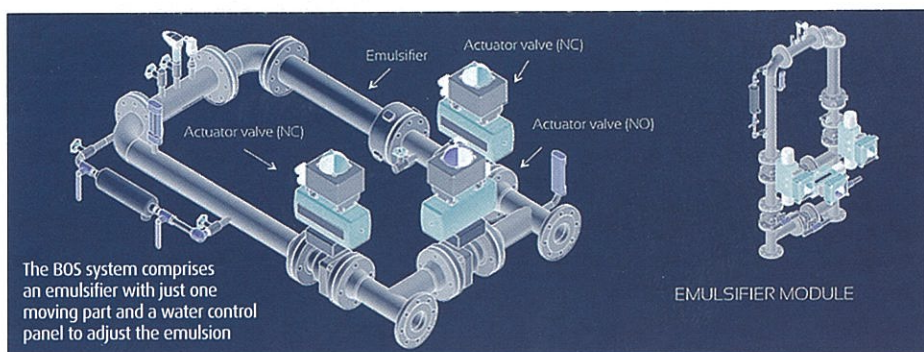


# Taking emulsions beyond proof of concept

While some suppliers and shipowners are only starting to trial emulsion fuels, Keppel Offshore & Marine subsidiary Blue Ocean Solutions has been active in the market since the 1980s and is already optimising its product for use with today's electronically controlled engines.



AFTER EARLY SEA trials starting in 1986, the Singapore-based company quickly settled on an emulsifier concept that uses the hydrodynamic shearing effect at the intersection of jets of fuel and water to create a stable emulsion. The patented system – now in operation on more than 120 vessels – has just one moving part (the water pump), and its parameters can be easily adjusted to produce the required droplet size (between two to eight microns depending on the fuel) and oil film distribution.

Compared to the more complex solutions that have been used to create water-fuel emulsions, including rotating homogenisers and ultrasonic systems, the BOS Emulsifier is incredibly simple, explains Jerry Ng, managing director of Blue Ocean Systems. “Very often when you see a homogeniser in an engine room it is sitting in the corner broken,” he says. “They use high-speed rotating parts with a fine tolerance, and it is a miracle if they are not quickly broken. Our system is much simpler to use and maintain.”

The company's robust system has won several repeat customers. APL uses the BOS Emulsifier on seven ships, while Diamond S Shipping runs two vessels on emulsified fuels, with one each running on emulsions of heavy fuel oil and marine gas oil. And Mitsui OSK Lines has used the system since 1986, and now has a BOS Emulsifier on 12 of its ships. Other customers with the BOS Emulsifier in permanent operation include Norwegian Cruise Lines, Regent Seven Seas and Wallenius Line.

That list of satisfied clients is one reason why BOS is not fazed by the difficulties that emulsified fuels specialists have found in obtaining letters of no objection from engine manufacturers. “We know the concept

works and we know that it doesn't damage the engine,” explains Ng. “In fact it clearly improves performance. Unlike other emulsifying systems, we can create a stable emulsification using MGO without additives. And it cleans the engine; when the emulsifier is turned on, the cleaning effect means that exhaust is black at first. Within 24 hours it becomes brown, and then clean.”

BOS has worked with both MAN Diesel & Turbo and Wärtsilä, on both two-stroke and four-stroke engines, and using both HFO and MGO. A study with Wärtsilä as part of the European Commission funded Hercules project investigated an MGO fuel emulsion with a two-stage turbocharged W6L20-CR engine with Miller timing. The trial showed faster heat release with an emulsion than with untreated fuel, with clear evidence of the secondary atomisation effect of emulsions (caused by the combustion of water-coated droplets). Wärtsilä and the project team concluded that “the water emulsion system improved engine performance, especially part load (below 60%)”.

“MAN Diesel & Turbo has also released its own guidance on using emulsified fuels in its engines,” notes Kaisa Honkanen, regional manager Europe and North America, Blue Ocean Solutions. “Along with the verification from the Wärtsilä study, we take these to be indirect letters of no objection.”

The company has also had its results onboard various vessels verified independently by class societies, among them DNV GL and Lloyd's Register, with a fuel consumption saving of between 2-5%. However until recently proving the system's impact on fuel consumption was a long and time consuming process, taking many months in order to compensate for the impact of short-term environmental changes on specific fuel oil

consumption. Also, ISO testing standards only provide accuracy and reliability to around 3%, making it difficult to identify savings below or around that amount. Similarly, the fuel consumption stated by engine manufacturers has a tolerance margin that makes identifying small savings difficult. Last year BOS pioneered a new testing methodology, running several short SFOC tests on fuel oil and emulsions at intervals of around two and a half hours. “Because you are working over a short period, you can be confident that external factors have not changed significantly,” explains Ng.

The new testing method provides greater confidence in a shorter time to potential clients, says Ng, and has already been accepted and used by classification societies.

It is clear that the BOS emulsification system has advanced well beyond proof of concept. In fact, the team is already tackling far more advanced and intricate problems – in particular the impact of modern engine control systems on emulsified fuels.

Today's engine governors and autotuning systems attempt to maintain fuel pressure at a maximum safe level in order to optimise performance. The challenge with emulsion fuels is that, because of the increased water content, a greater volume of liquid – and therefore a higher fuel pressure – is needed to get the same energy to the engine. This means that the fuel pressure for emulsions might exceed limits set by engine controls. In order to counter this, BOS is able to configure the controls on its emulsion fuel system to override the fuel pressure limits set by the built-in engine controls.

In a paper presented last year, the Ng and Honkanen noted: “The proposed solution was able to cater to the increased fuel index due to emulsified fuel, and also protects the engine and fuel pumps from possible damage. It has been successfully implemented on vessels at sea.”

Among those vessels are the latest four APL container ships to use the BOS Emulsifier: APL Barcelona, APL Havre, APL Paris and APL Qingdao. Analysis of the combustion data recorded by these vessels' data logging systems has revealed that the combustion efficiency of the engines when using autotuning and the BOS Emulsifier system was much better improved compared to the operation of either the emulsifier or auto-tuning separately.

That result rewards BOS' advanced understanding of the combustion of emulsion fuels and its commitment to verifying data. And the company is confident that its efforts will be rewarded as uptake of emulsion fuels continues to gather pace

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