Exhaust Gas Emissions Today and Tomorrow

AUTHOR 1- CADET ANUP KUMAR (9941482276)

[anupworldcom@gmail.com]

AUTHOR 2- CADET YOGESH PRATAP SINGH (7338979345)

[yogeshpratap4997@gmail.com]

ABSTRACT--- Quite a number of emission control measures have already been developed, and are in use today. Emission control has turned into the most important driving force for development.

Hence, this is an area to which extensive development effort is allocated. This emphasizes both NOx control, SOx limitation, particulate control and, to an increasing extent, CO2 emission, the latter reflecting total engine efficiency. With CO2 considered a greenhouse gas, the CO2 concentration in the atmosphere is looked at with some anxiety. In any case, the low speed diesel is the heat engine available for ship propulsion with the lowest CO2 emission. This is possible simply by virtue of its high thermal efficiency. However, we still see possibilities of increasing the efficiency by means of waste heat recovery and achieving a total efficiency of the fuel energy used of up to 60%! This will not only reduce the CO2 level, but also the amount of emissions of NOx, SOx, PM, CO and HC.

KEYWORDS: NOx emission control, SOx emission control, ECA and Fuels, etc.

Case Study: SAGARMALA PROGRAMME,

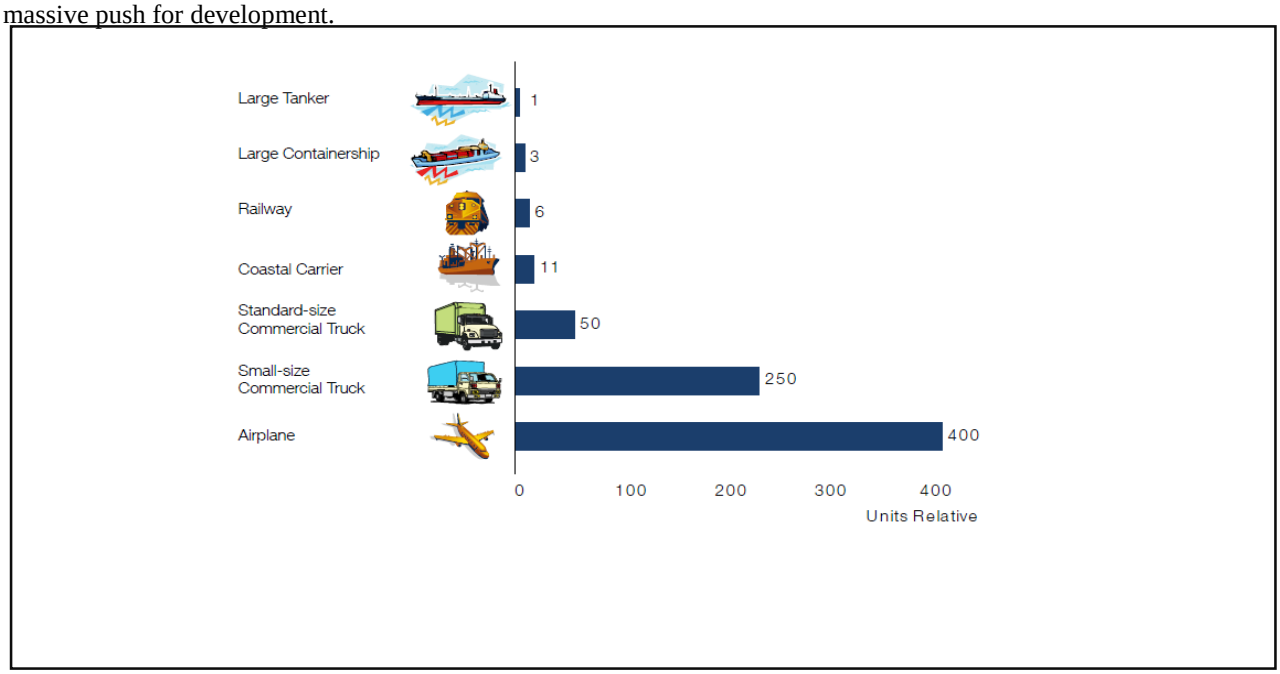
I. SIGNIFICANCE OF PROJECT

This is the first of its kind project in India as it will be executed in the area of the world's 2nd highest tidal range. This project on completion will result in reduction in motorable distance of 231 kms between Gogha and Dahej in Gujarat to mere 31 kms. It will pave for launching India's first roll on -roll off vessel passenger ferry services. Besides it will reduce the travel time to 1 hour from 7 hours. It will also result in savings in fuel, reduction in road congestion.

Sagarmala when integrated with the development of inland waterways will help to reduce cost and time for transporting goods, benefiting the industries and export/import trade.

Serious concerns are being raised about the environmental effects on the coasts with issues like coastal erosion, coastal accretion as well as severe problems of dredging and the effects on the sea bed due this.

Both NFF (National fisher workers forum) and NAPM (National alliance of people's movement) leadership asserted that such projects will effect fishing community because of large scale ocean and land grabbing and displacing the people. The ecological devastation has also been accelerated which is being sidelined in this massive push for development.



As regards CO2, commercial ships transport approx. 90% of all goods traded worldwide, and still represent by far the most efficient way of transportation, with the lowest production of CO2 per weight/million moved, as shown in Fig.

Whereas on the other hand the Sagarmala project will create ports that can post offshore sites to source renewable energy. As part of India's green energy plan, wind -propelled plants are scheduled to power the coastal states of Gujarat and Tamil Nadu by 2021.It is to establish commercial offshore wind projects in India under the facilitating offshore wind in industry(FOWIND) programme funded by the European union.
Hence, all this case study addresses that by the optimization of the Sagarmala project and switching for water transportation leads to lower exhaust gas emissions as the exhaust gas emissions from a ship contributes to addition of air pollution which is much lower in comparison is minimal with respect to other modes of transportation.

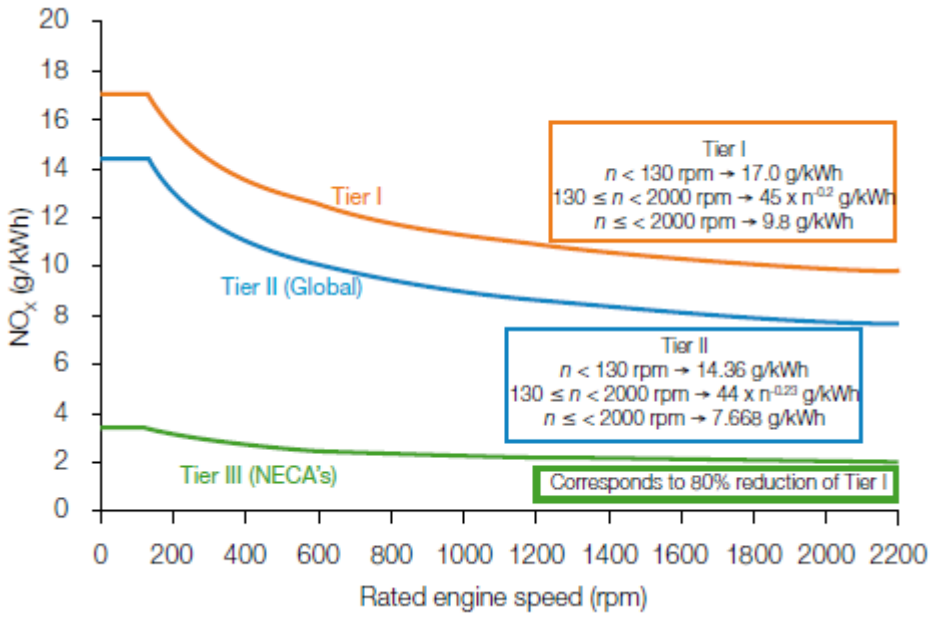
II. MAIN TEXT

To comply with the demands and regulations made to the maritime industry. This involves cooperation with authorities, governments and international organizations on the development of new regulations to fulfil the goal of reducing exhaust gas emissions by realistic methods. The aim is to arrive at methods that are applicable and practical to ship operators, and which will maintain a high level of safety and reliability of the engines.

Recent advances on our electronically controlled ME engine have shown that the unique rate shaping possibility of ME engines makes it possible to lower NOx emissions with none or very little effect on fuel efficiency. In this way, the expected NOx limitations of Tier II will be met by engine internal methods.
For the ME/ME-C engine types, the modification, basically, consists in an adjustment of the programming of the electronically controlled injection of the fuel oil.

III. INFLUENCE OF SULPHUR EMISSIONS

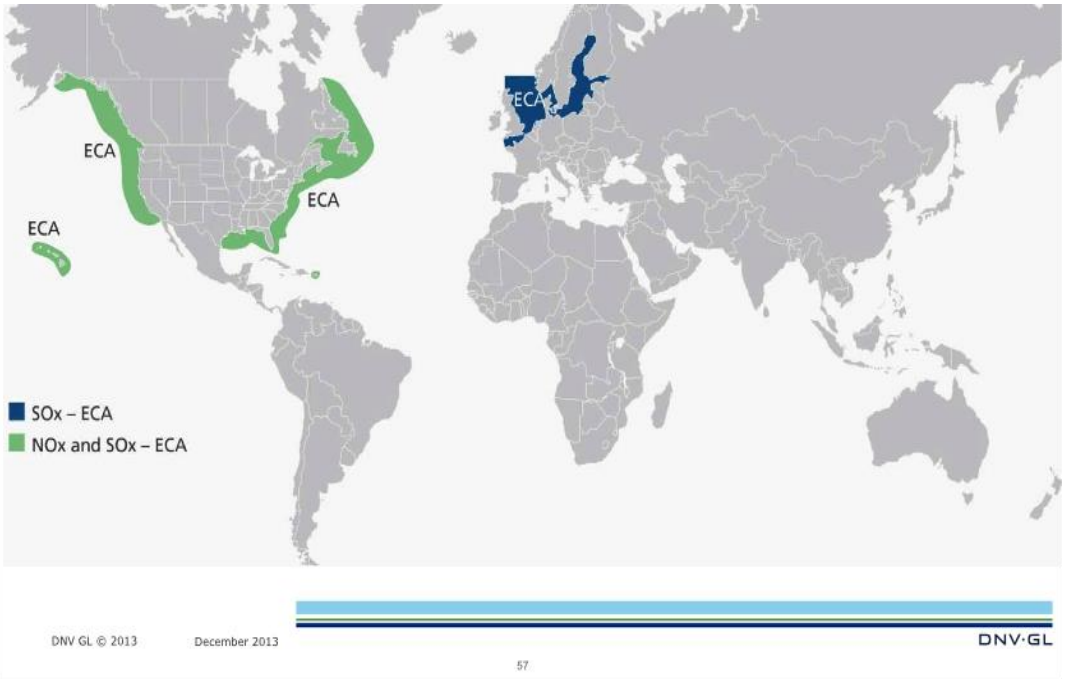
The Sulphur content in fuel oil has a strong impact on the particle level in the exhaust gas. IMO and the EU have introduced a restriction of Sulphur of 1.5% in SECA areas like the North Sea and the Baltic Sea in northern Europe. And local marine emission rules, e.g. in Sweden and Norway, are aimed at reducing particulate emissions substantially. In the 1990s, IMO, EPA and the EU concentrated their work on a reduction of NOx and SOx through MARPOL Annex VI. Tier II will continue the focus on lowering NOx for new buildings and SO_X emissions for all ships in service. Also, such exhaust gas components as particulates,
unburned hydrocarbons and CO2 will be considered for future engine designs and development.



In this paper, the different values for Tier II and Tier III are based on the result of the latest MEPC58 meeting, and the decisions made in May 2008 for the final adoption of revisions of Annex VI and NTC (NOx Technical Code) on 6-10 October 2008.

Tests and analyses of exhaust gas have shown that a high-Sulphur HFO can give particle levels that are several times higher than if the engine is operated on gas oil. A large part of the difference between HFO and DO is related to the Sulphur, which together with water forms particulates.

MAN B&W researched and designed many emission control techniques to two-stroke designs and, currently, have water emulsion and SCR in service.



MAN, Diesel believes that the target should be the introduction of international regulations on emissions. The regulations should be accepted for worldwide trading and have internationally-approved special areas, such as ECA (emission control area) and SECA, where inland waters and the environment call for further regulation, as is already seen with SECA in the Baltic Sea and North Sea in Europe today.

Furthermore, it is very important that the regulations do not dictate which emission control methods should be used, but only specify the emission levels to be met.
The goal of our research is that internal methods like EGR, WFE, SAM and/ or combinations of these will make our two-stroke engines ready for current and future IMO regulations with regard to NOx, without using SCR with agents such as urea or ammonia. Compared with SCR, which for many years has been considered the optimum solution for NOx reduction, the new methods have significant advantages that need to be further investigated and matured for the market.

Fuel sulphur limits – implementation dates and use of scrubber

Implementation Date	SO_x Emission Control Areas	SO_x Global	Scrubbers
Existing regulation	1.5%	4.5%	Only in ECA's
1 March 2010	1.0%		Alternative meas-
2012		3.5%	ures (scrubbers in
2015	0.1%	Review of 2020	ECAs and globally)
2018		fuel situation	
2020		0.5% (HFO allowed)	
2025		Alternative 0.5% intro date	

IV. Two-stroke MAN B&W Emission Projects in Progress

With regard to SOx and PM regulation, this is to be controlled by limitations in the Sulphur content of the fuel used. An alternative measure is the use of scrubbers.

Emission projects currently in progress are listed below:

- Water emulsion -On 11K90MC engine owned by APL.
- Singapore- Low-Sulphur fuel operation laboratory test, fuel pump test, and test in service on a ship. Initiated by CARB, APL, APM, Seaspan and MAN Diesel.

- SAM (scavenge air moisturizing)- Full scale test on a 6S60MC engine on a Wallenius Wilhelmsen car carrier.
- EGR (exhaust gas recirculation)- Test on the MAN Diesel 4T50MEX research engine in Copenhagen has already been completed, and a 70% NOx reduction was achieved. A full-scale test at sea is scheduled in 2009 together with a European shipowner.
- Scrubber and after-treatment- To remove SOx and PM. Has been successfully tested at Holeby on a different scrubber design in cooperation with shipowners. A full-scale test is scheduled in 2008.
- Fuel change-over- A new change-over system between DO/DG and HFO, and vice-versa, has been developed to protect the engine. Will be tested at sea in 2008.

CONCLUSION

Tier II and Tier III of IMO Annex VI are currently being settled in order to specify the acceptable levels of exhaust gas emissions in the years to come. The MC and ME type MAN B&W engines will be able to meet the Tier II NOx limits by internal engine methods.

Today, the expected Tier III 80% NOx reduction requirement can only be met by the use of external engine methods such as SCR. However, by development and research, MAN Diesel has been able to achieve a NOx reduction of 70% by means of such internal methods as SAM and EGR. In the coming years, these systems will be matured to the market.

According to IMO, SOx and PM will be reduced by fuel sulphur level limits. Alternatively, an abatement system can be installed, e.g. a fuel oil scrubber solution. MAN Diesel is also investigating this option to ensure a safe, reliable and environmentally friendly operation of MAN B&W propelled vessels.

It is difficult to further reduce the CO2 emission level created by the two-stroke process. However, by utilizing the waste heat, an improvement of the total energy utilized from fuel burned is achieved. Various system configurations offer up to 60% efficiency.

High fuel prices and emission concerns have increased the focus on utilizing natural gas as fuel oil. Not only in the LNG market, but also for other types of commercial vessels traditionally operating on HFO. The MAN Diesel engine programme covers this growing market with the low speed MAN B&W gas operating ME-GI type engine and the medium speed L51/60DF type engine.

ACKNOWLEDGEMENT

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APPENDIX

ECA- Emission Control Area

EGR- Exhaust Gas Recirculation

EPA- Environmental Protection Agency

SECA- Sulphur Emission Control Area

TES- Thermal Efficiency System

DO- Diesel Oil

HFO- Heavy Fuel Oil

IMO- International Maritime Organisation

MEPC- Marine Environmental Protection Committee

SAM- Scavenge Air Moisturising

SCR- Selective Catalytic Reduction

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[2] “NOx control in practice and demands made on owners and engine builders”, MAN B&W Diesel paper for meeting at the Maritime Museum in Bergen, March