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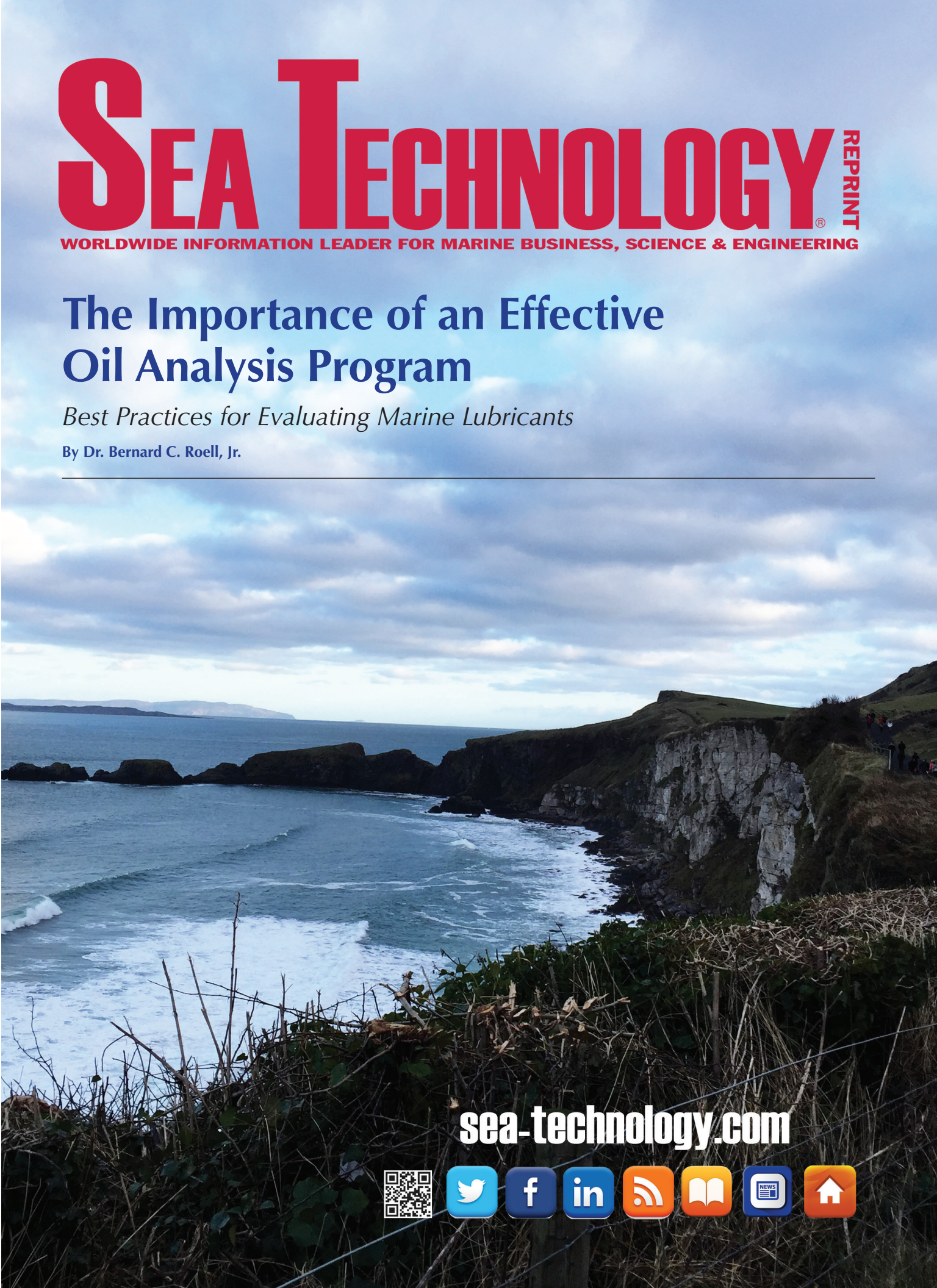
By Dr. Bernard C. Roell, Jr.



The Importance of an Effective Oil Analysis Program

Best Practices for Evaluating Marine Lubricants

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Many factors come into play when evaluating lubricant options for your fleet. These factors include: quality, intended application or use, performance, oil life and price. But there's another very important factor that's often overlooked—how to evaluate lubricant effectiveness once it's in use. This article will take a deep dive into the importance of an oil analysis program and highlight best practices you can apply as you establish your program.

Benefits of an Oil Analysis Program

Choosing a quality lubricant that meets your needs and is well suited for application is essential. When enrolling in an oil analysis program, you can expect: a detailed breakdown of the lubricant's performance; more value out of your oil investment; maximum performance out of your lubricant and your parts; a proactive program instead of a reactive emergency; fewer repairs and equipment downtime; and potential cost savings. Oil analysis offers a snapshot into how your machinery is operating at any given time. It also allows you to compare samples from previous tests so you can make necessary adjustments to keep your equipment operating at peak performance and to plan for maintenance in advance. By knowing the condition of the oil in your system and how it is performing, you can adjust changeover intervals as necessary. Oil that is in good condition and working properly can be kept in the system longer, reducing replacement costs.

What Is Oil Analysis?

Oil analysis is the laboratory analysis of: a lubricant's properties, suspended contaminants and wear debris. This analysis is performed by capturing oil samples during routine predictive maintenance to provide meaningful and accurate information on lubricant and machine condition. By tracking oil analysis sample results over the life of a particular machine, trends can be established that help extend equipment life and eliminate costly repairs.

Who Performs Oil Analysis?

There is a wide range of oil analysis practices ranging from standardized and routine sampling to ad hoc sampling, or performing no analysis whatsoever. Data are best analyzed by lubrication engineers and tribologists, who specialize in studying the lubrication and the effect of wear of machinery.

Best Practices for Developing a Program

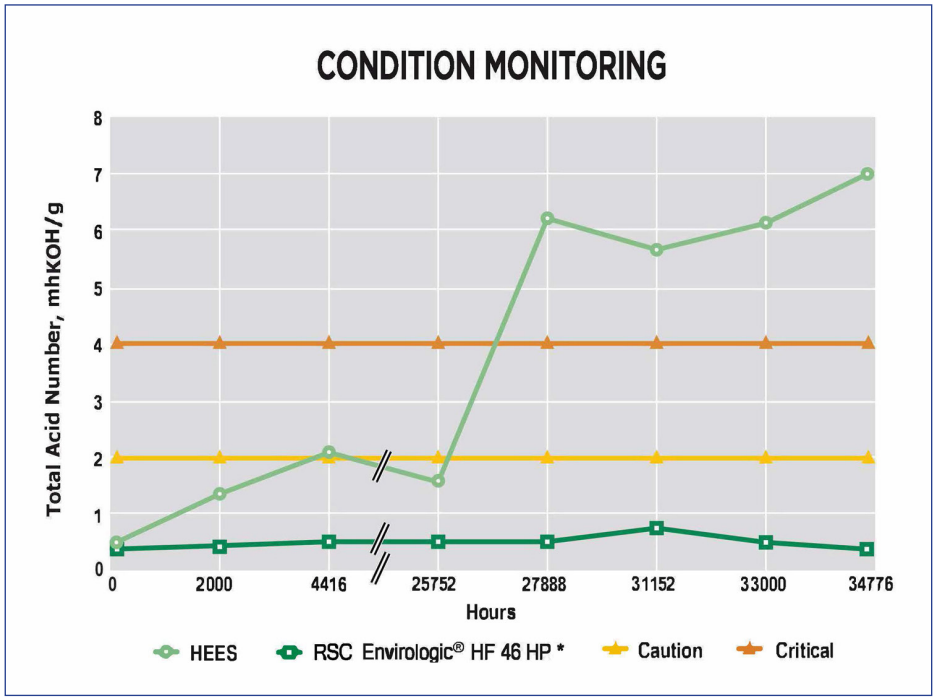
Not all oil analysis programs are created equal. Approach your oil analysis the same way you would a business partnership. Here's how.

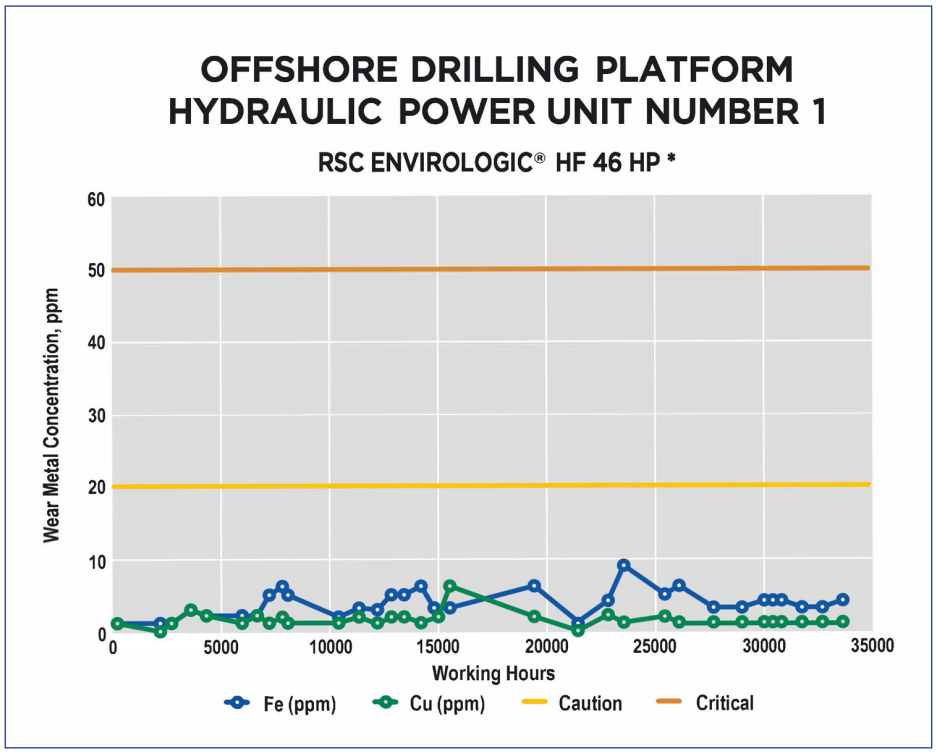
Regular and Consistent Proactive Oil Analysis. You have bigger things to worry about than the cleanliness of your lubricant, and with all the Environmental Protection Agency mandates and regulations, your plate is full. As you evaluate your oil analysis partner, chose one that's going to lead. They should develop a clear plan of how often (monthly or quarterly) and at what intervals your lubricant should be sampled, as well as sampling instructions and where to send your sample. They should remind you of testing needs and deadlines for sample collections. Once a sample is analyzed, they should communicate the results and offer any recommendations to ensure lubricant optimization.

Use Independent Laboratories for Oil Testing and Analysis. Some oil manufacturers use third-party (or independent) labs to perform their analysis, while other manufacturers offer in-house analysis services. Seek out a manufacturer that uses an independent lab. A lab that doesn't have a vested interest in the results means you would have better authenticity with this third party. Secondly, you get results at the same time as the manufacturer, which means quicker access to your results.

Request an In-Depth Analysis. Get a manufacturer that serves as a consultant, as opposed to a vendor. The report is very important, but the interpretation from an oil expert plus a corrective action plan is really what you seek. Use an industry expert that's actively engaged in analyzing and communicating the results in a way that you understand. Ask to see a sample analysis and make sure it tests for viscosity, acid number, water, elemental content and particle count. Look for comprehensive reports that offer a deeper level of analysis in the above categories. Lastly, expect reports that provide an overview of the results—including any recommendations to ensure lubricant and machinery optimization.

Oil Viscosity. To measure fluid's resistance to flow, or





(Top) Plot of the results from a sample industry in-service oil analysis, showing condition monitoring according to ASTM D664. In comparison are the performance of HEES and RSC EnviroLogic HF 46 HP (formerly EnviroLogic 3046). (Bottom) Sample data from an offshore drilling platform showing wear metal concentration. The level of iron and copper never approached the caution threshold during all measured hours of operation using RSC EnviroLogic HF 46 HP (formerly EnviroLogic 3046).

shear stress, the International Organization for Standardization (ISO), in agreement with the American Society for Testing and Materials (ASTM), British Standards Institute (BSI), Deutsches Institut für Normung (DIN) and the Society of Tribologists and Lubrication Engineers (STLE), has upheld the ISO Viscosity Grade (ISO VG) as the definitive measurement standard for both lubricant suppliers and OEMs. A standard test used to measure viscosity is ASTM D445, which measures kinematic viscosity at 40° and/or 100° C.

Total Acid Number. Hydrolytic stability is the ability of a lubricant to resist chemical decomposition in the presence of water and is quantified by measuring acidity levels within the fluid. ASTM D664 is the standard test method to determine the Total Acid Number (TAN) value in a given sample of hydraulic fluid. This metric is used as a guide to determine the extent to which lubrication degrades over time, and it indicates the development of acidic elements in fluid as a result of oxidation under stress.

Acid development in fluid samples, trended over time, provides information regarding the projected longevity of hydraulic fluid. Over time and under stress, the TAN value of fluid rises, indicating a product at the end of its lifespan and in need of replacement, requiring premature oil change outs and equipment downtime. Additionally, acidic elements can lead to accelerated rust, corrosion, wear and seal degradation, further damaging the equipment itself. Damage incurred to the hydraulic system will lead to equipment failure at best, and could result in severe safety incidents for operating personnel.

The current industry standard for condemning oil limit is a TAN measurement of 2.0 units for petroleum products (ASTM D664). RSC Bio Solutions indicated in a 2014 report that environmentally acceptable lubricants (EALs) can operate at above an absolute TAN measurement of 2.0 with no negative impact on the performance of the fluids. Therefore, with EALs, the condemning limit is a TAN greater than 4.0, and when the oil exceeds 2.0 TAN a cautionary note is documented.

Let's look at the results from a sample industry in-service oil analysis. These results indicate that HEES (hydraulic environmental synthetic esters) exceeds the established cautionary limit of 2.0 at approximately 26,000 hours of service, while RSC EnviroLogic HF 46 HP maintains a fairly consistent level well below the standard TAN limits. The synthetic ester product then completely breaks down at 26,500 hr., passing the condemning limit of 4.0 units.

Water Contamination. Water contamination in a fluid can cause detrimental effects to a system. The ingress of water in the system can cause an acid number to increase and fluid viscosity to change. The increase of acid in the system can cause wear on the system. During oil analysis, the fluid is tested for water. A Karl Fischer titration method is used (ASTM D6304) to find the amount of water in the fluid. If the amount of water determined is greater than 1,000 ppm, a recommendation is made to remove the excess water through normal separating methods (i.e., centrifuge, water separator or decantation).

Synthetic ester products, for example, are produced by catalyzing fatty acid chains with alcohols and acids. Introducing water particles and heat to a synthetic ester fluid will reverse these chemical reactions, reforming both acid and alcohol, which, as previously covered, will not only contribute to general aging and weakening of the fluid's structure, but also enable corrosion and deteriorate seals. By contrast, leading EAL manufacturers have found that HEPRs (hydraulic environmental polyalfaolefin and related hydrocarbons), composed of readily biodegradable hydrocarbon, do not have the same properties as esters, making them less susceptible to hydrolytic instability and breakdown.

Element Particle Content. To test for the elemental content in fluid samples, particularly the levels of wear metals such as iron (Fe) and copper (Cu), many analysis laboratories employ forms of magnetic and spectrometer testing. High concentrations of wear metals in a hydraulic circuit indicate equipment deterioration and contribute to further internal abrasion of the hydraulic line.

In these tests, it is important to account for the hours the oil has been used. Under normal conditions, this number, measured in parts per million (ppm), will rise over time.

In an offshore example, data were gathered on the use of an EAL in an offshore drilling platform hydraulic power unit, indicating that the level of iron and copper never approached the caution threshold during all measured hours of operation using HF 46 HP.

Don't Be Afraid to Ask About Cost. Oil analysis is a great tool, and if it prevents equipment breakdown and purchasing replacement parts, then it is even more valuable. But how much does oil analysis cost, and can you afford it? The costs can vary from manufacturer to manufacturer and laboratory to laboratory. Some manufacturers, such as RSC Bio Solutions, offer low-cost or no-cost oil analysis as a value-added service to their customers. There is no reason not to start this type of program, one that will allow you to gain important data from your fleet and operations.

Use the Data. The return on investment in your oil analysis program is directly proportional to the actions taken based on the oil sample results. Failing to take appropriate maintenance actions when the oil sample clearly indicates a situation that requires a correction reduces the ROI of your lubrication program.

Most sample report recommendations are straightforward and are designed to consider the cost-benefit ratio of the maintenance action. Before carrying out a sample report recommendation, ensure that it is practical and cost-effective. It's important to be sure that your maintenance staff understands the requirements and responsibilities and has the authority and support to carry out recommendations. Consult with the analyst to discuss the recommendation and potential alternatives.

Where to Start

If you are not doing proactive and detailed oil analysis, the best way to start is to contact your lubricant vendor to determine how they can help and what they recommend. At RSC Bio Solutions, we work closely with customers to set up a program unique to their needs and continue to make recommendations based on regular results.

Benjamin Franklin once said, "An ounce of prevention is worth a pound of cure." The same rings true when it comes to equipment lubrication. Preventative maintenance is less expensive than replacing parts and having your equipment out of commission. Approach your oil analysis like you would a business partnership, and find someone that is just as invested in your success as you are. **ST**

Dr. Bernard C. Roell, Jr. is the vice president of research and development at RSC Bio Solutions. He brings more than 25 years of R&D, business development and general management experience. Over his career, he has led process improvement teams, managed technology groups and run business units for Lubrizol, Ciba Specialty Chemicals and Houghton, and has deep experience with a wide range of industrial lubricant applications. Roell holds both a B.A. and a B.S. degree from Lock Haven University, as well as a doctorate in organic chemistry from Ohio University.