

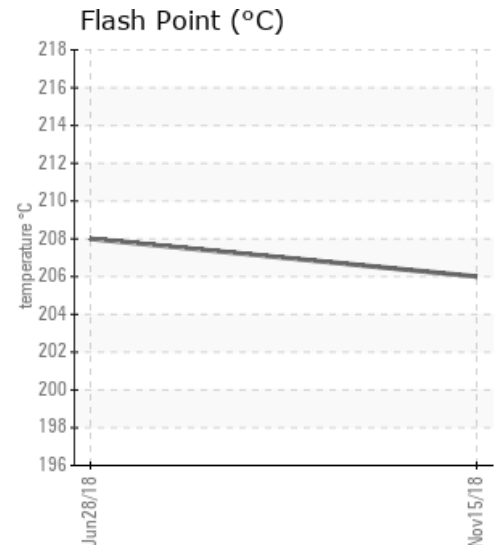
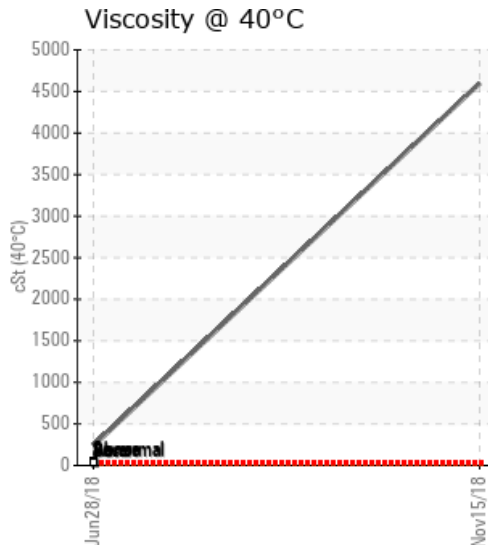
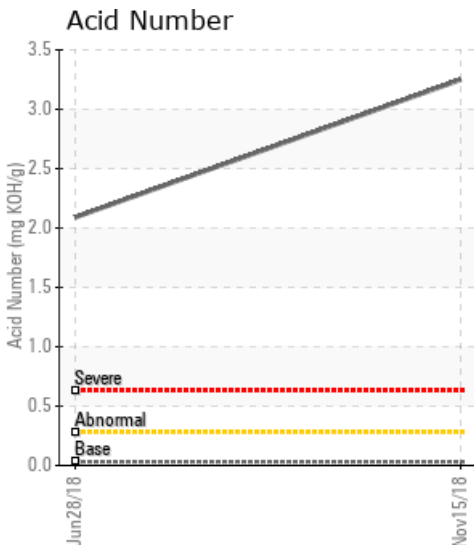
[TANGLE CREEK ENERGY 02-26-52-12W5M] HEAT TRANSFER

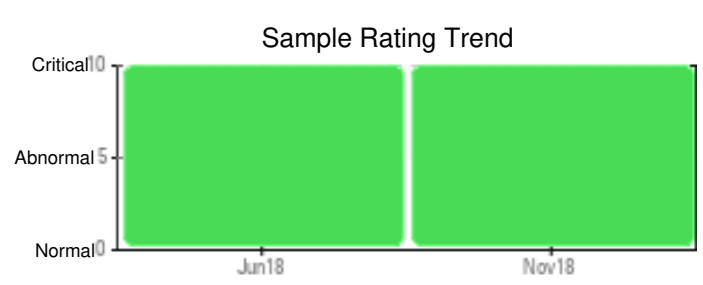
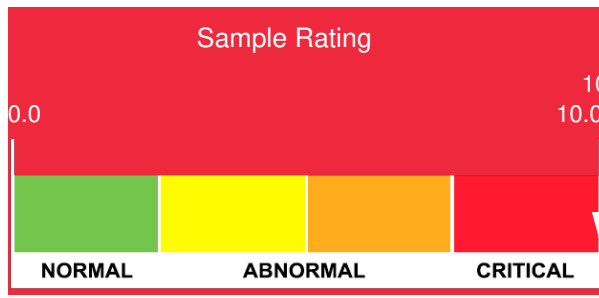
Customer: PTRHTF20201	System Information	Sample Information
TANGLE CREEK ENERGY 2-26-52-12W5M WHITECOURT, AB T7S 0A2 Canada Attn: Jason Kerr Tel: (780)706-1778 E-Mail: jkerr@tanglecreekenergy.com	System Volume: 1200 gal Bulk Operating Temp: 347F / 175C Heating Source: Blanket: Fluid: PETRO CANADA PETRO-THERM Make:	Lab No: 02255306 Analyst: Peter Hartevelde Sample Date: 11/15/18 Received Date: 12/05/18 Completed: 12/07/18

Recommendation: The fluid is in a poor condition and needs to be replaced asap. AN has exceeded the limit and viscosity is extremely high. In combination with a high 90% GCD temperature this indicates degradation by oxidation which is related to contact between hot oil and oxygen out of the air. Absence of blanket gas may cause this. The fluid has become highly acidic (AN = 3.25) Evidence of this is the Fe content of 2153 ppm which is generated by corrosion. Not replacing the fluid asap may lead to holes forming in steel components like piping, heat exchangers and vessels. Since the viscosity is extremely high and the Pentane Insoluble (solids) content is also high, the system needs to be cleaned/flushed prior to filling with fresh Petro-Therm. The high viscosity may complicate disposal of the fluid by solidifying at ambient temperature. Please contact your Petro-Canada Tech Service Advisor to discuss this.

Comments: Iron ppm levels are severe. PQ levels are severe. Pentane Insolubles levels are severely high. Acid Number (AN) is severely high. Visc @ 40°C is severely high. (GCD) 90% Distillation Point is abnormally high. Manganese ppm levels are abnormally high.

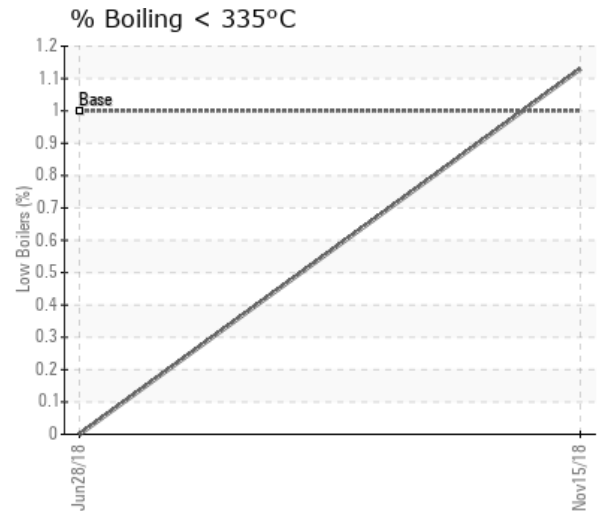
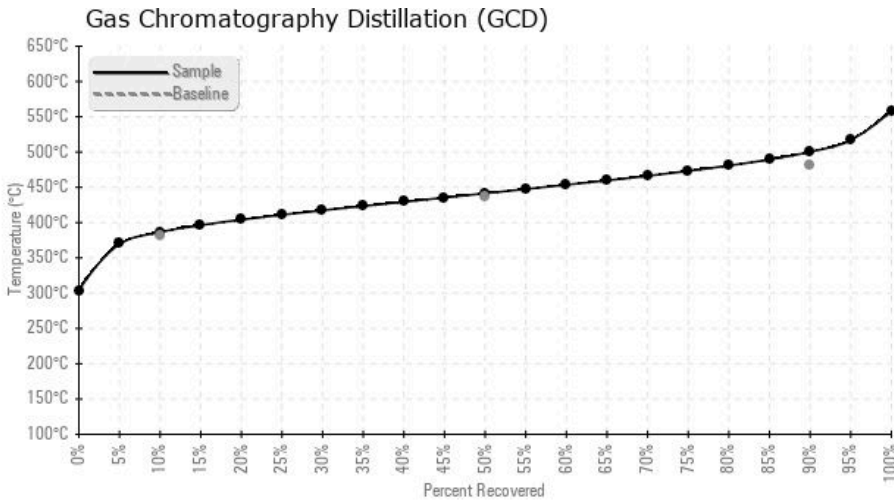
Sample Date	Received Date	Fluid Age	Sample Location	Flash Point (COC)	Water (KF)	Viscosity (40°C)	Acid Number	Solids	GCD 10%	GCD 50%	GCD 90%	GCD % < 335°C
	mm/dd/yy			°F/°C	ppm	cSt	mg/KOH/g	%wt	°F/°C	°F/°C	°F/°C	%
11/15/18	12/05/18	0h		403 / 206	72.6	4599	3.25	1.10	728 / 386	827 / 441	933 / 500	1.13
06/28/18	07/17/18	0h	BOTTOM OF THE PUMP	406 / 208	263.9	238	2.09	0.749	714 / 379	779 / 415	881 / 472	0.00
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
11/15/18	2153	1	0	7	0	0	0	0	0	0	14	11	0	0	0	0	25	0	1	0	4	0	0	1
06/28/18	1429	0	0	7	0	0	0	0	0	0	10	12	0	0	0	0	17	0	0	2	4	0	0	1
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

06/28/18

The fluid is severely degraded and has to be replaced. The viscosity is very high. AN has exceeded the limit. The oil has become corrosive and therefore the Fe content is high. GCD 90% temperature is slightly low. The symptoms indicate degradation by oxidation. The Pentane Insoluble (solids) content has exceeded the reportable limit of 0.5%. Since oxidation is usually caused by hot oil contacting atmospheric air, it is advised to check proper operation of the blanket gas system. Before filling with fresh fluid an internal inspection of the heater is recommended. This because the solids content is at 0.749%. If necessary the system needs to be cleaned/flushed prior adding a fresh fill. Please take a sample of the fresh fill in circulation while cold and another sample of hot fluid after 24 hours of service. The results will be used as baseline references. For further questions please contact your Petro-Canada Tech Service Advisor. Iron ppm levels are severe. PQ levels are severe. Pentane Insolubles levels are severely high. Acid Number (AN) is severely high. Visc @ 40°C is severely high. (GCD) 90% Distillation Point is marginally low.