

COMMON WEAR MECHANISMS IN INDUSTRIAL EQUIPMENT

HOW TO IDENTIFY THEM BY OIL ANALYSIS

WEAR MECHANISM	OTHER NAMES	DEFINITION	SUSCEPTIBLE MACHINE PARTS	TYPICALLY CAUSED BY:	TYPE OF WEAR PARTICLES IN OIL	RECOMMENDED OIL ANALYSIS TEST(S)	POSSIBLE LUBRICANT PROBLEMS/RECOMMENDATIONS
Mild Adhesion	Normal Wear	Removal of surface material from parts in relative motion.	All	Moderate loads, speeds and temperatures. Correct, clean lubricant. Proper surface finish.	1 – 5 micron wear particles in low concentration.	Adequately trended using spectrometry.	None. Monitor wear, viscosity and fluid cleanliness to ensure continued trouble free operation.
Severe Adhesion	- Scuffing - Scoring - Galling - Sliding	Cold welding of metal surfaces resulting in removal of material.	Piston rings, cylinder barrels, gears, roller bearings	High loads and/or temperatures, insufficient lubrication. Inadequate Extreme Pressure (EP) protection.	Irregular shaped wear fragments > 5 micron in size.	Large particle wear assessment (i.e. sediment patch or ferrographic analysis)	Ensure correct lubricant is being used. Monitor EP package using spectrometry. Check lubricant viscosity.
Abrasion	- Cutting - Scratching - Gouging	Scoring of surface material by abrasive contaminants or rough surfaces.	All parts in relative motion	External contamination. Rough surface rubbing against softer material. Break-in wear.	High wear metal content (1 – 5 micron). High silicon and/or particulate contamination.	ISO particle count to monitor fluid cleanliness. Ferrographic analysis to evaluate wear fragments.	Check correct viscosity. Install micro-filtration to remove contaminants.
Erosion	-	Cutting of metal surfaces by hard particles entrained in fast flowing lubricant.	Journal bearings near oil holes, hydraulic valves and pumps	Contaminated lubricant flowing at high speed.	High silicon content, and/or large particle contaminants.	ISO particle count to monitor contaminants.	Install micro-filtration to remove contaminants.
Polishing	Bore Polishing	Polishing of surface material by very fine abrasives.	Cylinder bores (diesel engines), gear teeth, valve lifters	Corrosive oil/contaminant. Fine abrasives in oil.	Fine contaminant/wear particles (< 5 micron).	Spectrometry to trend wear metals and/or contaminants.	Use a less chemically active lubricant. Remove source of chemical contamination or abrasives.
Contact Fatigue	- Fatigue Wear - Spalling - Frosting	Material removed by cracking/pitting due to cyclic elastic stress.	Heavily loaded roller/ball bearings, valve train parts, gears	Cyclic stress over long periods. Oil contaminants (water & dirt). Poor quality bearing materials.	Large wear particles (> 5 micron) with sharp edges and/or spherical in shape.	Ferrographic analysis to trend large wear particles.	Inadequate EP additives and/or low viscosity. Remove water contamination.
Corrosion	- Chemical Wear - Oxidative Wear	Removal of surface layers by corrosion.	All bearings, cylinder walls, valve train, gears	Corrosive environment. High temperatures. Rust promoting conditions (high temp and humidity).	Corrosive contaminant and oxidative products observed in oil.	Spectrometry to detect contaminants and wear particles. Ferrography to identify oxidation products.	Depleted corrosion inhibitor (oil left in service too long). Monitor oil life by neutralization numbers. Remove oxidation promoters by filtration.

COMMON WEAR MECHANISMS IN INDUSTRIAL EQUIPMENT

HOW TO IDENTIFY THEM BY OIL ANALYSIS

WEAR MECHANISM	OTHER NAMES	DEFINITION	SUSCEPTIBLE MACHINE PARTS	TYPICALLY CAUSED BY:	TYPE OF WEAR PARTICLES IN OIL	RECOMMENDED OIL ANALYSIS TEST(S)	POSSIBLE LUBRICANT PROBLEMS/ RECOMMENDATIONS
Cavitation	-	Removal of metals by implosion of bubbles at metal surface.	Hydraulic valves, pumps and gear teeth, cylinder liners/ piston rings	Sudden changes in pressure due to microbubbles.	Large chunks or spheres of metal in oil.	Ferrographic analysis to monitor wear particles.	Check for source of air leak. Check anti-foaming characteristics of oil.
Electrical Discharge	• Electrical • Pitting • Sparking	Removal of material by high amperage electric discharge or spark between two surfaces.	Bearings in high speed applications (i.e. turbines, compressors, etc.)	High speed rotation coupled with increased oil conductivity.	Large round metal particles in oil caused by localized melting.	Ferrographic or sediment analysis to detect wear particles.	Check for increased conductivity of oil (caused by water and/or metal contamination).