Energy efficiency in maritime transport

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Abstract: This paper covers the possibilities of fully exploiting available resources in order to raise energy efficiency. High energy efficiency can be achieved by adjusting and improving current systems on ships with proper maintenance.

Shaft generator and turbo generator are two separate systems on ships power plant that can be used to increase its efficiency. A shaft generator on a ship is powered by the main engine and it powers the electricity network. Turbo generator consists of a generator powered by turbine that uses superheated steam in order to achieve rotation of its shaft. Maintenance is very important for raising ships efficiency not only in a way of keeping the power plant clean, undamaged and fairly organised but also making sure that all of the plants parameters are in order. Ships efficiency can be greatly increased by making sure that the fuel consumption is in its optimal limits as well as providing the best one, parallel work of more than one pump under condition they all work in the same parameters, better isolation and more ways to use heat exchangers, cooling of the main engine has to be regulated to keep in its limits for the best performance etc… Sankey diagram can be used to visualise the percentages of power distribution for the power plant and also how changing the parameters affects its end result.

Even though ships are by far the most economic means of transporting goods this can be greatly increased by following some guidelines and investing in some specific systems that enable raising it to much higher level with less losses and maximum usage of given resources.

Key words: Turbo generator, shaft generator, parameters, optimal work, Sankey diagram.

1. Introduction

This presentation introduces existing systems and maintenance options in order to fully exploit resources available on a ship. By implementing these methods and systems it is possible to use a higher percentage of generated power.

2. Sankey diagram

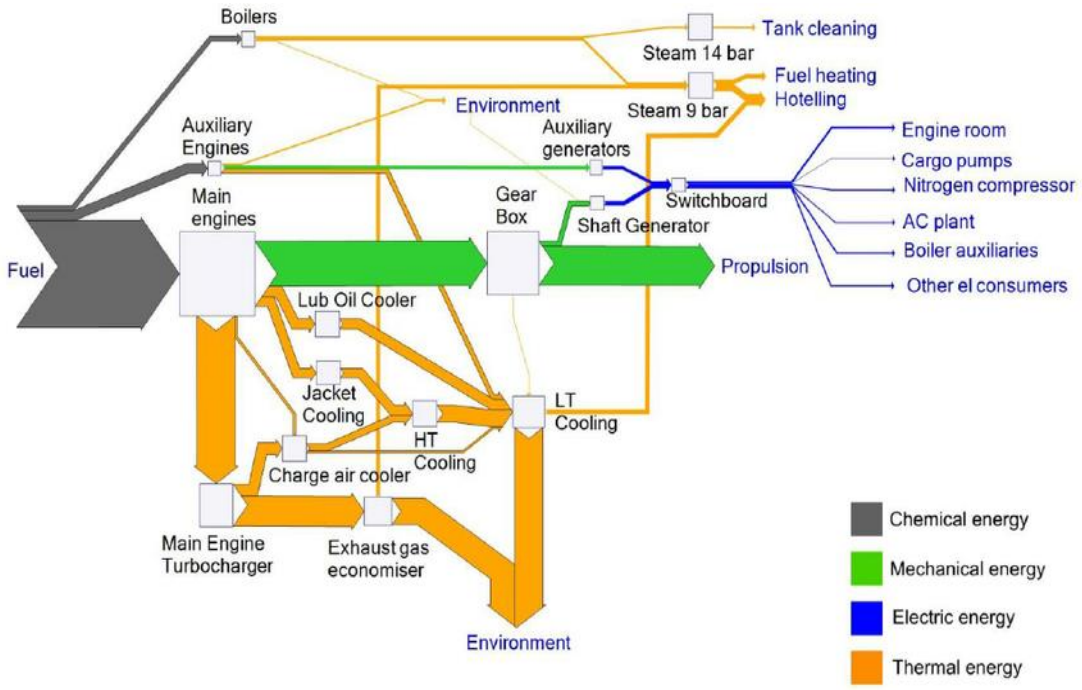

Fig 1: Sankey diagram[1]

This diagram, figure 1, shows energy consumption of all systems on a ship. Main engine uses almost 90% of energy input while 70% is used on propulsion. Most of the systems potential for a better usage of energy lies in exhaust gas (41%) manipulation. Exhaust boiler consists of economizer, evaporator and super heater and with it is possible to use the heat energy of exhaust gas. Economiser is used to preheat the feed water before entering the main boiler, evaporator is placed in recirculation of the steam generation plant and finally super heater is being used to superheat the saturated steam and transmit it to high pressure turbines of the turbo generator. The low-pressure turbine blades use almost all

[1] Francesco Baldi, Hannes Johnson Von Knorring, Cecilia Gabrielii, Karin E Andersson, Energy and exergy analysis of ship energy systems - The case study of a chemical tanker, ResearchGate , June 2014

generated superheat energy. Increased pressure in steam generator ensures higher efficiency. For better efficiency the turbine exhaust steam has to be condensed, by calculations it is shown that systems with condensers have 37% increase of efficiency. [1]

Very low efficiency of all auxiliary heat consumers could be overcome by using a different heat transfer fluid or, in alternative, steam at a lower pressure. Less than 9 bar steam could be used to reach temperature of fuel handling (70-80°C) apart from HFO(90-100°C). It would be possible to generate the same heat requirements while using much lower heat-grade sources.[1]

3. Shaft generator

Implementing this system it is possible to reduce fuel consumption where it is driven by the main engine that uses less expensive heavy fuel oil or LNG. The realisation of this system is now possible with frequency converter to ensure the maintenance of the network frequency. There is no need for additional panels on the main switchboard where it can adapt to shore supply voltages and frequencies.

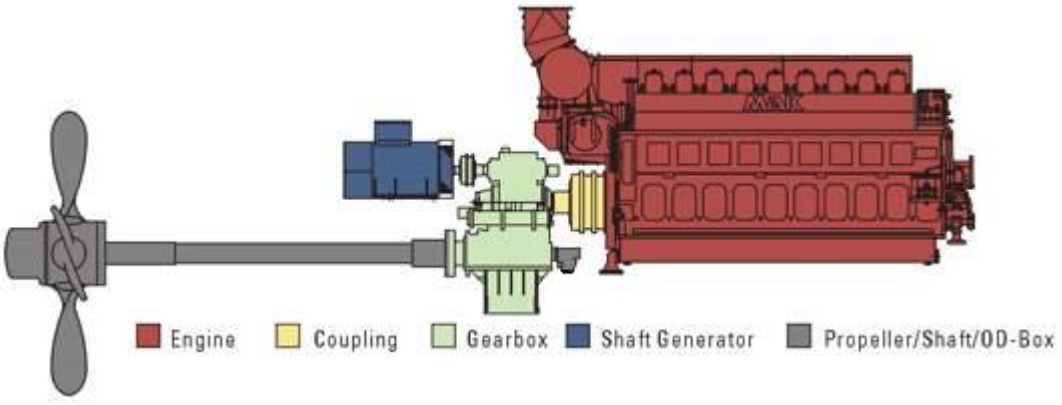

Fig 2: Main engine, shaft generator and propeller [2]

4. Conclusion

Energy efficiency in maritime engineering is a very popular topic nowadays but also a very big subject. This paper has only scratched the surface but it shows some interesting solutions

[1] Francesco Baldi, Hannes Johnson Von Knorring, Cecilia Gabrielii, Karin E Andersson, Energy and exergy analysis of ship energy systems - The case study of a chemical tanker, ResearchGate , June 2014
[2] Martin Leduc, The marine Diesel engine, Part two: The four stroke engine, Martin's Marine Engineering Page, 2001

to these problems. The hope behind this seminar is to rise interest and encourage further research. A lot of energy is being wasted through heat and mechanical energy that is not being fully exploited.

Reference

[1] Francesco Baldi, Hannes Johnson Von Knorring, Cecilia Gabrielii, Karin E Andersson, Energy and exergy analysis of ship energy systems - The case study of a chemical tanker, ResearchGate , June 2014

[2] Martin Leduc, The marine Diesel engine, Part two: The four stroke engine, Martin's Marine Engineering Page, 2001