



R&T Reliability Technologies P/L is a Plant and Machinery Wear Debris Analysis & Root Cause Analysis Microscope Laboratory.

R&T has been providing Oil, Grease & Plant Condition Monitoring services via Wear Debris Analysis for the past 20 years throughout Australia, New Zealand & the Asia Pacific Regions.



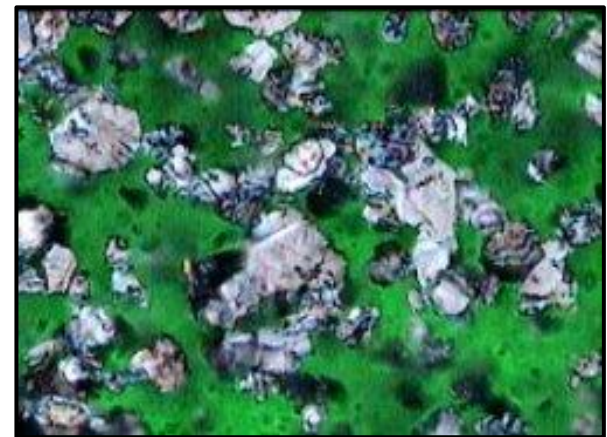
R&T has been fortunate with gaining a wide range experience of monitoring manufacturing plants from paper mills to sewage plants to power generation turbines.

Wear Debris Analysis (WDA) by microscope enables instant recognition of abnormal wear conditions in plant and machinery and root causes the catalyst triggering the abnormal wear conditions enabling steps to be instigated to prevent any further recurrence.

The Normal Spectrographic Oil Analysis can only identify very fine metallic wear particles sized smaller than a tenth of a human hair thickness, because of this the machine has the commence to wear abnormally before spectrographic analysis can detect it.

Date	Fe	Pb	Cu	Al	Cr	Si	Na	Sn	Mo	Mg	Zn	Ca	P	B	Ox	W	Vis	ISO	PQ
20/09/15	36	2	1	<1	<1	16	4	<1	<1	<1	180	59	161	<1		<0.1	101	22/16	47
20/07/15	5	<1	<1	<1	<1	1	<1	<1	<1	<1	184	61	163	<1		<0.1	102	21/16	16
20/05/15	5	<1	<1	<1	<1	2	<1	<1	<1	<1	184	61	162	<1		<0.1	101	19/15	20
New Oil	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	194	52	163	<1		<0.1	99	18/14	9

Spectrographic Analysis can give a few clues that abnormal wear conditions are occurring but Wear Debris Analysis by Microscope can detect these abnormal wear conditions 3-6 months before spectrographic analysis. WDA will root cause the wear then provide recommendations on how to eliminate the abnormal wear conditions.



The reason the microscope is far more efficient is the microscope is sensitive to all sizes of wear and contaminating debris rapidly detecting the difference between normal wear and abnormal wear modes.

Normal Wear Appearance by Microscope.



Normal Wear Mode at a low rate of wear

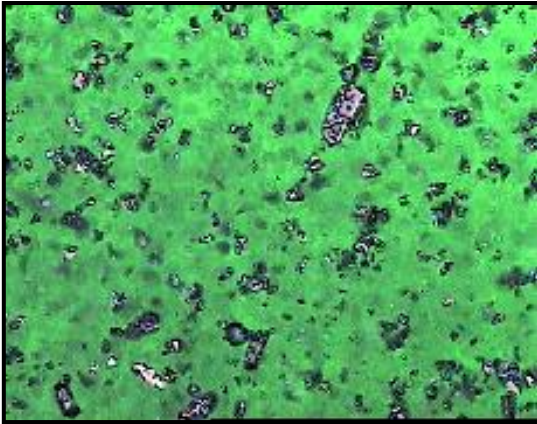


Normal Wear Mode at a light rate wear

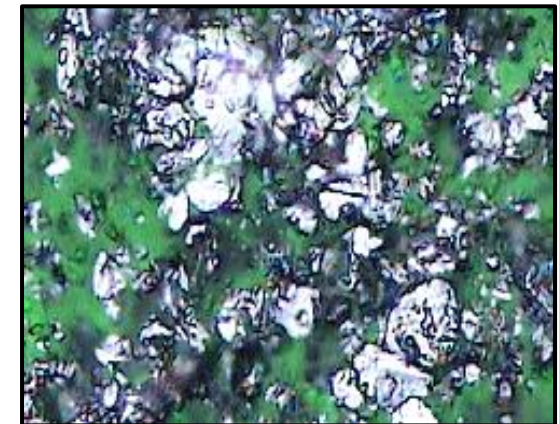
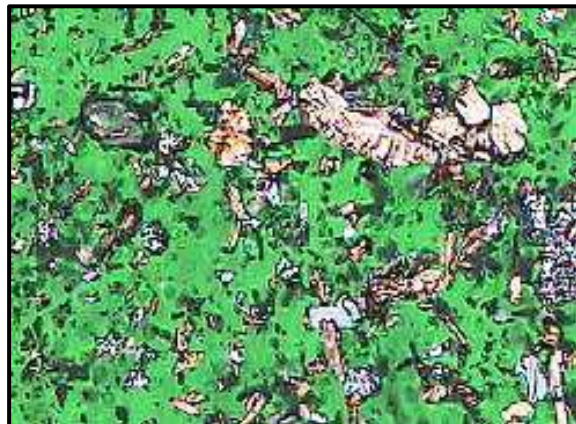


The green background to the images is the microscopes bottom light shining up through the sample WDA accurately indicates the contamination level encountered per mL of lubricant in the application tested enabling the machine owner to understand the amount and severity of wear occurring.

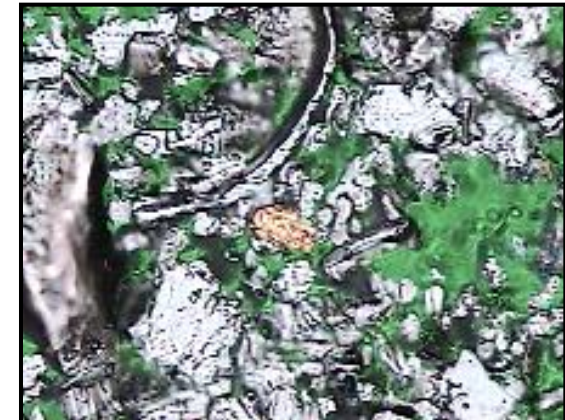
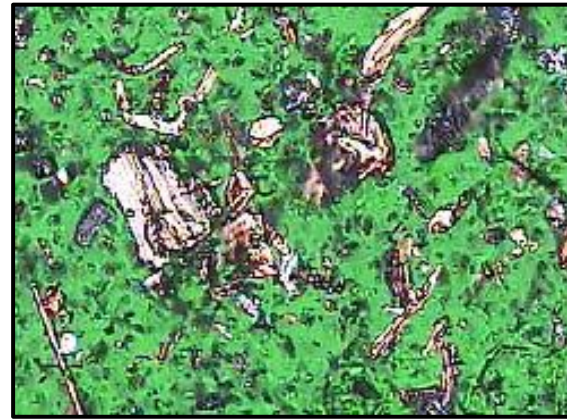
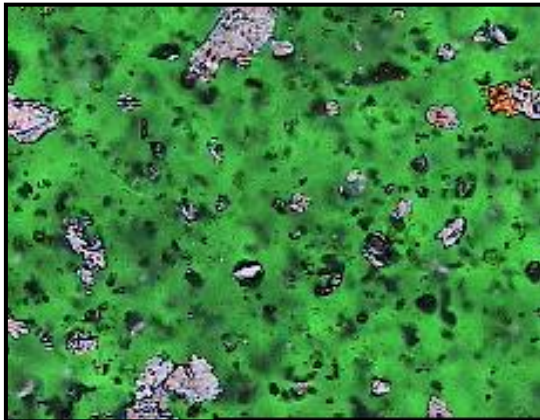
Abrasive Wear (Three Body)



Light Abrasive Wear



Moderate Abrasive Wear



Abrasive Wear is a result of the wear surfaces being abraded, there are two categories of Abrasive Wear

This is Three Body Abrasive Wear, the third body being an introduced hard particle, usually hard silica type crystals from the environment.

Abrasive Wear (Two Body)

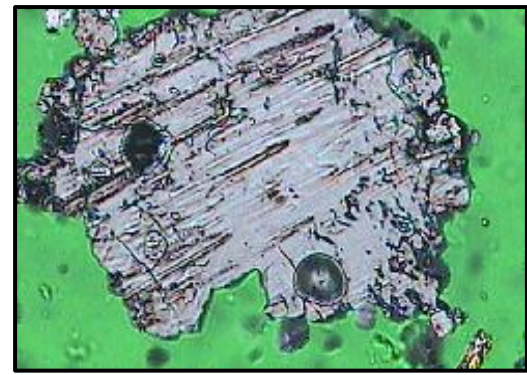
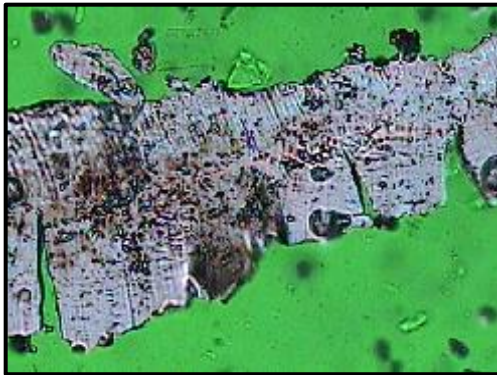


Moderate Abrasive Wear

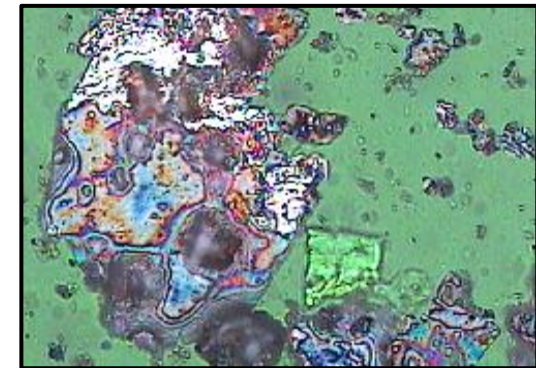
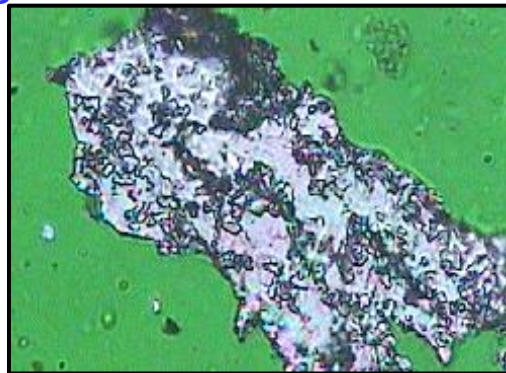
Two Body Abrasive Wear occurs when two machine components have been forced into heavy contact with the harder machine surface abrading metal from the softer machine surface, Two Body Abrasive Wear Particles are usually larger than Three Body Abrasive Wear Particles whose size is decided by the hard particles causing the wear.

Note how the microscope images indicate the contamination level that would be encountered per mL of lubricant in the application tested enabling the machine owner to understand the type and severity of wear occurring.

Rolling Fatigue Wear

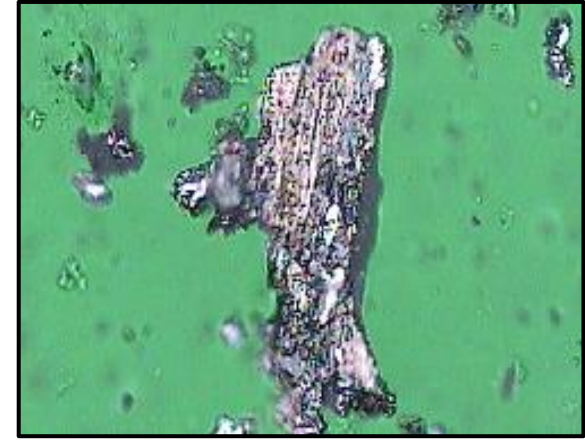


Fatigue wear occurs when machine components are exposed to repetitive high-stress micro pitting, impacting and flexing forming fine cracks and small spalls in the subsurface of the metal. This fine subsurface crack and spall damage over time propagates defoliating random shaped particles usually with a 10:1 aspect ratio from the damaged wear surface.

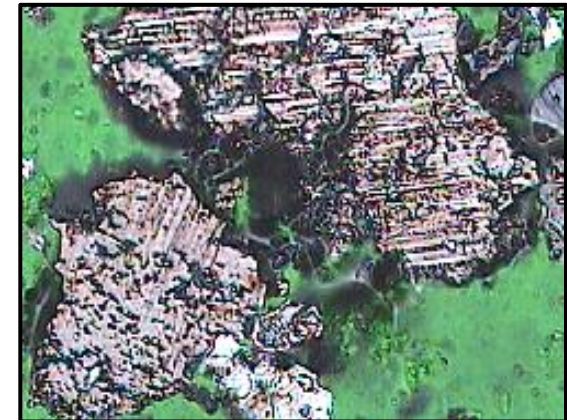
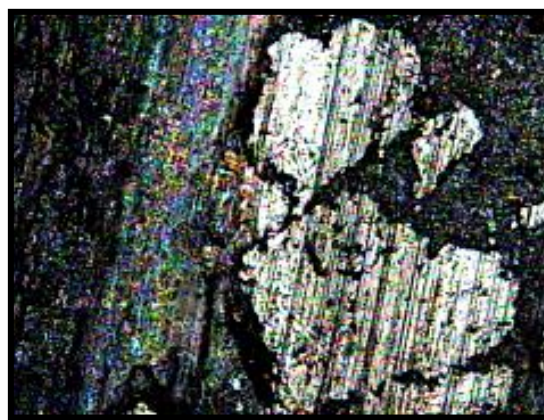
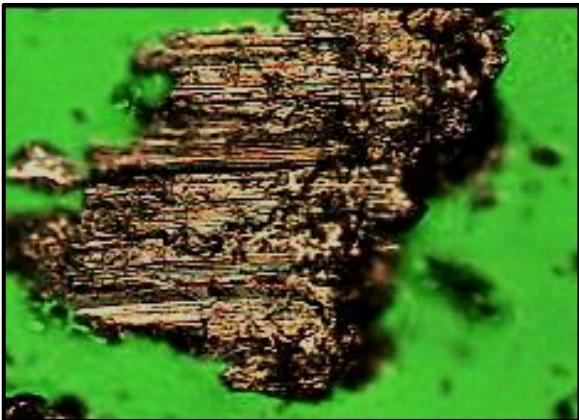


Spectrographic Analysis Particle Size Detection limits are $< 6-8 \mu\text{m}$ with the majority of the wear particles displayed here being too large for Spectrographic Analysis to detect.

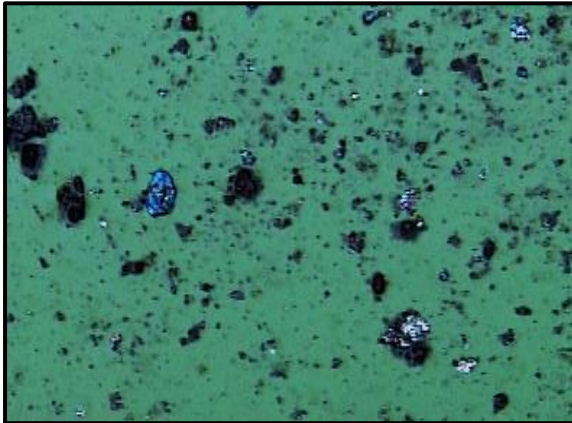
Sliding Wear



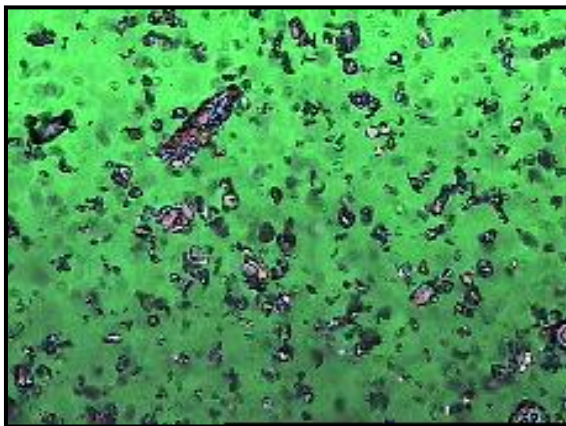
Sliding Wear & Abrasive Wear are lightly similar with Abrasive Wear cutting up the wear surface defoliating fine chips and Sliding Wear resulting in the deformation of the wear surface without the formation of a significant amount of wear debris. Sliding wear occurs when surface stresses are too great and the area becomes unstable and large particles commence to break away rapidly accelerating the rate of wear.



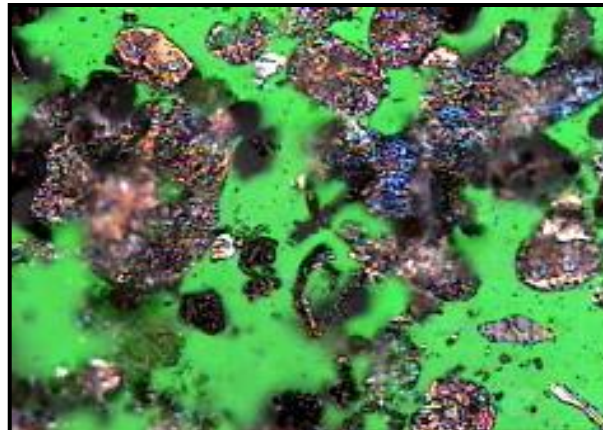
Adhesive Wear



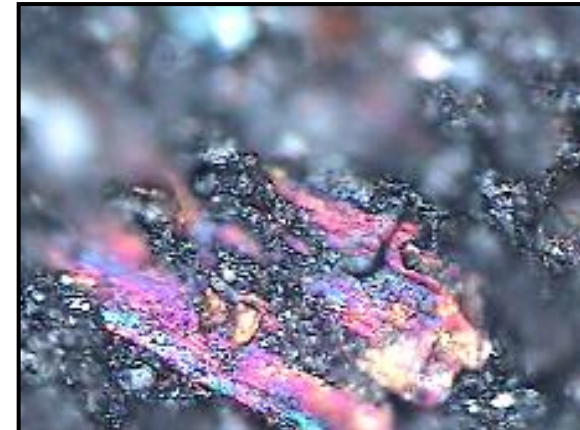
Adhesive Wear occurs in heavily loaded poorly lubricated sliding machine contact points. Light adhesive wear is called scuffing, heavy adhesive wear results in galling, overheating and if not prevented, failure.



20 μm

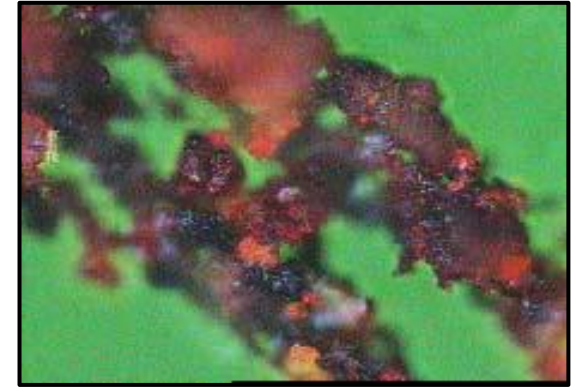
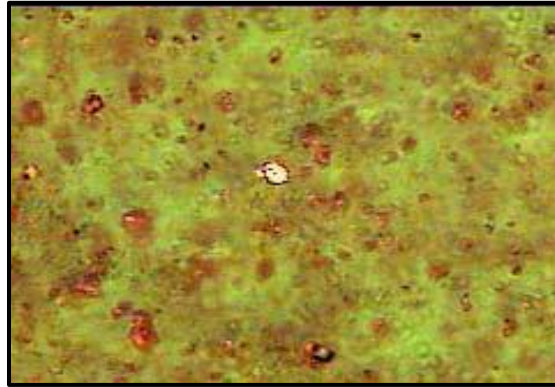
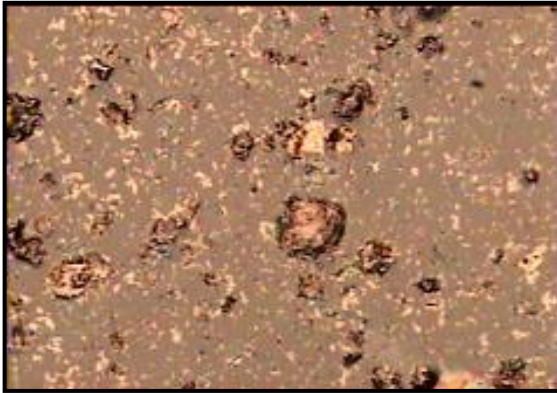


50 μm

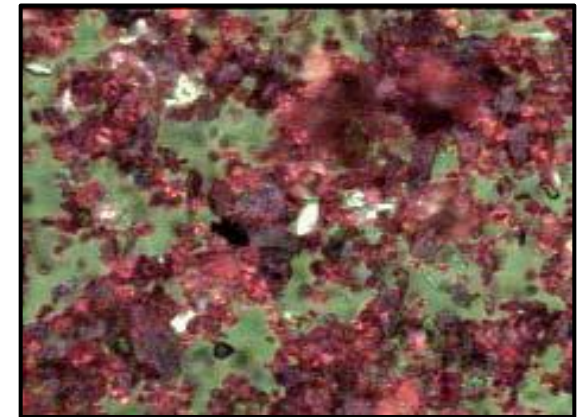


The lubrication film thickness formed in these applications is $< 1 \mu\text{m}$, thinner than the black borders on these images.

Chemical Corrosive Wear



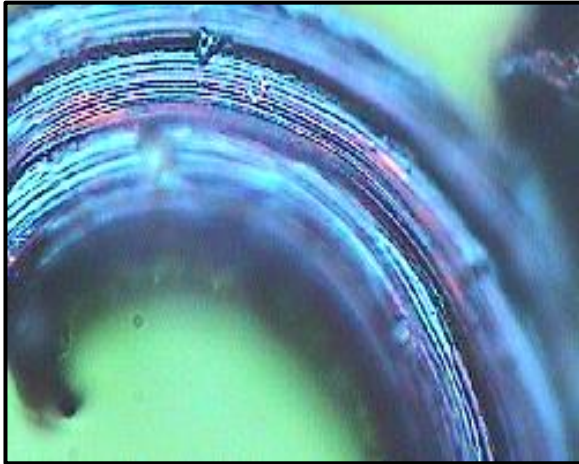
Light abnormal wear may be accelerated by corrosion (oxidation) of the rubbing surfaces due to the removal of the protective oxide films from the surface. As friction buffs the oxide film off the wear surface the polished metal surface rapidly forms a new oxide layer. Metallic Oxides are usually harder than the underlying metal and accelerate the rate of wear as the harder particles abrade the metal surfaces further.



Fretting Corrosion is a similar wear mechanism with water often providing oxygen accelerating Corrosive Wear.

Heat Treatment of Wear Debris Analysis Slides

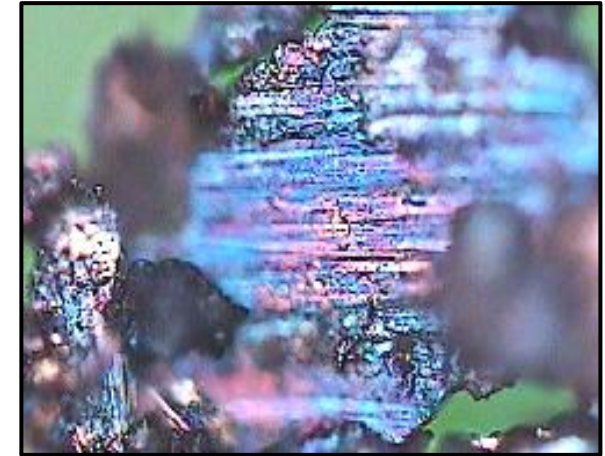
Heat Treatment of the analysis slide in the furnace forces metallic oxides to form on the wear particles surface, the distinctive oxidation colours formed identify the metallic alloy.



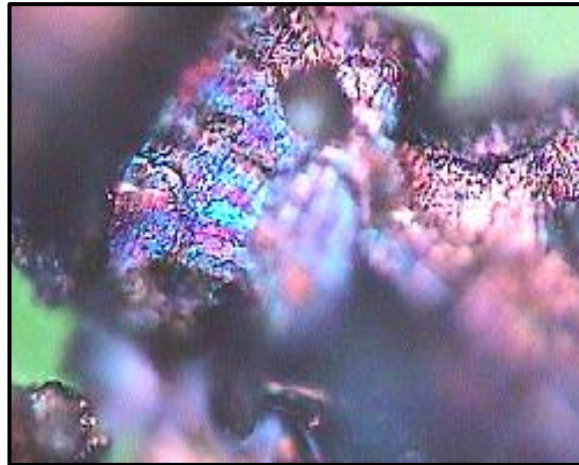
Open Gear Teeth



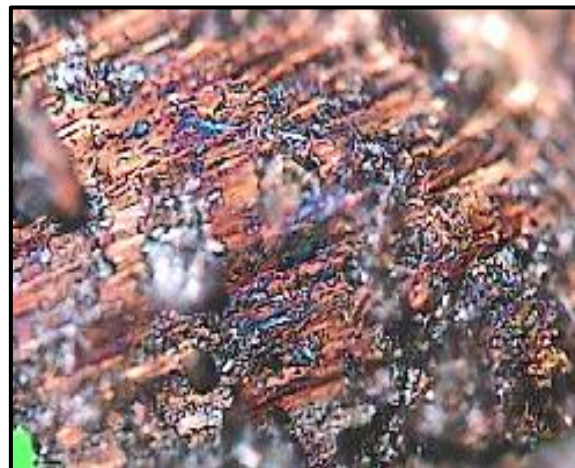
Open Gear Teeth



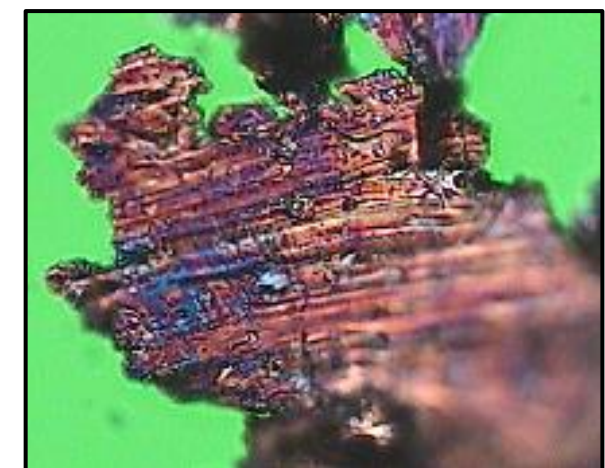
Detroit Diesel Crankshaft



Detroit Diesel Crankshaft



Cast Iron



Cast Iron

Heat Treatment of Wear Debris Analysis Slides



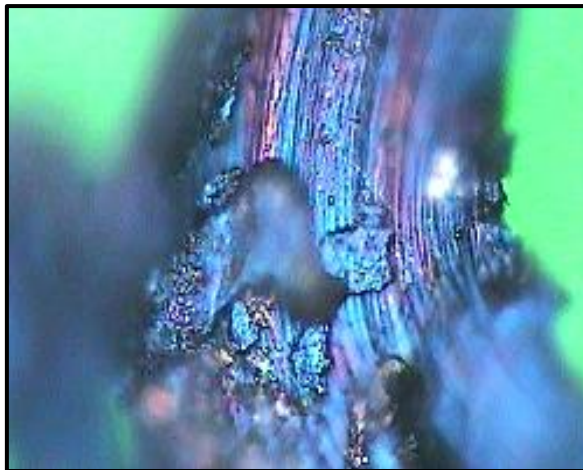
High Alloy Bearing Steel



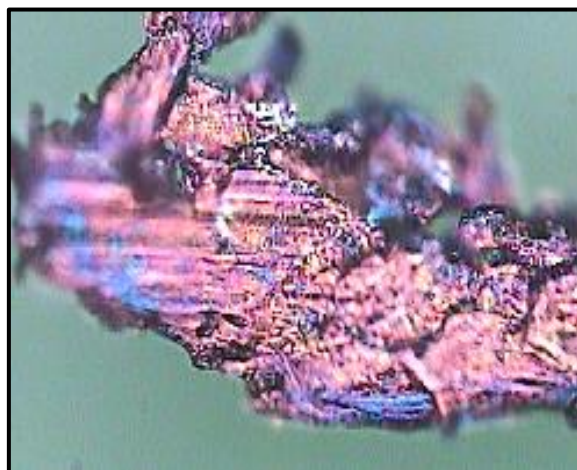
High Alloy Bearing Steel



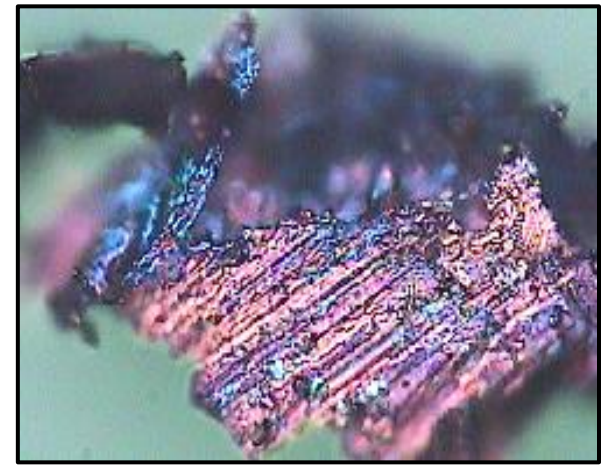
High Alloy Bearing Steel



High Alloy Bearing Steel



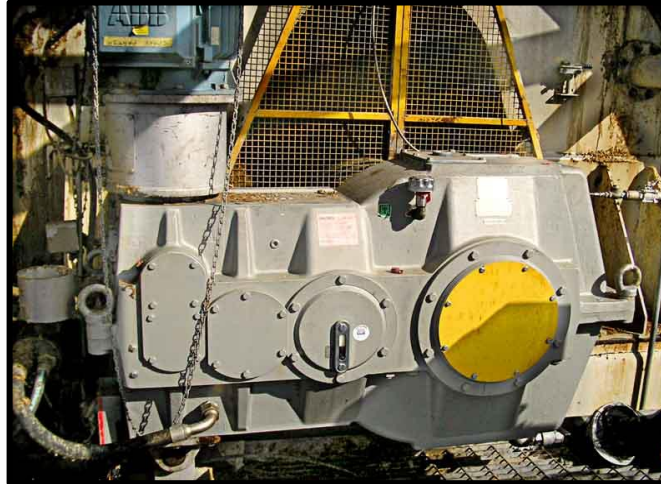
Low Alloy Steel



Low Alloy Steel

Equipment and lubricant condition monitoring of manufacturing plants by Wear Debris Analysis (WDA) by microscope is not new with equipment and lubricant condition monitoring by WDA developed by Monash University back in the 1970's.

R&T has specialised in the process and has been monitoring the same plants for 20 years with zero equipment downtime and low rates of wear.



R&T's involvement with oil sampling and remedial oil changing work has allowed R&T using WDA to research the most efficient way of guiding plant and equipment back to normal wear.

To assist in this area, R&T has developed simple systems that assist maintenance staff to easily visually monitor all the plant items under their care. For further information and assistance please contact **Rob** on **M: 0411 243 150** or **www.rttech.com**