Cutters Cut Costs with Oil Analysis

By Jerry Fireman

Oil analysis plays a critical role in the mission readiness of the United States Coast Guard's fast response cutters and national security cutters by alerting engineers to problems that have the potential to damage vital equipment and help them efficiently deploy resources for critical maintenance activities.

The traditional approach to oil analysis is to ship samples to a central laboratory, which requires waiting days before results are received. The delay can be exacerbated when ships are at sea for long periods of time. Because of this, the Coast Guard has implemented handheld oil analyzers onboard its FRCs and NSCs to regularly monitor lubricant condition in diesel engines and other components.

"The new onboard analyzers are used to detect oil quality issues and prevent potential damage to equipment, avoid unnecessary oil changes and perform oil changes based on actual condition," said Edgardo Guevara, Coast Guard lubrication program manager. "An abnormal condition detected by the onboard analyzer alerts the engineers to perform corrective action and submit the oil sample to our contracted oil lab for complete oil and wear analysis."

The 154-foot-long Sentinel-class FRCs are replacing aging Island-class patrol boats, while the 418-foot-long Legend-class NSCs, the largest in the Coast Guard's cutter fleet, replace Hamilton-class high-endurance cutters. NSCs have an estimated procurement cost of around $682 million per ship and FRCs are $58 million each, according to a report from the Congressional Research Service published July 6. Onboard oil analysis also is used on two polar icebreakers, the CGC Polar Star and the CGC Healy, Guevara noted.

Prior to 2012, the Coast Guard had no centralized oil laboratory testing and analysis program. Cutters sent oil samples to the Navy Oil Analysis Program or Joint Oil Analysis Program labs, engine manufacturer labs and other commercial testing facilities. "It typically took weeks after the samples were taken to get results, often too late for cutter engineers to take corrective action," Guevara said. Most cutters perform scheduled engine oil changes every 500 to 1,000 hours on main engines and 250 to 500 hours on ship service diesel generators.

Guevara added that onboard oil testing was limited to measuring viscosity of the oil in the cutters' main diesel engines by using falling ball viscometers. "There were no standardized testing requirements for different components, and the test results remained at the different laboratories where the oil testing was performed. Some reports did not provide analysis or recommendations," he expanded.

Analyzing the Options

Around the time Guevara joined the Coast Guard in 2011, the engine manufacturer for the FRCs, MTU Friedrichshafen GmbH, stated that a shipboard testing unit was required to monitor the oil in the main engines. The same was required for the NSCs, which are powered by a combined diesel and gas turbine propulsion system integrating a General Electric LM2500 gas turbine and two MTU 20V1163 diesel engines, according to Naval Technology magazine.

"The [Asset] Project Office was considering the use of traditional one-test-at-a-time kits that rely on chemicals and reagents to perform oil analysis," Guevara said. "I was concerned about the amount of time required to perform the tests and the potential for inaccurate results because they are dependent on using the right amount of oil and chemicals and the condition of the test kit."

Guevara suggested two oil analysis devices as alternatives to the chemical kits: The FluidScan handheld oil monitor (formerly the FluidScan Q1000) and the MiniVisc 3000 (formerly called SpectroVisc Q3000) portable kinematic viscometer, both made by Chelmsford, Massachusetts-based measurement instrument manufacturer Spectro Scientific. Both analyzers have a cost of about $31,000, Guevara said.

The FluidScan measures oil condition parameters such as total acid number, total base number, oxidation, nitration, sulfation, additive depletion, incorrect lubricant, water, glycol, soot and glycerin in synthetic and petroleum-based lubricants and fluids. The device provides reproducibility and repeatability comparable to a benchtop Fourier Transform Infrared Spectroscopy test using ASTM E2412. The MiniVisc 3000 is a portable, battery-operated instrument that determines

A cutter engineer reads results from the FluidScan oil analyzer. (Photo: U.S. Coast Guard)

An oil sample is inserted into the FluidScan for analysis. (Photo: U.S. Coast Guard)

kinematic viscosity in the field without the need for solvents, density checks or a thermometer, and includes sampling pipettes. A check fluid is provided with the measurement instruments to determine if test parameters are out of range.

"I recommended the Spectro FluidScan handheld monitor and MiniVisc 3000 portable viscometer as a better alternative because they provide results in much less time than chemical kits and deliver consistent results comparable to central labs without being sensitive to the skill of the operator," Guevara elaborated, adding that both instruments meet the technical requirements for shipboard use as specified in the Coast Guard Technical Standard 262 – Lubricating Oils and Systems, Testing and Analysis. His recommendation was based on his comparison of the Spectro Scientific instruments against the oil test units that used reagents.

Legend-class national security cutter Stratton navigating the Pacific Rim. (Photo: Ryan Riley – U.S. Navy)

Guevara also created a protocol for engineers on the two new cutter classes to test vital equipment on a regular basis. "Using the FluidScan and MiniVisc combo units, engineers onboard the NSCs can closely monitor increasing soot content in the engine oil as it moves towards the limit where an oil change is required. The FluidScan is also used as a troubleshooting device to monitor water ingression in the reduction gears," Guevara pointed out.

Improved Data-keeping

Guevara recognized the need for the Coast Guard to maintain full control of its oil analysis data from the centralized lab and the cutters' onboard analyzers through an internet-based database. After two years of research, he selected the SpectroTrack information management system software as the database to archive this data. Engineers are able to view the results from the oil analysis and decide when to perform oil changes and other maintenance activities based on the actual condition of the oil and equipment.

The Coast Guard's goal in the near future is to have the capability to upload the test data from the FluidScan unit to the SpectroTrack database directly from the cutter. The SpectroTrack database currently holds about 13,000 sample test results from the centralized laboratory. The database is not currently being implemented for fleet-wide use until it has obtained approval from the Coast Guard's Capability and Requirements Oversight Panel.

"Through the centralized oil testing program and use of onboard analyzers, the Coast Guard now has complete ownership and visibility of all test data for the first time," Guevara said, adding that this has made it possible to avoid spending money on unnecessary oil changes and maintenance. "In several cases, onboard analyzers have identified potential problems so they could be corrected before equipment was damaged, which would have required expensive repairs and potentially put the cutters out of action."

Guevara said the cost savings associated with onboard oil analysis have been substantial. "We found that by monitoring the condition of the oil on the NSC main engines, we were able to increase the oil change interval from 500 hours to 1,000 hours based on actual oil conditions, eliminating two oil changes per engine per year, which will save each cutter about $10,000 per year in oil change and disposal costs and also reduce downtime. We are now reviewing our oil change policy on the FRC ship service diesel generators to extend the interval from 250 hours to 500 hours or as oil analysis results dictate." ▮

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