ADDRESSING VARNISH PROBLEMS

BALANCED CHARGE AGGLOMERATION RESULTS IN 50,000 HOURS OF LUBE OIL OPERATION ON GE FRAME 7 TURBINES

RAY GOMES

Operators at a large South Eastern U.S. power utility with seven GE Frame 7 turbines began to notice varnish buildup in their tanks. They heard that other companies were experiencing significant varnish issues with the same turbines at 8,000 run hours. Before a serious varnish issue could arise, they decided to try a different approach to varnish control.

GE was aware of the varnish problems being caused by using group II lubricating oil and had offered advice in a Technical Information Letter to all GE turbine users. GE TIL 1528-3 described the issue and recommended that users add either an Electrostatic Precipitator (EP) or a Balanced Charge Agglomeration (BCA) system.

This utility decided to add nine BCA systems, seven on gas turbines and two on steam turbines. Oil analysis and operational results on these turbines have been closely tracked since January 2005.

Turbine	Varnish Potential	Gravimetric Patch mg/l	ISO Particle Count	RPVOT Minutes to 25%	RPVOT Remaining Life
New Oil	< 5	75	18/16/3*	1700	100%
Unit 1	13	4	14/12/10	1216	72%
Unit 2	9	20	13/12/9	1377	81%
Unit 2	3	2	19/17/14	1228	72%
Unit 4	3	16	17/14/10	1140	67%
Unit 5	5	4	14/12/10	1324	77%
Unit 6	5	16	14/12/9	1157	68%
Unit 7	3	18	15/13/10	1275	75%

Chart: Oil Analysis at 48,000 Hours vs. New Oil

**** Conoco Phillips' Ultra Clean Turbine Oil ISO Particle Count***

Charged particles

BCA charges the particles in oil with a positive and negative high voltage in two separate flow paths. The charged particles are allowed to mix in a single flow path. Due to electrostatic attraction in the mixer the particles, some as small as .01 microns, stick together and agglomerate. The resulting large particles are then easily filtered out. The cyclical nature of the BCA-based cleanup is achieved by the purifier cleaning the oil of contaminants and varnish, followed by the oil cleaning the machine internals which saturates the oil with more contaminants, which are then cleaned.

In reality, it took several months to fully clean varnish-covered spool valves and tank walls. When these internal components were finally clean of all varnish, contamination levels fell dramatically (Chart).

In 2009, the thrust bearing on one unit was opened for inspection. The internal surfaces of the bearings, seals and thrust bearing components were all found to be free of varnish buildup (Figures 1 & 2). By comparison, a unit in another plant with no purification system was covered with a heavy orange varnish buildup after four years of operation.

The first three of the turbines are at 50,000 run hours and approaching their tenth year in operation. They have never had an oil related shutdown or a servo valve failure due to varnish. Some experts claim varnish can only be removed at oil temperatures under 40°C with electrostatic-based purification systems. Although located in a semi-tropical location, the oil in these GE 7FA turbines rarely goes below 40°C yet all varnish has been removed.

These turbines recently completed their first tear down. The journal bearings showed no wear and no varnish buildup. The tanks, however, did have a small patch of varnish on one pipe. It was later determined that the high voltage power supply had failed in this purifier.

Improved lube oils

Lubricating oil manufacturers have developed new additives that can hold varnish in suspension longer, so that it is less likely to buildup. They guarantee the oil for 15 to 20 thousand run hours. These plants have already achieved 50,000 run hours on the original oil. The oil's remaining useful life determined by Rotating Pressure Vessel Oxidation, ASTM D2272 (RPVOT), a test for remaining antioxidants, is around 70% in all seven turbines.

As a result, this plant has avoided two or three oil changes. This adds up to savings of 2.5 to 4 million dollars across the plant in oil change costs for a relatively small initial investment. And, since the remaining life of the oil is still around 70% it will last many more years. TI

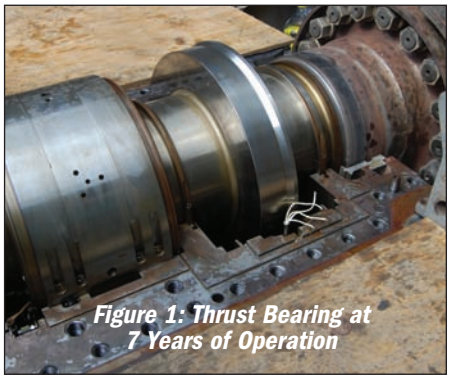

Figure 1: Thrust Bearing at 7 Years of Operation

Figure 2: Turbine Journal Bearing at 50,000 Hours and No Varnish Buildup

Author

Ray Gomes, CEO of ISOPur Fluid Technologies, has an EE Degree from the University of Rhode Island where he worked in Ocean Engineering and Ship Analytics in charge of hardware design for simulation systems. Prior to ISOPur, he was VP Techology at Hi-Tech Extrusion.