*Detecting Failures Using Oil Analysis**

(Case history provided by National Tribology Services)

Equipment: Induced Draft Fan

Component: 500 HP Motor

Analytical Instruments: The oil analysis test package included the following tests

- Normal RDE spectrometric for dissolved and fine particles
- AES/RFS rotrode filter spectroscopy for large particles
- Viscosity
- **FTIR** Fourier Transform Infra Red analysis

Additional analytical testes are conducted whenever results from the above screening tests indicate abnormal conditions. This includes analytical ferrography and other tests such as TBN, TAN and KFW.

Observation & Recommendation:

Normal RDE spectrometric analysis for dissolved and small particles (< ~10µm) indicated 6 ppm iron and 3ppm lead but the AES/RFS (rotrode filter spectrometric) analysis for the same sample indicated 82 ppm iron and 20 ppm lead.

	Fe	*Cr*	*Pb*	*Cu*	*Sn*	*Al*	*Ni*	*Ag*	*Mo*	*Ti*	*Si*	*B*	*Na*	*Mg*	*Ca*	*Ba*	*P*	*Zn*
Normal	6	0	3	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
AES/RFS	82	0	20	1	5	0	0	0	0	0	1	0						

The technique detects large and course wear metal and contaminant particles in used oil. Course particles include particles larger than 6µm. These particles are very important as indicators of the onset of abnormal wear conditions.

Rotrode filter spectroscopy provides a low cost efficient screening technique for ferrography, and is superior to DR (direct read) ferrography because of its ability to also measure and detect nonferrous wear particles. Due to the soft babbitt metal in babbitted sleeve bearings, the wear particles generated during abnormal wear like wiping, are coarse and greater than 10µm in size.

The babbitt metal does not break up into smaller particles. Instead, it is removed from the surface as rubbing wear and smeared or re-deposited to another point on the surface of the bearing. The few babbitt metal particles that are removed from the surface have larger diameters and appear elongated and flat. Thus the use of RFS is extremely important to detect nonferrous abnormal wear particles. Most laboratories that use atomic emission spectrometers only detect the dissolved and small particles. As indicated in the result the normal spectrometric analysis does not detect this abnormal wear condition. However, comparison of the normal and RFS results clearly indicate an abnormal condition due to large particles.

SPECTRO INC.
Industrial Tribology Systems
160 Ayer Road Littleton, MA 01460 USA • Tel. (978) 486-0123 • Fax (978) 486-0030 • email: sales@spectroinc.com • www.spectroinc.com

Ferrography

The RFS analytical results prompted ferrographic analysis to be performed on this sample. The ferrogram indicated light amount of fine ferrous wear particles and moderate amount of severe sliding wear particles at the entry point of the ferrogram. The severe ferrous wear particles have a particle diameter in the range of 15 to 35µm. The ferrogram also indicated nonferrous wear particles all along the ferrogram. Most of the nonferrous wear particles are babbitt metal particle and have a particle diameter in the range of 20 to 45µm. Some of these babbitt metals have oxidized surface due to the fact that Pb/Sn alloys are extremely susceptible to oxidation at temperatures that are considered low in ferrous metallurgy.

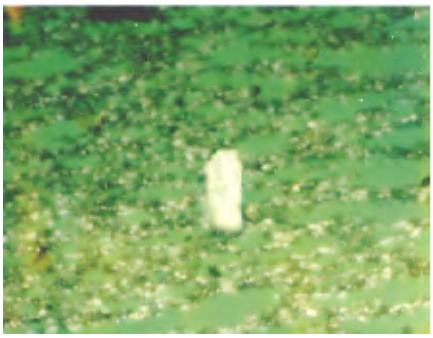


Fig.1 Photomicrograph of a babbitt metal.Particle size 45µm. Magnification 500X

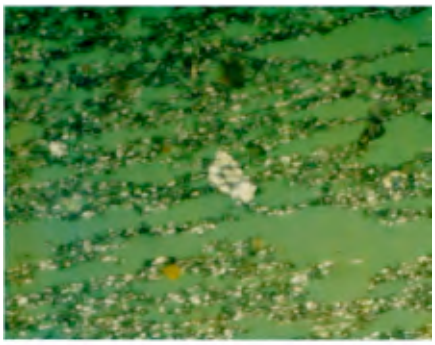


Fig.2 Photomocrograph showing partially oxidized babbitt metal. Magnification 500X

Fig.3 Photomicrograph indicating an isolated copper particle. Magnification 500X

Light amount of crystalline nonmetallic (sand/dirt) contaminants were also present.
The presence babbitt wear particles on the ferrogram and the high level of iron and lead detected by the RFS indicated the criticality of the wear mode in the bearing. A recommendation was given to the customer to inspect the motor bearing.

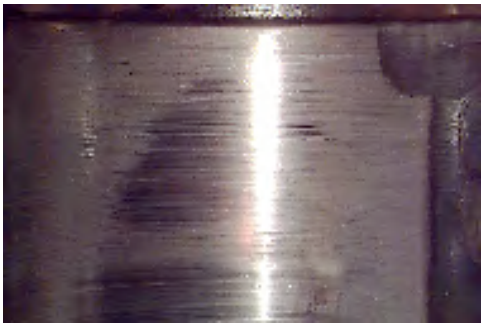
Discussion & Findings:

As expected and recommended, inspection of the bearing indicated wiping of the lining. The babbitt lining was clearly smeared by wiping and also was removed from the surface of the bearing. The extent of wiping damage as indicated in the picture is higher at the end side of the bearing.

New Bearing

Wiped Bearing

Wiping can result due to loss of lubricant, overload and misalignment of the bearing. Lack of balance of the shaft ,for example, due to thermally bent shaft could cause the kind of wiping indicated on the bearing.



Close up of the wiped bearing

Conclusion: The use of RFS (rotrode filter spectroscopy) and ferrographic analysis in detecting nonferrous wear damage in babbitt lined bearings is clearly seen in this case. Based on the oil analysis and inspection of the bearing the customer can take the appropriate measure to avert the expense of unexpected downtime and catastrophic failure.

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