REAL Services
RELIABILITY ENGINEERING ANALYTICAL LABORATORY

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EQUIPMENT CONDITION ANALYSIS

GREGORY POWER PARTNERS
Sherwin Alumina
Gregory, TX

CRITICAL

Sample ID:	GPP-297228	Sample Date:	6/30/2013
Equip. Desc.:	GTG 1A; Gas Turbine	Received Date:	7/9/2013
Lubricant Type:	Chevron GST-32	Test Date:	7/10/2013
Reservoir Cap.:	6,200.00 Gal(s) 23,467.00 Ltr(s)	Prev. Sample:	5/12/2013 M
Machine Time:	72,874.0 Hr(s)	First Sample:	4/9/2001
Lube Time:	1,587.6 Hr(s)	No. Samples:	137

Recommendation(s):

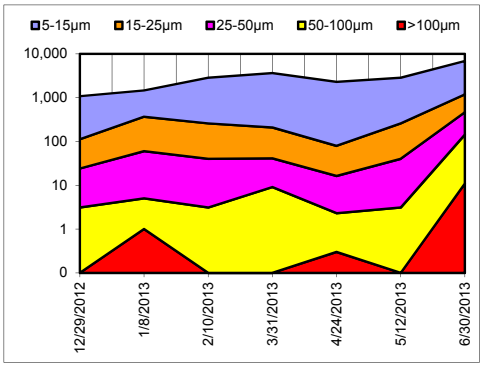
RESAMPLE this equipment at your earliest possible convenience to verify the generation of Babbitting wear and case hardened steel. Consider scheduling this equipment for maintenance action in the near future. Specifically , possible wiped journal bearing. CHECK OPERATING LOADS & TEMPERATURES to ensure that they are within O.E.M. specifications.

Discussion of Test Results:

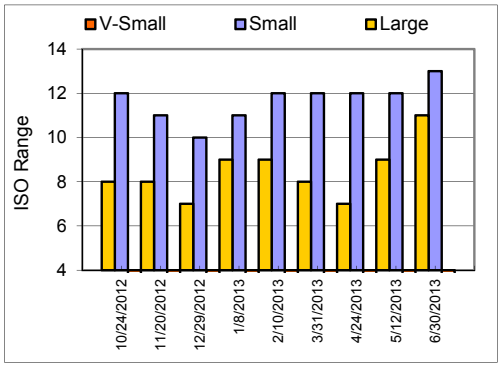
Although the equipment particle concentration (EPC) has decreased for this equipment from 2,845 to 1,581, analytical results show the re-appearance of 45 micrometer (um) High Carbon (~12%) steel Severe Sliding wear and 125um case tempered Hardened steel Rolling Contact (Bearing) wear particles. Tempering is the rainbow coloration resulting from elevated temperatures at the critical contact pint. Temperatures at this critical contact point are in the 330°C (626°F) range. Analysis also shows the appearance of 125um white non-ferrous metal Severe Sliding wear and Black Metal Oxides (Fe_3O_4). The white non-ferrous metal particles are most likely Aluminum, however, Chrome, Nickel and Stainless Steel are also other possibilities. These particles are of great concern. These particles are of sufficient size to cause a metal to metal interference with close tolerance components.

QUANTITATIVE TESTING:

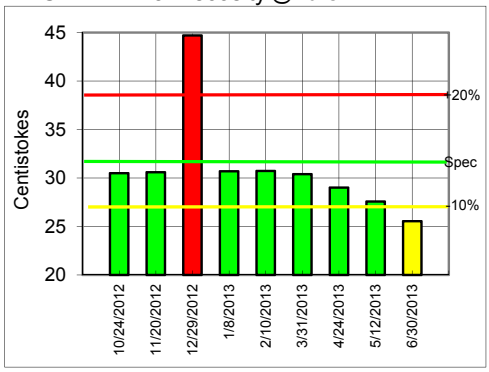
NAS-1638 Particle Count / 100 mL



ISO-4406 Contamination Code / 1.0 mL



ASTM-D-445 Viscosity @ 40°C



QUALITATIVE TESTING:

Ferrous Metal Wear:

Classification	1	5	10	Max µm
Rubbing				≤ 15
Severe Sliding				45
Cutting/Plowing				
Rolling Cont (Bearing)				125
Spheres				
Gear				
Black Oxides (Fe_3O_4)				N/A
Red Oxides (Fe_2O_3)				N/A
Corrosive (FeO)				
Other				

Non-Ferrous Metal Wear:

Classification	1	5	10	Max µm
Rubbing				≤ 15
Severe Sliding				125
Cutting/Plowing				
Rolling Cont (Bearing)				
Spheres				
Gear				
Oxides				
Other				

Contaminants:

Classification	1	5	10	Max µm
Filming				N/A
Sand & Dirt				N/A
Fibers				N/A
Spheres				
Plastic/Ceramic				
Carbon & Organics				

Non-Ferrous Metal Alloys	Copper	White	Babbitt

Particle Data		Lube Data	
2-5 µm	N/P	40°C cSt:	25.54
5-15 µm	5,678	Water-IR:	464
15-25 µm	725		
25-50 µm	321	D-974 TAN	2.12
50-100 µm	132	D-1500 Color	2.0
>100 µm	11		
EPC:	6,867	D-92 Flash	375°F
PLP	17.3%	R-BOT min.	1,560
ISO Scale:	N/P 13 11	Cu D-130	1B

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Discussion of Test Results (cont'd):

The viscosity of the lubricant is more than 10% below specification. This low viscosity has been confirmed kinematicly. Please confirm that the lubricant type listed in the report header is the correct lubricant for this equipment. The low viscosity has contributed to the increased wear in this equipment.

ASTM-D-1500 - remains at 1.5 to 2.0 (GE 2.0 max) Color
ASTM-D-974 - has worsen, increasing from 0.14 to 1.50 to 2.12 mg/KOH (GE 0.20 max) Total Acid Number

ASTM-D-130 - has improved slightly from 1A / 1B to 1A (GE 1B max) Copper Strip Corrosion
- the previous test was performed on 3/31/2009.

ASTM-D-2272 - has decreased for this sample from 2,468 to 1,560 minuets (GE 500 min.) Oxidation Stability by Rotary Bomb last results on 3/31/2009 sample.

Routine equipment sampling, testing and analysis provided the optimal benefits of Reliability Centered Maintenance (RCM) program.

Image 1

Interpretation:
Shown in this image an example of the 125um Case Hardened steel Rolling Contact (Bearing) wear particles seen in this equipment. Note that this image was taken AFTER heat treatment.

Lighting: White Reflected & Green Transmitted

Magnification: 500X — 35 µm —

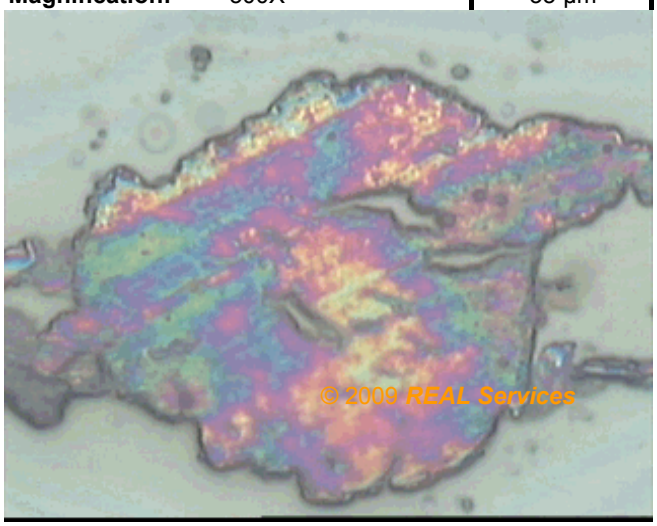

Image 2

Interpretation:
This image displays an example of the 125um white non-ferrous Babbitting alloy Severe Sliding wear particles seen in this equipment. Note that this image was taken AFTER heat treatment.

Lighting: White Reflected & Green Transmitted

Magnification: 500X — 35 µm —