The way forward

Vessel owners continue to seek ways to reduce operational and maintenance costs in an era of variable demand and increased environmental regulations

Dan Walsh, Spectro Inc

Oil analysis is a critical shipboard tool for the early detection of problems that have the potential to damage vital systems and for enabling the efficient allocation of maintenance resources. Current onboard tests typically duplicate lab-based titration methods, which are relatively time-consuming, involve considerable reagent and solvent costs, and require testers to work with hazardous chemicals. It is possible to reduce the use of these chemicals with modern test kits, but doing so necessitates a major upgrade to new equipment.

A number of military and commercial shipping organizations switched to portable instruments that operate on the same principles as laboratory instruments while substantially reducing analysis time, eliminating the need for reagents and solvents, and avoiding the need for hazardous chemicals.

One fleet lowered its costs with this approach and reduced manpower requirements to perform oil analysis by 25% and analysis costs by 75%, eliminating the need to purchase, ship and dispose of hazardous chemicals. This technology is of great interest to vessel operators but with a higher initial investment than for the existing solution, how can a business case be built to leverage these savings?

Portable instruments: a new approach

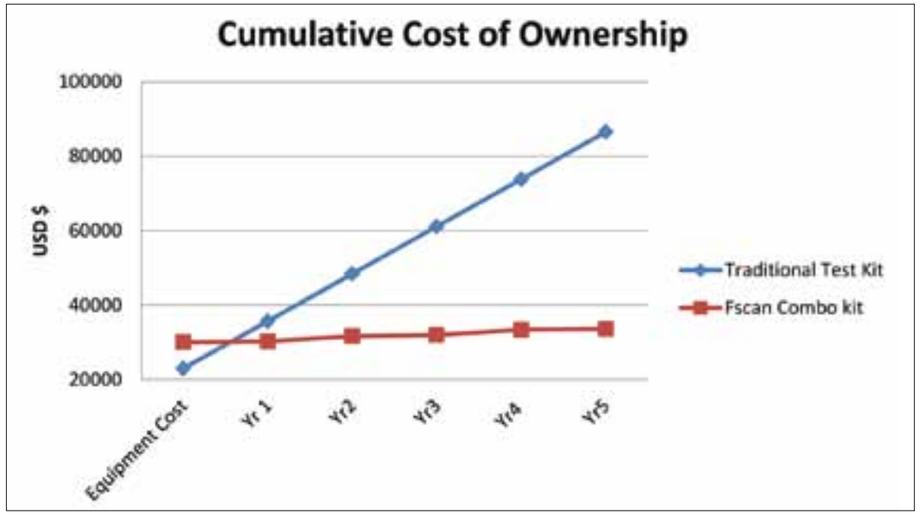
A new generation of instruments eliminates the need for hazardous chemicals and operator interpretation of the results to greatly reduce the cost and time involved in shipboard oil analysis. The portability of the new instruments makes it possible to bring them to the machinery that is being tested.

Test results can be obtained in just 2.5 minutes, which saves considerable shipboard manpower. Only a few drops of oil are required for analysis, which dramatically reduces waste. The instruments greatly simplify the process of testing oil and do not require any interpretation by the operators, so results are more accurate and repeatable. The instruments store test results and provide automatic alarms, so the need for manual logging is eliminated.

How it works

The FluidScan Q1000 is a rugged, handheld infrared spectrometer that measures a range of key oil condition parameters in synthetic and petroleum-based lubricants and fluids. It can determine lubrication contamination, degradation and cross-contamination at the point of use by measuring key oil condition

> **Oil analysis is a critical shipboard tool for the early detection of problems that have the potential to damage vital systems**



parameters in both synthetic and petroleum-based lubricants and fluids. The technology works by first identifying and classifying the fluid via its infrared spectrum into its general chemical family. From this information, the instrument selects the appropriate set of chemometric algorithms to analyze the fluid and provide quantitative total base number (TBN), oxidation, nitration, sulfation, additive depletion, incorrect lubricant, water, glycol, soot, glycerine and FAME in biodiesels.

The SpectroVisc Q3000 reports kinematic viscosity at a standard operating temperature of 40°C. The device requires no reagents, just a shop rag or paper towel, and only 60µl of sample. It operates as a capillary viscometer.

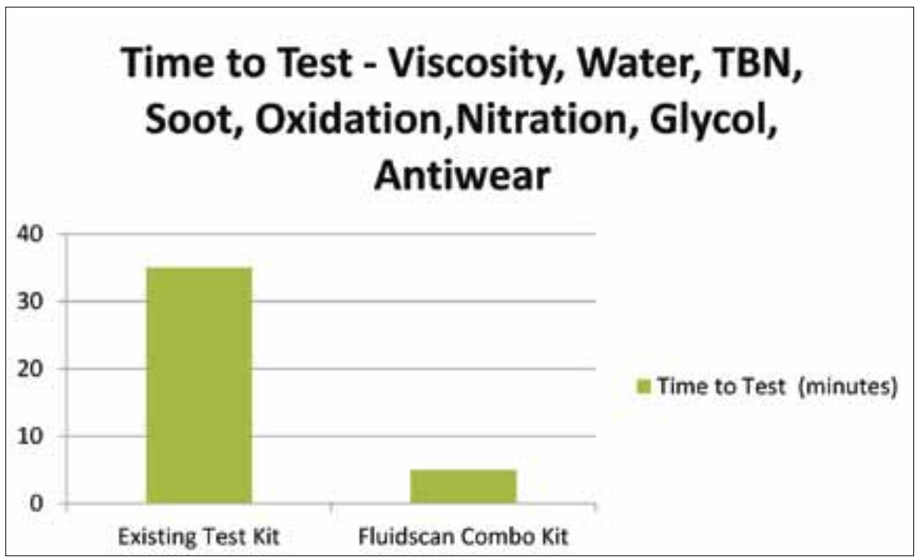
By taking advantage of capillary effects and highly repeatable mechanical spacing, the operator can open the capillary tube to clean it instead of running solvents down a glass capillary tube and drying, as is typically done with laboratory viscometers. Each sample is measured at a constant temperature for consistent accuracy without pre-test measurements.

Case example

A naval fleet performed an evaluation of the new oil analysis technology to compare it with the test kits previously used. The field evaluation program showed that the new approach eliminates the use and disposal of hazardous waste involved in fluid sampling.

ABOVE: **Chart reflects the ongoing consumable and maintenance costs for the combo kit and traditional test kit over five years (labor excluded)**

RIGHT: **Test times with the combo kit**



ONBOARD OIL ANALYSIS SYSTEMS COMPARISON		
System to use	**Traditional system**	**Fluidscan combo system**
Hazardous chemicals?	Hazardous chemicals in the kit • Calcium hydride • Raw solvent extracted gas oil • Orthophosphoric acid • Raw Stoddard solvent • Raw fatty alcohol exthoxl • Requires a cleanup system for all the chemicals and materials used • Cost of chemicals and materials per test	Zero hazardous chemicals • No employee HazMat exposure • No chemicals • No cleanup • No storage • No shipping • No reordering • No gloves • Minimal waste, only wipes and pipettes
Safety	Employee exposure • Many precautions have to be taken when workers are exposed to the hazardous chemicals used	No employee exposure • Operator can take samples at the source to eliminate excess waste stream
Training	• Skilled crew member only • Training to transport, store, handle and recycle hazardous chemicals • Training on testing water/soot in oil, TAN and TBN	• Minimum training needed • No skilled crew member required
Test set: water, TBN/TAN, soot, viscosity	• 18 minutes turnaround time • Manual operation • Manual data transfer • No trending • Total samples used: 30-40ml • Total reagents used: 50ml	• Five minutes turnaround time • Automated operation • Automated data transfer • Trending on FluidScan • Total samples used: 120µl (six drops)
Off-site calibration	Periodic off-site calibration	No off-site calibration required
Portability	Draw and remove oil samples to test equipment in a small lab on vessel	Take the meters to the oil source
Flexibility	Moderate, used mostly for maritime	Versatile, large oil library covers all lubricant systems on vessel, including weapon systems
Sample preparation for water, TBN/TAN, soot, viscosity	Four separate tests needed. For each test: • Add 10-20ml reagent • Add 10-20ml oil • Shake for two minutes • Three to four minutes' analysis each (12-16 minutes in total) • Write down the result on a piece of paper	Two separate tests needed. For each test: • Put three drops of oil (60µl) directly on to the flip cell • One to two minutes' analysis time • Data stored in the meter for trending plot, and transferable to a computer

For 130 ships, it is estimated that the technology saves 5,200 gallons of waste oil and 650 gallons of hazardous waste per year.

The labor, operations and maintenance savings were estimated to be 260 man-hours per ship, potentially saving US$175,000 per year with full deployment. The business case analysis shows a return on investment of less than 18 months. Higher accuracy and immediate results from the portable instruments provide multimillion-dollar savings in increased asset availability. This is because many critical items currently wait until laboratory analysis confirms that the fluid is acceptable before it is used. The faster speed, lower cost and simpler operation of the portable instruments make it possible to monitor engines and components that currently rely on time-based changeout. Problems with equipment can be identified immediately, potentially greatly extending equipment life.

Promising future

The portable infrared spectrometer and kinematic viscometer enable efficient allocation of scarce resources by planning maintenance based on actual need rather than at set intervals. The potential for major cost reductions and improved monitoring capabilities is real. \\

About the author

Dan Walsh is director of product management for Spectro Inc

AUDITING OIL ANALYSIS PROGRAM COSTS

Vessels typically use a combination of methods, including periodically sending samples to an offshore laboratory and some onboard testing based on laboratory titration methods.

Machinists typically collect oil samples, bring them back to the control room, and label and pack them for shipping to the offshore lab. The samples intended for onboard analysis are decanted and mixed with the solvents and reagents in the test kit. Many of the reagents and solvents used in these tests are hazardous, such as calcium hydride, raw solvent extracted gas oil, orthophosphoric acid, raw Stoddard solvent and raw fatty alcohol exthoxl.

Offshore oil analysis costs
The costs may be distributed per sample or by program. Common prices range from US$15 to US$35 for basic test slates. The previous year's sample volume should be reviewed, and the costs associated with bottles, software, shipping costs and resampling.

Onboard oil analysis costs
Direct costs per test for solvents and reagents are about US$12 per test. The cost to transport solvents and reagents are also high, with many ships operating in less developed parts of the world. There are newer, less hazardous chemicals available that reduce the burden of shipping costs; however, the onboard oil testers must be upgraded or replaced in order to work with these new chemicals. As a result, considerable investment is required.

Labor for onboard oil analysis activities
Currently a good operator can run a suite of tests in 35 minutes per sample. The accuracy of these tests depends on the diligence of the machinists in using the right amount of oil and chemicals, and the test kit. Samples must be manually logged (a three-minute effort).

RIGHT: **The portable FluidScan Q1000 handheld spectrometer and SpectroVISC Q3000 kinematic viscometer**