

Eco-friendly Hybrid and Battery Propulsion and Power Supply Systems for Coastal Vessels



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Reducing greenhouse gas (GHG) emissions is an urgent challenge to mitigate global warming, and to this end, the development of ships with excellent environmental performance is required. As a system integrator, we have developed hybrid propulsion and power supply systems as well as battery propulsion and power supply systems that utilize our proprietary gas engines, thereby significantly improving the environmental performance of ships.

Introduction

Reducing greenhouse gas (GHG) emissions is an urgent challenge to mitigate global warming. As environmental restrictions have been tightened in the marine industry as well, the development of ships with excellent environmental performance is required.

1 Background

In July 2023, the International Maritime Organization (IMO) adopted GHG reduction strategies for the international maritime industry. The IMO aims to achieve net zero GHG emissions by around 2050 and has set gradual reduction goals to do so.

Momentum for GHG emissions restrictions is also increasing in Japan, and the Ministry of Land, Infrastructure, Transport and Tourism raised the goal for reducing CO₂ emissions attributable to non-international coastal trading from 15% to 17% by FY2030 compared to FY2013.

Though individual pieces of equipment have been improved in conventional ships, such as enhanced hull forms and improved engine and propeller performance, further performance improvements are now required to respond to these rising social needs.

To attain this ambitious goal, we decided to achieve optimization by considering the amount of necessary

energy for each ship as a whole. We have developed two systems in order to propose the optimal configurations according to ship operations and cruising distances.

2 Hybrid propulsion and power supply system

The system shown in **Fig. 1** is suitable for long cruising distances as it electrically couples the main engine, which serves as the propulsion power source, and the generator, which functions as the onboard power supply, to achieve optimal supply for ship operations so as to realize energy-efficient operation. This system has the following features.

- ① High environmental performance achieved in combination with a pure LNG engine

The combination of our proprietary pure LNG engine, Kawasaki Green Gas Engine L30KG (**Fig. 2**), and a battery achieves high environmental performance.

- ② Improvement of fuel economy

The fuel economy of ships drops when engine loads fluctuate due to climate and hydrographic conditions. By using the battery to limit the impact of this load fluctuation on the engine, we can significantly improve fuel economy, especially in rough weather.

- ③ Zero emissions in ports

In situations in which the required propulsion power is small, such as in ports, the system enables zero-emissions travel when powered solely by the battery.

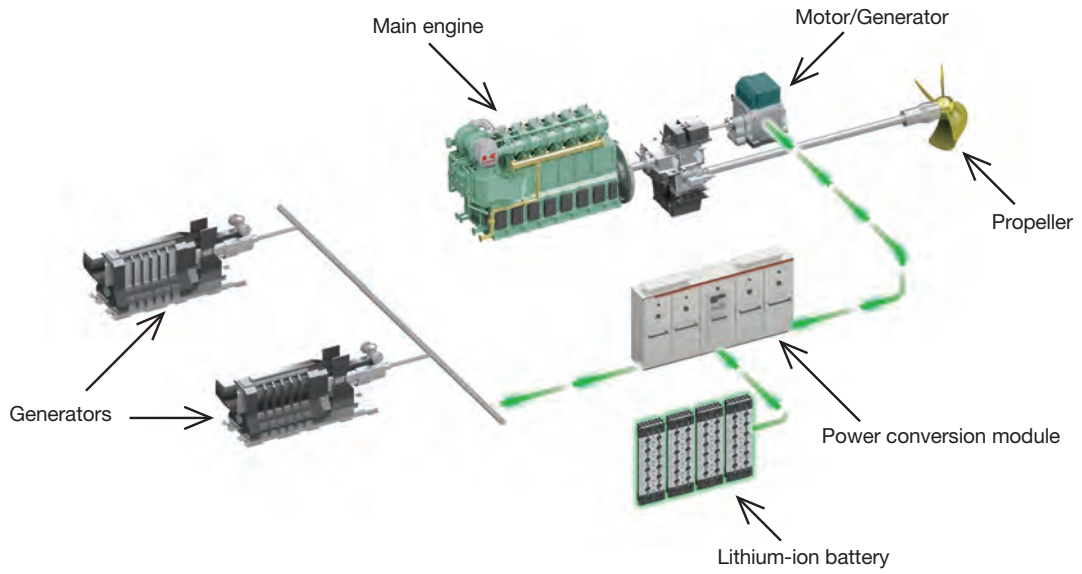


Fig. 1 Hybrid propulsion and power supply system

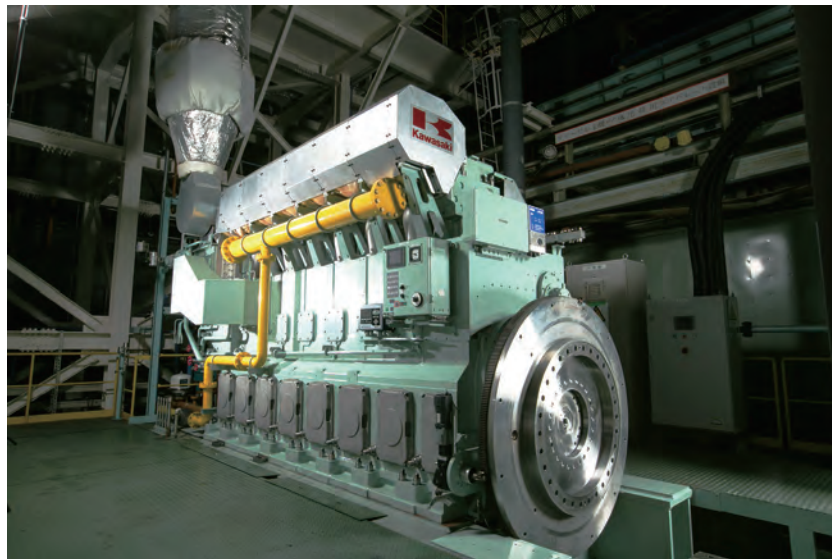


Fig. 2 Kawasaki Green Gas Engine L30KG

④ Safety enhancement

Even if the engine is inoperable, the ship can continue navigation with battery power.

3 Battery propulsion and power supply system

The fully battery-powered system is suitable for short cruising distances. This system has the following features.

① Zero emissions

The ship does not emit any GHG during operation.

② Reduction in vibration and noise

Free of engine vibration and noise, the ship does not cause a nuisance to the crew or people living near ports.

③ Power supply to land in disasters

The ship can supply electricity stored in its battery to land as an emergency power supply in the event of a natural disaster.

④ Crew workload reduction

Crew workloads are significantly reduced because the ship does not require a warming-up operation or main engine maintenance.

4 Delivery and implementation cases

To make the most of the features of each system, appropriate equipment and a system configuration must be selected according to the application and cruising

distance of the ship. We can propose the optimal propulsion and power supply system for ship operations by leveraging our rich experience accumulated over many years as a marine equipment manufacturer.

(1) Limestone carrier

We have received an order for the gas engine hybrid propulsion and power supply system to be installed on a limestone carrier that NS United Naiko Kaiun Kaisha, Ltd. plans to operate. The system properly controls the gas engine, motor/generator, and 2.8-MWh large-capacity battery to achieve optimal operation for GHG emissions reduction. The carrier can reduce CO₂ emissions by about 30%, NO_x emissions by about 90%, and SO_x emissions by about 100% compared to conventional carriers of the same type at normal output, and it reduces methane slip. In other words, this is a very environmentally friendly carrier. The carrier is planned to be completed in 2024.

(2) The world's first pure battery tankers, Asahi and Akari

The world's first pure battery tanker incorporating our battery propulsion and power supply system, Asahi, was completed in March 2022 (Fig. 3). This carrier, which was



Fig. 3 Pure battery tanker Asahi

(Source: Asahi Tanker Co., Ltd.)

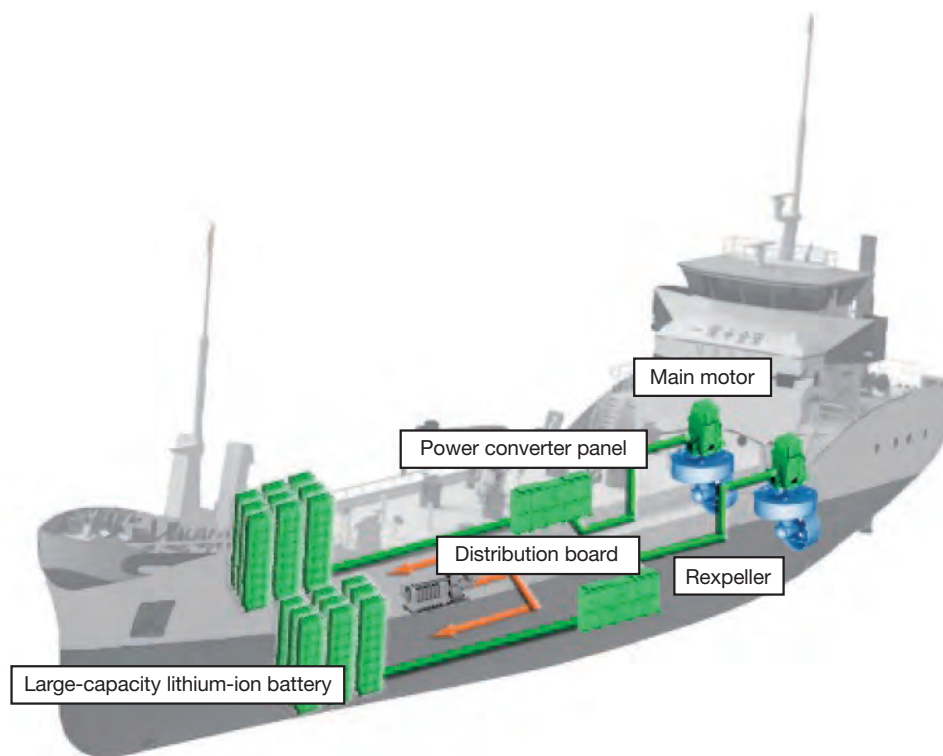


Fig. 4 Installation of main components

ordered by Asahi Tanker Co., Ltd., achieves zero emissions during operation by using electricity stored in a 3.5-MWh large-capacity battery for propulsion and power supply. **Fig. 4** shows the installation of the main components, which we were in charge of. Its sister ship that employs the same system, Akari, was completed in March 2023, and both are now used to supply marine fuel in Tokyo Bay.

Conclusion

We will continue to contribute to improving the global environment, aiming to popularize environmentally-friendly ships that employ this system.

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