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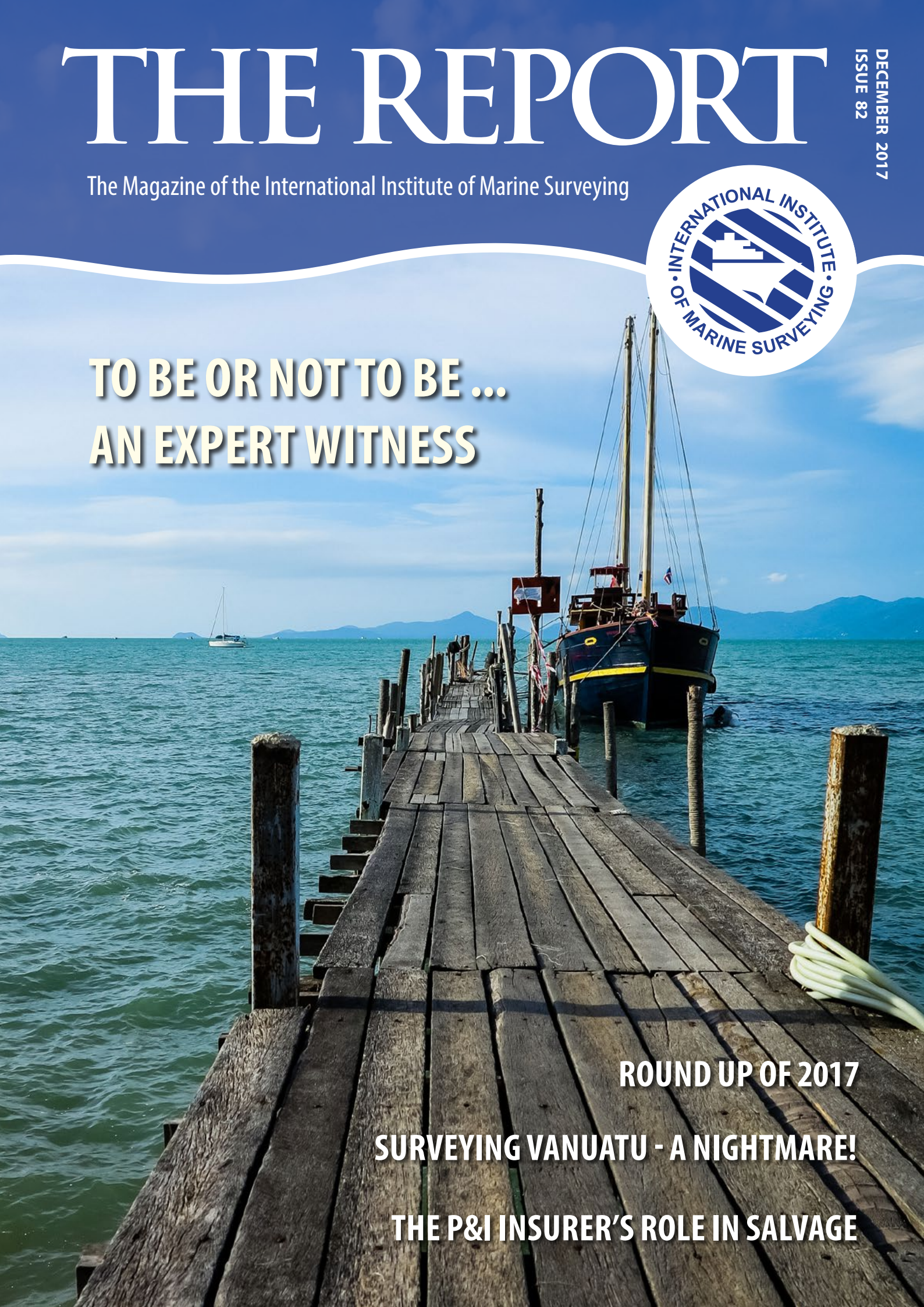


TO BE OR NOT TO BE ... AN EXPERT WITNESS

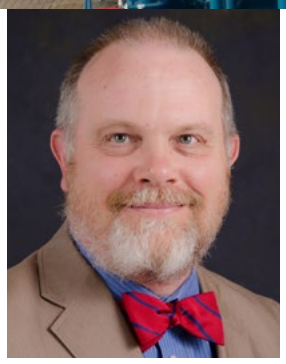
ROUND UP OF 2017

SURVEYING VANUATU - A NIGHTMARE!

THE P&I INSURER'S ROLE IN SALVAGE

The problem of oil washed overboard from hydraulic deck equipment...

... and the regulations and environmentally acceptable lubricants surrounding the issue



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Regulations and Environmentally Acceptable Lubricants (EALs)

With stringent global environmental regulations increasing, oil spills and leaks continue to be of great concern in marine operations. While most think of oil spills in terms of major failures or leaks, the more common ongoing fluid leakage and discharges from marine equipment result in millions of gallons of oil and hydraulic fluids being released into the aquatic environment each year. Chronic leaks, which are very difficult to prevent, far outpace catastrophic events and result in lost productivity, environmental damage, costly fines, remediation costs, and negative public image.

To address the increasing concern regarding the impact of spills, leaks and discharges of chemicals into the oceans, the U.S. Environmental Protection Agency (EPA) developed the 2013 Vessel General Permit (VGP). The VGP is applicable to all commercial vessels larger than 79 feet, operating within three nautical miles of either the United States coastline or in any of the Great

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For over 30 years Dr. Beaver has been actively involved in the commercialization of safer consumer and industrial chemical products. His experience ranges from developing low-VOC waterborne coatings to creating safer alternatives to replace arsenic-based wood preservatives. His current research efforts focus on safer zero-VOC cleaners, degreasers, and specialty lubricants and functional fluids for DIY and commercial use.

Dr. Beaver is the principal inventor on more than 14 patents covering product design and novel sprayer technologies for cleaners, coatings, and lubricants. He has served as President of the Southern Aerosol Technical Association where he currently serves as a member of that association's board of directors. Dr. Beaver is also active within the National Aerosol Association, the Western Aerosol Information Bureau, and the Society of Tribologists and Lubrication Engineers. He currently serves on the Industry Advisory Board for the Tribology Minor in the College of Engineering at Auburn University.

Dr. Beaver has spoken on various regulatory topics at the international, national and regional level. He is considered an expert in VOC regulations (CARB, SCAQMD, OTC, LADCO) and formulating products to meet those requirements.

Dr. Beaver was granted a B.A. in Chemistry and Biology at Cedarville College and a Ph.D. from Miami University in Oxford, Ohio.

Lakes. It requires the use of Environmentally Acceptable Lubricants (EAL) in equipment that requires a lubricant and has a potential oil-to-water interface.

Marine Applications that use EALs

EALs should replace traditional petroleum lubricants in all marine applications where there is any oil-to-water interface. Marine vessels contain a variety of equipment that require lubricants, oils or greases. The oil-to-water interfacing equipment includes stern tubes, stabilizers, thrusters, rudders, propellers, bow thrusters, etc. While legislation has not yet mandated the use of EAL in deck equipment, it is recommended by the EPA in the 2013 VGP to use biodegradable lubricants. Applicable deck equipment includes deck cranes, winches, mooring drums, windlasses, capstans, emergency towing arrangements, hatch covers, etc.

Data on Discharge Contributors

Dagmar Schmidt Etkin, Principal Consultant at Environmental Research Consulting, conducted a study on operational discharges of lubricant oils within ports and harbors, as well as when in transition from harbor to port. In turn, an abstract was developed by Etkin titled "Worldwide Analysis of In-Port Vessel Operational Lubricant Discharges and Leakages".

Etkin concluded that most blue water ships operate with oil-lubricated propulsion systems and a significant number of applications for on-deck and in-water (submerged) machinery utilize lubricating oils as well. As what was once considered typical "operational consumption" of oil – oil leakage from propulsion systems – is now a major oil pollution concern with hefty legal consequences. With the leakage caused by stern tubes, as well as spillage from other types of lubricants used in maritime operations, this has driven the need to assess alternatives to conventional oils and a means to oversee and alleviate the discharging of lubricants from a vessel.

Equipment with an oil-to-water interface such as stern tubes, stabilizers, thrusters, rudders, propellers and bow thrusters are the biggest discharge contributors and have been the primary focus of environmental regulations e.g. EPA's 2013 VGP. Equally important are other discharges that result from runoff or wash-off from deck equipment such as deck cranes, winches, mooring drums, windlasses, capstans, emergency towing arrangements, hatch covers, etc. Deck equipment can have leaking seals on shafts and in turn cause gear oil leakage that will leak onto the deck and will ultimately wash over the side of the vessel and into the water. Intermittent spillage or leakage of petroleum-based oils are very apparent due to the rainbow sheen that resides on the surface of the water.

Etkin estimated the discharges from deck machinery and in-water machinery based on the amount of oil used that was reported to a lubricant supplier in a five-year collection of data on daily usage of lubricants while in port and en route of port. In Table 1 below, Etkin estimated the average per-port visit inputs (discharges) from deck equipment from all vessel types. Keep in mind that leakage from deck machinery lubricants can enter the water during washdowns and stormwater runoff.

Table 1. Average Input of Lubricants from Deck-Based Machinery in Port

Deck Machinery Type	Average Input per Port Visit (liters)
Deck crane gears	0.073
Dredge pump shaft bearings	0.033
Gear-driven mooring winches	0.102
Gear-driven windlasses	0.024
Hose-handling cranes	0.007
Hydraulic system prov cranes	0.022
Hydraulic deck machinery	0.197
Hydraulic windlass mooring winches	0.019
Hydraulic capstans	0.030
Hydraulic cranes	0.096
Hydraulic hatch systems	0.126
Hydraulic mooring winches	0.110
Hydraulic split systems	0.007
Hydraulic system stern ramps	0.027
Miscellaneous hydraulic systems	0.210
Ro-ro hydraulic systems	0.007
Hydraulic water-tight doors	0.004
Hydraulic windlasses	0.095
Towing winches	0.005
Towing winch gears	0.003
Hydraulic trim tabs	0.025
Tugger winches	0.010
TOTAL	**1.232**

D.S. Etkin. (2010)

In Table 2 shown right, Etkin estimated the average inputs (discharges) of lubricants from deck equipment from all vessel types. According to research findings provided by Etkin, it is estimated that approximately 10% of the oil that enters the water is through runoff or deck washdowns.

Based on Etkin's research, discharges from deck equipment were primarily from bulk carriers and container ships. Hydraulic deck equipment was the greatest source of lubricant discharge.

Table 2. On-Deck Machinery: Lubricant Consumption per Vessel Port Visit

Vessel Type	Average Consumption per Port Visit (litres)
Bulk Carrier	57.92
Container Ship	57.70
General Cargo	52.14
Chemical Tanker	51.00
Cement Carrier	42.38
Passenger/Ro-Ro	39.96
Ro-Ro Cargo Ship	36.90
Self Disch. Bulk	30.47
Crude Oil Tanker	30.18
Pontoon	25.00
Chemical Tanker	24.79
Dredger	23.60
Refrig. Cargo	21.03
Oil Prod.Tanker	20.12
Tug	20.00
Ore Carrier	19.00
Offshore Tug	13.40
Passenger /Cruise	12.50
Motor Hopper	12.33
Heavy Load Carr.	11.67
Fishing Vessel	11.50
Crane Ship	11.00
Container Ro-Ro	10.87
Vehicles Carrier	10.17
Trans Shipment	9.50
Wood Chip Carr	9.50
Offshore Supply	8.56
Bulk/Oil Carrier	7.00
Dredger	7.00
Palletised Cargo	7.00
Research Vessel	6.67
Live Fish Carrier	6.00
Passenger/ Cargo	5.25
LPG Tanker	5.05

D.S. Etkin. (2010)

Solutions that meet your needs

For heavy duty deck equipment, the shipping industry need EALs that offer the appropriate performance characteristics for the harsh environment – water resistance, good spray-off resistance, good shear stability and the ability protect ferrous and yellow metals – while also meeting the stringent global regulations that are in effect. Utilizing solutions that offer optimal performance while offering a safer choice for employees to handle with less impact on the environment is the right choice. In addition to regulations requiring EAL usage, cleaners that are VGP compliant are also required. These are often an overlooked component of the VGP.

The Paradox of Deck Equipment Runoff

All deck surfaces and equipment will periodically impact water quality — either through precipitation, green water or sea spray — resulting in vessel runoff. Green water carries residue like oil, grease, paint chips and debris from deck or equipment surfaces. It can also include runoff from deck washdowns performed by the crew, which includes soaps, detergents and cleaning solvents. Discharge rates from deck runoff vary from vessel to vessel depending on a wide variety of factors including weather, frequency of deck washdowns, and the type, size and maintenance state of deck machinery.

What has been an interesting paradox is that the focus for oil entrance into the oceans has focused on below surface propulsion systems. Granted, those systems contribute the most to polluting the environment with petroleum oils but the oils on the surface of the ship that end up in the water are largely ignored by both the controlling agencies and the ship owners themselves. It's only a matter of time before the scrutiny of multiple environmental agencies focus on the oil coming from the surface equipment. Why aren't ship owners "early adopters" for using EAL fluids in all equipment on the ship where the chance of it ending up in the water is great? It's a mindset! There are those ship owners that have started using EALs in their surface equipment because they believe in environmental protection and doing their part. However, most will wait until they are forced by legislation or liability concerns to adopt EALs.

Choosing the Most Suitable VGP Compliant Cleaner

Little attention has been paid to an important, but often overlooked component of the VGP regulations: routine deck and cargo hold washdowns. Cleaners aren't typically top of mind when discussing VGP compliance. They are 100% loss products and little thought is given to the safety of those using them or the impact of the cleaner when it ends up in the ocean. However, just like the oils, they can impact the aquatic life in the ocean if proper attention isn't paid to the type of cleaner used. In addition to being phosphate free and biodegradable, the cleaner should be effective in cleaning but also pose no risk to the people using them or the aquatic life in the water. Safety Data Sheets clearly outline the hazards to both the workers and the environment, but in many cases, the hazards are overlooked or the buyers selecting the products are unaware of the safer alternatives.

What's Next?

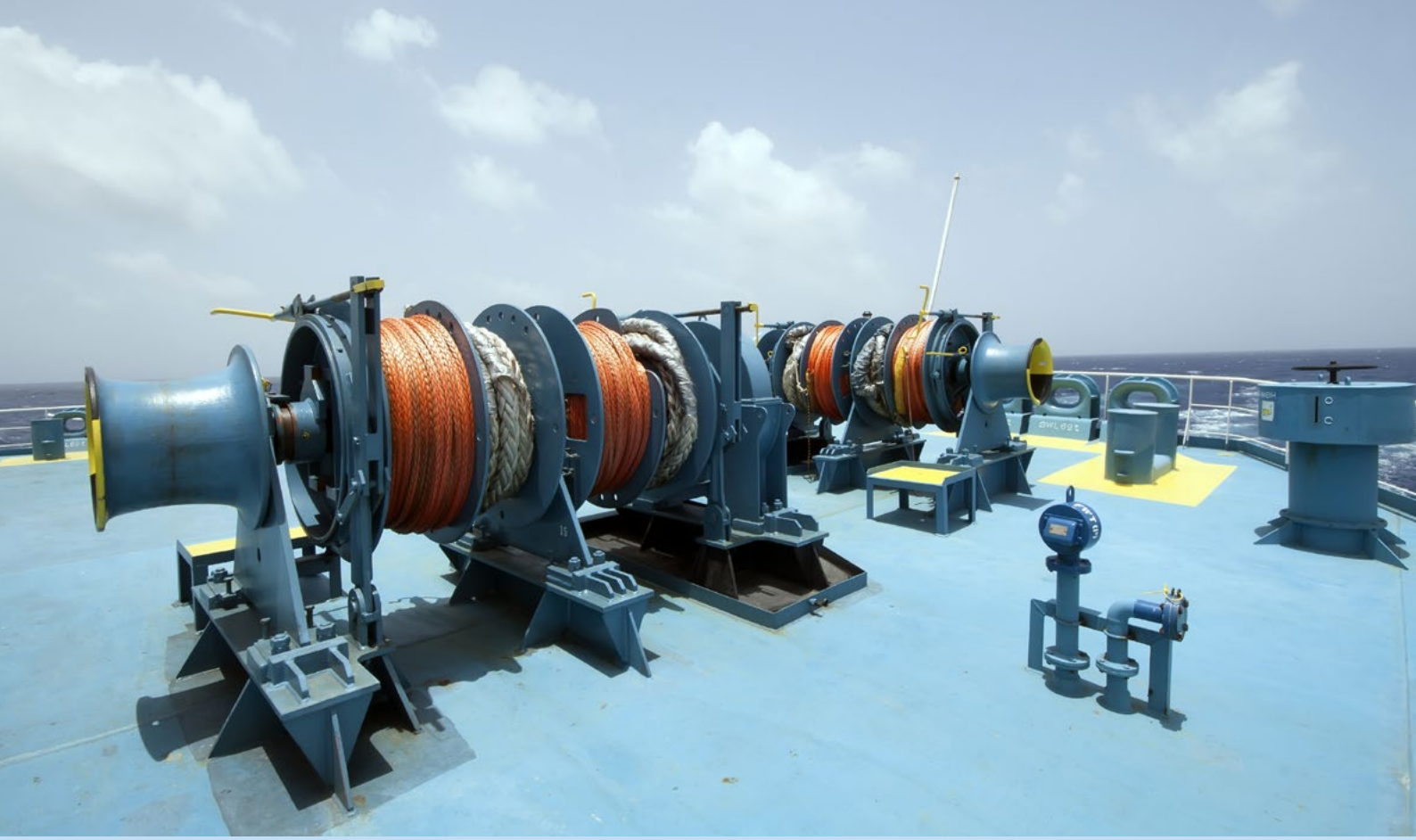
According to environmental consultants and advisors, there are currently thousands of new environmental regulations awaiting attention from regulators around the globe. Different standards hamper growth and thus, pressure to harmonize regulations is likely to continue alongside the regional and global integration of markets. Currently, EPA and the International Maritime Organization (IMO) are working together to develop and implement legal standards that address vessel source pollution and ocean dumping. EPA also works with the United Nations Caribbean Environment Program based in Jamaica, focused on reducing land-based sources of marine pollution, including in the Gulf of Mexico and the wider Caribbean region. With the VGP, the pending Small Vessel General Permit (sVGP), and other global sustainability initiatives firmly in place to regulate discharges, you can select the right EAL or cleaner that will meet or exceed your equipment needs. Keep in mind that while EALs are mandated by legislation to be used in oil-to-water interfacing equipment, they are not required but recommended by the EPA to use in all deck machinery/ equipment.

Conclusion

In marine operations, oil and lubricant spills and discharges are unavoidable. The industry has worked diligently to meet and exceed what is required of operators in these situations and to proactively minimize their adverse impact on the environment. Broad use of EALs is one way to help address the issue, whether it's the requirement to use an EAL with oil-to-sea interfacing applications or a recommendation to use EALs with deck machinery. Using EALs in all equipment where there is a risk of the oil getting into the water is not only complying with current regulations but is the right thing to do for the aquatic environment.

Legislation and Environmentally Acceptable Lubricants (EALs)

The marine industry is one of the most heavily regulated industries and was amongst the first to adopt widely implemented international safety and environmental



Legislation and Environmentally Acceptable Lubricants (EALs)

The marine industry is one of the most heavily regulated industries and was amongst the first to adopt widely implemented international safety and environmental standards. It is principally regulated by the International Maritime Organization (IMO), which is responsible for the protection of the marine environment and has, over many years, adopted a wide range of measures to prevent and control pollution caused by ships. One of the main goals of IMO is to mitigate the effects of any damage that may occur as a result of maritime operations and accidental spills, leaks and discharges.

In 2008, the EPA issued the first version of the Vessel General Permit (VGP). The VGP was amended by the EPA in 2013 to require all vessels to use EALs, rather than mineral oils, in all oil-to-sea interfaces unless technically infeasible.

Environmentally Acceptable Lubricants are defined by the EPA as offering these three characteristics. First, they must be "biodegradable" - biodegrading into carbon dioxide and water by ≥ 60% or more within 28 days (according to OECD 301B or ASTM D7373 methods). Next, they must be "minimally toxic," causing only a light impact on the aquatic environment (LC50> 100mg/L for lubricants and LC50>1000mg/L). Lastly, they are "not bioaccumulative," and must have a low propensity to bioaccumulate in organisms.

Reporting Under "The Sheen Rule"

The Clean Water Act of 1972 mentions discharges of oils should not exhibit any visible 'sheen' on the water's surface otherwise it is considered a pollutant (according to CFR 40 Part 435 A). This has led to a common misperception that the United States Coast Guard approves oils based on the oil not leaving a sheen. Under the legal authority of the Clean Water Act (CWA), the Discharge of Oil regulation, more commonly known as the "sheen rule," provides the framework for determining whether an oil spill or discharge to inland and coastal waters and/or their adjoining shorelines should be reported to the National Response Center. Specifically, the regulation requires the person in charge of a facility or vessel responsible for discharging oil that may be "harmful to the public health or welfare" to report the spill to the federal government. The regulation also establishes the criteria for determining whether an oil spill needs to be reported.

The criteria are:

- Discharges that cause a sheen or discoloration on the surface of a body of water;
- Discharges that violate applicable water quality standards; and
- Discharges that cause a sludge or emulsion to be deposited beneath the surface of the water or on adjoining shorelines.

Environmentally Acceptable Lubricants (EALs) offer a full range of performance levels while minimizing (but not eliminating) the risk of triggering the reporting requirements of the "sheen rule". It's important to note that correctly formulated EALs provide higher

performance and longer service intervals than some petroleum based lubricants.

EAL Confusion in the Marketplace

There's conflicting information in the marketplace about EALs. A lack of agreed-upon definition is one contributing factor, as is lack of awareness of the four different types of EALs that are available. Inconsistent performance claims from manufacturers have also led to the confusion.

Let's address a few myths right from the start:

EALs DO:

* Perform equal to or better than petroleum lubricants
* Mitigate the discharge's environmental impact
* Improve productivity, which leads to profitability

EALs DON'T:

* Eliminate spill occurrence
* Eliminate the need to report a spill or discharge
* Eliminate the need to clean up a spill or discharge

The Four Types of EALs

According to ISO standard 6743/4 for hydraulic fluids, there are four chemically different types of lubricants available to meet the specified needs for environmental acceptability. The categories are as follows:

- Vegetable Oils (HETG)
- Synthetic Esters (HEES)
- Polyalkylene Glycols (HEPG)
- Polyalphaolefins (PAOs) and related hydrocarbon products (HEPR)

While these categories may be unfamiliar to some, the typical fluids that fall into these categories will be more familiar, and it quickly becomes apparent which are the best options available for marine-based hydraulic applications.

Here are the four types of EALs, along with their performance advantages and disadvantages:

HETG

This type of environmentally friendly fluid is better known as conventional vegetable oil-based fluid. While these fluids are readily biodegradable and deliver a lower impact on the environment, enhanced frictional characteristics and improved viscosity index at high temperatures, in a marine setting this category's performance can be limited due to oxidative and hydrolytic stability. With the demands of certain applications, HETG lubricants' limited temperature range reduces the performance they can deliver and, often, their life cycle expectancy.

HEPG

Polyglycol synthetic (PAG) lubricants deliver a fire-resistant option. The downside is that they frequently are not compatible with conventional seals or filters. In switching to or from another type of lubricant, HEPG fluids are also typically not compatible with petroleum- or vegetable-based fluids, which could add significant maintenance costs to flush or remove the previous fluid before introducing the replacement fluid. These synthetic lubricants absorb water over time, which negatively impact performance and lead to the formation of rust or acid and ultimately damage equipment.

HEES

Synthetic ester-based lubricants make up the HEES type of fluid. HEES fluids are often hydrolytically unstable, meaning that their molecules essentially "unzip" when water is introduced. These lubricants are also susceptible to acid formation and subsequent seal deterioration.

HEPR

Poly Alpha Olefins (PAOs) and related products, in particular bio-polyalphaolefin (BPO) fluids, deliver the best option for most marine hydraulic applications. These fluids are more durable and able to operate in a wide range of temperatures, which leads to longer fluid life and often a lower total cost. HEPR-type fluids offer good seal compatibility and deal well with water ingress, as they separate from water (demulse) without impacting their performance properties or their chemical stability. This demulsing characteristic also allows for the fluid to be separated from the water, filtered, and returned to use.

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