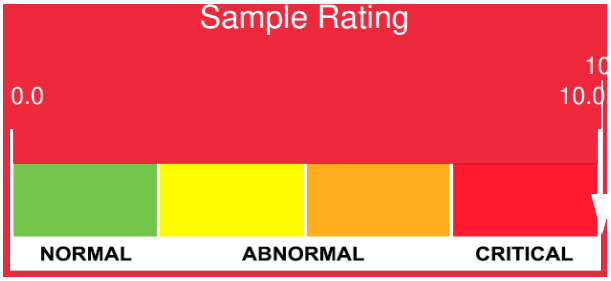
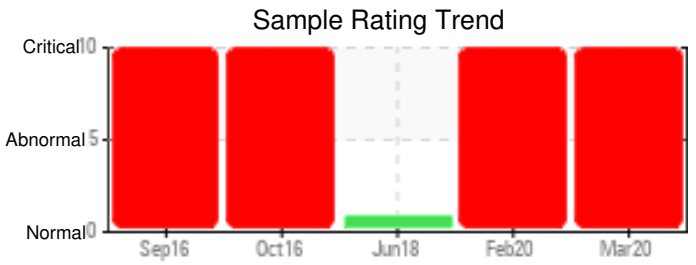




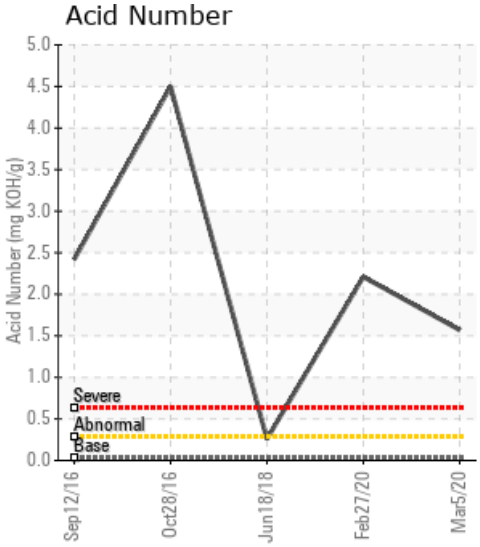
[ARC RESOURCES LSD / 10-36-65-25-W5] ARC SIMONETTE

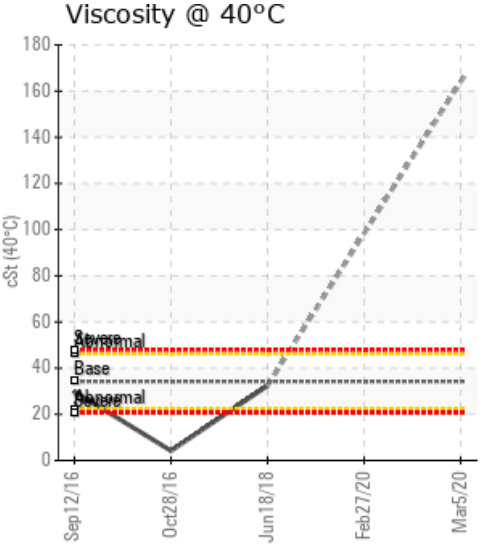
Customer: PTRHTF20177	System Information	Sample Information
ARC RESOURCES LTD. 10-36-65-25-W5 VALLEYVIEW, AB T0H 3N0 Canada Attn: Duane Penson Tel: (780)552-3022 E-Mail: dpenson@arcresources.com	System Volume: 2500 ltr Bulk Operating Temp: 150F / 66C Heating Source: Blanket: Fluid: PETRO CANADA PETRO-THERM Make:	Lab No: 02341968 Analyst: Peter Harteveld Sample Date: 03/05/20 Received Date: 03/06/20 Completed: 03/13/20 Peter Harteveld peter.harteveld@hollyfrontier.com

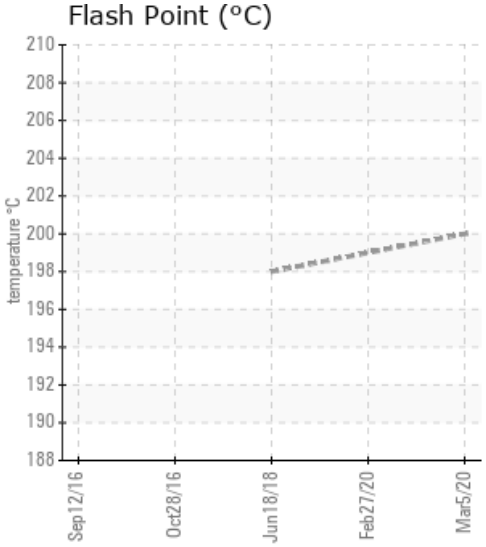
Recommendation: The fluid is in a poor condition and has to be replaced. AN is high. This in combination with the water content has resulted in corrosion of system internals. High Fe is evidence of that. Viscosity is high because the solids content of the fluid is at 10% which is 20x the alert limit. The 10% GCD temperature is low. This in combination with 4.14% low boiler vapor content is an indication of thermal degradation of the fluid. The 90% GCD temperature is high. This indicates oxidation of the fluid which occurs when the high temp fluid comes into contact with outside air (oxygen). (blanket gas in place ?) Operations informed PC that the system will be modified to TEG. Cleaning of the system is required prior to filling with TEG.

Comments: PQ levels are severe. Iron ppm levels are abnormal. Aluminum ppm levels are noted. Pentane Insolubles levels are severely high. Water contamination levels are marginally high. ppm Water contamination levels are marginally high. Acid Number (AN) is severely high. Visc @ 40°C is severely high. Sodium ppm levels are abnormally high. (GCD) 90% Distillation Point is abnormally high.

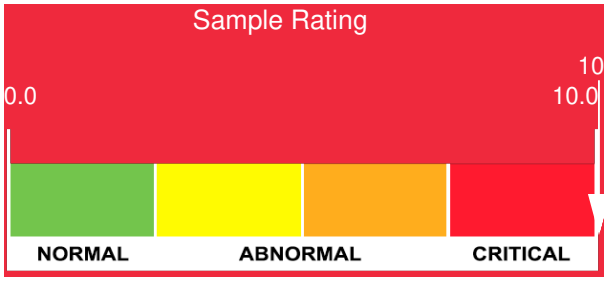
Sample Date	Received Date	Fluid Age	Sample Location	Flash Point (COC)	Water (KF)	Viscosity (40°C)	Acid Number	Solids	GCD 10%	GCD 50%	GCD 90%	GCD % < 335°C
	mm/dd/yy			°F/°C	ppm	cSt	mg/KOH/g	%wt	°F/°C	°F/°C	°F/°C	%
03/05/20	03/06/20	0.0y	0227	392 / 200	524.6	164	1.57	10.0	695 / 368	818 / 437	927 / 497	4.14
02/27/20	03/06/20	0.0y	THICKER		910.1		2.21	15.2				
06/18/18	06/25/18	4.0y		388 / 198	40.4	32.4	0.26	0.213	689 / 365	778 / 414	870 / 465	2.18
10/28/16	11/07/16	17.0y			264750	4.2	4.50					
09/12/16	09/29/16	18.0y			27322.8	29.8	2.42	5.44	683 / 361	807 / 430	914 / 490	5.49
Baseline Data				433 / 223		34.2	0.03		720 / 382	817 / 436	900 / 482	1.00

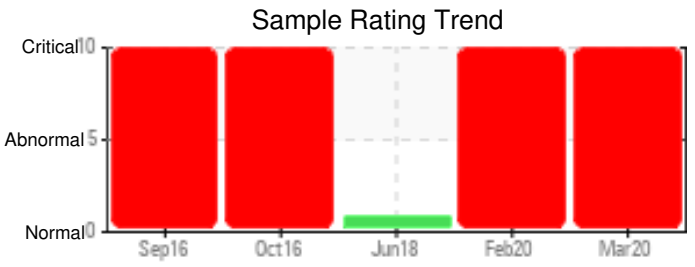






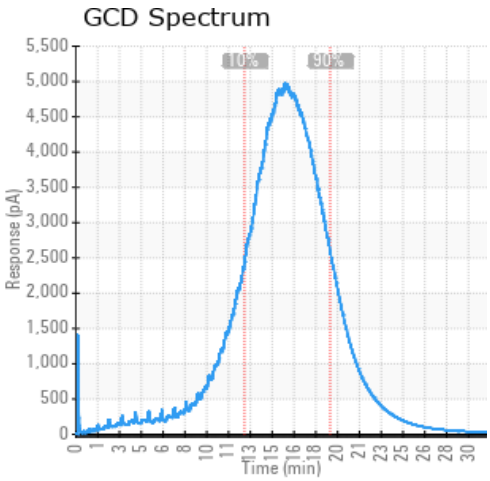
PETRO-CANADA LUBRICANTS

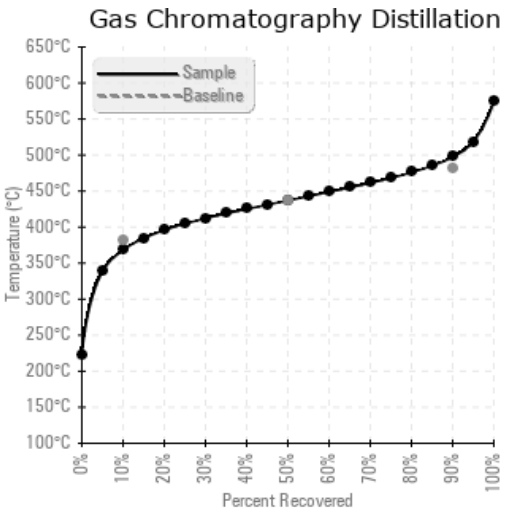


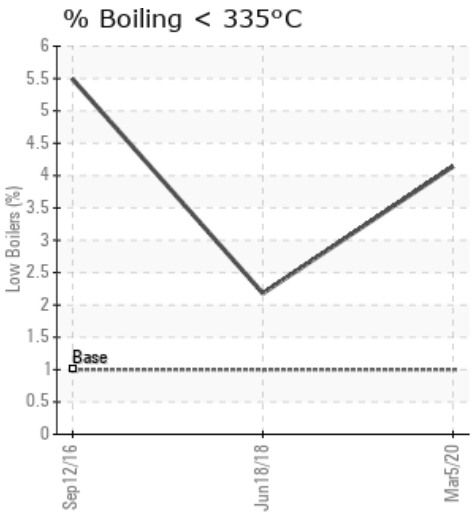


Sample Date	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin	Cadmium	Silver	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
03/05/20	351	0	0	13	0	0	0	0	0	0	13	23	4	0	0	0	2	0	0	0	6	0	1	4
02/27/20	630	0	2	39	2	0	0	0	0	0	23	31	13	0	0	8	6	4	3	0	13	0	0	10
06/18/18	37	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/28/16	1156	1	2	10	1	0	0	0	0	0	15	585	447	0	14	3	42	0	16	9	105	0	6	4
09/12/16	475	0	0	50	1	0	0	0	0	0	347	104	26	2	0	0	8	0	3	8	29	1	17	29
Baseline Data			0	0						0			0	0					0				0	

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







Historical Comments

02/27/20	Due to the nature of the sample (sludge) taken from the bottom of the heater not all parameters could be determined. The test package was determined based on a request from the customer to use the analysis of the sludge sample as a diagnostic tool to determine what the cause of the experienced problems is. The analysis shows a large content of wear metals (Fe and Al) and contamination (Si, Na) and some K, Ca and Zn. The wear metals in combination with very high AN indicates corrosion. The viscosity could not be determined because the sample is too thick. This is caused by an extremely high solids content of 15.2% which is 30x higher than the warning limit of 0.5%. Without having all parameters available the degradation mode of the fluid can't be determined with certainty however the condition of the sludge based on known parameters shows either the result of thermal degradation and/or oxidation. If blanket gas was in place during operation, oxidation can be ruled out. Thermal degradation in non-circulated systems is taking place because the lack of circulation (low fluid film velocity in contact with the fire tube) results in a very large differential temperature between bulk fluid temperature and skin film temperature. This causes the fluid to thermally degrade. This is further enhanced by the low operating temperature of the fluid (130-135C) and intermittent burner operation. Below 150C the coefficient of heat transfer of Petro-Therm is too low to accept the full heat of the burner. Thermal degradation forms light ends (vapor) and carbonaceous material (solids). Summarizing: System design and low operating temperature creates a condition in which Petro-Therm cannot operate in a reliable fashion.
06/18/18	The fluid is in good condition but the distillation curve as a whole is not representative for Petro-Therm. This in combination with a slightly decreased Flash Point and increased low boiler vapor content (%<335C.) may indicate mixing with a lighter fluid. The fluid is suitable for further use. Please re-sample in 6 months. (GCD) 90% Distillation Point is abnormally low.
10/28/16	The acidity of the fluid is at an unacceptable high level. Corrosion is taking place. It is recommended to drain the fluid, flush the system and re-fill with fresh Petro-Therm. Before doing this the source of contamination has to be eliminated.NOTE: The sample was approximately 50% glycol. Suspect that the customer has sampled from a low point in the system and that is why the glycol content is so high.Iron and manganese ppm levels are severe. PQ levels are abnormal. Glycol contamination levels are severely high. Water contamination levels are severely high. Water contamination levels are severely high.. ppm Water contamination levels are severely high. Potassium ppm levels are abnormally high. Acid Number (AN) is severely high. Calcium ppm levels are severely high. Visc @ 40°C is severely low. Sodium ppm levels are notably high.
09/12/16	This sample has 2.7% Water in it. If this is representative of the oil in the system, you risk doing a boil over of the water causing the system to overflow. This could create a potentially dangerous situation. The metallic components are indicate contamination.This system needs to be either cleaned up or replaced. TAN is severely high indicating the oil requires changing. Verify whether the sample taken was representative of the oil in the system. If in fact it is, an oil change and system cleaning is recommended.Aluminum and iron ppm levels are severe. Silicon ppm levels are severely high. Water contamination levels are severely high. Water contamination levels are severely high.. ppm Water contamination levels are severely high. Pentane Insolubles levels are severely high. Potassium ppm levels are abnormally high. Sodium ppm levels are severely high. Acid Number (AN) is severely high. Zinc ppm levels are abnormally high. Calcium ppm levels are abnormally high.