Overview

ASTM D 4378, Practice for In-Service Monitoring of Mineral Turbine Oils for Steam and Gas Turbines, was developed by Subcommittee D02.C on Turbine Oils in response to the needs of the electrical power generation community. The organizations for which this document is intended are the utilities and industries which generate their own electrical power. The purpose of D 4378 is to recommend:

1. Which tests to run.
2. The frequency of testing.
3. The interpretation of the results.
4. Corrective actions.
5. Limiting values.

This symposium brought together suppliers and consumers to present their views on turbine fluid monitoring.

An overview was presented by Roberton giving the user needs that generated D 4378. The history of the document was discussed with the reasons for having the tests which are included, the basis for interpreting the results, and the appropriateness of the limits.

The necessity for a monitoring program was brought forth by Bonett, who presented the experiences of an American utility. These show that a program can identify problems so that corrective action can be taken in time to prevent a major shutdown.

The views of an American lubricant supplier were given by Trabert and Schreuders, who stressed the need for close cooperation between the turbine operator, the turbine manufacturer, and the lubricant supplier to ensure the successful operation and effective monitoring of a turbine circulating system.

Ohgake and his associates reported on the technological revolution in Japan since 1955. Maximum unit capacity has increased from 66 MW in 1955 to 1000 MW in 1987. At the same time, steam pressure of 60 kg/cm^2 in 1955 has risen to 246 kg/cm^2 with a corresponding rise in steam temperature from 480°C to 566°C. Turbine oil operating temperatures increased by 10 to 15°C, thereby potentially more than doubling the oxidative degradation rate of the lubricant.

Ohgake confirmed the use of ASTM D 2272 in their monitoring programs and for the calculation of turbine severity, and also indicated that the concept of regular makeup (replacing part of the oil charge) to compensate for oil degradation was still considered a useful practice to ensure long oil service life. In Japan and in the United States, increased demands have been placed on turbine lubricating oils by changes in the design of the turbine generators. The increased use of combined cycle stations has added the requirement that the same lubricant be used in both gas and steam turbines. (In a combined cycle installation,

heat recovered from the gas turbine exhaust is used to help generate steam for driving a steam turbine.) These new demands on the oil have made monitoring programs even more important than previously.

Although D 4378 addresses the more commonly used petroleum oil turbine lubricants, fire-resistant fluids based on phosphate esters are increasingly being used for electrohydraulic control (EHC) system lubricants. They are also used in some applications to lubricate steam and gas turbines. Documents similar to D 4378 but covering phosphate ester fluids are being developed both in ASTM and the International Standards Organization (ISO). Anzenberger covered the program of a manufacturer of such fluids. This manufacturer provides sample bottles in which fluid can be sent to the supplier's laboratory for testing. A report sent to the user gives results, recommended limits, and suggested corrective action if appropriate.

Although the gas turbines covered in D 4378 are heavy duty, that is, not aircraft, the paper by Pachuta et al. demonstrates the desirability of a monitoring program in testing lubricants for aircraft jet engines. The methods of storing and plotting data are of interest to any monitoring program. With increased use of aircraft derivative gas turbines for ground applications monitoring programs for these engines can be expected in the future.

A previous symposium, "Aspects of Lubricant Oxidation," published as STP 916, discussed methods of measuring oil oxidation and the significance of oxidation on remaining oil life. It would be well to review STP 916 in conjunction with this present document, STP 1021, since oxidation is of major concern in oil monitoring. Many of the observations of Dr. Pachuta and his colleagues on oil oxidation, particularly those on total antioxidant capacity (TAC), are relevant to the previous STP.

It was the intent of the symposium to review the current status of turbine oil monitoring. It emphasized the importance of a monitoring program to maintain power generation equipment in good operating condition. It is hoped that the readers of this STP will give the editors their suggestions on improvements to D 4378 as well as their thoughts on what other monitoring documents appropriate for power generation should be prepared under the auspices of D02.C.

D 4378 is the basis for an ISO document on the same subject which should be issued in about one year. As mentioned previously, similar documents are being prepared in both ISO and ASTM on phosphate ester fluids for electrohydraulic control (EHC) systems. As experience accumulates with users of these documents, an appropriate subject for a future symposium would be a review of these and user experience with them as well as an update on D 4378.

We wish to thank the authors for their contributions, the paper reviewers for their time and thoughts, the ASTM personnel whose efforts have resulted in this publication, and the members of ASTM Subcomittee D02.C who prepared and reviewed D 4378.

William C. Young
General Electric, Schenectady, NY 12345; symposium cochairman and coeditor.

Reginald S. Roberton
Princeton, NJ 08540; symposium cochairman and coeditor.