MSAR®
Transforming Energy Economics

Multiphase Superfine Atomised Residue (MSAR®) technology provides an alternative use for the bottom of the barrel that can both enhance a refiner’s margins and create an advantaged fuel for a wide range of applications.

Quadrise International Ltd’s well-proven, low-cost MSAR® process can improve refiners’ margins by up to $3 per barrel. Refineries traditionally mix bottom-of-the-barrel residue with high-value distillates to create heavy fuel oil (HFO). Quadrise’s innovative technology, supplied under licence by AkzoNobel, mixes the residue with water instead to create an HFO substitute. This releases the refinery distillates for higher value uses.

Crucially, the residue in MSAR® has a thermal value that is almost equivalent to that of HFO. It can be used in boilers, furnaces and engines that are designed for HFO and, therefore, has a range of applications, including those in
- refining
- shipping
- power generation and industrial operations such as cement manufacturing
- upstream operations.

Moreover, MSAR® fuel offers benefits to end-users in two key areas:
- cost – MSAR® fuel can typically be manufactured and supplied at 10–20% less per unit of energy than HFO
- environmental performance - Typical NOx emission levels from burning MSAR® fuel are about 20% lower than those produced by HFO, and particulates (including black soot) are significantly reduced.

THE LOW-COST MSAR® PROCESS ENHANCES REFINING MARGINS BY RELEASING VALUABLE DISTILLATES THAT ARE TRADITIONALLY USED FOR HFO MANUFACTURE.

MSAR® – THE ADVANTAGES

- In the refinery, distillates are not needed to dilute the residue to create HFO, which enhances margins, as these distillates can be sold as high-value products.
- Instead, residue is mixed with water and special additives to create MSAR® fuel, for which there are many markets.
- For end-users, MSAR® fuel costs less than HFO – and also offers certain environmental advantages.
MSAR® technology draws on over 25 years of experience in the production of oil-in-water emulsion-based asphalts and fuels. A direct substitute for HFO, MSAR® fuel is establishing an enviable reputation as Quadrise engages with some of the largest corporations in the energy and transport sectors.

**MSAR® TECHNOLOGY**

**APPLICATIONS**

There are many applications for MSAR® fuel, as it can be used in boilers, furnaces and diesel engines that were designed for HFO. The HFO market is one of the world’s largest liquid fuel markets and exceeds 600 million tonnes per year (Mt/y).

**REFINING**

In addition to producing MSAR® fuel to enhance margins, refineries can also use it for their process heating needs and thereby cut costs. Joint studies with oil majors have identified that a refinery can be reconfigured in under 12 months, with any necessary tie-ins being incorporated into scheduled maintenance shutdowns. Quadrise works with customers to provide tailored design and operational experience to ensure that a smooth transition to the new process is achieved.

**IN A REFINERY PRODUCING HFO...**

- Typically, just 50% of the crude processed is sold as high-value premium transportation fuels.

**IN A REFINERY PRODUCING MSAR®...**

- Some 70% of the crude processed is sold as high-value premium transportation fuels.

**SHIPPING**

The international marine bunker market is one of the largest global HFO markets, and large international shipping companies could make major savings because of the lower cost of MSAR® fuel compared with HFO. Targeted savings are up to $200 million per year for larger users. As an example, Quadrise has agreements to develop and supply a marine version of MSAR® to the A.P. Møller-Mærsk Group.

In addition, the shipping industry faces serious challenges relating to emissions compliance. From 2020, any increase in the sulphur content of HFO must be dramatically reduced, which might require costly reconfiguration, or ship owners will have to deploy expensive on-board emissions scrubbing. Marine MSAR® fuel enables refiners to continue to supply the heavy residues from existing plants, thereby enhancing their profitability without expensive reconfiguration. The fuel savings made by the shipping companies could significantly contribute to the cost of on-board emissions scrubbing.

**POWER GENERATION AND INDUSTRIAL OPERATIONS**

Quadrise is working with some major consumers that could save at least $20 million per year by switching to MSAR® fuel. For example, PowerSeraya, one of Singapore’s leading power utilities, has signed a memorandum of understanding with Quadrise to fuel three of its nine 250-MW steam boilers on Jurong Island. Under the agreement, Quadrise will source residue from refiners around the world for the manufacture and supply of MSAR® fuel for these boilers.

**UPSTREAM OPERATIONS**

MSAR® fuel is especially suitable as an in situ energy source for steam raising for enhanced oil recovery or carbon sequestration of heavy crude in remote locations. The fuel can be produced on-site from the oilfield’s own production.

**HOW IT WORKS**

The MSAR® production process is relatively simple:

1. Residues are taken from refinery run-downs (typically, vacuum units or visbreakers) and treated to under 200°C to achieve the required viscosity (typically 300–500 cSt).
2. Water, which can be derived from several utility or waste-water sources, is added to the residue stream.
3. Special surfactants and chemicals are added to stabilise the emulsion for long-term storage and transport, and to promote complete combustion.
4. The mixture is processed in a proprietary MMu to a high hydrocarbon content (typically 70%) oil-in-water emulsion.

**COMMERICAL VALIDATION**

A major commercial trial in Lithuania at the 200,000-bbl/d ORLEN Lithuanian refinery near Mazeikiai has validated every facet of MSAR® technology, from refinery integration through manufacture, storage, dispatch and transportation to combustion.

Over a six-week period, the refinery manufactured 120,000 bbl (over 20,000 t) of MSAR® fuel in a continuous operation. The fuel was shipped 300 km by rail to the 1800-MWe Elektrėnai power station near Vilnius, which is Lithuania’s largest thermal power plant.

MSAR® fuel was used to fuel two 150-MWe boilers feeding power into the Lithuanian grid while complying with strict EU emission standards through the use of conventional flue gas treatment technologies.

**KEY COMPARISONS FOR END-USERS: MSAR® versus HFO**

- Compared with HFO, MSAR® fuel offers typically 10–20% cost savings per unit of energy.
- At least 20% lower NOx emissions.
- MSAR® is a pre-atmosed fuel with a hydrocarbon particle size of <5 μm (atomised fuel oil droplets are typically 50–100 μm) and therefore has enhanced combustion properties.
- Lower energy consumption. Unlike HFO, MSAR® fuel can be handled at ambient temperature and generally does not need to be heated for viscosity control.
- Emissions of sulphur dioxide and carbon dioxide are generally equivalent to those incurred from burning HFO.

**MSAR® ENHANCES MARGINS:** Because premium distillate fuels are replaced with low-cost water and a small amount (~1%) of additives, a higher proportion of the more valuable components of the barrel can be sold as higher margin products.
Perhaps you can identify with these situations

- In the present climate, margin improvement is a key issue for our refinery. Using valuable distillates in the manufacture of HFO appears to be a waste but there is no alternative. . . is there?
- Market outlets for our HFO are shrinking but heavy, viscous residues are unavoidable by-products of our process with the refinery configuration as it stands. However, we are unlikely to find the capital for a major project at the moment. Are there any simple, economic solutions that reduce HFO and, ideally, also increase distillate production?
- We burn HFO extensively across the site to fire our facilities, but it is becoming harder and harder to meet our environmental mandate. What can we do to reduce emissions from the site or justify investment in emissions control equipment?

Delivering Value

An MSAR® refinery upgrade can

- enhance margins through the increased yield of high-value transportation fuels
- have minimal operational impact
- provide an environmentally benign and economic alternative to investment in polluting and expensive complex upgrading technologies.

Moreover, the MSAR® fuel can be sold to customers in a range of applications that currently use HFO. MSAR® fuel not only costs less than HFO, it also offers certain environmental advantages.

About Us

Quadrise Fuels International plc (QFI) was listed on the London Stock Exchange AIM market in April 2006. The business focus was to establish MSAR® fuel as a lower-cost substitute for HFO.

Quadrise International Ltd (QIL) is a subsidiary of QFI. Its function is to commercialise the technology through licensing and establishing joint ventures that will build, own and/or operate MSAR® production facilities.

Many of the Quadrise in-house group of experts are from the core team responsible for the technical and commercial development of Orimulsion® (the only other successful oil-in-water emulsion fuel to be commercially established and formerly supplied to global consumers by Petróleos de Venezuela SA, PDVSA, until 2006). They provide the company with valuable insights into the large-scale manufacture and application of emulsion fuels.

Building on this unique experience, MSAR® fuel is now a second-generation emulsion fuel designed to supersede Orimulsion®, as the global demand for lower-cost energy continues to provide commercially viable opportunities for the application and use of Quadrise’s MSAR® fuel.

AkzoNobel, a world-leading specialty chemicals company, is a long-term Quadrise alliance partner. Its surface chemistry group has worked with Quadrise to advance the emulsion fuel technology to a new level, and supplies and licenses the MSAR® production units and the all-important chemical additive package.

Further Information

If you are interested in transforming your refinery economics by implementing a low-cost process to free valuable distillates that are traditionally used for HFO manufacture, please

Call us on: +44 20 7550 4930
Or email: info@quadrisefuels.com
Or visit www.quadrisefuels.com

Quadrise International Ltd, Parnell House, 25 Wilton Road, London SW1V 1YD, UK

This document is being supplied to you solely for your information and may not be reproduced, redistributed or passed to any other person or published in whole or in part for any purpose. The material in this document is not intended for distribution or use outside the United Kingdom.

It or any part of it does not form the basis of and should not be relied upon in connection with any contract. Neither A.P. Møller-Maersk nor AkzoNobel, nor PEMEX, nor PowerSeraya nor PKN ORLEN make any representation or warranty, express or implied, as to the accuracy of any of the content herein and accept no liability for the use of or reliance on this document and/or its contents by any other party. Neither QFI nor QIL shall be liable for any direct or indirect damages, including lost profits, arising in any way from the information contained in this material.

By accepting this document, you agree that you have read the above disclaimer and to be bound by the foregoing restrictions.

By the Numbers

- 600 Mt/y is the size of the global HFO market.
- 200 Mt/y is size of the marine bunker fuel market.
- >60 Mt is the amount of oil-in-water emulsion fuel that has been consumed worldwide since the 1980s.
- 4000 bbl/d is the residue processing capacity of each MMU (6000 bbl/d of MSAR®).
- >100 is the number of AkzoNobel production emulsion production modules that have been supplied worldwide.
- 50–100 μm is the typical particle size of HFO droplets before combustion.
- <5 μm is the particle size of MSAR® fuel droplets.