CHALMERS
UNIVERSITY OF TECHNOLOGY

Concept design for an ammonia and/or hydrogen driven ship

(Scientific fields: Energy systems, Naval architecture, marine engineering, Risk assessment)

Background

The UN agency for international shipping, IMO, has agreed to reduce greenhouse gas (GHG) emissions from shipping by at least 50% by 2050 and to continue to phase out GHGs as soon as possible in this century. The Swedish government has also set a target for how state-owned vessels can reduce emissions by 70% by 2030 and be fossil-free by 2045 (Trafikverket, 2019). In both industry and politics, there is an interest in more knowledge about various marine fuels and technical solutions which could contribute to ships without GHGs. It is urgent since the sector is growing fast and ships that are built in the coming years will be used until 2050.

More knowledge is needed on low zero carbon shipping for actors that are involved in the complex task of choosing marine fuels and propulsion technologies with low environmental and climate impact. Hydrogen and ammonia are interesting potential future marine fuels, but more knowledge is needed on how they can be used on a ship.

Aim and approach

The overall aim of the thesis work is to develop a conceptual design of a case study vessel using ammonia and/or hydrogen as the main energy carrier. The case study will be representing costal or short sea shipping (the selection of will be done during the autumn 2021). The main parameters of the vessel and mission profile will be provided – the focus of the thesis work will be on the propulsion system design including fuel storage and supply systems and power conversion technology options (fuel cell and/or internal combustion engine). It is the second case study assessed in the research project “Hydrogen, ammonia and battery-electric propulsion for future shipping” funded by the Swedish Transport Administration’s industry program Sustainable shipping led by the Swedish Maritime Competence Centre (Lighthouse). A simplified risk assessment will be carried out on the case study designs to identify hazards and ensure that risks associated with the options are at acceptable levels. Possible risk mitigation measures will be identified. The conceptual design will form the basis for an assessment of the life cycle cost and environmental performance of

the concepts. The thesis workers need to cooperate closely with the project group in the research project "Hydrogen, ammonia and battery-electric propulsion for future shipping" consisting of participants from IVL Swedish Environmental Research Institute, Chalmers and SSPA.

Tasks

The project will include as a minimum the following tasks:

- Literature study on use of ammonia and hydrogen as ship fuel, focusing on power conversion and fuel storage
- Analysis of operational profile / route and development of sizing of components and minimum fuel storage requirements
- Developing a general arrangement layout for electrical propulsion, power converter and the energy storage system, considering risks associated with the options are at acceptable levels.
- Description of how the proposed general arrangement impacts the ship's stability
- Writing the thesis report and presenting it in a public seminar.

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