

REAL BIG WATER & POWER

Portage Trail Substation
Cuyahoga Falls, OH

CRITICAL

Sample ID: PWP-C-03422-5-1-LTC
Equip. Desc.: C-03422-5-1; Load Tap Changer
Lubricant Type: Shell Dalina
Reservoir Cap.: 345.00 Gal(s) 1,305.83 Ltr(s)
Operations: 7,362
Lube Time: Not Provided Hr(s)

Sample Date: 4/25/2004
Received Date: 4/28/2004
Test Date: 4/30/2004
Prev. Sample: 2/14/2004
First Sample: 3/1/2004
No. Samples: 4

M

Recommendation(s):

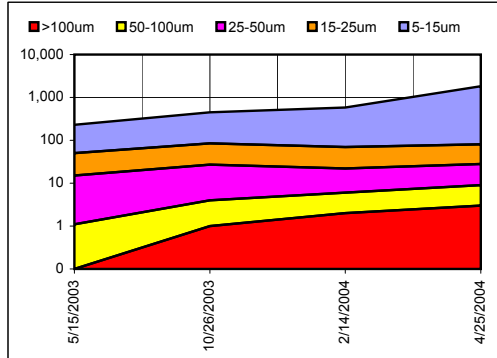
Consider efforts to schedule this unit for maintenance action in the near future. Specifically, inspect contacts for electrical discharge, secure loose mounting hardware and reduce water contamination. CHANGE OR FILTER FLUID to reduce water and coking contamination. CHECK contact tension to ensure it is within O.E.M. specifications. RESAMPLE equipment to verify the generation of electrical discharge properties.

Discussion of Test Results:

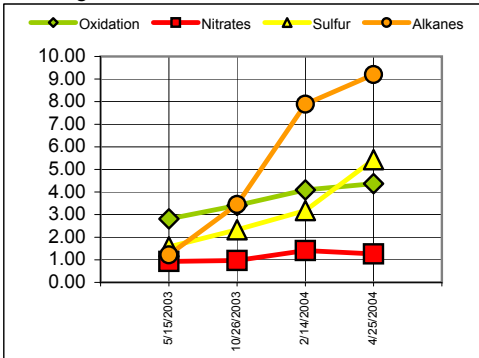
The equipment particle concentration (EPC) has increased for this equipment from 581 to 1,826, this EPC level remains well within acceptable limits for this type of equipment. Analytical results show a high concentration of Ferrous metal particles. These metal particles are from the Load Tap Changer (LTC) mounting hardware. The movement of this hardware has resulted in the electrical discharge to surrounding components. Indication of the electrical discharge is from the generation of Spheres. The electrical discharge is supported by the increasing concentration of Coking and Filming compounds. Analysis also show particles in the 60 micrometer (um) range along with 120um Cutting wear indicating wear on the switch shaft. The Filming compounds can be quantified in terms of Coking at 78 ppm, Oxidation at 4.37 Abs/cm, Nitration at 1.26 Abs/cm, Sulfur at 5.43 Abs/cm. Volatile and explosive compounds in the form of Alkanes have continue to increase from 3.45 to 7.89 to 9.20 Abs/cm. This elevated levels is of great concern and can lead to ignition by the internal electrical discharge.

QUANTITATIVE TESTING:

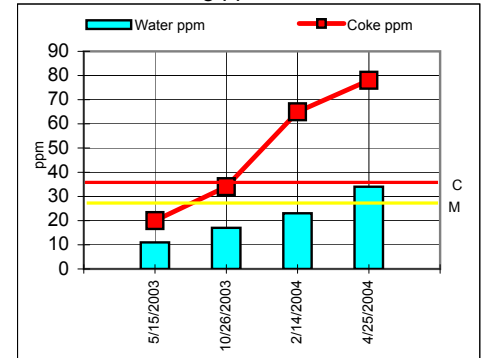
NAS-1638 Particle Count



Filming & Volatile Gas Indicators



Moisture & Coking ppm



QUALITATIVE TESTING:

Ferrous Metal Erosion:

Classification	1	5	10	µm	Max
Resonance / Fatigue	█	█	█	█	≤ 15
Severe Sliding	█	█	█	█	60
Cutting/Plowing	█	█	█	█	120
Rolling Cont (Bearing)	█	█	█	█	> 5
Spheres	█	█	█	█	> 5
Impaction	█	█	█	█	> 5
Black Oxides (Fe ₃ O ₄)	█	█	█	█	N/A
Red Oxides (Fe ₂ O ₃)	█	█	█	█	N/A
Corrosive (FeO)	█	█	█	█	N/A
Other	█	█	█	█	N/A

Non-Ferrous Metal Erosion:

Classification	1	5	10	µm	Max
Resonance / Fatigue	█	█	█	█	≤ 15
Severe Sliding	█	█	█	█	60
Cutting/Plowing	█	█	█	█	60
Rolling Cont (Bearing)	█	█	█	█	> 5
Spheres	█	█	█	█	> 5
Impaction	█	█	█	█	> 5
Oxides	█	█	█	█	N/A
Other	█	█	█	█	N/A

Non-Metals:

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

Non-Ferrous Metal Composition	Copper	White	Babbitt
	█	█	█

Particle Data		Lube Data	
5-15 µm	1,745	40°C cSt:	10.0
15-25 µm	53	Water ppm	34
25-50 µm	19	Coke ppm	78
50-100 µm	6	Oxidation	4.37
>100 µm	3	Nitrates	1.26
EPC:	1,826	Sulfur	5.43
ISO Scale:	18/13	Alkanes	9.20

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Discussion of Test Results (cont'd):

Water contamination is 34 ppm. The combination of Coking and Filming compounds have resulted in the increase of resistive material. These resistive material caused an increase in power levels and burning of fluid as seen in elevated combustible compounds, sulfur and coking. Analysis also shows the presence of Fiber material. This Fiber material is composed of cellulose (paper media) of the insulation and indicates the degradation of this insulation.

Image 1

Interpretation:

Shown in this image shows examples of the Electrical Discharge Spheres.

Lighting: White Reflected & Green Transmitted

Magnification: 500X

35 um

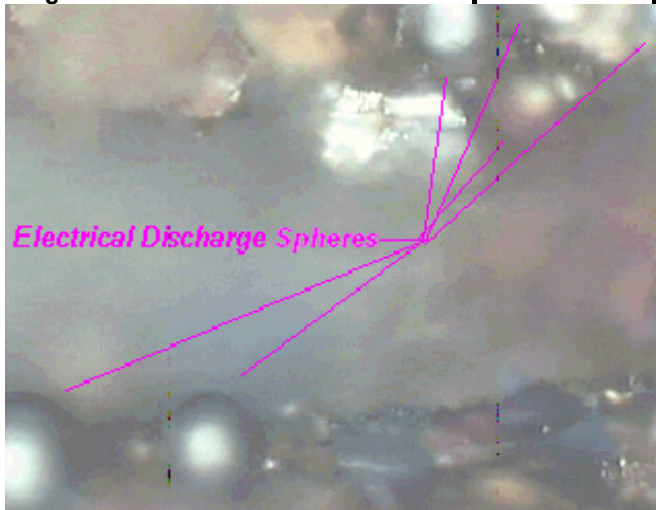


Image 2

Interpretation:

This image displays the excessive concentration of Ferrous metal particles Electrical Discharge Spheres. Note that this image was taken under lower magnification to show the extent of the problem.

Lighting: White Reflected & Green Transmitted

Magnification: 200X

75 um

