used. A number of assumptions are made in the financial models, which, if not realistic, may result in financial investments with disastrous outcomes. Some of these assumptions are the forecasting of future revenues, terminal values, and costs of finance. The impact of new financial regulations, e.g. IFRS 16, Basel III and IV, as well as Poseidon Principles, must be well understood.

For an investor interested in investing in ships, identifying the segment, size and age of the ship plays an important role. As the investment grows, different strategies, for example the portfolio approach, will help to keep the risk decently managed.

Ship finance involves investing money in an industry which has unique characteristics. These include capital intensity, mobile assets subject to international regulations (including Flag State and Port State), and a complicated veil of incorporation. Over the years, particularly since the global financial crisis in 2008, banks have come under tremendous pressure due to high exposure in shipping, the need to diversify risk, pressure to focus on core areas and consolidation, compounded by capital and funding constraints, and regulatory pressure.

In addition, with the shipping market going through tough times, asset values tend to fluctuate further and more frequently than the predictions made by the banks. This results in reluctance from bankers to provide ship finance deals mutually agreeable to the lender and the borrower. In view of the above, banks have become more cautious and selective; less funding is available from traditional shipping banks; drop in asset values in the last few years have resulted in a number of deal restructurings; strong focus is placed only on shipping projects with reliable and credit-worthy long term contracts; finance is available to those with good track records and is relationship driven.

There has been a growth of alternate sources of funding in both equity and debt capital markets, as well as ship finance leases.

About the Author

*(**Jagmeet Makkar** writes for MER under the column, 'Shipping Matters', on 'Legal Aspects of Shipping'. jmakkar@skillplus.sg)*

Tribute to Captain H. Subramaniam

He was one of the finest human beings I have known with extraordinary talent and ability. His death is a loss to the Marine Fraternity. He spent several years of his life for the promotion of the LBS College. Like a true Statesman he will not be around to tower over it anymore.

He was an Institution by himself and a father figure to everyone. I recall one of his favourite quotes:

If you write my name in paper, it will be torn;

If you write it on a rock, it will decay;

But if you write it in the heart of Students, it will remain forever.

N. Nanda
thisisnans@gmail.com

(This column will highlight news from Classification Societies)

INDIAN REGISTER OF SHIPPING (IR CLASS) OVERCOMES CHALLENGES FROM GLOBAL PANDEMIC TO LAUNCH OF ADVAITA, IN CHINA

Advaita, a dedicated cement carrier, was successfully floated out on 30th March 2020 in China amidst various challenges posed by the COVID-19 pandemic. Under construction at Penglai Zhongbai Jinglu Ship Industry Co., Ltd, China, it is being built under classification of Indian Register of Shipping (IRClass). Mr. P K Mishra, Head (Operations) of IRClass, said this was a true test of competence and he is proud of the IRClass team for pulling it off successfully in such tough circumstances. The Advaita is 160m long, 22200 dwt, designed to comply with all the latest IMO conventions and codes for worldwide operations.

For more information, please visit: http://www.irclass.org

IACS LAUNCHES SINGLE STANDALONE RECOMMENDATION ON CYBER RESILIENCE

IACS announced the publication of its Recommendation on Cyber Resilience (No. 166). This standalone Recommendation consolidates IACS' previous 12 Recommendations related to cyber resilience. The new recommendation is applicable to a vessel's network systems using digital communication to interconnect ship systems and systems which can be accessed by equipment or networks off the ship. Inputs from a wide range of industry partners contributing via the Joint Industry Working Group on Cyber Systems have helped improve the recommendation. IACS Chairman, Arun Sharma said this is a significant milestone in IACS' work to support the maritime industry in the delivery of cyber resilient ships.

For more information, please visit:
http://www.iacs.org.uk/news/

DNV GL LAUNCHES NEW CERTIFICATION IN INFECTION PREVENTION FOR THE MARITIME INDUSTRY

DNV GL has launched a new certification in infection prevention for the maritime industry. It aims at helping to resume operations, better prepared for COVID-19 or other emerging pathogens. This adds another feather to the cap of DNV GL Healthcare's work in infection risk management, which has been ongoing since 2008. As part of the certification, DNV GL assesses vessel operations including sanitation procedures, kitchen hygiene, physical distancing requirements, use of personal protective equipment (PPE) by crew members, among other essential safety norms. Genting Cruise Lines is the first customer working towards the CIP-M certification for their vessel, the Explorer Dream.

For more information, please visit:
https://www.dnvgl.us/assurance/healthcare

DNV GL AND ABB LAUNCH NEW MOU TO ADVANCE MARINE DIGITALIZATION WITH A REMOTE SIGNING CEREMONY

DNV GL and ABB signed a new MOU to accelerate digitalization in the maritime industry, signed remotely by DNV GL – Maritime CEO, Knut Ørbeck-Nilssen, and ABB Marine & Ports Managing Director, Juha Koskela. The two institutions will work together on a "Digitalization Roadmap", to examine how the maritime industry can benefit from data analysis, interconnected systems and new technologies like AI and machine learning. A series of workshops are planned for the development of the Roadmap, while ABB and DNV GL cooperate to unlock the benefits of new digital technologies and data analytics.

For more information, please visit:
https://www.dnvgl.com/maritime

AUTONOMOUS DRONE INSPECTIONS MOVE STEP CLOSER AFTER SUCCESSFUL TEST

Scout Drone Inspection and DNV GL successfully carried out an autonomous drone inspection of a 19.4 m high oil tank. The tank was on board a Floating Production, Storage and Offloading vessel and the video shot was analyzed in real time using algorithms to detect cracks in the structure. The drone uses LiDAR to navigate inside the tank, which creates a 3-D map of the tank and all images and video is accurately geo-tagged with position data. Altera Infrastructure hosted the test on Petrojarl Varg. The video was live streamed via Scout Drone Inspection's cloud-system back to Altera's headquarters in Trondheim.

For more information, please visit:

https://www.dnvgl.com/research/review2018/featured-projects/adrasso-autonomous-drone-ship-surveys.html

A SAFE PATH TO RECYCLING COMPLIANCE: DNV GL'S NEW GUIDANCE WORKS TO SUPPORT SHIPOWNER DECISIONS

DNV GL launched a new guidance on recycling to help shipowners navigate the complex regulatory environment. With the IMO Hong Kong Convention not yet in force, strict enforcement of the EU Ship Recycling Regulation and the EU Waste Shipment Regulation requires shipowners to carefully plan for recycling their vessels. The new guidance aims to give a better basis for decisions on recycling and sets out the main recycling options, the legal, reputational and financial risks. DNV GL has designed the process to give shipowners a template for action when they are dealing with yards not on the EU approved list.

For more information, please visit:

https://www.dnvgl.com/maritime/publications/ship-recycling-navigating-complex-regulatory-landscape-download.html

MER Class Action News Compilation: Neelam Goswami, Faculty, IMU, Chennai Campus.

CALL FOR DONATIONS FOR IME (I) BUILDING FUND

Work on the addition of a 3rd floor to the IMEI House at Nerul, Navi Mumbai, is now complete and this new space is being fitted out to provide for better equipped classrooms, labs and enhanced infrastructure for our Training and Learning activities.

It is a matter of immense pride that the building, hitherto, was built and equipped entirely from contributions from its members and well-wishers. To fund this expansion and fit-out,we are once again reaching out to our members and corporates to seek generous contributions to the fund.

All contributions will be gratefully acknowledged.

IT deductions can be claimed under section 80G.

Cheques should favour:"The Institute of Marine Engineers (India)"

For online NEFT

Name of the account	– The Institute of Marine Engineers (India)
Name of the Bank	– IDBI Bank
Savings Bank A/c. No	– 244104000013165,
IFSC Code	– IBKL0000244.

Free IMarEST Student Membership

The Institute of Marine Engineering, Science & Technology (IMarEST) UK, offers free Student Membership to all full-time students (undergraduate and post graduate), full time cadets, apprentice or trainee on any course, for the duration of ones' studies.

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- IMarEST TV
- e-Marine --bimonthly industry newsletter

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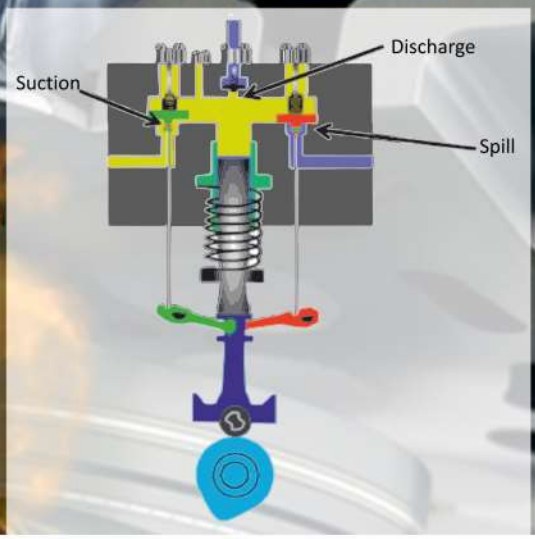
- Use of post nominal 'SIMarEST' [Post nominals letters or designatory letters are placed after a person's name, as a suffix, to indicate academic or other credentials eg. BSc, Phd,]
- 25% off on selected books



Fuel Injection in Diesel Engines

(This column is for the Competency examination and related topics. The Knowledge Guru for this month is VRV from HIMT, Chennai)

Fuel systems in diesel engines are critical systems. The basic purpose of an engine is to convert the heat energy from combustion of fuel into mechanical work and so the fuel system enabling this combustion, becomes the core system of a diesel engine. On the other hand, cooling and lubrication systems are more like "support systems".

Fuel combustion involves the fuel injection system and the scavenging/ turbocharging system. This write - up focusses on a few characteristics of the fuel injection system.

Atomisation of fuel

In a compression ignition system, air alone is compressed and fuel is injected into the hot air. As the fuel is sprayed into the hot, dense air, it breaks into small droplets. This process is called atomisation, which we are all well aware of. The atomised fuel droplets can be 100 times smaller in diameter than the nozzle hole itself.

How exactly does liquid fuel get atomised?

The mechanisms by which the jet of liquid fuel breaks into much smaller droplets are complex and many. The major features of the atomising fuel are:

a) The jet is of very high velocity

b) Fuel has a particular viscosity (for the atomisation to occur)

c) The injection happens in an atmosphere of dense air, which is at high pressure.

How is the high velocity achieved?

If a jerk type fuel pump is taken as an example, comparison of the plunger diameter with the nozzle hole can show that the velocity of the jet leaving the nozzle will be very high. All the liquid fuel pumped by the plunger exits through very small nozzle holes. Formula for liquid flow rate is,

Q = Cross sectional area x Velocity

Since the area of the nozzle is very small, the velocity is increased many folds.

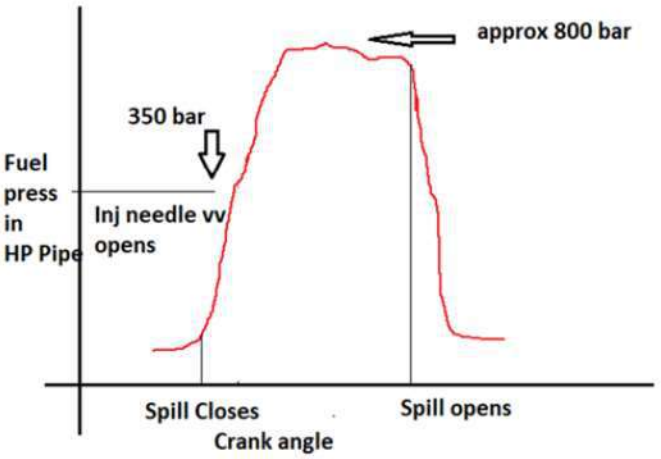


Figure 1 Pressure in HP pipe of a slow speed engine

When a high velocity jet is injected into the air, there is a large amount of fluid friction. Unlike dry friction, fluid friction increases with velocity. The outer layers of the jet, in contact with the air, experience maximum friction and hence will slow down. The inner layers travel further and will in turn get exposed to air and slow down. In effect, the fuel jet is stripped off layer by layer from the surface.

This penetration of the fuel has to be good for enveloped mixing with air to achieve perfect combustion. A lesser penetration will cause incomplete combustion and too lengthy penetration might cause the fuel to spray on the liner surface, resulting in local overheating when the fuel begins to burn.

Viscosity on the other hand tends to hold the jet together. When you drain water from a settling tank, if water is flowing out, it will splatter around. When oil is drained, the flow becomes laminar. This is because oil has a much higher viscosity and it holds the stream together. In other words, higher viscosity makes fluid flow more laminar.

The factor which explains these phenomena is called the

Reynolds number. Reynolds number is the ratio between inertia forces and viscosity forces. The formula for Reynolds number is

where:

· ρ is the density of the fluid

· u is the velocity

· D the diameter of the flow

· μ is the dynamic viscosity

· v is the kinematic viscosity

As Reynolds number increases it means the inertial forces dominate and viscosity cannot hold the liquid jet together. Turbulence sets in at high values of Reynolds number. From this formula it can be seen very clearly that velocity of the jet and viscosity of fuel play a major role in atomisation of fuel. This is the reason why the fuel viscosity has to be maintained at the required level (i.e., the correct temperature at which the fuel is supplied to the injector).

What are the factors affecting the jet velocity?

a) In a cam-driven jerk type injection system: The rpm of the engine has a strong influence. At lower engine rpms, the low plunger speed results in low jet velocity and poor atomisation.

b) Enlarged nozzle holes (residual fuel in sac volume can affect the nozzle tip).

c) Any leakage in the fuel injection system after the injection pump. For example, if the leakage at the plunger barrel or the needle and guide increases, the jet velocity will reduce and atomisation will be affected.

Fuel injection pressure:

It is often thought and understood that high fuel injection pressure is necessary for atomisation of fuel. While this is not incorrect, the relation is not straight forward. In any pumping system, pumps displace liquid or attempt to do so. The pressure in the discharge side depends on factors other than the pump alone.

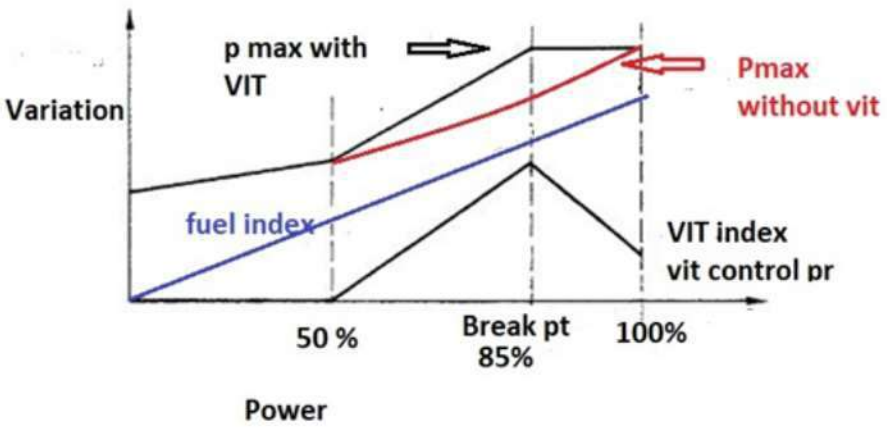


Figure 2 Load vs Engine Parameters (Pmax; Fuel Index; VIT Index)

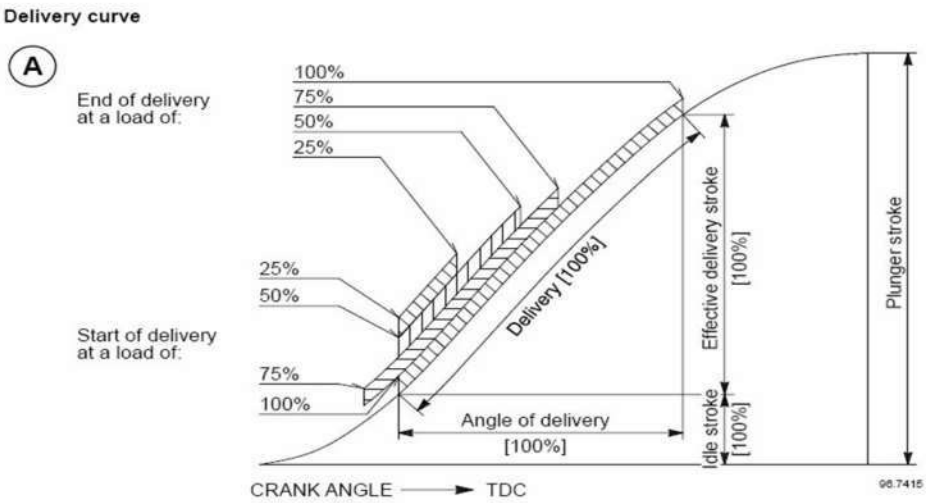


Figure 3 Cam profile, Crank angle and Plunger stroke

For example, if an auxiliary diesel engine's fuel valve is to be pressure tested, you will fit it to the test stand, connect the fuel injection pump and operate the pump. The pressure gauge would show a pressure of 350 bar or so as the fuel injector operates and you will see the fuel being injected. If the same pump was operated without the fuel injector connected, what will be the pressure?

The gauge will hardly register any pressure at all. The reason for this is, without the injector, the oil flows freely and there is no resistance to the flow. Without an opposing force, applied force also is less.

If the same fuel valve is fitted back to the diesel engine and the engine run, what will be the pressure in the HP pipe? Will it be 350 bar?

In fact, it will be much more. Probably more than 1500 bar. See Figure 1.

How can this be so?

This is due to the difference between fuel injection pressure and the fuel valve opening pressure.

The fuel injector needle valve is kept closed by the spring force and to overcome this force and lift the needle valve, the fuel pressure has to rise to a particular value. For example, at 350 bar pressure, the needle valve will lift. However, during injection, the fuel still has to pass through the nozzle holes, which offer much greater resistance. The pressure which exists in the HP pipe during injection is controlled by the size of the nozzle holes and not by the spring force of the injector valve.

The rising plunger in the fuel pump barrel keeps the fuel exiting from the nozzle holes. Due to the comparative resistance offered by the small nozzle holes, the pressure also rises as the plunger rises.

In a slow speed engine this pressure can be typically between 700 and 900 bar. In medium speed engines it will usually be between 1500 – 2000 bar. Since a medium speed engine runs faster, a higher degree of atomisation is required in these engines.

Relation between Ignition delay, engine rpm and injection pressure

Ignition delay is the delay between beginning of injection and beginning of combustion. In a slow speed engine running at 120 rpm, each revolution is completed in 0.5 sec. An ignition delay of 5 milliseconds corresponds to a crank angle of 3.6 deg. This means, from the beginning of injection the engine will turn 3.6 deg., before the combustion starts. Now for another engine running at 1200 rpm, the same ignition delay of 5 milliseconds will convert to a crank angle of 36 deg.

Can an ignition delay of 36 degrees be permitted? No.

This shows that as the engine runs faster, ignition delay has to be reduced, usually in inverse proportion. Thus, to keep the same ignition delay of 3.6 deg., crank angle, in terms of time it has to be 0.5 milliseconds. That brings us to the question of how to reduce the ignition delay. One solution is to achieve much greater level of atomisation and to do it faster. To achieve this, nozzle holes of much smaller diameter have to be used, which will result in much higher injection pressures.

Fuel injection timing

The usual meaning of fuel injection timing is the beginning of the fuel injection with respect to the TDC of the piston in the unit. As everyone should know, the changes in the timing affect peak pressure and exhaust temperature. The selection of a particular timing is based on many factors, including rpm, compression ratio, degree of turbocharging etc. For many years, main engines especially have had the feature called variable fuel injection timing.

The purpose of VIT is to adjust the fuel injection timing (beginning of injection) according to the engine load to improve the specific fuel oil consumption. Compared to a fixed beginning of injection, by advancing the beginning, peak pressure is increased and more importantly, exhaust temperature is reduced. Since any heat carried by the exhaust is wasted energy, reducing the exhaust temperature, improves the thermal efficiency of the engine. The increased thermal efficiency can also be explained by the increased value of the Pmax/ MEP ratio.

By using VIT, power of the engine will not change. For a particular engine rpm, the output power of the main engine is determined only by external factors such as speed of vessel, wetted surface area, hull condition, weather etc. Since the main engine is controlled through the governor, any changes to fuel, timing, defects in engine etc., will be compensated by governor to maintain the rpm. Another way to explain this will be, as below.

Assume that in a vessel we can put the VIT into use or remove it as per our wish, by a switch. Right now the engine is running at say 120 rpm, developing 10000 kw power. With VIT off, let us say that in a particular cylinder the peak pressure is 120 bar and the exhaust temp is 390 deg. C. If the VIT is now enabled,

a) Fuel injection will begin earlier. Since it begins earlier, peak pressure will rise. With earlier injection, combustion will end earlier.

b) In the PV diagram, even though maximum pressure rises, the curve will drop lower in the expansion / power stroke. Thus, the area of the PV diagram will not increase. Mean Indicated Pressure will remain same.

c) The engine rpm will not change. This is because the purpose of the governor is to maintain the required rpm, which it will do. This point is important to understand.

   When the engine rpm is controlled through the governor, changes in fuel will not change rpm. For example, if you reduce the fuel rack of one unit, or if the fuel pump suction valve leaks in one unit, the governor will increase the common rack so that the rpm is maintained.

   If the fuel is changed to diesel, you may think that the rpm will reduce because density of diesel is less than that of HFO. However, the governor will increase the rack to compensate for this. Thus the engine rpm will remain same.

d) If the engine rpm remains same, engine power will also remain same. It will not increase. There is no change in the external condition, resistance to hull will remain same, thus power cannot change and it will remain at 10000 kw.

e) Peak pressure will rise, say to 135 bar and exhaust temperature will fall to, say 360 deg. C. This is because the combustion will end earlier as explained earlier.

f) The reduced exhaust temperature will improve the thermal efficiency of the engine by a small amount.

g) Thermal efficiency is related to the ratio Pmax/ MIP. As this ratio increases thermal efficiency increases.

h) This improvement in efficiency will result in a small reduction in fuel consumption. The fuel rack will reduce slightly. Even with a slightly reduced fuel index, the same engine rpm and power is maintained.

I) With the reduced fuel consumption at the same power, SFOC value will be less.

j) The peak pressure against power graph, which is made available is to tell the engineer, will show the limits within which the peak pressure is to be kept. It really does not explain the purpose of VIT.

The graph in Figure 2 shows that the timing is advanced from about 50% power and maximum peak pressure is reached at 85% power and then maintained. Without the VIT, the PMax would have followed the graph linearly (the inflexion at 50% load would not occur). With VIT, the Pmax rises (linear with a different slope) as seen in Figure 2. From the 85% power point onwards, the same peak pressure is maintained.

Another example of timing change is shown in Figure 3. From 50% load onwards the beginning of injection is advanced, the maximum advancing is at 75% power and from then onwards timing is again adjusted back towards normal.

FQS: Even though the VIT system increases the peak pressure according to the load, it does not measure the peak pressure. VIT index is varied according to the fuel rack position. When the ignition quality of the fuel is varied, peak pressure will vary from the expected. Hence an additional adjustment of fuel injection timing according to the quality of fuel is necessary. In RTA engines a common FQS arrangement is given. In MAN BW individual VIT racks have to be adjusted.

Exercises:

1. Check the specifications of the fuel nozzles employed on 4S and 2S engines on board your ship and make brief notes on how they affect the combustion. Consider factors such as chamber geometry, bore, fuel etc.
2. Check the crank angles when VIT is in operation. Write brief notes on why the injection timing is advanced or retarded.

(About the Author:
Chief Engineer V. R. Venkatesan *is the Director (Academics) with Hindustan Institute of Maritime Training, Chennai. vrv@himtmarine.com)*

Query on DP Transmitter

Sir,

Thank you for the informative article on Boiler water level measurement by DP Cell. Would be much thankful if you could clear a doubt regarding same. You have depicted the LP side being connected to the wet leg or reference leg which has higher static head than that of the HP side. How come the higher water head is connected to the LP side and not the HP side?

Thank you in advance.

Ajit Kumar K.T.

AM- 3529

Explanation for the Query (from Jagbandhu Mazumdar):

Why is the wet leg connected to the LP side of Boiler water level DP transmitter?

Let us say the wet leg is connected the other way (i.e., wet leg is connected to the HP side as shown in the Figure 1). This will be connected not to the Boiler water side but to the space above the water in the Boiler drum. The Output of DP transmitter will then represent the empty space in the drum and not the water level. To get the value of ΔP to represent the water level (H1), the connections are reversed.

Note: To properly calibrate the transmitter, a positive bias (H2) is needed to elevate the transmitter output. This positive biasing technique is called **zero elevation.**

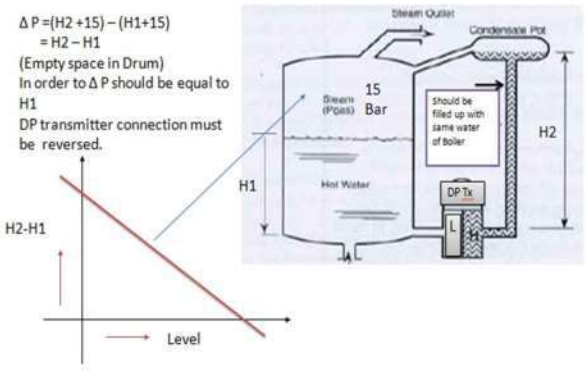


Figure 1 Wet leg connected to HP side

So let us connect the wet leg to LP side and HP to Boiler side as shown in Figure 2.

$P_{high} = P_{gas} + \sigma.g.H\ 1$
$P_{low} = P_{gas} + \sigma.g.H2$
$\Delta P = P_{high} - P_{low}$
$= \sigma.g\ (H\ 1 - H2)$
$= (H1 - H2)$ ($\sigma.g$ is constant)

Wet leg H2 is of fixed value
If + H2 (+ bias) added
ΔP output
= (H1 – H2) + H2
= H 1 = Boiler Water level

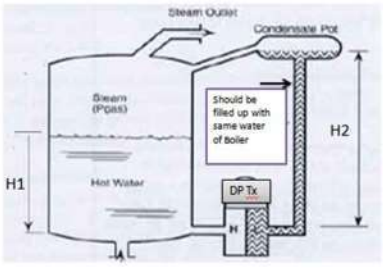
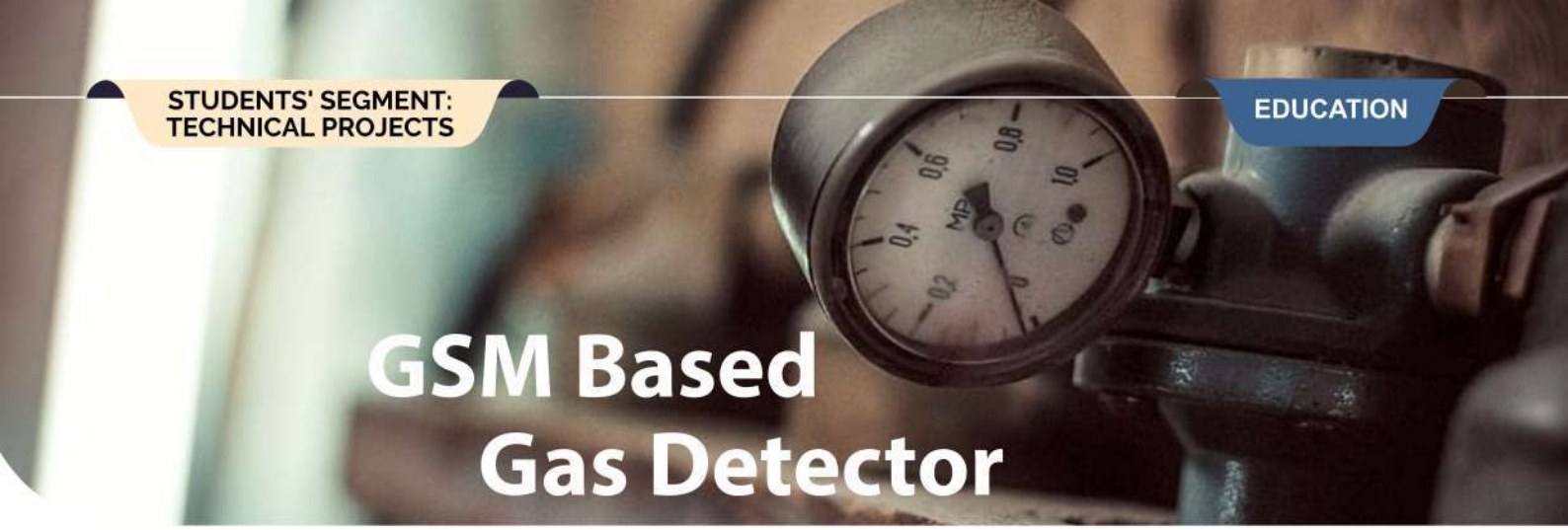


Figure 2 Wet leg connected to LP side



GSM Based Gas Detector

OBJECTIVE: To test the leakage of gas using this module. To optimize time intervals for repeated alerts.

PRINCIPLE/CONCEPT: The working principle behind the MQ-5 gas sensor is as follows: The sensor has a sensitive filament made of SnO2. In the presence of clean air, this filament tends to have lower electrical conductivity.

When a combustible gas such as LPG is introduced, the filament's conductivity rises, and the amount of change in its conductance/resistance can be used to indicate the equivalent gas concentration. This effect tends to be particularly pronounced at higher temperatures, and hence a resistive heating element is present as well. SnO2 is particularly sensitive to Methane, Butane and Propane, but is also sensitive to other combustible gases.

TEST EQUIPMENT: Sensor, batteries, GSM module, Arduino board, connecting wires, A 5-Amp power supply.

SPECIFICATIONS OF EQUIPMENT USED FOR THE EXPERIMENT: MQ-5 Gas Sensor Module (Detecting concentration;200-10000 ppm), 9V DC batteries, GSM module 900-A, Arduino UNO board.

DESCRIPTION OF OPERATION/EXPERIMENT/PROJECT:

ARDUINO UNO Board:

The Arduino UNO is an open-source microcontroller board based on the Microchip Atmega328P. The board is equipped with sets of digital and analogue input/output pins that may be interfaced to various expansion board and other circuits. The board has 14 digital input/output pins, 6 analogue input/output pins and is programmable with the Arduino IDE, via a type B USB cable. It can be powered by USB cable or by any external 9-volt battery, through it accepts voltages between 7 and 20 volts.

GSM 900A Module:

Global System for Mobile communication (GSM) is digital cellular system used for mobile devices. It is an international standard for mobile which is widely used for long distance communication. There are various GSM modules available in market like SIM900, SIM700, SIM800, SIM808, SIM5320 etc. SIM900A module allows users to send/receive data over GPRS, send/receive SMS and make/receive voice calls. The GSM/GPRS module uses

Model No.			MQ-5
Sensor Type			Semiconductor
Standard Encapsulation			Bakelite (Black Bakelite)
Detection Gas			LPG, Methane, coal gas
Concentration			300-10000ppm(Methane, Propane, Butane, H2)
Circuit	Loop Voltage	V_c	≤24V DC
	Heater Voltage	V_H	5.0V±0.2V AC or DC
	Load Resistance	R_L	Adjustable
Character	Heater Resistance	R_H	31Ω±3ΩRoom Tem.
	Heater consumption	P_H	≤900mW
	Sensing Resistance	R_s	2KΩ-20KΩ(in 2000ppm C_3H_8)
	Sensitivity	S	Rs(in air)/Rs(1000ppm C_3H_8)≥5
	Slope	α	≤0.6($R_{1000ppm}/R_{500ppm}$ H2)
Condition	Tem. Humidity		20±2℃65%±5%RH
	Standard test circuit		Vc:5.0V±0.1V V_H: 5.0V±0.1V
	Preheat time		Over 48 hours

Table 1 Technical Specifications of the MQ-5 Gas leakage sensor

USART communication to communicate with microcontroller or PC terminal. AT commands are used to configure the module in different modes and to perform various functions like calling, posting data to a site, etc.

The Technical specifications for the MQ-5 sensor are tabulated in Table 1.

Program of the Arduino board:

```
#include <SoftwareSerial.h>
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
SoftwareSerial mySerial(9, 10);
int sensor=7;
int speaker=8;
int gas_value,Gas_alert_val, Gas_shut_val;
int Gas_Leak_Status;
int sms_count=0;
void setup()
{
pinMode(sensor,INPUT);
pinMode(speaker,OUTPUT);
mySerial.begin(9600);
Serial.begin(9600);
lcd.begin(16,2);
delay(500);
}
void loop()
{
CheckGas();
CheckShutDown();
}
void CheckGas()
{

lcd.setCursor(0,0);
lcd.print("Gas Scan - ON");
Gas_alert_val=ScanGasLevel();
if(Gas_alert_val==LOW)
{
 SetAlert(); // Function to send SMS Alerts
}}

int ScanGasLevel()
{
gas_value=digitalRead(sensor); // reads the sensor output (Vout of LM35)

return gas_value; // returns temperature value in degree celsius
}
void SetAlert()
{
digitalWrite(speaker,HIGH);
while(sms_count<3) //Number of SMS Alerts to be sent
{
SendTextMessage(); // Function to send AT Commands to GSM module
}
Gas_Leak_Status=1;
lcd.setCursor(0,1);
lcd.print("Gas Alert! SMS Sent!");
}
void CheckShutDown()
{
if(Gas_Leak_Status==1)
{
Gas_shut_val=ScanGasLevel();
if(Gas_shut_val==HIGH)
{
lcd.setCursor(0,1);
lcd.print("No Gas Leaking");
digitalWrite(speaker,LOW);
sms_count=0;
Gas_Leak_Status=0;
}}}
void SendTextMessage()
{
  mySerial.println("AT+CMGF=1");    //To send SMS in Text Mode
 delay(1000);
    mySerial.println("AT+CMGS=\"+919495xxxxxx\"\r"); // change to the phone number you using
 delay(1000);
    mySerial.println("Gas Leaking!");//the content of the message
 delay(200);
 mySerial.println((char)26);//the stopping character
 delay(1000);
      mySerial.println("AT+CMGS=\"+918113xxxxxx\"\r"); // change to the phone number you using
 delay(1000);
    mySerial.println("Gas Leaking!");//the content of the message
 delay(200);
    mySerial.println((char)26);//the message stopping character
 delay(1000);
 sms_count++;
}
```

Tests/Experiments were carried out as follows:

Firstly, the sensor was only tested for LPG but later it was found that it can detect Methane, Carbon Monoxide, Hydrogen, LNG, Butane in gaseous forms. The power supply was given to the Arduino board and GSM module and then the program was inserted on to the Arduino UNO board and then gases were bought close to the sensor. Table 2 shows the result summary.

S.No.	Gas	Apparatus Source	Detection
1	LPG	LPG Cylinder	Grade A (every time)
2	Butane	Cigarette Lighter	Grade A (every time)
3	Hydrogen	Hydrogen cylinder	Grade A (every time)
4	Carbon Monoxide	Burning timber	Grade B (sometimes failure)
5	Methane	Rotted food vapour	Grade C (Success twice)

Table 2 Summary of Detection Instances for various Gases

Grade A - Detection of gases: 100%. (LPG from domestic gas cylinder, Butane from cigarette Lighter and Hydrogen from hydrogen cylinder).

Grade B – Detection of gases: 50% - 60%. (Carbon Monoxide produced from burning wood in low oxygen environment).

Grade C - Detection least accurate around 20%. (Methane produced by anaerobic bacterial decomposition of food).

The sensor can detect all the above gases without any issue of failing. Grade B and C tests were successful on many counts. Due to the low amount of source gas availability, the sensor did not activate the alarm, a few times. But based on the high number of response alarms, it can be said that the sensor was reliable.

Arduino can be programmed in different ways for sending alerts to various personals. We programmed it in such a way that three messages can be sent to a person at time intervals of 6 seconds. Figure 1 shows the Arduino and GSM Board arrangement. Figure 2 shows the circuitry.

Results & Observations: The alert was received within 6 seconds of detection of gas.

Conclusion/Inference: This Model can be widely used in factories, houses, etc., which will help to avoid accidents. Model will help us to prevent accident which leads to a lot of destruction of property and wealth. The life of person's working around can be solved. This can be vastly used in industrial purpose and housing and on ships.

Scope for further Studies: The size of the Arduino board can be reduced. The GSM module can be replaced with a Wi-Fi module, Bluetooth Module or a GPRS Module connected with the ship's internet or internal Wi-Fi system. This whole system can be fixed into a smaller water tight packing so that it can also be placed on deck to receive signals.

Project Participants:

Cadet Aniruddh Dugar, Cadet Ayush Pathak, Cadet Devansh Garg, Cadet Devendra Ojha *(All From Tolani Maritime Institute, Induri, Pune)*

Figure 1 Arduino and GSM Board Arrangement

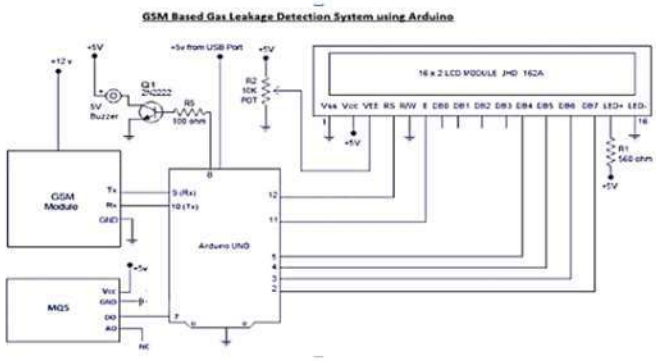


Figure 2 Gas Detection Unit Circuitry

Bibliographic References used for the Project:

1. Sensor Information: http://www.hwsensor.com.
2. Circuit Diagram: https://www.circuitstoday.com/gas-leakage-detector-using-arduino-with-sms-alert
3. GSM Module: https://www.electronicwings.com/arduino/sim900a-gsm-module-interfacing-with-arduino-uno
4. BoardPurchase:https://bm-es.com/product/gsm-sim900a-modem / ?gclid = CjwKCAjw26H3BRB2EiwAy32zhaRWo6XdfG_g1SqlyrVN6722CjotZaLQ8D3qAmVMTbswoXgP-gNjxBoC1g8QAvD_BwE
5. Sensor Purchase: https://www.amazon.in/gp/aw/d/B07D4F3TK6

Man B&W ME Engine – FIVA valve failure due to water ingress in L.O. sump

- Gaurav Lobo

(This forum is for sharing on board/off shore/on shore problems and sharing the experience as lessons learnt)

A routine top-up of the M/E L.O. sump ended up crippling a vessel and causing serious damage to the electronically controlled fuel injection and exhaust valve actuation (FIVA) valves when water got into the sump.

The vessel was loaded and was on her way to the discharge port. The vessel had received fuel, lubes and stores a few days earlier and was now underway with good weather and calm seas and the engineers decided to top up the Main Engine L.O. sump, a very routine and simple task done many times before.

10 minutes after about 1000 litres of oil was added to the sump, the alarm monitoring system sounded the "Water In Oil" alarm followed by the oil mist detector "Abnormal Alarm" and "Exhaust Temperature Deviation Alarm" from a few units.

The engine slowed down automatically activated by these deviation alarms.

Upon investigation and testing multiple samples, it was found that water had gotten into the sump and the engine was stopped.

Crankcase inspection also revealed presence of water (emulsified oil patches and water droplets) (Figure 1 & 2).

The entire contents of the sump had to be transferred to the L.O. settling tank, the sump and crankcase cleaned and fresh oil taken in to the sump.

When the engineers tried to restart the engine, they received FIVA valve alarms. When attempts were made to start the engine and run, many units of the engine were misfiring. The engine could not be run in this condition.

After overhauling and replacing with the spares available on board, the engineers were able to get only 3 units working. The developed power was not enough to move the vessel at a slow steaming range. The nearest port of refuge was around 500 nautical miles away. A minimum of 4 units is required to run a 6- cylinder engine to develop power for moving at a sea steaming range.

The vessel finally had to be towed to the port of refuge, where upon receipt of the pilot valves for the FIVAs, the problem was resolved. A total of 14 days was lost.

Root Causes

Upon Investigation, the source of water was traced to the leaky flange on the vent of the L.O. storage tank. The vent on this vessel was located on the main deck within a save-all tray (Figure 3, 4 & 5).

During the recent bunkering operations, the save-all was plugged as per standard SOPEP practice.

However, due to the heavy rains during and after the bunkering, the save-all tray flooded and water entered the vent line through a leaky flange.

The fault was attributed partly to the ship-builder and partly to the ship's crew.

Vents for most L.O. storage tanks are located in the engine room and for those located on deck, the flanges are usually placed above the height of the save-all coaming.

But in the case of this vent line, the pipe connection flange was located within the height of the coaming. Any accumulation/filling inside the tray will submerge this flange. If the flange is leaky (say due to a perished gasket),

the water can get in to the vent-line and find its way to the sump. With continuous rain, this ingress can get substantial.

The error committed by the crew was that they did not unplug the save-all after completion of bunkering, or if the practice was to keep save-all plugs, did not routinely empty the save-all of water. Also the regular draining of the LO storage tanks have not been carried out (especially prior to dropping oil into the sump).

Lessons learnt

1. **Save-all drain plug was not removed** after bunkering. If the practice was to keep save-all plugs (not a preferred practice), no routine emptying/draining of accumulations was carried out.
2. **Oil storage tank vent heads needs to be checked and inspected** as part of routine maintenance for corrosion and signs of wastage at flange.
3. **Routine draining of tanks** during LO bunkering & Prior dropping oil into the sump: The spring loaded drain valve of the lubricating oil storage tank needs to be operated to ensure no water is present.

Note: If copious flow of water is noticed, extended draining till no more water is detected has to be carried out. Purification of the oil has to follow to ensure that the LO is usable.

(About the Author : Mr. Gaurav Lobo, *is a Technical Superintendent with Scorpio Shipping. He is an Alumnus of Tolani Maritime Institute, Induri, Pune.)*

Figure 1 LO Sump: Emulsified oil patches indicating presence of water

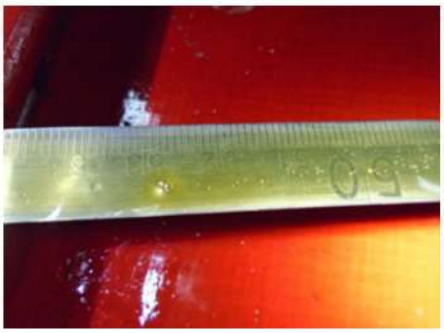


Figure 2 Sounding tape: Emulsified oil patches indicating presence of water

Figure 3 Vent head of the L.O. storage tank

Figure 4 Flange location below the top edge of the save-all coaming

Figure 5 Vent head opened out for inspection

Figure 6 Traces of corrosion at seal face of flange (poor sealing caused water ingress)

24th May 2020 – Organized by IME(I) Mumbai Branch

ANTAKSHARI – SUR MILAE SABBKA

The event was conducted on Zoom and 108 very active participants participated from 200+ who registered for the Event.

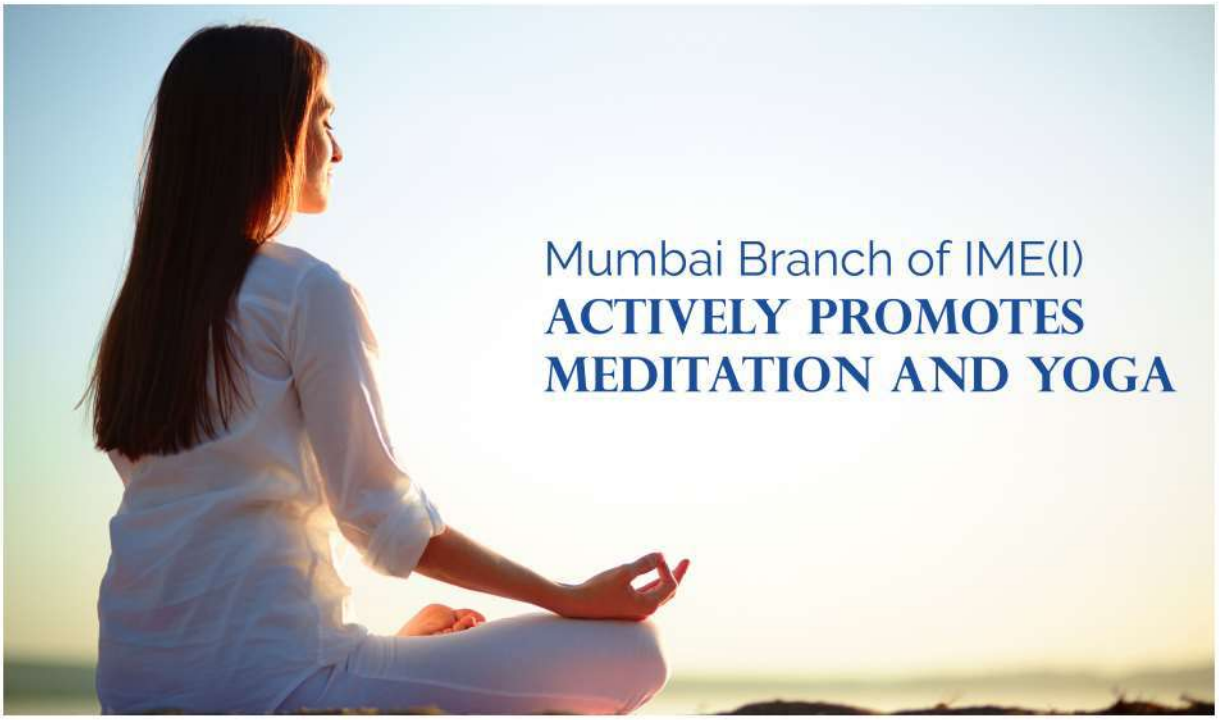
Mr. V.K. Jain, Chairman IME(I) Mumbai branch kick-started the Event. Ms. Sonali Banerjee, the Co-Host and Mrs. Seema Srivastava, the Anchor got the participants into a sombre mood through some soulful singing. Set of Core Singers' heart rendering melodies then came as a blast from the past tingling the memories of all participants who were eager to get onto the mic thereafter.

A well researched video conducted by Mr Saanjeev Mehra, Head of 'Social Initiatives Sub-Committee' was a tough one and guesses by the participants set the chat box on fire. A few smart ones guessed the song right from the first frame of the video itself. Excitement peaked in the next two rounds where the guesses had to be from photos flashed from a movie as the Clue and the mix and match of music video with different song.

Mr Anupam Rajvanshi, a film buff and himself an expert in the domain including singing from USA, judged the event and he picked the winners of each round. While the Winners Ms. Jyotsna Tata, Ms. Nitisha Gupta, Ms. Tamalike Biswas and Ms Viranchi Kaushik took home Boat Speakers arranged by the Media House 'Offing', a Surprise bonus round was held specifically for IMEI members and their families. Mr. Shailendra Varma correctly guessed the song and movie of 'Rang-de-Basanti' from a representative image that flashed for just 15 seconds. A Carvan from 'Offing' was for his to take with all honours as his son performed impromptu for a song from this iconic movie.

The event came to an end with a special performance by Mr. Prakash Iyer and Mandeep Lamba.

Mr. Saanjeev Mehra proposed Vote-of-thanks around 7 PM. Curtains were drawn to the joyful evening with the National Anthem by all participants from their homes.



The resounding success of 'Meditation with Yogic Transmission,' conducted on-line by the Mumbai Branch on 2nd May by Shri Sanjay Bhatia – IAS, Chairman, and the subsequent feedback added to the enthusiasm of the Mumbai Branch to re-energise the shipping community through more such e-Meditation sessions. A repeat session was organised online on Sunday evening at 5 PM on the 31st of May with heartfulness meditation technique performed by 114 registered members and streamed to an equal number live on the IME(I) YouTube Page.

Two weeks later on yet another Sunday evening a Live Meditation Session was conducted on the 14th June 2020. This was facilitated by Ms. Nandita Pai, a CA by Profession and a Partner at Deloitte, India (from 'The Art of Living' foundation, of world-renowned humanitarian and spiritual teacher - Gurudev Sri Sri Ravi Shankar). More than 140 People participated and Ms Pai clarified doubts on meditation and explained Gurudev's philosophy: "Unless we have a stress-free mind and a violence-free society, we cannot achieve world peace."

The Mumbai Branch also celebrated the 'International Day of Yoga' on the 21st June 2020. More than 400 Yoga enthusiasts had registered for the event conducted by Mumbai Port Trust and the Maha Mariners Association under the auspices of Ayush Ministry. After the 'heartfulness meditation' by Shri Sanjay Bhatia, IAS Chairman MbPT and IPA, about 200+ participants thereafter participated in exercises guided by Ms Chhaya of Shri Ambika Yoga Kutir. The program ended with the National Anthem.

I-COMMUNIQUE

The Newsletter of the Mumbai Branch and the Navi Mumbai & Gujarat Chapters

The Mumbai Branch released its inaugural Newsletter, the 'i-Communique' on June 13th with an objective to keep its Members updated of the happenings within the Branch and also get its Membership involved in contributing non-technical articles. The newsletter contains a brief write-up by all the sub-committee heads and also articles about all major events organised by the Branch in the last few months.

It is clarified in the newsletter that there is no conflict with the Institute's and India's largest Marine journal - MER and that it will not contain any technical articles.

It is meant to touch upon the human side and recognize individual achievements of the large Branch Membership and their families. Members can express themselves in these areas through the newsletter and promote social interaction and fellowship. Mr. David Birwadkar will be the Editor of this newsletter. The newsletter may be accessed from:

https://linktr.ee/imei.m

Contributions may be sent to 'The Honorary Secretary' at: 'mumbai@imare.in'.

The Institute of Marine Engineers (India)

Newsletter of Mumbai Branch

Navi Mumbai Chapter & Gujarat Chapter

i-Communique

Inaugural Issue June 2020

FROM CHAIRMAN'S DESK

Dear Members of the Mumbai Branch Navi Mumbai Chapter and Gujarat Chapter of the IME(I).

It gives me great pleasure in introducing this inaugural version of our newsletter to you. The idea of starting this newsletter is to keep Members informed and also get the Membership involved in contributing to the happenings of the IME(I).

The corona virus has imposed various changes and restrictions on our lifestyle in the last couple of months. On the other hand it has provided us an opportunity to explore a lot of areas which were confined hitherto to only in our 'mind'. E-classes, Webinars, eNewsletters, enhanced

Branch mandatorily volunteered to be in a Sub-Coms of his choice. Each Member therefore started doing social work in an area of his choice. I am pleased to report that our this experiment has worked well. Not only have the Sub-Coms done some phenomenal

and shall try and see what best we can do with them.

Also, this newsletter is not meant to be a conflict to the Institute's and India's largest Marine journal - the MER. It will not contain any technical articles. It is meant to touch upon the human side and recognize individual achievements of our large Mumbai, Navi Mumbai & Gujarat Membership and their families. It is meant to acknowledge the writing and other creative skills of our Members who wish to contribute towards this. Social initiatives and acknowledgements take a back seat in a professional body like ours. Whereas, an attempt is being made to encourage them

AWARENESS PROGRAM ON 'PRINCIPLES AND APPLICATIONS OF CONVENTIONAL NDT METHODS' CONDUCTED BY IME(I), MUMBAI BRANCH ON 6 June 2020

Images of few NDT Tests

A technical session was held on 06 June 2020 on a web platform with the objective to refresh the knowledge of the participants in various conventional NDT methods used in maritime industry and also to ensure that these methods are correctly applied. It was conducted by the subject expert **Mr. Arvind K Sharma** (Consultant for QA/QC, Welding & NDT).

Mr. David Birwadkar, Head of Training Committee, Mumbai Branch of IME(I), introduced the guest speaker, Mr. Sharma, whose professional qualifications include ISO 9712 NDE Level 3/ ASNT NDT Level-III in RT and UT/ Diploma EWE/IWE from TWI-Cambridge-UK/ IRCA registered QMS Principal Auditor.

Mr. V. K. Jain, Chairman, Mumbai Branch, in his introductory speech mentioned about the webinars and seminars conducted by IME(I) during this lockdown period. He also shared his experience in the field of thickness measurement and the new changes witnessed by today's Maritime Industry.

This technical session had about 200 participants and an equal number watching the proceedings live on the Facebook and YouTube. The technical session was comprising of **4 modules** on 1) Penetrant Testing 2) Magnetic Particle Testing 3) Radiography Testing 4) Ultrasonic Testing.

The **first module** was on Penetrant Testing ranging from Safety Precautions, Test Procedure for Penetrant Testing, Selection Criteria for Liquid Penetrant Testing and its

advantages, Application of Penetrant. He also covered topics such as Lux meters, Ultraviolet Radiation Meter used for Interpretation and Evaluation of specimens. A key takeaways were on False indications, Non-relevant indications, Relevant indications which are mostly overlooked during this test. The Module concluded with sharing limitations, Applicable codes, and key take away points such as minimum and maximum time elapsed between steps, minimum light intensity and importance of dwell times with respect to temperatures.

The **second module** was on Magnetic Particle Testing. The talk was on Magnetism and Ferromagnetic Materials, the importance of longitudinal and circular magnetic fields viz., the importance of direction of induced magnetic field based on defects. The speaker talked about procedures and important considerations to be followed and provided examples of MPI indications. This module was concluded with sharing of Advantages and limitations of Magnetic Particle Testing along with ASME Section V applicable codes.

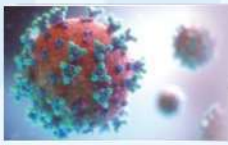
The **third module** of the session emphasised on Principles of Radiography, X-ray and Gamma rays, Image Quality Indicators, Radiography Techniques used, Artifacts and Applicable codes. Mr. Sharma also touched upon equipment's used for radiographic testing, Isotopes, Radioactive decay, film types used, Image Quality Indicator thereby helping students to minimize faults arising while development of Radiographic image.

The **final module** of this session was on Principles of Ultrasonic Testing, Types of probes used and its Calibration, Distance Amplitude Correction Curve (DAC) and Applicable Codes. This module was concluded with highlighting of the advantages and limitations while using Ultrasonic testing. The session concluded with information on ASME Section V requirements and NDT Certification Schemes.

The talks were followed by a **Question and Answer session,** coordinated by **Mr. David Birwadkar** with assistance from **Mr Surendra Rai, fellow of IME(I).** A quick feedback was also taken at the end. **Mr. David Birwadkar** proposed the Vote of Thanks and the proceedings were concluded by reciting the **National Anthem.**

INDICATOR CARDS

**(This forum is for reflections from readers.
Do mention your Name, email, Membership Grade & Number
[if associated with IMEI] when you send in your mails).**



ISHTAPATTI

When a disaster strikes, one has to struggle hard to face it and find a solution. Very often during the course of this struggle, some good things happen. This makes us say that the God is not so unkind. He favours us with something that makes us forget the hardship that we have undergone. Such a situation is described in one word as Ishtapatti.

The preventive measures (for the pandemic) have resulted in some good things that are proving to be blessings in disguise. Some of these are listed below:

1. Cleanliness – Today people have understood the importance of cleanliness. They are now following all the measures to clean themselves. I hope this becomes a habit to be followed by all for all times to come.
2. Quality of atmospheric air – The restriction on the use of vehicles has brought down the carbon dioxide emissions. Let us travel only when we must. Do not use any type of vehicle for short walkable distances.
3. Quality of water – With industrial activities at minimum levels, the quality of water flowing through the rivers has greatly improved as also the pollution of the seas. This is good for the human beings as also for the aquatic life and the ecosystem.
4. Learning new skills – Many people are learning new skills because of restrictions in movement. There is always something new that one can learn. It is a very good and satisfying way of spending your free time.
5. e-Communication – People are now attending offices online, students are attending e-learning classes, examinations are being conducted online, as also many webinars. But let us not forget the importance of personal relationship. Man should not become another machine.
6. Increased medical facilities – The number of hospitals and the facilities are increasing. This will surely improve the public healthcare even after the present crisis is overcome.

Look at all this in a positive way. We shall very soon overcome the corona fear and start living our normal life. Look forward and go ahead for a better living.

A.S. Tambwekar

(Received from his son, Ajay A. Tambwekar, Deputy Director, Institute of Maritime Studies, Goa)

(ajayt@imsgoa.org)

THE GODLY SEAFARER TOUCH

25 June: Day of the Seafarer:

A Tribute to Seafarers (Frontline Workers)

Today's world is a materialistic world wherein everyone wants to possess anything which would bring comfort. The wish list is endless for all. People are willing to spend a fortune to fulfill their own wishes and wishes of their dear ones.

When such demand expands, it certainly puts a huge challenge to this world. Not only do we have to move these goods across different terrains but also have to deliver these goods at a price affordable to common man.

Who will do this? We will, say the seafarers. Yes, and today on board 70000 odd ships, 1.6 million seafarers do this job for the 7.6 billion people across the 7 continents. From basic needs to specific needs anything that is moved across the globe has the touch of the seafarer.

While the world rests, the seafarer works. He has travelled beyond where your vision ends into vast seas and oceans, sacrificing his own near and dear ones, facing the perils of the sea, working day and night to move his/her ship filled with goods to meet the global needs. Words will not be enough to thank them for their sacrifices. All we can do for the sacrifices to stand up and give him/her a big salute and thank them for their Godly seafarer touch and being right in the frontline.

Captain Vinod Naveen

(Associate professor, IMU Kochi Campus.)

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Dots

The Council of the International Maritime Organization (IMO), meeting for its 102nd Session in London on 29 June to 3 July 2009, agreed that next year's theme for World Maritime Day will be "2010: Year of the Seafarer", thus endorsing a proposal from IMO Secretary-General Efthymios E. Mitropoulos. IMO also took steps to establish 'Day of the Seafarer', shortly said as DotS, under a special resolution adopted with the STCW convention. They designated 25 June as the day for this DotS.

While proposing the DotS, Secretary- General Mitropoulos said that "the unique hazards confronting the 1.5 million seafarers of the world - including pirate attacks, unwarranted detention and abandonment - coupled with the predicted looming shortage of ships' officers, make it even more incumbent to take immediate and effective action to forestall a situation from developing in which ships are not manned with sufficient skilled personnel".

The main purpose of this resolution was to recognize the unique contribution made by seafarers from all over the world to international seaborne trade, the world economy and civil society as a whole. The DotS acknowledges the good work of seafarers by efforts to bring an international attention to various issues affecting seafarers work and life on board. IMO through various steps calls all Nations and governments to develop necessary policies to treat marine people fairly. All ship owners and operators are asked to provide good facilities and comfort on board to ensure that the marine people can spend their work time on board without affecting their mental health and physical health.

Day of the Seafarer is also recognized by the United Nations as an observance day.

Themes for campaign during Seafarers Day promotion:

2011- First Seafarers Day

2012 – It came by sea and I can't live without it... "thank you seafarers"

2013 - Faces of the sea

2014 – Seafarers brought me

2015 – #CareeratSea

2016 – At Sea for All

2017 – Seafarers matter

2018 – Seafarers well being

2019 – I am on board with gender equality

And this year is the 10th Anniversary of Seafarers Day 2020 –**Seafarers are Key Workers**

This year special attention is given due to the epidemic virus Covid 19. Seafarers had to undergo more difficulties and hardship than ever.

2020 Campaign: Seafarers are Key Workers

In his Day of the Seafarer message, IMO Secretary-General, Kitack Lim said, "Just like other key workers, seafarers are on the front line in this global fight. They deserve our thanks. But they also need – and deserve – quick and decisive humanitarian action from governments everywhere, not just during the pandemic, but at all times".

The campaign also seeks to raise awareness of the work achieved by seafarers in response to the pandemic and to thank them for their contribution. Everyone is invited to recognize that the ability of seafarers in delivering vital goods is central to responding to, and eventually overcoming this pandemic.

The campaign encourages everyone to treat seafarers with respect and dignity they deserve, so that they can continue to provide their vital services to keep world trade moving.

What can you do on this day?

Day of the Seafarer is an innovative campaign that harnesses the power of social media to raise awareness of seafarers and their unique role. Everyone, regardless of where they live, can join the campaign online. IMO wants everyone to be part of their efforts in showing respect, recognition and gratitude to seafarers everywhere. Governments, shipping organizations, companies, ship-owners and all other parties concerned are invited to promote and celebrate the Day in an appropriate and meaningful manner.

Send a note to a seafarer or their family

Say an appreciating word for seafarers on your social media

Post a picture of sea or seafarer on social media

Write a 'thank you, seafarer' note to IMO and other maritime organisations

Share and repost this write-up to your group, friends and others.

J K M Nair
jkmnair@gmail.com

Continuing Corona Crusades

Predictions... Pandemic aftermath

The crystal ball gazing is on and post-pandemic (whenever it happens) forecasts are flying out like bit notices. These reports vary from damning to dreary. In the flood of what-will-it-be webinars and platitudes, I found one level-headed report in The Danish Ship Finance's Shipping Market Review, May 2020. The general sentiment is low for shipping and an easy answer for all the southward or stagnant trend is: Low Economic Activity-Pandemic Effect (LEAPE).

A summary of few waves from the Review with few foamy inputs from self:

Segment	What has hurt the growth?	Any positives?
Car Carriers	Low car sales; LEAPE	Scrap market peps up?
Chemical Tankers	LEAPE	Demand for Product Tankers supporting
Container Vessels	Non-essential spending low	Scrap market peps up?
Crude Tankers	Over supply	Storage options; Better rates
Dry Bulk Carriers	Low commodity demand	Scrap market peps up? Low Freight rates?
Gas carriers	LEAPE	Vessel supply balanced with demand
Offshore	Supply surplus	Lower costs; Lower emissions
Product Tankers	LEAPE	Storage options; Better rates

Shipping being a service sector, takes a direct hit as the global economic activities weaken. Compared with earlier recessions, the 'industry seems better positioned to handle a drop in world trade volumes...'. Asset values might dip further and there are bound to be readjustments in new vessel deliveries and scrapping.

Though trend has been going down for new ships, shipbuilding sector appears to be stable. This could be due to the nature of the product preparation (Ships take time to be built). But the oversupply (and trend for building large vessels) will have a telling effect.

Decarbonisation efforts: Likely to continue. Scrubber installations expected to increase. Other expenditures (e.g., Installation of BWTS etc.) are likely to remain stable. Effect on freight rates? Unpredictable.

World economy:

In worst recession. Low consumer demand-supply chain disruptions and overdependence on China are major factors which are affecting. (I am sparing all statistical numbers on GDP declines, India-China economic growth etc.).

Any hope at all? Yes. There is one common factor I noticed with all the pundit-predictions. They all assume that the pandemic will go away sooner. But given the limitations of human knowledge, we can possibly make a bounce back if the pandemic goes away latest by end of 2020.

Else, we have to keep doing the crystal ball gazing (and biting our fingernails).

On the plight of the stuck seafarers

It appears to be a problem which cannot be wished away. The average sign-offs (after contract completion/average 4-9 months) are placed around 50000/week and with the Covid scare, this number-pointer hovers near to few thousands. The situation is mirrored for those who are ready to sign-on.

Who are the most affected? Indians (as always) and Filipinos.

Anything being done? Yes. IMO has issued the protocols for safe crew-changes.

Where is the problem? Most commercial flights are grounded. Many countries do not allow seafarer embarkation/disembarkation.

What is needed? Commitment of Ship Management companies towards welfare.

Very importantly, the Governments have to be serious in recognising seafarers' issues and implementing IMO protocols.

Can seafarers be grouped under 'essential services'? Guess so. If supply-line supports on land (goods carriers, lorry drivers etc.) can be 'essential', why not the ships and seafarers?

~

Tech Talks

To keep abreast with things, we are wandering into a world of webinars and white papers. While we are making attempts to bring some comprehensive papers (as republications) to find a place in the MER Pages, my sharing of bits and pieces from here and there shall continue.

Lubricants

Use of VLSFO has brought 'sufferings without sulphur' and a common problem is that of lubricating oils. A Chevron white paper on LO for Dual fuel engines has some good insights.

LO for 2S: Separate for Crankcase and cylinders. Cylinder lubrication by continuous injection.

LO for 4S: Single Trunk Piston Engine Oil. Cylinder lubrication by recirculating from sump. This brings about contaminants and difficulties in switching fuels (DF engines).

Higher the Sulphur in distillate fuels, greater has to be the alkalinity [BN] in the LO. This may lead to ash deposits.

Another issue: Asphaltenes in residual fuels resulting in sludge.

Way to go:

1. Choose the fuel employed: LNG [or] LNG + Distillate Fuel [or] LNG + Distillate Fuel + Residual Fuel.
2. Choose the LO based on the Fuel choice.

Staying on DF engines, there is an Intelligent Control by Exhaust Recycling (ICER) being introduced by WinGD which will capture the Methane slipping out in the exhaust stream and get it back for combustion.

How is it done? Wait for more to come.

Turbochargers

Planned/Emergency maintenance of turbochargers will become easy with a novel 'plug and play' concept, claims KBB. Breakdowns require balancing of the turbocharger and this adds to the maintenance burden (both for those on board and the ship owner).

In the proposed swap model, when a breakdown occurs, the OEM will supply a cartridge with the essential parts (bearing housing, rotor, other system parts). The old parts can be removed, new parts inserted in place and the machine is ready.

Other parts also can form part of the extended cartridge: Nozzle ring, diffuser, compressor casing etc. In this case, insert all in sequence, fasten, check the turbine end clearance and you are ready to rev up!

~

On contributions to MER

While we walk into July, we at MER wish to reiterate our appeal for contributions with few words of concern and caution:

We get a number of write-ups from a number of enthusiastic writers.

Many contributory articles are rip-offs from the wider web sources... (and even maintenance manuals).

Many are just words on wishful thinking, opinions bordering on school book essays with platitudes...

Many technical articles come in the garb of seriousness, but turn out to be dumps of data with little or no value addition. They flatter to deceive and appear to aim only for an 'also-published feather' in an unworn cap.

Of course, we cannot expect every write-up to be an original but certainly we can hope that they bring value and interest to our readers (students, sailing marine engineers, shipping personnel etc.).

Yet we try to accommodate as much as we can to encourage. While we cultivate your interests, we at the Editorial Board are also duty bound to cull and clear those contributions of less merit. Hence there will be non-inclusions.

My humble appeal: Do contribute but ensure your write-up has some value addition.

Where you have sourced your writing based on information available on the internet/others' works rather than your own research/projects, please include few analytical thoughts. And certainly, cite and list all the information sources.

Do check for language errors (syntax, spellings etc.).

And please write on issues relevant to Marine Engineering and Shipping.

Please!

~

1 July: Doctors' Day.

India celebrates this Day every year
and this year (while we cower with Covid scare):
Celebrate, we must!

- Rajoo Balaji

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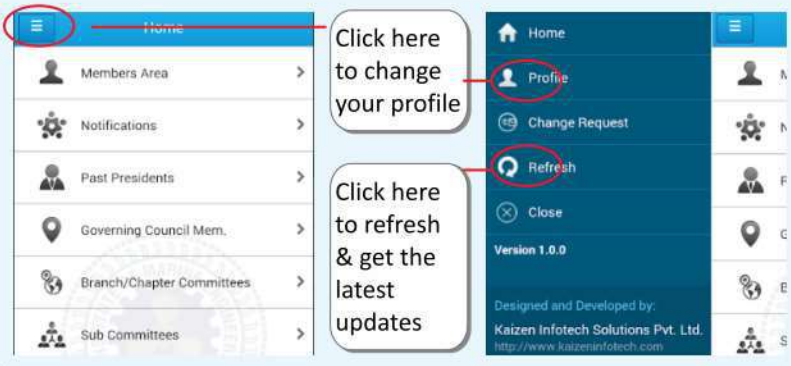

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