



GreenPort

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Balancing Environmental Challenges with Economic Demands



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Environmentally friendly lubricants



Whatever you call them - bio oils or green lubricants, these environmentally 'acceptable' lubricants (EALs) are increasing significantly in their use, particularly where water is close-by, writes **Phil Cumberlidge**, Panolin International Inc.

Panolin EALs are being used by the ship-to-shore container handling cranes at the inland waterways Veghel Terminal



WHATEVER YOU CALL them - bio oils or green lubricants, these environmentally 'acceptable' lubricants (EALs) are increasing significantly in their use, particularly where water is close-by, writes Phil Cumberlidge, Panolin International Inc.

They have been used and approved in many countries, each issuing certificates of environmental compatibility. The emergence of the European Ecolabel has, in one certification, brought together a European-wide vision of many environmentally-friendly products of which lubricants, is one product sector.

However, one of the biggest leaps of environmental legislation relating to lubricants in recent times was when the US Environmental Protection Agency introduced its second Vessel General Permit in 2013 changed one key word - MUST, instead of SHOULD, that was stated in the 2008 VGP - '.....every ship Operator navigating in or entering US waters MUST use Environmentally Acceptable Lubricants in all applications with oil-to-sea interface', for example across sealing systems and, in 'open' (deck) applications where rainwater and sea spray can wash grease and oil into the sea/lake.

More recently, in January this year, the IMO Polar Code came into force, stating that 'discharge into the sea of oil or oily mixtures from any ship are prohibited', as are chemicals, sewage and garbage, unless meeting stringent controls. Ballast water is also subject to controls to minimise the risk of transfer of invasive species.

The concern/understanding of environmental issues and the willingness of companies to strive to be as

environmentally considerate as possible is growing significantly.

Types of EALs

With critical pieces of vessels' propulsion, steering and stability equipment, dredging/offshore equipment and portside passenger/freight handling machinery relying on the performance of EALs for environmentally sensitive areas - or to comply with current (and future) legislation - the right selection of EAL is essential. With a bewildering number of EAL offerings claiming environmental benefits, better performance, long life, and some sold at a 'more competitive' (cheaper!) price, just exactly are you getting for your money?

The base oils of lubricants that are generally accepted as being environmentally (biodegradeably) 'friendly' are:

- Triglycerides - plant/seed based, commonly known as vegetable oils
- Polyalkylene glycols, shortened to Polyglycols
- Polyalphaolefins (PAO) or synthetic 'hydrocarbons' (man-made mineral oil in low viscosities)
- Synthetic Esters - two classes: fully Saturated Esters and Unsaturated Esters

Reliability and long-life of a lubricant comes from the 'partnership' of the base oil and additives and is the sum of:

- The stability of the base oil viscosity and shear - with no need for viscosity improvers that can be broken-down
- Its resistance to ageing - oxidation and thermal stress - not depositing varnish, or gumming
- The stability of the dispersion of the additives and not separating, or being filtered-out

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Panolin EAL is used in the hydraulic cylinders of the garbage cage lifting cranes which power the cranes on the barges

- The compatibility with seals, metals and protective coatings, to not cause component degradation, failure or corrosion
- The stability with contaminants - other oils and water - to not cause emulsions that cannot readily separate the water that can lead to bacterial growth, bad smells and corrosion

Triglycerides have poor low and high temperature performance so not good from an engineering perspective; Polyglycols have a good low temperature operating characteristic, but have a question over toxicity and cases of corrosion of metals due to their hygroscopy. PAOs require Viscosity Improvers (VI) to provide higher viscosity lubricants such as gear oils. These VI additives can be broken down under conditions of shear, reducing viscosity, compromising equipment performance and life and requiring regular monitoring to replace oil when viscosity drops. This leaves the Esters - unsaturated esters are susceptible to thermal oxidation, resulting in polymerisation and an increase in viscosity. Under thermal stress a lubricant can go into a piece of machinery as oil and turns into a grease! Again, regular monitoring of unsaturated ester viscosity is required.

The base oil technology dictates the correct selection of the additives. Additives such as 'pour point' depressants (reducing the temperature at which the oil ceases to flow), 'extreme pressure' (EP) additives for gear applications and friction modifiers for 'wet' clutches enhance the performance of the base oil. Anti-corrosion

additives are also used, but the inherent 'polar' (molecular attraction to metal surfaces) nature of esters provides an excellent corrosion protection system base. In cold conditions however, certain base lubricants exhibit poor additive solubility, resulting in separation (crystallisation) of additives, clumping and being filtered out, so compromising equipment performance and potentially leading to equipment failure.

Top Tier 'fully Saturated Synthetic Ester' based lubricants, such as Panolin, exhibit very good thermal oxidation resistance and shear stability, have excellent additive solubility and low temperature 'pour point' performance characteristics and meet all the current environmental requirements. With their long performance life and consistency of properties, fully saturated synthetic esters reduce operational costs by reducing maintenance requirements and enhancing equipment performance and life and ensure critical pieces of safety equipment are fully operational should the worst happen, in the worst of conditions.

On-going development

With over 30 years' experience in designing and making high performance fully saturated ester base oils and selecting appropriate additives - in addition to its 'Flagship' product HLP Synth, developed in the mid-eighties, Panolin has developed a range of robust, long-life speciality lubricants like Stella Maris stern tube lubricant and Margear gear oil.

Lubricants in propulsion systems can be subject to seawater contamination as heavy seas can induce propeller shaft 'bounce' within the stern tube bearing, resulting in stern tube seal 'pumping', causing seawater ingress. Whilst not so prone to seawater ingress, thrusters can also suffer from seawater contamination due to seal wear/damage. Here, it is vitally important that any water in the oil that lubricates the gears and rolling element bearings in the thruster can readily separate, to be removed (drained/filtered) from the system. This requires a lubricant that demulsifies quickly.

Some 'development' is actually taking place on vessels at sea. Owners are frequently taking the EAL offerings (newly developed synthetics, or re-brands) from the oil company they have always used, or have fuel and lube contracts with, but this is now changing.... Some experiences in vessels at sea indicate that some lower performing 'bio' lubes are experiencing degradation due to thermal oxidation (thickening) or shear instability (viscosity loss) and consequently, reduced lifetime. As biocides are not allowed in 'bio' friendly lubricants, those lubricants that do not readily separate from water, or those that are purposely made to 'emulsify' and hold water in the event of water ingress to a system, are exhibiting slime and bad smell issues in equipment.

Proven performance

Vancouver is taking a lead in environmental issues in the forefront of environmental understanding with pollutants: Air, noise and toxic mineral oil. Vancouver is the first port and Canada is the first country to offer a

marine noise reduction incentive to ship operators - the new marine noise reduction criteria forming part of the Vancouver Fraser Port Authority's EcoAction programme, which was launched in 2007. The new noise reduction incentive grew out of the Vancouver Fraser Port Authority-led ECHO Program, which launched in 2014, with the goal to better understand and reduce the cumulative impacts of commercial vessel activities on at-risk whales throughout the southern coast of British Columbia).

After 'experimenting' with some 'bio' types of lubricants at Global Container Terminals Vanterm operation - to ensure 'bio lubes' perform as well as, or indeed, better than toxic mineral oils and to ensure no compromise to equipment performance and operational life-time expectation - there followed a year-long investigation of the performance of Panolin hydraulic fluid, which has now been adopted in ship-to-shore container cranes.

In Australia, Panolin environmental lubricants have been used extensively in the development of Victoria's commercial port, including in dredging and piling equipment used for the channel deepening operations.

While at Ravenna in Italy, container stackers in the port have successfully been tested and are now using Panolin Biofluid ZFH - not only for environmental benefits, but also on performance and economic (longer life and less maintenance down-time) grounds.

Some other examples of Panolin EAL use are in the ship-to-shore container handling cranes at the inland waterways Veghel Terminal in The Netherlands and at the Port of Southampton in the UK, on passenger walkways.

The walkways are designed to be manoeuvred and



In Tampa, Panolin high performance hydraulic fluid has been used in the winch systems of a vessel escort/fire-fighting tug

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aligned with the boarding points of cruise liners. Conscious of the walkways' proximity to water, the decision was made to fill the system with Panolin long life hydraulic fluid, providing an environmentally considerate solution.

When it comes to ferries and cruise, in Canada, BC Ferries has turned to Panolin to improve performance and environmental consideration/compliance in ports and harbours. Using Panolin hydraulic fluid in the propulsion CPP system has helped to minimise out-of-service time.

Panolin use in ports has included, in Tampa, Florida, US, the use of high performance hydraulic fluid in the winch systems of a fast response high power ocean-going 'vessel escort/fire-fighting tug'.

In Venice, where port cleanliness is taking the forefront when it comes to business and residents' garbage being collected, garbage is placed in collection cages on the Canal sides and the cages are then loaded into barges with the use of hydraulic cranes. Panolin EAL is used in the hydraulic cylinders of the garbage cage lifting cranes which power the cranes on the barges.

Stakeholder 'green' business strategy

Most company business models are primarily based around product profit. Profit for the manufacturer and profit earning capability of the equipment for the stakeholder/user, be it a ship-to-shore crane, or a vessel. 'Costs' play a big part in company profitability, but 'value' can prove to be more profitable. It is vitally important to have 'reliable' lubricants. So, how does one decide which base oil type to select? - And then, which supplier of that base oil type lubricant does one choose if there is more than one supplier?

Typically, EALs costs range from 2.5 to four times the cost of mineral oil, but they (depending on the base oil type) can still be in perfect operational condition in hydraulic and gearbox applications over TEN times longer than mineral oil service times, as they do not lose their viscosity, or resistance to shear. They do not leave varnish and do not increase viscosity (gumming) and any water ingress can be effectively managed with lubricants that demulsify, as part of the vessel's/machinery's Best Management Practice condition monitoring procedure. Specialist stern tube and thruster lubricants are available that can be drained at the normal dry-docking period, filtered if required and stored, ready to go back into the vessel. They are not disposable, like mineral oils are. In fact, the use of more expensive products tends to lead to better control of

their use and the reduction (if not elimination) of over-lubrication of loss-lubricant equipment such as open machinery, rudder systems, wire ropes etc.

Even if the environmental feature of a synthetic EAL is not required, the demonstrable enhanced performance of the synthetic lubricant and cleanliness/health of the equipment, offer longer operational life of both lubricant and equipment - contributing to extending times between dry-dockings/maintenance. What is the 'cost' of a critical piece of equipment being out of action through wear or failure in Port/Harbour/Lock system infrastructures?

Experience in the dredging industry and in water-side equipment, where operation can continue around the clock, saturated synthetic ester lubricants have been working, without change, for approaching 100,000 hours. Seven years of operation without oil change are common.

Calculation of CO₂ reduction is also possible. One dredger back hoe hydraulic system with 11,000 litres of ISO VG46 Panolin hydraulic fluid reduced its CO₂ emissions by 180 tonnes over the course of 39,000 operational hours - and, by the way, saved €88,000 in the process.

With correct synthetic lubricant selection (including EAL selection), through-life operating costs will be reduced through:

- Improved equipment efficiency - doing the job it was designed for
- Increased equipment reliability - more operational hours can be 'sold'
- Reduced maintenance - less labour time/cost
- Longer equipment life - allowing a more competitive 'selling' price per operational hour, to win contracts
- Less oil changes - reduced equipment downtime and cost of fresh lubricant
- Less used oil disposal costs - storage, transport, destruction of old oil - leading to...
- Less environmental damage (cost of clean ups) and...
- Win contracts by having EAL filled equipment, for environmental areas

Panolin, Switzerland, make a range of fully saturated synthetic ester lubricants that are non-emulsifying and demulsify quickly and are: CEFAS, OSPAR, US EPA VGP and Polar Code compliant, for all vessel, platform, sub-sea asset and land-based machinery lubrication requirements with availability around the world.

Lastly. Your equipment lubricant is an ASSET - Consult the lubricant manufacturer to understand what you are buying. Select it wisely and look after it!

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