Technical Topic

Turbine Oil System Care & Maintenance

We've Come a Long Way

Steam and gas turbines are so highly efficient and extremely reliable, it's no surprise they have been around for a long time. In fact, the turbine has a rich history that dates back to the period of BC when the first predecessor to the hydro-turbine, the water wheel, was used by the Greeks and the Romans for grinding grain. And two hundred years before the Christian era, Egyptians were using the first known steam turbine, which actually had the same principle of action that is employed in today's modern reaction turbines. Because these turbines were simply constructed to take advantage of natural forces such as water and air currents, their lubrication was relatively simple. In most cases, water or no lubricant at all was sufficient to keep them running.

Turbine Lubrication has come a long way since those early days, evolving right along side the improvements and changes in turbine design. Up until the middle or late 1940's, straight mineral (non-additive) oils were used in most steam turbines. These oils were made in order to provide the correct physical properties, retain the natural ability to resist oxidation and provide protection against wear. However, as bearing loads, generator capacities and temperatures increased and oil reservoir sizes and make-up rates decreased, the demand on lubricant performance became much greater. Straight mineral oils no longer had an acceptable life and it became necessary to strengthen the characteristics of the oils with chemical additives and higher quality base oils.

While oil quality is extremely critical to successful turbine operation, it should be clearly understood that system maintenance is equally as critical. Poor system maintenance will lead to:

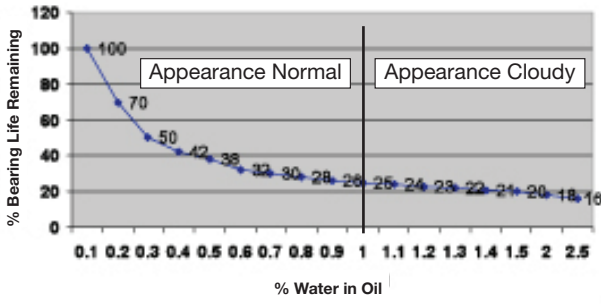
- Reduced Lubricant Life
- Increased Waste Oil Streams
- Reduced Turbine Bearing Life
- More Frequent Down-Time Intervals
- Less Profit Per Kilowatt

Turbine System Care & Maintenance

You want to get the most out of your turbines and keep them operating at their maximum efficiency. This can be achieved by following the seven simple steps:

1. **Keep Your Oil Clean** — Maintaining turbine oil cleanliness is important for maximizing equipment and lubricant life. Particulate contamination, the most destructive contaminant in lubricating oil, will significantly reduce the life of bearings and gears, as well as impact servo valve operation and promote system foaming. Turbine systems are subject to contamination from several sources and deposits will accumulate even though the oil is clean. Inspect the system frequently and maintain the filtration system to its maximum effectiveness. Consult your OEM for their recommended ISO Cleanliness Level (also called ISO Particle Count).

2. **Keep Your Oil Dry** — Water contamination is the second most destructive contaminant in lubricating oil and should be kept at a minimum for the sake of bearing life/longevity Water contamination not only displaces the oil film (in cases of extreme contamination), but also causes sub-surface micro-cracking due to hydrogen "free radicals" which break off from water molecules as they pass between the rollers and raceways. This micro-cracking (also called "hydrogen imbrittlement") progresses over time to pitting and spalling. The graph below (Ref. SKF) illustrates how bearing life is drastically decreased with just a small amount of water:



Maintaining minimum water levels is a must. The most common methods of continuous water removal are centrifugal purification for large amounts of water and vacuum dehydration (polishing) for concentrations under 400 ppm.

3. **Analyze Your Oil Periodically** — Take samples of oil and any deposits found at regular intervals for visual examination and laboratory analysis. We recommend daily visual examinations, monthly laboratory examinations for general system and oil conditions, and six-month laboratory examinations for a more in-depth determination of future oil life. By doing this, you will be able to detect the start of deterioration, contamination and other troubles early and take corrective action to prevent unexpected and costly downtime. Please see our Technical Topic titled "Turbine Oil Testing" for more information on this topic.

4. **Ventilation** — Oil and water don't mix. Remove water and minimize its harmful effects by making sure your turbine lubrication system is adequately ventilated. When vacuum venting is used, negative pressure over the oil in the system should be accurately controlled. In atmospheric pressurized systems, be sure the air vent is sufficiently sized and has a good moisture/air breather in place.

5. **Prevent Leakage** — It's vital that you trace any oil leaks to their source and eliminate them for the sake of safety and reliability and reducing waste and unnecessary oil consumption. Where should you look? Common sources include:
   - Bearing Seals
   - Oil-Supply Lines
   - Cooler Tube Joints
   - Valve Connections

   Keep in mind that oil-supply pressure should not be excessive. For water leakage into oiling systems from turbine seals, oil coolers, etc., eliminate the problem through continuous purification and ventilation. You'll want to keep these prevention practices in operation for as long as necessary. Do you know you have leaks, but are having trouble finding them? Please see our Service Data Sheet titled "Comprehensive Leak Detection" for more information on how ExxonMobil may be of service in this endeavor.

6. **Maintain Temperature Records** — Keep a log on the temperatures of:
   - Oil and water to and from coolers
   - Oil in reservoirs
   - Oil return from main bearings
   - Oil inlet to purification equipment

   This will help you notice any sudden changes so that you'll be able to investigate at once. Gradual changes in oil coolers may indicate the formation of deposits on cooling surfaces. Maintaining sufficiently high temperatures in reservoirs and purification equipment will aid in removal of water and insoluble contaminants.

7. **Keep Operating Records** — Keep operating records of:
   - Turbine and purification operating hours
   - Oil condition, lab results and service hours
   - Time and amount of make-up and whether new or purified oil was used.
   - Time of filter change and service hours
   - Repairs, replacements and overhauls

Refs: "Turbines and Their Lubrication"
By Kevin McKenna, P. E.
The Engineered Difference — Spring 2001

Additional Tech Topics relating to gas turbines are available from ExxonMobil.

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