

"Green methanol" will power innovative mtu marine engines

Heading for the future with e-methanol: Rolls-Royce develops high-speed mtu methanol engines as a game-changer for climate-friendly shipping.

Methanol is one of the world's most widely used chemicals - and as "green methanol" it has the potential to shape the energy revolution in marine propulsion systems, for example for tugs, yachts, fast ferries and coastal shipping. It is precisely this future that Rolls-Royce is currently making a reality with the development of a new engine for its mtu brand: "We are already using methanol as a fuel on a daily basis in thermodynamic tests with our technology demonstrator on the test bench," explains Mathias Müller, technical project manager for development projects at Rolls-Royce's Power Systems business unit. Müller and his team are working on a high-speed, methanol-fueled gasoline engine for commercial shipping. "In the second half of the 2020s, we will need such solutions!" reminds Müller of the urgency of the development.

Clear commitment to methanol as fuel for green shipping

At the presentation of the development project last December, Denise Kurtulus, Vice President Global Marine at Rolls-Royce Power Systems, already underlined the importance of the project: "With the new development of mtu methanol engines, we want to lead the way as pioneers in the marine industry," she said. She added that the company is clearly committed to e-methanol as a fuel for green shipping. The new mtu engine is intended to set standards - so the project has the potential to be a real game-changer.

Why Methanol?

Mathias Müller, a 34-year-old mechanical engineer, lists the advantages of the concept, whose development will also be funded by the German Federal Ministry of Economics and Climate



Protection in the "MeOHmare" project starting in the fall of 2022: "'Green methanol,' so-called e-methanol, has the advantages of a liquid, energy-dense fuel for mobile applications," Müller says. "In addition, we expect its production to be economically competitive and advantageous over other e-fuels in the future. Methanol as a common chemical product is traded and transported worldwide and is, in principle, globally available. The required modifications to existing infrastructure are less than for other alternative gaseous fuels." These points give e-methanol an edge over pure electric propulsion and hydrogen-fueled energy converters in the aforementioned marine applications, as well as over solutions using other e-fuels.

Diesel, gas and methanol engines: what remains, what changes?

The mtu methanol engine will operate according to the Otto process, which has so far been used in the brand's engines mainly in gas engines. Rolls-Royce Power Systems has extensive experience with liquid fuel, primarily through its diesel engines. However, methanol (chemical formula: CH_4O) differs fundamentally from diesel in many chemical and physical parameters. These range from specific energy content, density, evaporation properties and ignition energy to viscosity and lubrication behavior.

"The changes required in the methanol engine compared with existing engines are significant," explains Müller: "This applies in particular to many subsystems, from injection and turbocharging to the entire cylinder power unit, the lubrication circuits and the engine control system." Rolls-Royce can draw on experience from the development of the mobile gas engine to present marketable concepts as early as possible. For example, there is overlap in terms of safety concepts and the modifications required to integrate the engine into the ship. Natural gas and methanol are fuels with a low flash point, for which special safety precautions must be implemented on ships.

A "Silver Bullet" does not exist

Denise Kurtulus, Vice President Global Marine at Rolls-Royce Power Systems, is certain that the development effort will be worthwhile. After all, given the wide variety of marine applications, there will not be a single solution for environmentally friendly marine propulsion systems of the



future. "No such 'silver bullet' exists," she stresses. Instead, she says, there needs to be a variety of solutions based on renewable energies.

It is obvious that e-methanol, as a CO₂-neutral fuel for Rolls-Royce, is well ahead in this race of innovations. It meets the requirements of an e-fuel because it is produced from hydrogen and CO₂ with the aid of wind or solar energy. For on-board storage, it requires significantly less space than would be needed for hydrogen in fuel cell drives or for batteries with the same range. In addition, methanol is less toxic than other e-fuels, such as ammonia. Production costs are also expected to fall faster than those of e-diesel due to economies of scale.

Leverage existing methanol infrastructure

A major plus for ramping up the new technology will be its ability to build on existing infrastructure for methanol, says Müller: "Dealing with conventionally produced methanol as a chemical feedstock is now well established in ports and other areas, so switching to e-methanol as a fuel presents comparatively fewer challenges than with other e-fuels." This defuses the "chicken-and-egg" discussion that always arises when new drive technologies are introduced: Does the infrastructure have to be built up in the area first, or do we first need a relevant mass of consumers for the new energy source? This question is familiar both from battery-electric cars and from hydrogen-based fuel cell technology.

Methanol engine and fuel cells as a duet

In Rolls-Royce Power Systems' broad-based Net Zero strategy, the high-speed engine powered by e-methanol is one of many solutions. But internal combustion engines will not become the sole energy converters of large ships, as they have been in the past. Fuel cells will also be used. This is because fuel cells powered by hydrogen produce no harmful emissions whatsoever, neither CO₂ nor nitrogen oxides or particulates, and have a very high level of efficiency. "Each of these developments has its own strengths that are particularly important for the respective customer," says Denise Kurtulus. E-methanol may play a role in other applications in the future beyond the new engine for commercial shipping. The fuel can also be used in combustion engines using the diesel principle, or with the help of a reformer to produce electrical energy in



fuel cells. It is also this versatility that could make e-methanol one of the most important fuels of the future.

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