

[North River Midstream / LSD 16-11-82-9W6] 4TH CREEK PLANT #1

Customer: PTRHTF20127
 SPECTRA ENERGY
 BAG 6180
 FORT ST JOHN, BC V1J 4H7 Canada
 Attn:
 Tel: (780)351-2131
 E-Mail: mdmoxness@spectraenergy.com

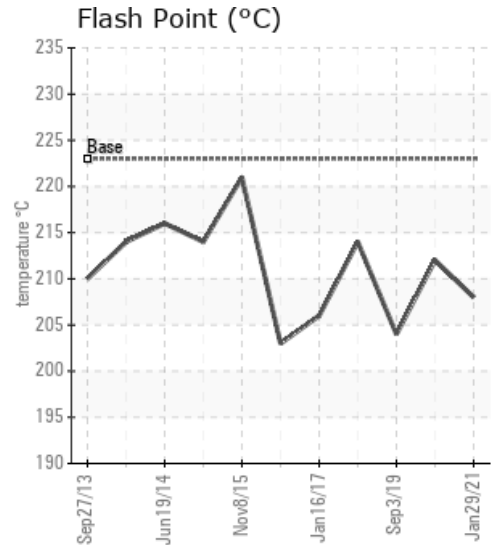
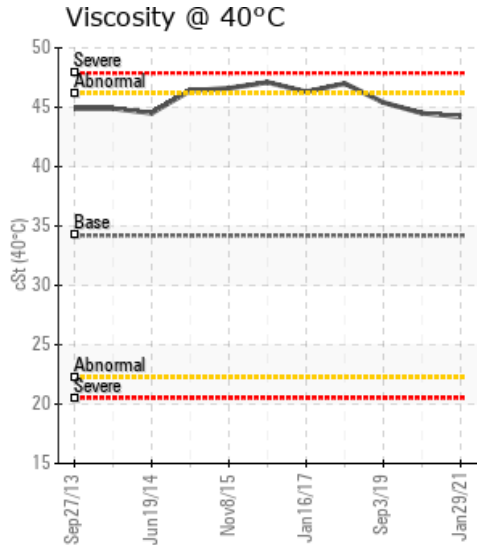
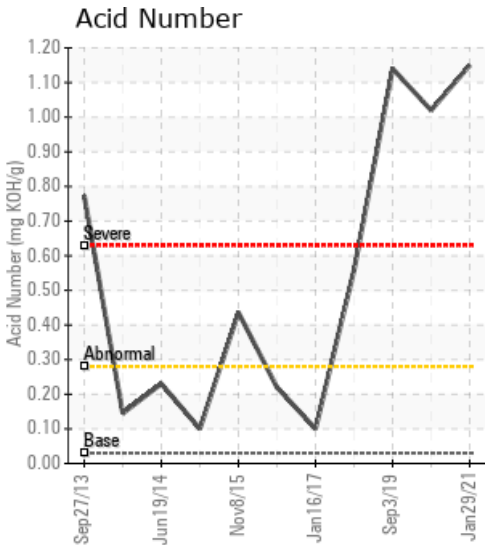
System Information
 System Volume: 30000 ltr
 Bulk Operating Temp: 383F / 195C
 Heating Source:
 Blanket:
 Fluid: PETRO CANADA PETRO-THERM
 Make: RUSHTON

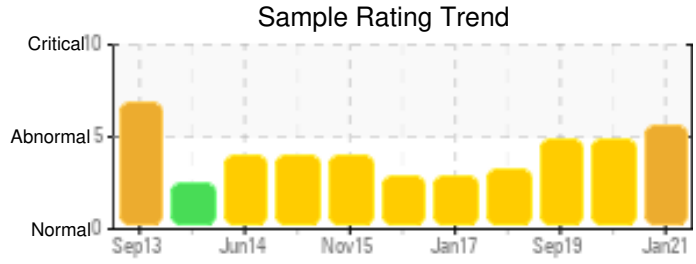
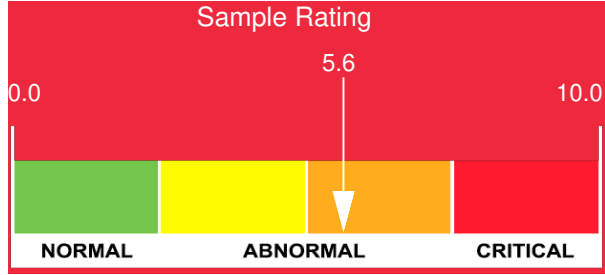
Sample Information
 Lab No: 02401489
 Analyst: Clinton Buhler
 Sample Date: 01/29/21
 Received Date: 02/03/21
 Completed: 02/08/21
 Clinton Buhler
 Clinton.Buhler@hollyfrontier.com

Recommendation: Sample results indicate that the fluid condition remains quite similar to the previous analysis from June 2020. Acid Number remains elevated and above the recommended limit of 0.4 and solids content is still elevated but hasn't increased. It is recommended to make a plan for fluid replacement in the future. Please ensure blanket gas is operational. Please re-sample in 6 months

Comments:

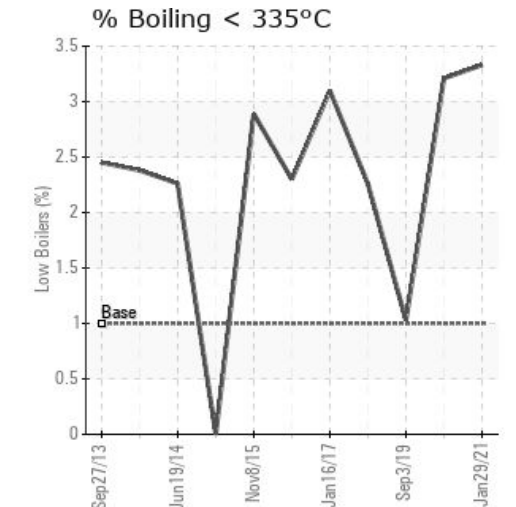
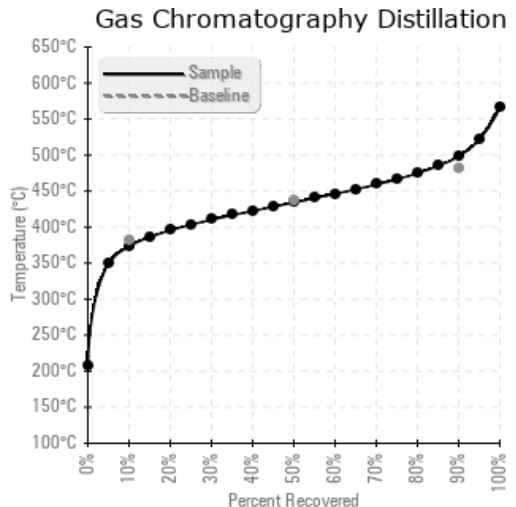
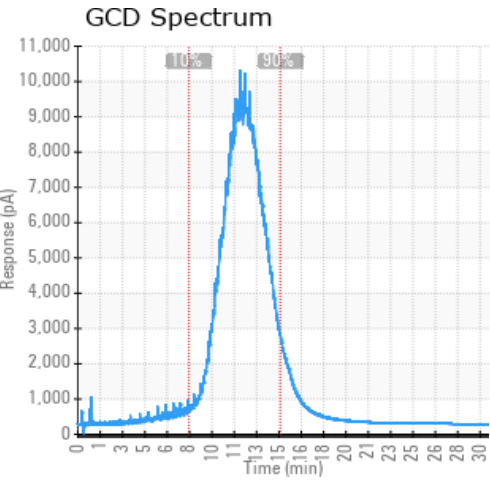
Sample Date	Received Date	Fluid Age	Sample Location	Flash Point (COC)	Water (KF)	Viscosity (40°C)	Acid Number	Solids	GCD 10%	GCD 50%	GCD 90%	GCD % < 335°C
	mm/dd/yy			°F/°C	ppm	cSt	mg/KOH/g	%wt	°F/°C	°F/°C	°F/°C	%
01/29/21	02/03/21	22y	Heat med bldg	406 / 208	34.5	44.2	1.15	1.66	704 / 373	814 / 434	929 / 498	3.33
06/26/20	07/07/20	21y	HEAT MEDIUM BLDG	414 / 212	52.0	44.5	1.02	2.23	707 / 375	815 / 435	927 / 497	3.21
09/03/19	09/10/19	0y	HEAT MEDIUM BLDG	399 / 204	53.4	45.4	1.14	1.54	703 / 373	793 / 423	888 / 476	1.03
10/06/17	10/17/17	20y		417 / 214	57.4	47.0	0.558	0.544	707 / 375	817 / 436	932 / 500	2.26
01/16/17	01/23/17	0y	HEAT MEDIUM #1	403 / 206	61.4	46.3	0.10	2.20	698 / 370	809 / 432	935 / 502	3.10
Baseline Data				433 / 223		34.2	0.03		720 / 382	817 / 436	900 / 482	1.00





Sample Date	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin	Cadmium	Silver	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
01/29/21	14	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0
06/26/20	14	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
09/03/19	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
10/06/17	18	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	2	0	0	0
01/16/17	22	0	0	0	0	0	1	0	0	0	1	4	0	0	0	0	0	0	0	0	2	0	0	0
Baseline Data			0	0						0		0	0					0				0		

Elemental analysis results (above) in parts per million (ppm). [10,000 ppm = 1.0%]



Historical Comments	
06/26/20	Sample results indicate that fluid degradation and system fouling is ongoing: Solids has increased to 2.23%, acid number is at 1.02 and is well above the threshold of 0.4% for when sweetening would have been of value. % of low boiling vapors (3.21%) also indicates thermal degradation ongoing along with the oxidation. System cleaning and fluid replacement is recommended. Pentane Insolubles levels are severely high. Acid Number (AN) is severely high.
09/03/19	Sample results indicate that the fluid may be experiencing oxidative degradation as evidenced by the increased Acid Number and increased Pentane Insolubles (Solids). Solids content can indicate system fouling. Please ensure that blanket gas is operational. Planning should begin to consider reducing the fluids Acid Number and solids content by performing a cleaning and fluid replacement as the cost to sweeten would also be significant considering the system volume. Please re-sample in 6 months. Contact Petro-Canada Lubricants Technical Services for further assistance. Pentane Insolubles levels are severely high. Acid Number (AN) is severely high.
10/06/17	Acid Number has increased significantly from previous sample. This is a strong indication of ongoing oxidation. Elevated viscosity and 90% distillation supports this. Solids levels are still high, yet they have improved since last sample. Improvement may be related to the addition of ~5 barrels of fresh fluid during vessel cleaning. Solids can be the result of oxidation by-products or from metals. Increased acidity can cause corrosion of system. Ensure that nitrogen blanket is functioning properly (between 2-3 psi). Begin sweetening with new fluid to bring Acid Number down. Re-sample in 6 months Pentane Insolubles levels are abnormally high. Acid Number (AN) is abnormally high. (GCD) 90% Distillation Point is abnormally high. Visc @ 40°C is abnormally high.
01/16/17	(GCD) @ 90% is slightly elevated indicating some heavier end is the oil sample likely to some oxidation. Pentane insoluble is elevated indicating the same. The TAN and Flash Point are still good. Ensure Nitrogen blanket is in place to prevent oxidation and continue to operate. Resample in 6 months. Pentane Insolubles levels are severely high. (GCD) 90% Distillation Point is abnormally high. Visc @ 40°C is abnormally high.

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