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MULTIPLE WAYS TO SAVE ENERGY ON MEDIUM-SIZE HEAVY LOAD VESSELS

STG Ship Efficiency 2021

SAL Engineering investigates several development projects to increase the energy efficiency onboard ships. Some cover the general energy efficiency actions which can be applied to almost any ship. In addition, we study ship specific options, in this case for medium-size heavy load vessels, of which some will be presented in this conference. These actions can be divided into two categories: Improvements for the existing fleet in way of retrofit as well as energy savings for newbuildings.

Existing fleet

Three projects will be discussed for energy savings on existing ships: A hydrogen generator, the improvement of the combinator mode as well as a battery implementation study.

First, a hydrogen generator was installed as a pilot project onboard MV Annette for an auxiliary engine type Volvo D30. This was the first maritime application worldwide. The functionality was verified by an extensive test program on a testbed at FVTR Rostock. With the support of the engine maker and clarification with flag and class, a commercial framework was set up for the second generation of hydrogen generator to be installed on a series of 6 sister vessels of SAL Heavy Lift. This is the first permanent maritime application, the first for the main engine as well as the first for all auxiliary engines.
This technology reduces the CO2 emissions of these vessels by 10-15%, an approximately 2600 t CO2 per year per vessel, the nitrogen oxides by 30 to 80% and the particles up to 40%.

Second, medium-sized heavy load vessels are commonly equipped with a 4 stroke medium speed engine as well as a controllable pitch propeller. In addition, they are equipped with a PTO, initially installed to improve the energy efficiency of the ship. This requires the main engine to run at a constant speed and the pitch of the propeller determines the thrust. This results in efficient engine operations, however, it impacts the propulsion efficiency.
Onboard measurements and analysis have been conducted for several speeds, load and propeller pitches. The goal is to obtain an operation related engine performance and propeller curve contributing to a load depending combinator curve. Finally, a frequency drive shall be designed for this specific PTO and operational profile. This shall improve the SFOC of the engine, the propulsion efficiency and the overall performance of the ship.

Third, the implementation of batteries onboard has been studied for the common reasons to reduce the peak loads of auxiliary engines and to run them on a more optimal load. For these specific heavy load vessels, the crane operations in harbour are analysed. Besides the peak shaving, energy can be refeed from the braking energy during load lowering. The loads are relatively little resulting in small batteries for peak load assistance of the auxiliary engines. These are commercially realistic in comparison to large batteries for replacing generators due to high investment costs and relatively small fuel savings. However, these are interesting for newbuildings when the amount of AEs can be reduced during the design stage.

Newbuilding

The energy-saving options for newbuildings are more versatile and on a larger scale due to the possibility to influence the energy efficiency during the design stage. Thanks to current technology, first, the operational profile can be measured in almost every detail and analysed correspondingly. The approach continues with a hull form development including seakeeping as well a suitable propeller design for exactly this profile.

The hull form has been optimized in calm water using a potential flow code. The bow wave was reduced by 1m compared to the initial hull, followed by a smoother forward shoulder and transom resulting in a lower wake field.

Regular waves are added to the resistance before calculating the resistance in irregular waves via a transfer function.

The aft ship is analysed for the propeller design to reduce the pressure pulses and cavitation sensitivity. Draft variations are investigated to represent the operational variety especially for these vessels and operation profiles.

The seakeeping behaviour of the vessels is highly relevant due to client requirements on accelerations of cargo and safe lashing. The analysis includes a simulation of real data with a defined load case as well as the calculation of ROAs and lever arms. These add to the prediction of parametric roll and motion analysis.

Last, hatch covers are heavily important for heavy load ships, first, for the possible loading and intake and second, for efficient operation. This saves time which can be used at sea resulting in lower average speed and lower consumption. From a structural point of view, a hatch cover standardization is missing resulting in high class requirements and operational wise limited capacity of the hatch covers. This deviation is reduced in the study resulting in a more customized hatch cover providing the possibility to transport load without weight spreading. This saves planning, equipment and welding contributing its part to less time in port.

Outlook

The discussed methods represent some of the currently ongoing energy-saving projects inside our group. Further, we constantly create ideas for future projects, internal ones but also in public research projects. The future looks bright with the current research projects, available tools and competent engineers. This way SAL wants to contribute to a more efficient shipping industry and reduce the carbon impact induced by us.