



Turbine Oil Analysis Report GREAT LAKES GENERATION

Insight Services, Inc.

20338 Progress Drive
Cleveland, OH 44149
Phone: 216-251-2510
Fax: 216-251-2515



Turbine Oil Condition

Lubricant Health	Marginal
Contamination	Normal
Turbine Wear	Normal
Varnish Potential	Normal

Plant: Blue Spruce
 Address: 1751 N. POWHATON DRIVE
 AURORA, CO 80019
 Contact: Jack Boilerman

Machine Name:	BS CT2 LUB		
Unit Id:	BS CT2 LUB		
Sample Date:	09/03/2009	Received Date:	09/04/2009
Report Date:	09/04/2009	Lab Number:	541350
Analyst:	MM	Sample Number:	1328-1-4
Lube Type:	TERESSTIC 32	Machine Type:	Industrial Turbine
Machine Manuf.:	GENERAL ELECTRIC	Machine Model:	7FA

Summary:

This sample failed the demulsibility test. Levels of solid and water contamination are very low, indicating clean dry oil. There is no evidence of abnormal wear to turbine components. Varnish potential tests show acceptable values.

Recommendation:

In this application (combustion turbine), demulsibility performance may not be needed. If water levels are kept low, this lubricant is suitable for continued service. Continue scheduled sampling.

Test Data Summary Table

Date		09/03/2009	9/3/2009	1/16/2009	7/15/2008	7/15/2008	3/13/2008	12/3/2007
Lab No	Reference	541350	541348	487605	481156	481155	481154	481153
Hours		48635	48635	43115				
Event		n/a	n/a	n/a	n/a	n/a	n/a	n/a
SPECTROSCOPIC ANALYSIS (Reported in ppm) ASTM D5185								
Wear Metals	Iron	<40	0	0	0	0	0	0
	Copper	<25	0	0	0	0	0	0
	Lead	<25	0	0	1	0	0	0
	Aluminum	<35	0	0	0	0	0	0
	Tin	<25	0	2	0	0	0	0
	Nickel	<15	0	0	0	0	0	0
	Chromium	<15	0	0	0	0	0	0
	Titanium	n/a	0	0	0	0	0	0
	Vanadium	n/a	0	0	0	0	0	0
	Silver	n/a	0	0	0	0	0	0
Additives	Calcium	0	8	8	8	0	0	0
	Magnesium	0	0	0	0	1	1	0
	Phosphorus	0	5	4	0	0	0	0
	Zinc	0	4	4	5	6	6	7
	Barium	0	0	0	0	0	0	0
	Molybdenum	0	0	0	0	0	0	0
Contam.	Silicon	<25	0	0	1	0	1	1
	Boron	<25	0	0	1	0	0	0
	Sodium	<25	4	3	0	0	0	0
	Potassium	<25	0	0	0	11	11	0
PHYSICAL PROPERTIES								
Viscosity @ 40C	32	31.1	31.1	30.8		31.9	31.6	31.4
Acid Number	<0.2	0.06	0.06	0.06		0.06	0.06	0.06
FTIR Indexing Number (JOAP Method)								
Oxidation	3	3	3	3				
Nitration	3	2	2	3				
Antiwear	10	10	11	10				
Other Fluids	29	26	27	26				
PARTICLE COUNT (Reported in particles per ml) ISO 4406.99								
ISO CODE	18/16/14	15/14/10	16/15/11	14/13/9		12/10/8	12/11/8	15/13/9
>4 Micron	2500	261	482	130		30	30	120
>6 Micron	640	101	187	50		8	15	60
>14 Micron	160	7	14	3		2	2	4
>50 Micron	0	0	0	0		0	0	0
>100 Micron	0	0	0	0		0	0	0
CONTAMINATION								
Water ppm	<0.05	30	30	70	Neg	0	0	17
ADDITIONAL TESTS								
Demulsibility	40/40/0 (30)	1/18/61 (30)						
Color		<3.0						
Foam Test (Sec.)	<250 s	30						
RPVOT (Mins.)	>200	560						
Rust	Pass	PASS						
VARNISH POTENTIAL ANALYSIS								
Ultra Centrifuge	<5	2						
MPC Value	<35	18						
Ruler (%)	>25%	110.8						

Discussion of test results:**Spectroscopic Analysis by ASTM D5185**

SPECTROSCOPIC ANALYSIS (Reported in ppm) ASTM D5185								
Date		09/03/2009	09/03/2009	01/16/2009	07/15/2008	07/15/2008	04/30/2008	03/13/2008
Lab No	Reference	541350	541348	487605	481156	481155	481141	481154
Wear Metals	Iron	<40	0	0	0	0	0	0
	Copper	<25	0	0	0	0	0	0
	Lead	<25	0	0	1	0	0	0
	Aluminum	<35	0	0	0	0	0	0
	Tin	<25	0	2	0	0	0	0
	Nickel	<15	0	0	0	0	0	0
	Chromium	<15	0	0	0	0	0	0
	Titanium	n/a	0	0	0	0	0	0
	Vanadium	n/a	0	0	0	0	0	0
	Silver	n/a	0	0	0	0	0	0
Additives	Calcium	0	8	8	8	0	0	0
	Magnesium	0	0	0	0	1	1	0
	Phosphorus	0	5	4	0	0	0	0
	Zinc	0	4	4	5	6	6	0
	Barium	0	0	0	0	0	0	0
	Molybdenum	0	0	0	0	0	0	0
Contam.	Silicon	<25	0	0	1	0	1	1
	Boron	<25	0	0	1	0	0	0
	Sodium	<25	4	3	0	0	0	3
	Potassium	<25	0	0	0	11	11	0

Spectroscopic analysis quantifies the presence of metals in parts per million (ppm). The reported elements may be associated with machine wear, contamination or oil additives.

Wear Metals - All wear metal levels are low and do not indicate any abnormal wear.

Additives - The levels of additive metals in this sample are consistent with the oil type listed.

Contaminants - No significant levels of contaminant metals were found.

Demulsibility by ASTM D1401

ADDITIONAL TESTS								
Date		09/03/2009						
Lab No	Reference	541350						
Demulsibility	40/40/0 (30)	1/18/61 (30)						

Demulsibility tests the oil's ability to separate from water. A turbine oil should fully separate from water in 30 minutes, with a passing result defined as less than 3 ml of emulsion after 30 minutes.

This sample failed the demulsibility test with 61 ml of emulsion remaining after 30 minutes. This is an unacceptable result and indicates that this lubricant does not readily separate from water.

Acid Number by ASTM D974

PHYSICAL PROPERTIES								
Date		09/03/2009	09/03/2009	01/16/2009	07/15/2008	04/30/2008	03/13/2008	12/03/2007
Lab No	Reference	541350	541348	487605	481155	481141	481154	481153
Acid Number	<0.2	0.06	0.06	0.06	0.06	0.07	0.06	0.06

Acid Number (AN) is an indicator of oil health. As the oil oxidizes, acidic byproducts are generated within the oil. As the oil's ability to resist oxidation drops, more of these byproducts are generated causing the AN to increase. A sharp increase in acid number can indicate that the oil is approaching the end of its useful life. Turbine oil generally has an AN of around 0.03 new, and in service should not exceed 0.2.

The acid number for this sample is 0.06 which is well below alarm limits.

Viscosity by ASTM D445

PHYSICAL PROPERTIES								
Date		09/03/2009	09/03/2009	01/16/2009	07/15/2008	04/30/2008	03/13/2008	12/03/2007
Lab No	Reference	541350	541348	487605	481155	481141	481154	481153
Viscosity @ 40C	32	31.1	31.1	30.8	31.9	31.7	31.6	31.4

Viscosity is a measure of lubricant's resistance to flow. Changes in viscosity indicate improper servicing, dilution, contamination or lubricant breakdown in service. Test results are reported in centistokes (cSt) at 40C.

The viscosity result is acceptable for this lubricant. The result indicates it is within range for an ISO VG 32 lubricant.

FTIR Spectroscopy by JOAP Method

ADDITIONAL TESTS								
Date		09/03/2009	09/03/2009	01/16/2009				
Lab No	Reference	541350	541348	487605				
Oxidation	3	3	3	3				
Nitration	3	2	2	3				
Antiwear	10	10	11	10				
Other Fluids	29	26	27	26				

FTIR covers the monitoring of base stock degradation, oxidation, nitration, and additive depletion in machine lubricants, hydraulic fluids, and other fluid types. This test is based on trending of different parameters in various oils and fluids.

FTIR results for this sample indicate no significant lubricant degradation and a strong correlation to both reference and trend data.

Particle Count by ISO 4406

ADDITIONAL TESTS								
Date		09/03/2009	09/03/2009	01/16/2009	07/15/2008	04/30/2008	03/13/2008	12/03/2007
Lab No	Reference	541350	541348	487605	481155	481141	481154	481153
ISO CODE	18/16/14	15/14/10	16/15/11	14/13/9	12/10/8	13/11/9	12/11/8	15/13/9
>4 Micron	2500	261	482	130	30	60	30	120
>6 Micron	640	101	187	50	8	15	15	60
>14 Micron	160	7	14	3	2	4	2	4
>50 Micron	0	0	0	0	0	0	0	0
>100 Micron	0	0	0	0	0	0	0	0

Using the fluid flow decay principle, oil is passed through a calibrated screen and particles are classified according to their size in microns. The raw data is then converted to an ISO code using ISO 4406.

Particle count data for this sample indicates a very low level of particulate contamination and is below the alarm of 18/16/14.

Color by ASTM D1500

VARNISH POTENTIAL ANALYSIS								
Date		09/03/2009						
Lab No	Reference	541350						
Color		<3.0						

Color analysis is a simple quantification of the oil's appearance. There are no pass or fail specifications. The results are used as a comparison to new oil or trend data.

Foam Test by ASTM D892

ADDITIONAL TESTS								
Date		09/03/2009						
Lab No	Reference	541350						
Foam Test (Sec.)	<250 s	20 / 0 / 30						

Foaming tendency is a measurement of the relative resistance to foaming exhibited by the oil. Air introduced into the oil sample should generate no more than 450 ml of foam after 5 minutes, and the foam should dissipate after a 10 minute settling period and ideally less than 250 seconds.

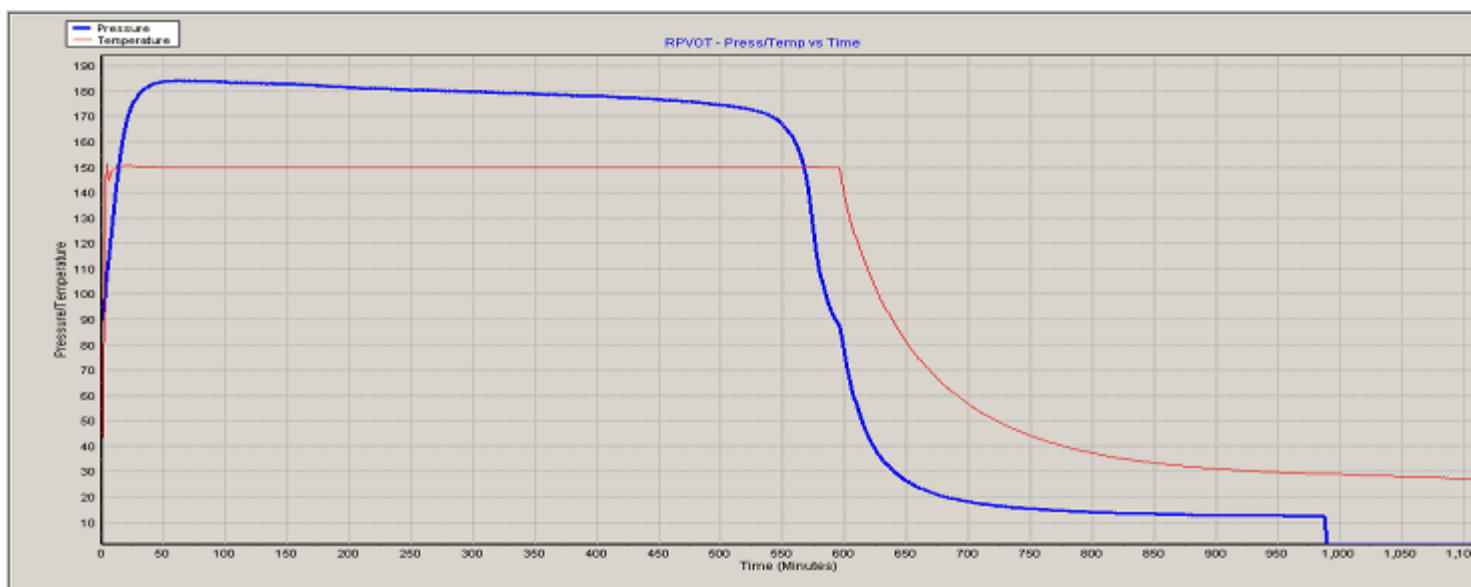
This sample generated 20 ml of foam which fully dissipated in 30 seconds. This is considered an acceptable result.

Rotating Pressure Vessel Oxidation Test by ASTM D2272

ADDITIONAL TESTS								
Date		09/03/2009	04/30/2008	05/03/2007	05/31/2006	05/13/2005		
Lab No	Reference	541350	481141	481140	481148	481144		
RPVOT (Mins.)	>200	560	702	726	511	610		

The RPVOT test accelerates the oxidation process in order to evaluate the oil's remaining ability to resist oxidation, with the result expressed in minutes. Generally, an oil's condemning limit is 25% of new oil value, with an absolute lower limit of 200 minutes.

The RPVOT result for this sample was 560 minutes, indicating a healthy antioxidant additive package.



Rust Test by ASTM D665 A

ADDITIONAL TESTS								
Date		09/03/2009						
Lab No	Reference	541350						
Rust	Pass	PASS						

The rust test is an indication of the rust preventing characteristics of inhibited mineral oil in the presence of distilled water. A portion of the sampled oil is mixed with water. A steel test rod is placed in the mixture and is agitated by stirring. The test duration is 4 hours after which the steel rod is inspected for the presence of rust. A passing result is the absence of rust on the steel rod.

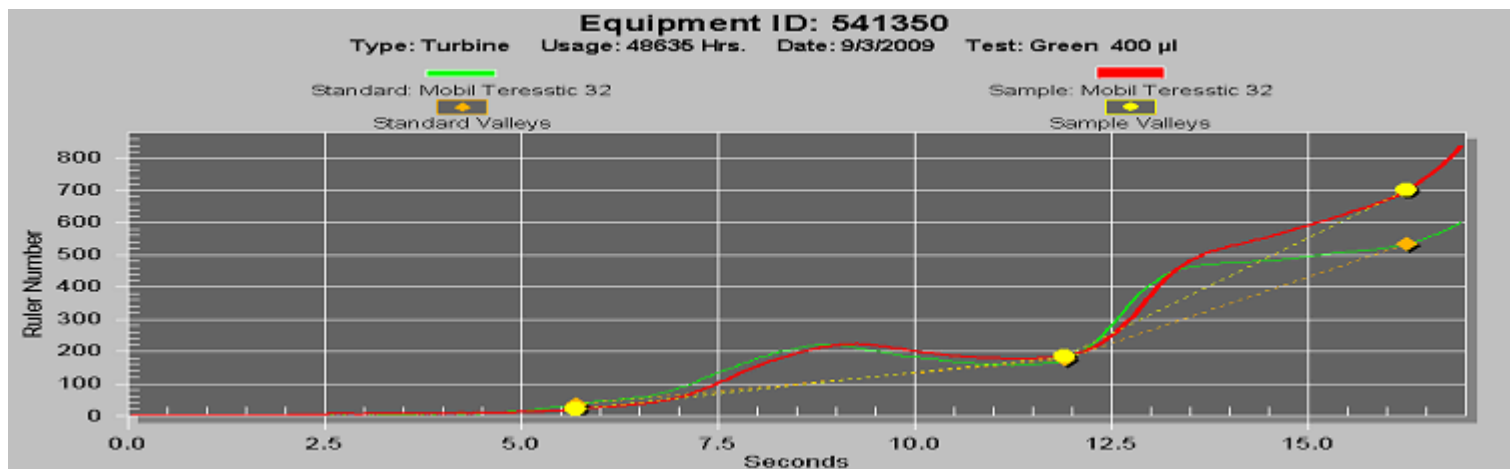
This sample received a result of Pass - Clean indicating excellent rust preventing characteristics.

RULER

VARNISH POTENTIAL ANALYSIS								
Date		09/03/2009						
Lab No	Reference	541350						
Ruler %	>25%	110.8						
Amine		97						
Phenolic		55						

The RULER accurately measures the remaining active antioxidants in the lubricant. Antioxidants are the most important additive components in many lubricants including turbine, hydraulic, compressor and aerospace fluids. The RULER number represents the concentration of the antioxidants monitored relative to a new oil.

This sample tested at 97% for Amines and 55% Phenolics. The overall Ruler number was 110%. This is an acceptable result and indicates a healthy active antioxidant additive package.



Water by Karl Fisher by ASTM D6304

CONTAMINATION								
Date		09/03/2009	09/03/2009	01/16/2009	07/15/2008	04/30/2008	03/13/2008	12/03/2007
Lab No	Reference	541350	541348	487605	481155	481141	481154	481153
Water ppm	<0.05	30	30	70	0	70	0	17

Karl Fischer titration is a direct measurement of water in a lubricating oil. Water is considered to be the most destructive of contaminants causing accelerated oil degradation and corrosion to system components. Also, excessive water in large static reservoirs can lead to microbial growth. The presence of water can severely alter the load carrying capacity of a lubricant. Industrial specifications set the warning limit for turbines at 0.1% or 1000 ppm.

Water was measured at 30 ppm for this sample. This is considered an acceptable result.

Ultra Centrifuge Test

VARNISH POTENTIAL ANALYSIS								
Date		09/03/2009						
Lab No	Reference	541350						
Ultra Centrifuge	<5	2						

A small amount of oil in a test tube is run for 30 minutes at 17,000 RPM in an ultra centrifuge. By subjecting the sample to significant G-forces, we are able to extract insoluble contaminants that are much too small to be detected by normal particle counting. The amount of the agglomerated material is compared to a rating scale to derive the UC Value (1-8). When the UC Value exceeds 4, a marginal condition is noted. A UC value exceeding 6 is considered to be a critical result.

This sample received an Ultra Centrifuge rating of 2 indicating an acceptable result.



Membrane Patch Colorimetry

VARNISH POTENTIAL ANALYSIS								
Date		09/03/2009						
Lab No	Reference	541350						
MPC Value	<35	18						

The process of making a patch isolates and agglomerates insoluble by-products associated with varnish. The color of the membrane patch provides a guideline as to the extent of varnish potential. Generally a value over 35 is considered abnormal.

This sample received a color result of 18. This is below the alarm limit of 35 and is considered to be an acceptable result.

