Turbine Oil Analysis

Oxidation Stability Analysis Assures Long Turbine Performance

Monitoring turbine oils is recognized by the power generation industry as a necessity to ensure long, trouble-free operation. The practice assists users in evaluating the stages of oil degradation and in carrying out meaningful programs to protect their systems.

Turbines in power generation generally rely on reservoirs with capacities that can exceed 10,000 gallons, containing oil that can remain in the lubrication system for up to 20 years. Consequently, monitoring the condition of turbine oils is critical for a number of reasons:

- Expense of repair and lost production when an undetected, wear-related condition leads to failure.
- Damage caused to the equipment as a result of oil deterioration in service.
- Expense of unnecessarily replacing multi-thousand gallons of oil and disposing of the changed oil.
- Lead time required to plan, prepare for, and change oil.

Turbine Killers

Viscosity, corrosion protection, anti-foaming, air release and demulsibility are important properties of lubricants for turbines in all applications.

The key element to a turbine lubricant's life, however, is its oxidation stability. An oil's initial resistance to oxidation is determined by its source and by the method and degree of refinement of the base stock. More critically, oxidation stability is determined by the type and amount of inhibitors blended with the specified oil.

Effects from operating conditions, air entrainment, elevated temperatures, oil compatibility with system metallurgy and water contamination cause the lubricant to degrade.

While lubrication requirements for steam and gas turbines are similar, oil degradation in these systems have different causes. Steam turbine oil problems are more likely to occur in modern installations with high output demands and higher load-to-oil ratios. Water contamination is more common in steam turbines than within gas turbines. Gas turbine lubricants, however, are subjected to significantly higher localized "hot spot" temperatures.

Two Levels of Assurance

Analysts' standard turbine oil analysis programs feature two separate test packages, each containing a battery of ASTM and Analysts' laboratory procedures.

The first package provides turbine owners with a measurement of the quality of new oil and assurance of ongoing oil quality. This package is used for both new oil and monitoring the oil in service. The second evaluates the condition of the lubricant throughout its service life.

Turbine Oil Quality (TOQ) is the more extensive test package. It includes spectrochemical and physical properties analyses, total acid number (TAN), appearance,

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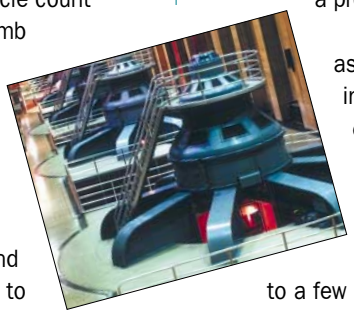
water content, color, rust resistance capability, particle count analysis, Rotating Bomb Oxidation Test (RBOT), copper corrosion, water separability, and foaming tests.



TOQ is recommended for new oil and new oil charges (prior to the oil's installation) for both gas and steam turbines. For gas turbines, TOQ also should be performed every 500 hours during the first six months of service; thereafter, every 1500-2000 hours. For steam turbines, TOQ is also recommended every 2-3 months during the oil's first 12 months of service; then, biannually.

Turbine Oil Monitoring (TOM), the second package, includes all TOQ procedures, except tests for copper corrosion, water separability and foaming. TOM is recommended every 500 hours for gas turbine oils. For steam turbine oils, TOM should be conducted monthly, except when the more extensive TOQ testing is performed.

Analysts is fully capable of performing advanced, special testing required by turbine manufacturers.

Oxidation Analyses

The **RBOT (ASTM D-2272)** laboratory analysis measures the oxidation stability of turbine oils. In this procedure, the oil is exposed to oxidation catalysts including water, copper, high temperature, agitation and oxygen in a sealed, pressurized "bomb." During the analysis, the pressure of the sample is monitored. When the oil's oxidation inhibitors fail, the oil will absorb the oxygen, resulting in a pressure drop.

The result is known as the RBOT Remaining Life, and it is expressed in minutes. Depending on the type of oil, ASTM D-2272 takes a few hours to a few days to complete.

The RBOT Remaining Life, when related to the RBOT Life of the oil when it was new, indicates the characteristics of the oil's current oxidation stability.

Stability Test Options

While RBOT is the standard oxidation stability test featured in Analysts' turbine oil programs, two others are offered: **The Turbine Oil Oxidation Test (TOST**, ASTM D-943) and the **Remaining Useful Life Evaluation Routine (RULER)**.

TOST simulates oxidation of the sampled oil, and measurements are made to determine the time required for the oil in-service to fail. The oil is exposed to oxidation catalysts in a reaction vessel: water, copper, steel, high temperature and oxygen. During the test, the oil's total acid number is monitored. The test is terminated when the acid number reaches a predetermined endpoint.

TOST most closely simulates the effects that turbine operating conditions bring to bear on specific lubricants. It is used by oil companies to confirm specifications of a refined product. When ordered by a turbine user, it provides a base line for future trend analysis. However, this analysis requires from 1,000 to several thousand hours to perform.

RULER is another technology to determine antioxidant levels. In this procedure, the antioxidants are measured by electrically charging a prepared sample and measuring chemical changes within it. The technique uses a solvent to chemically activate the oxidation inhibitor additives in the sample. Test results are presented in RULER Numbers which are used to track antioxidant depletion rates.

This test is used primarily for trend analysis and requires reference information on the oil before testing. The type of antioxidant additive blended in the oil must be known; the additive package cannot be changed; and, the solvent must be precisely matched to the type of antioxidant in the oil.

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