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Editorial

Ship Lifecycle

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With growing concerns of marine pollution, the International Maritime Organization (IMO) has recently adopted a new Resolution MEPC.304 (72), presenting a strategy on curbing greenhouse gas emissions (GHGs) from shipping. Along with this, a series of stringent regulations to limit emissions from shipping activities has been produced at both the international and local level. Such ambitious regulatory works urge us to trust that cleaner production and shipping is one of the most urgent issues in the marine industry.

In order to contribute to global efforts by addressing the marine pollution from various emission types, this Special Issue of the Journal of Marine Science and Engineering was inspired to provide a comprehensive insight for naval architects, marine engineers, designers, shipyards, and ship-owners who strive to find optimal ways to survive in competitive markets by improving cycle time and capacity to reduce design, production, and operation costs while pursuing zero emission.

In this context, this Special Issue is devoted to providing an insight into the latest research and technical developments of ship systems and operation with a life cycle point of view. The goal of this Special Issue is to bring together researchers from across the entire marine and maritime community into a common forum to share cutting-edge research on cleaner shipping. It is strongly believed that such a joint effort will contribute to enhancing the sustainability of marine and maritime activities.

Six novel publications have been dedicated to this Special Issue. First of all, as a proactive response to transitioning to cleaner marine fuel sources, the excellence of the fuel-cell based hybrid ships in several aspects was demonstrated through three publications. Jeon et al. [1] investigated the technical applicability of a molten carbonate fuel cell (MCFC), which is applicable for medium and large-sized ships by means of actual experiment on a hybrid test bed with combined power sources: a 100 kW MCFC, a 30 kW battery bank, and a 50 kW diesel generator. Research outputs demonstrated the technical reliability of MCFC applications on large vessels. Jeon et al. [2] focused on evaluating the safety and reliability of fuel cell-based hybrid power systems applicable for large ships. They adopted the failure mode and effects analysis (FMEA) method with risk priority number (RPN) to evaluate the potential risk of fuel cell systems, providing guidance on the proper approaches into the safety evaluation of marine fuel cells. Roh et al. [3] estimated the economic and environmental impacts of a fuel-cell system. Experiments with the test bed with the hybrid power system were conducted. While applying actual operating conditions for ocean-going ships, fuel consumption, CO_2 emission reduction rates of the hybrid, and conventional power sources were measured. The analysis results from the data of several merchant ships in operation have now revealed the sensitivity of different operating modes on the actual electrical power consumption. The CO_2 emissions of the hybrid system was compared with the case of the diesel generator alone operating in each load scenario where an average of 70%~74% reduction for both fuel consumption and CO_2 emissions was concluded. This research confirmed the excellence of fuel-cells being used as ship power systems. In addition, Jeon et al. [4]

introduced an excellent Active-Front-End (AFE) rectifier applicable for a large electric propulsion ship system. Through a series of simulation, they confirmed the technical maturity of the AFE rectifier as well as the feasibility of the system.

Two publications demonstrated the application of life cycle assessment (LCA) for case studies. Hwang et al. [5] performed a comparative analysis between the conventional diesel fuel oil and liquefied natural gas (LNG) for a 50,000 dead weight tonnage (DWT) bulk carrier, which was the world's first LNG-fueled bulk carrier. Studies have shown that the emissions levels for LNG cases are significantly lower than for MGO cases in all potential impact categories. Gualeni et al. [6] introduced LCA for ship maintenance as a performance assessment (LCPA) tool, which could allow an integration of design with the evaluation of both costs and environmental performances on a comparative basis. An examination of both of these studies concluded that life cycle assessments could provide a better understanding of the overall emissions levels contributed by marine fuel from cradle-to-grave. These conclusions would address the shortcomings of current maritime emission indicators.

From cradle-to-grave, a ship is engaged in various activities, leading to cost investment, energy consumption, and emissions production. This Special Issue has broadly dealt with various aspects of cleaner ship performance and will offer insights into the marine industry with an LCA approach for the application of sustainable energy in marine power systems.

Conflicts of Interest: The authors declare no conflict of interest.

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