Cleaner alternatives to heavy fuel oil

Quadrise's emulsion fuel technology will create a sustainable pathway to reduce costs

There is concern in the marine sector that future demand for biofuels will surpass supply availability, in part due to feedstock competition from the road and aviation sectors.

Quadrise's Oil-in-Water (OIW) emulsion fuel technology provides an innovative solution to this problem, allowing ship owners to unlock cheaper, low-carbon biofuel streams that were previously inaccessible for energy sector use.



bioMSAR™ technology provides an immediate solution to decarbonise the marine sector

What are oil-in-water emulsion fuels?

As the name suggests, an OIW emulsion fuel combines two notoriously immiscible phases, oil and water, to create a stable fuel blend using small quantities of surfactants.

Quadrise's proven bioMSAR™ emulsion fuel combines 50% of an oil component (heavy fuel oil, HFO, or heavy residue which can be high or low sulphur) with 40% waste glycerine and 10% water and surfactant mixture.

Glycerine is a non-toxic, low-carbon by-product from the manufacture of biodiesel that is traditionally immiscible with current marine fuels.

With bioMSAR™ technology, glycerine blending is now a viable and immediate solution to decarbonise the marine sector.

The manufacture of OIW emulsion fuels like bioMSAR™ is simple. The oil component is blended with the water phase stream in a high-shear colloid mill.

This process pre-atomises the heavy oil into droplets of around 5-10µm (smaller than the width of a human hair) in size and suspends them within the water phase.

The pre-atomised droplets are far smaller than HFO or diesel droplets atomised within an engine (around 80 µm), which results in enhanced engine efficiency of circa 5% and a significant reduction in black soot emissions when burning bioMSAR™, as the pre-atomised droplets combust completely, proportionately reducing fuel consumption and CO_2 emissions.

The presence of water in the fuel reduces the temperature of combustion, decreasing NOx emissions by around 30%.

The lower viscosity of bioMSAR™ also reduces the heating requirements for fuel storage and handling compared to HFO or biofuel blends of HFO with FAME such as B30. bioMSAR™ can be handled at ambient temperature (around 20-30°C), reducing energy consumption for marine applications as B30 is typically heated to much higher temperatures to use freely.

If a spill were to occur, bioMSAR™ readily disperses in water, causing less damage to marine life compared with HFO or biofuel blends. Owing to its high fraction of low-carbon glycerine, bioMSAR™ offers significant environmental benefits of over 20% CO_2 savings on a well-to-wake basis versus HFO.

On a per-unit energy basis, it is cost competitive with LNG in most locations and provides superior well-to-wake CO_2 reduction. bioMSAR™ requires little to no additional operational changes to burn in a diesel engine, unlike the high investment cost required to burn LNG.

Finally, there is no concern for 'methane slip' as methane is not present within the fuel.

bioMSAR™ is a competitive alternative to UCOME-based biodiesel blends such as B30. A CO_2 equivalent bioMSAR™ blend is cheaper on a cost-per-unit energy basis and testing has demonstrated no concern for microbial growth, which is a notable issue with biodiesel and B30 storage.

Moreover, bioMSAR™ qualifies for renewable credits in the EU as crude glycerine is featured as an advanced renewable feedstock on the RED II Annex 9A list.

Opportunities in the marine sector

The shipping industry accounts for around 3% of the world's greenhouse gas emissions. If left unabated, this may increase to 10-13% within a few decades[1]. The introduction of the environmental regulatory framework has been slow, but

is now gathering speed with mechanisms such as the EU Emission Trading Scheme (ETS) placing a price on carbon emissions and the International Maritime Organisation (IMO) Carbon Intensity Indicator (CII) ensuring gradual improvements in emissions are achieved by marine vessels. bioMSAR™ can deliver immediate benefits to schemes such as these.

The EU ETS will price maritime carbon emissions in the EU using a cap-and-trade scheme that requires shipowners to buy credits relating to the amount of carbon a vessel emits when travelling through the European Economic Area (EEA)[2].

The efficiency and subsequent fuel consumption benefits achieved by switching from FAME or UCOME blends to bioMSAR™ will reduce fuel costs and carbon payments to the EU ETS.

The IMO CII mechanism assigns a vessel grade ranging from A to E based on the carbon emissions it emits every year as a function of its size and weight[3].

Achieving a D or E grade requires corrective action to be taken with the grade boundaries becoming more strict each year.

Whether via traditional bunkering methods or Quadrise's Blend-on-Board system, bioMSAR™ will create a pathway to achieving these requirements, the company said.

Renewable glycerine or other biofuels could be gradually introduced into the vessel's fuel blend year-on-year to match the stricter grade boundary requirements, allowing the shipowner to balance regulatory obligations, CO_2 emission and cost.

bioMSAR™ experience

bioMSAR™ has undergone an extensive testing regime to confirm its high performance in marine applications.

Following completion of bioMSAR™ formulation testing in 2021, Quadrise has demonstrated bioMSAR™ in a high-speed four-stroke Cummins 40kW diesel test engine in collaboration with Aquafuel Research Limited, proving bioMSAR™ is viable as a diesel engine fuel. By advancing the injection timing in the engine and decreasing inlet air temperature, engine efficiency and NOx emission reductions were improved even further.

Pilot testing has recently been carried out by Wärtsilä Services of Switzerland as one of the precursors to a planned commercial-scale vessel trial with Mediterranean Shipping Company (MSC) Ship Management on the MSC Leandra, a 50,000 DWT container ship.

The findings from optical combustion and engine wear testing allow Quadrise to proceed to hazard identification and operability studies, also involving the Class Society, to assess feasibility and safe operability prior to use on a Wärtsilä two-stroke Flex engine.

Quadrise plans to supply bioMSAR™ to the MSC Leandra over a two-test regime starting later this year, initially with a 1,000mt proof-of-concept test followed by a 25,000mt operational test.

The validated performance of the fuel will be followed by a commercial supply.

In other sectors, Quadrise is conducting an industrial-scale trial involving bioMSAR™ for a Moroccan client and is holding commercial discussions for an upstream bioMSAR™ opportunity in Utah for end consumption in the power or marine sectors.

A zero-carbon future

Quadrise's bioMSAR Zero™ project aims to develop a

