Benefits of batteries in icebreakers

Battery technology has been evolving and is today increasingly used in both hybrid and fully electric vehicles. Aker Arctic is investigating the benefits of using batteries in icebreakers, not only to reduce harmful emissions to the atmosphere, but also to improve operational capability.

In today's maritime world, batteries are used daily in smaller fully electric vessels, such as car ferries, as well as in bigger cruise ships where they allow short-term operations without main engines. Battery prices have decreased, and there are products available both for fully electric and hybrid use.

However, there are still many open questions regarding durability in vessel use; how battery capacity may decrease over time, safety, and how upgrades can be made as technology develops.

"The technology is still evolving and not one specific solution has yet had a breakthrough, as the various technologies all have their benefits and disadvantages," says Antero Jäppinen, head of Aker Arctic's IT and Electrical Design.

Use in icebreakers

According to Aker Arctic's ongoing research, batteries could be beneficial in modern icebreakers as part of a hybrid machinery system, where batteries function as an additional energy storage between the power generation and electric propulsion system.

"Dual-fuel engines operating in gas mode have a limited capacity to respond to sudden load variations," explains Naval Architect Tuomas Romu. "The usual solution is to install oversized electric propulsion motors with additional torque capacity, referred to as overtorque, to maintain a stable power level as the propeller slows down due to ice interaction. Instead, batteries capable of storing and quickly releasing energy could balance the power demand and offer lower fuel consumption and emissions in long-term operation."

Furthermore, in operational icebreaking situations where power demand can be instantaneous, a battery pack could reduce the number of engines required to be online at any given time and allow the power plant to run at a more fuel-efficient load level. However, the complex equation of sizing the battery pack, amount of usable and available additional energy, system lifetime and cost must be calculated case by case.

"One incentive to make battery packs more attractive could be new legislation related to the reduction of emissions and emission control," adds Jäppinen.

Scandline's 2016-built hybrid ro-ro ferry Berlin, which operates on the Rostock-Gedser route, features a 1.5-megawatt-hour (MWh) battery system.
Photo source Pixabay

Fuel savings with batteries

Currently, batteries are not suitable for entirely replacing traditional fuel in icebreakers.

"However, they can be used in situations where the icebreaker is in waiting mode between icebreaking duties," Romu says.

Other realistic options include quick icebreaking duties within a harbour basin where the icebreaker can recharge on-shore between tasks.

Future in icebreaking

The benefits to the environment of using batteries are clear. Additionally, a large centralized power station is generally more efficient and releases fewer emissions per energy unit than a small diesel engine.

For long-term icebreaking, on the other hand, the energy density in batteries is not yet enough: the primary energy still has to be produced onboard with the vessel's own power plant.

"One solution to this could be using hydrogen fuel cells, a technology which is being tested also in Finland," Romu adds.

R & D project

Aker Arctic is currently conducting a research project, where the use of various alternative energy sources in icebreakers is simulated and investigated.

"Icebreaking and cold temperatures pose additional challenges to the use of alternative technologies. We continue to follow the development in this field, and very likely the next generation of icebreakers will already include some kind of battery solution," Romu says. ■