Lubmarine

Shaping the Future of Marine Lubrication - How Market Demands are Driving Marine Lubricant Evolution

[continued from blog piece]

Predicting the Future - The OEM View

A significant portion of the new engine order book today is occupied with engines able to operate on a Dual Fuel basis, notably LNG and/or Methanol. But what does the future look from an OEM perspective?

MAN ES	WinGD
• Firmly behind NH3 as the dominant future fuel • Expect NH3 to surpass LNG & MeOH by 2030 • Anticipates NH3 DF engines to be 40% of contracts by 2030 • Commercially available NH3 engine by 2024 • Retrofit package to follow	• Both options remain on the table • Possibly betting on Ammonia • All engines in service are 'Fuel Flexible' today • New engines will support MeOH and NH3 by 2025 • Retrofit packs also in 2025

What is clear is that it seems there is no one size fits all solution today.

Challenges of Product Development - Completing the Formulation Puzzle

From a lubrication perspective, the multiple fuels landscape presents challenges that, as manufacturers, we have to address. Different fuels will potentially have different performance requirements, and collaboration across the industry – for example with engine OEMs - is vital.

When it comes to lubrication development the formulation puzzle includes key issues such as:

Finished product stability	Compatibility	Oxydation stability
Hydrolysis	Detergency	Dispersancy
Thermal stability	Corrosion	Wear protection

When formulating a lubricant, it is not as simple as selecting 'ingredients' and assuming they will work well when they are mixed.

We can have particularly good components for each specific purpose, but they don't always complement each other, meaning the researchers must reach a finely tuned balance of performance, stability, compatibility, and of course cost.

We also need time, and of course access to suitable engines, to study the effects of the proposed fuels on the lubricant.

TotalEnergies has invested heavily on Ammonia testing facilities which includes the conversion of some commercially available engines to run on NH3 so that we can begin to examine the effects.

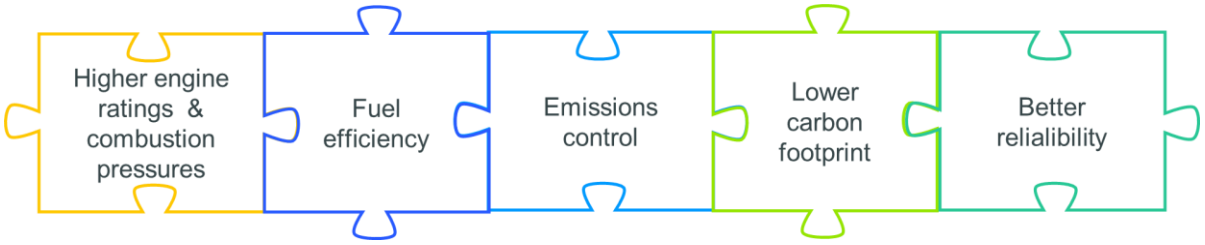
New Engine Designs and Cylinder Oil Specifications

Demands placed on cylinder lubricants by modern fuels and highly tuned engines mean that we must pay special attention to the key areas of the combustion chamber, the ring pack, the exhaust valve and especially the piston top land and top ring area.

TotalEnergies

For this we are focusing on low ash – for deposit control, and high detergency - for cleanliness.

We also need to look at key Operational Drivers including:



Importance of Ring Groove Cleanliness

The importance of good piston ring cleanliness cannot be overstated. This has been seen with the more recent Category II or HD – High Detergency cylinder oils recently introduced to the market.

So, our goal is to achieve:

✓	Proper sealing of the combustion chamber	Clean ring grooves (no deposit)	Free ring movement	Balanced stresses on the ring

Whilst avoiding detergency problems which, if they occur, can result in….

✗	Deposits on ring grooves	Limited sticky ring movement	Combustion gases blow-by	Imbalanced stresses / ring collapse danger

If we start to get a build-up of deposits behind the rings, in the grooves, this restricts the movement of the ring in the piston groove and that affects its ability to properly seal, leading to blow-by, putting excess stresses on the ring pack which may lead to failure, excessive wear and scuffing.

New Product Development Cycle

When we look at a typical lubricant product development cycle, we can begin to understand the complexities and time needed to deliver a viable, approved, product to the market.

First, we must identify the market needs, which takes into consideration any technical, environmental and regulatory requirements as well as any specific requirements requested by the OEM's.

From this we can begin to draw up a view of the desired specifications.

Next, we rely heavily on the expertise and knowledge we have in our research centres to formulate candidates using components that can be known, or they can be new molecules, which are screened and modelled before selected candidates proceed to the engine bench.

Following the performance testing and analysis of the bench test results, final candidates are ranked and discussed to select a candidate to move forward for field testing.

For a cylinder oil, the testing will range from 2000hrs for a first stage test through to 4000hrs or more for a full Non-Objection application to an OEM. This will often involve running the reference and candidate lubricants on a split engine. It requires at least two units to be overhauled and new parts fitted that are measured and recorded by the engine OEM. There are then intermediate inspections, generally non-invasive via the scavenge ports, before the final inspection where the candidate and reference units are dismantled, inspected and measured.

The process for a Trunk Piston engine would typically be 6000hrs or more and again two cylinders are normally overhauled at the start and end of the test, as well as interim borescope inspections. Assuming everything goes to plan we would hope to have a letter of non-objection, or approval, issued by the OEM.

It's at this point the decision is made whether to commercialize the product, or not. Not every product that reaches approval status is commercialized.

But the story doesn't end there, in fact it's just the beginning. From the time the first deliveries are made we start a process of monitoring the lubricant performance in a much wider set of circumstances than we could see with a field test. This data collection not only allows us to monitor the performance, but we also collect the data to support our future R&D work.

Separating BN from Cleanliness

Here we are looking specifically at 2 stroke crosshead engine cylinder oils.

When we consider the so called classically formulated products in the market, we are looking at BN 40, BN 70, BN 100 and BN 140 products.

They deliver an Ash Content Equivalent in addition to a Cleanliness Equivalent, of the typical BN value.

Until recently the market correlated Base Number, or BN, with cleanliness. Typically, the higher the Base Number, the higher the content of Calcium Carbonate and hence the greater cleanliness performance. It is sometimes referred to as the basicity of the product.

Generally, these products are formulated using the basic detergents of Calcium Sulfonate and Calcium Phenate. We refer to this as Conventional BN Chemistry.

When products are formulated with Calcium Carbonate, which is used to neutralize sulfuric acids formed during combustion, there is a balance to be found. Too much alkalinity and we can find deposits forming around the piston crown and rings which can be hard, lead to liner scuffing and piston rings sticking. Too little alkalinity and we risk having insufficient neutralization causing corrosion of the liner.

This Calcium brings with it, ash. As we begin to explore lubricants for future fuels it's clear that we must reduce the BN and the ash content, this therefore means less Calcium. But if we have said that we need the basicity (the calcium) to keep the engine clean, we face a challenge in reducing or removing it.
As far back as its launch in 2007, an early innovation of Lubmarine was Talusia Universal with a BN of 57 and a cleanliness equivalent of BN 70.

This product ripped up the rule book and gave operators the ability to use a BN 57 in place of switching with a BN 40 and BN 70 depending on the fuel they used, in and out of ECA etc.

It was one of the first oils to be DF validated by WinGD, and as demand for oils to fill the void of category II BN 40 increased it has performed with excellent results as an interim solution, again to avoid switching oils.

This oil gives us a reduction in ash content.

More recently MAN has asked lubricant manufacturers to come up with products that would have the cleanliness performance of a BN 100, these products are referred to by MAN as Category II cylinder lubricants. The demand also extended to having a product with the BN and ash equivalent of a BN 40 product.

Here we have our Talusia HD 40. With these products it seems we have reached the limits of conventional chemistry, and there is now a need to do something different.

New Lubrication Development - The Fuel Economy Innovation

To highlight the processes faced by lubricant manufacturers in developing new products, our latest solution - Aurelia FE - has been developed to provide 4-stroke engines with a significant decrease in fuel consumption thus delivering reductions in operating costs and CO2 emissions.

More recently the focus has shifted slightly from just looking at outright fuel economy, to the potential to deliver real life CO2 and emissions reduction, through fuel economy.

This becomes especially important with the recent introduction of the Carbon Intensity Index (CII) where an operator could offset some of their Carbon liability by simply switching to a fuel economy lubricant.

Aurelia FE BN20, BN30 and BN40 are multi-grade type lube oils designed with advanced chemical and physical properties for achieving fuel economy on engines running on MGO (BN20), VLSFO (BN30) or HSFO (BN40).

A successful test conducted on a passenger vessel has demonstrated an independently verified average fuel economy of 4.7% on main engines with good performance and reliability.

Whilst Aurelia FE is not yet approved by engine OEM's and is not yet fully commercialized, we have been supplying the product to a ROPAX operator as they found real benefit in the fuel economy performance.

Today we continue to innovate the Aurelia Fuel Economy concept and it is currently under test onboard a large cruise vessel.

Bench tests will shortly begin on the next generation of fuel economy lubricant.

Watch this space.

A More Complex Shipping Market Will Need More Specialist Solutions

As we have discussed the lubrication market is going to be an increasingly challenging one with multiple drivers shaping shipping operators' needs. Lubricant manufacturers will have to rise to these challenges through collaboration, expertise, research, development and investment to create specialist solutions to support shipping's journey to decarbonization.