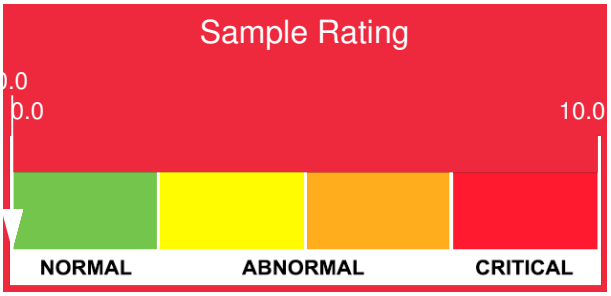
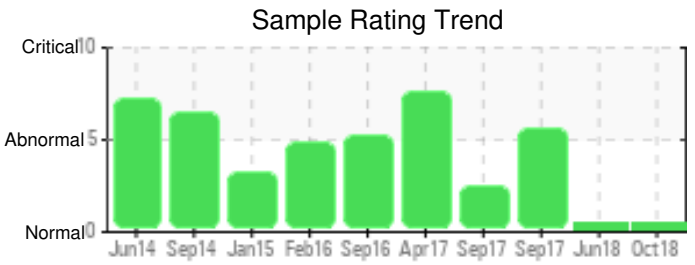
PETRO-CANADA LUBRICANTS





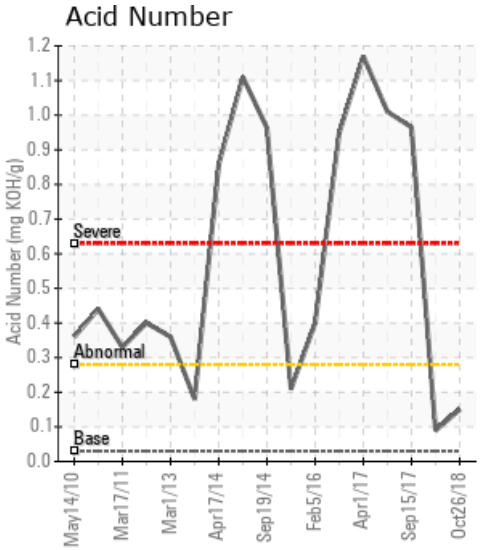
ENERGY PLANT HOT OIL

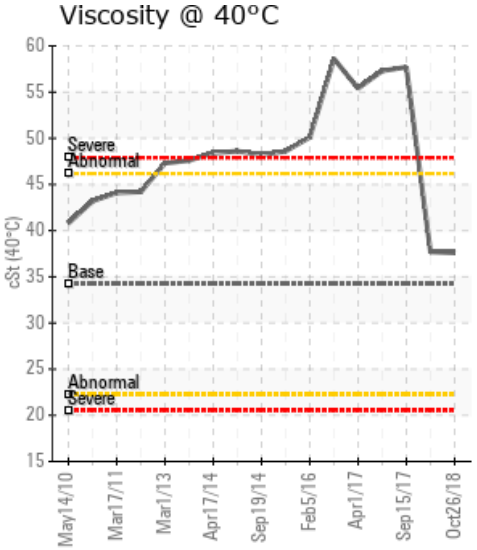
Customer: PTRHTF20043	System Information	Sample Information
WEST FRASER LVI PO BOX 1737 ROCKY MT HOUSE, AB T4T 1B3 Canada Attn: Renny Ceccato Tel: E-Mail: renny.ceccato@westfraser.com	System Volume: 38000 ltr Bulk Operating Temp: 500F / 260C Heating Source: Blanket: Fluid: PETRO CANADA PETRO-THERM Make: WELLONS	Lab No: 02250215 Analyst: Gordon Susinski Sample Date: 10/26/18 Received Date: 11/08/18 Completed: 11/16/18

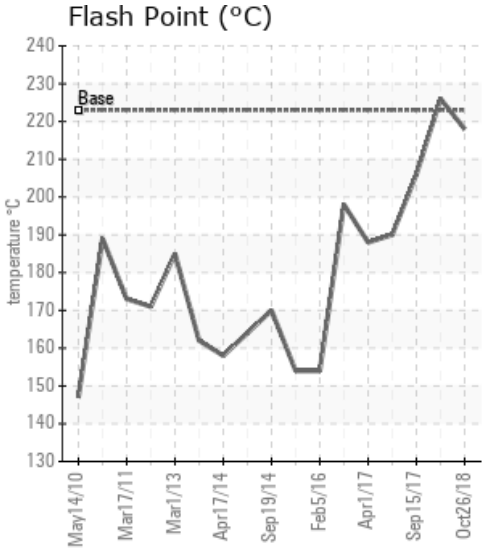
Recommendation: Results are normal. Resample at the next interval and continue to monitor the system.

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	%
10/26/18	11/08/18	0y		424 / 218	151.4	37.6	0.150	0.364	728 / 387	810 / 432	902 / 483	0.00
06/22/18	07/04/18	0y	PRIMARY PUMP	439 / 226	159.0	37.7	0.09	0.259	715 / 379	794 / 423	899 / 482	0.00
09/15/17	10/10/17	0y	72116-4500RB	403 / 206	2467.2	57.7	0.965	1.65	700 / 371	828 / 442	912 / 489	3.98
09/07/17	10/10/17	0y	12116-4500RB	374 / 190	51.7	57.3	1.01	0.782	734 / 390	846 / 452	924 / 495	3.38
04/01/17	04/12/17	12y	PRIMARY PUMP	370 / 188	92.8	55.4	1.17	1.27	735 / 391	848 / 453	932 / 500	3.82
09/09/16	09/14/16	11y	PRIMARY OIL PUMP	388 / 198	77.1	58.6	0.949	1.65	724 / 385	844 / 451	915 / 491	4.35
Baseline Data				433 / 223		34.2	0.03		720 / 382	817 / 436	900 / 482	1.00







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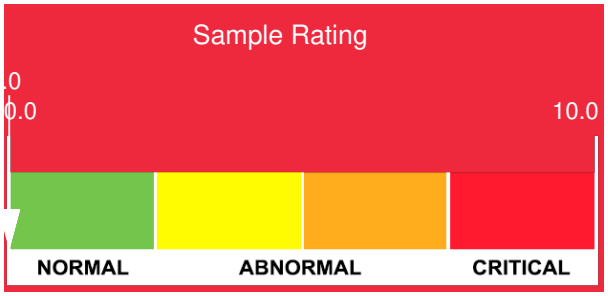
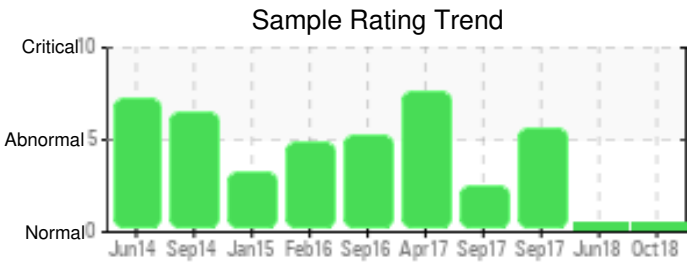
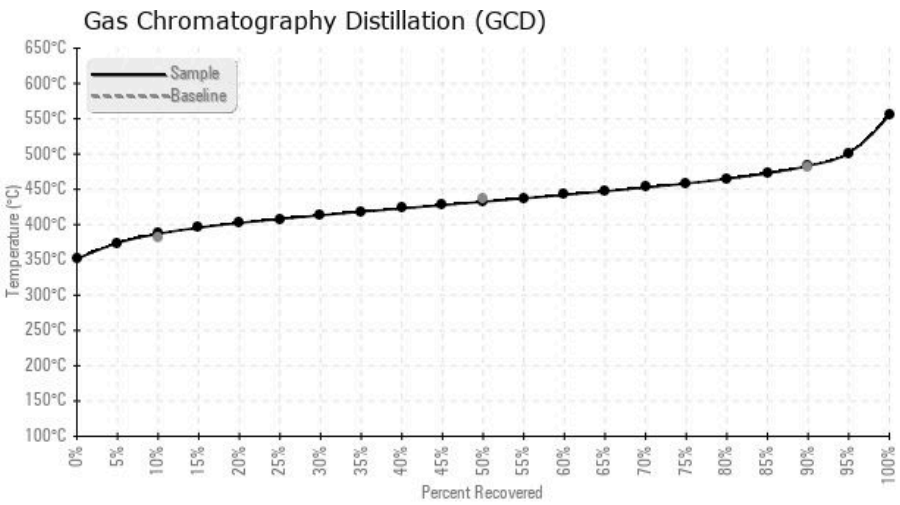
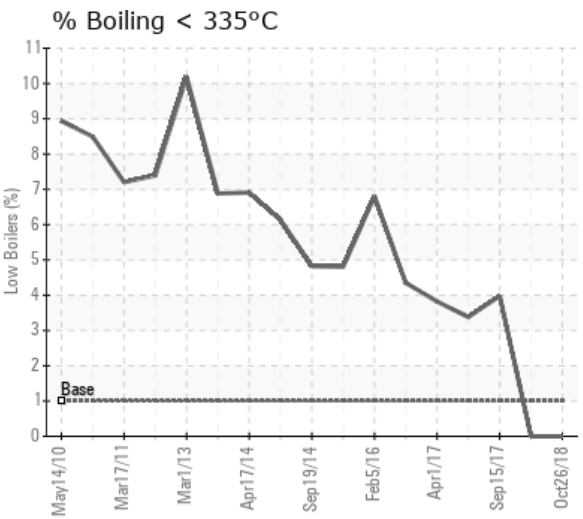




Sample Date	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin	Cadmium	Silver	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
10/26/18	8	0	0	0	0	0	0	0	0	0	0	16	1	0	0	0	0	0	0	0	24	0	1	0
06/22/18	6	0	0	0	0	0	0	0	0	0	0	10	2	0	0	0	0	0	0	0	35	0	2	2
09/15/17	6	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
09/07/17	7	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0
04/01/17	8	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0
09/09/16	13	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	1	0	0	0
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

06/22/18	Calcium levels are higher than expected. Typical sources of this element are other 1.) heat transfer products and 2.) outside contamination. Resample, taking care to obtain a representative sample of the system. Calcium ppm levels are abnormally high.
09/15/17	We are unable to comment on competitive product. 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. COC Flash Point is marginally low.
09/07/17	We are unable to comment on competitive product. Pentane Insolubles levels are severely high. COC Flash Point is abnormally low.
04/01/17	The oil service is indicated as 12 years, this is beyond the expected life of most heat transfer systems. Based on the information available to me, it appears the oil in service has been subjected to Oxidation and Thermal Degradation and corrective measures should be initiated to remedy the situation. The Pentane Insolubles are severely high. This analysis determines the amount of contaminants in used heat transfer oils which are typically from insoluble materials such as oxidation by products and carbonaceous material. The acid number is severely high and is a measure of the acidic compounds in the oil. Increases in the acid number are likely due to the formation of oxidation by products in the oil. This value will increase exponentially once the oxidation process begins. Tendencies are for sludge and deposits to increase and corrosion to occur if the fluid continues to be utilized beyond its limits.The 90% distillation Increase is due to high boilers and are normally associated with carbonaceous deposits in the system that can foul heat exchanger surfaces or plug small lines. The 40°C viscosity is abnormally high. Viscosity is the fluids ability to resist flow. Increases in viscosity in a heat transfer system is normally attributed to the oxidation process. The oxidation process increases the size of the molecules and increases the oils viscosity. The C.O.C. Flash Point is low (188C). This is the lowest temperature at which the fluids vapor will momentarily ignite when contacted by an ignition source. Reduction is typically associated with thermal degradation of the heat transfer oil or possibly contamination.Overall, the results indicate the fluid has been oxidized and thermally cracked and is in need measures to bring the product back into normal guidelines. Pentane Insolubles levels are severely high. Acid Number (AN) is severely high. (GCD) 90% Distillation Point is abnormally high. Visc @ 40°C is abnormally high. (GCD) 50% Distillation Point is marginally high. COC Flash Point is marginally low.
09/09/16	Based on the analysis results, it appears that the oil may have experienced one or both of the following deteriorating conditions. Insolubles and Oxidation. This may be due in part to the length of service on the oil (11 years indicated).Oxidation is a reaction of hydrocarbons in the oil with oxygen from air, forming various species including weak organic acids. Oxidation is accelerated by contaminants such as wear debris, dust, water, metals, and high temperatures. Changes in the fluid will be seen as discoloration, increased viscosity, formation of varnish, increase in acidity and finally the formation of heavy insoluble compounds. The acid number is a measure of the acidic compounds in the oil. Increases in the acid number are likely due to the formation of oxidation by products in the oil. This value will increase exponentially once the process begins. Tendencies for sludge and deposits to increases, and corrosion can occur if the fluid continues to be utilized beyond its limits. Pentane Insolubles are used for the determination of contaminants in used heat transfer oils, and to determine the amount of insoluble materials such as oxidation by products, dirt, carbonaceous material, and system wear components. These contaminants as a group are called pentane insolubles.Viscosity is the fluids ability to resist flow. Increases in viscosity in this heat transfer system is attributed to the oxidation process but may also be due to a heavier fluid being added. This process increases the size of the molecules and increases the oils viscosityObserved improvements in the system could be due to system filtration, sweetening with new oil or from previous samples that may have been taken from dirty sample points. Oil samples results indicate that the oil has reached the end of its useful life and that a system drain and clean process should be undertaken. Pentane Insolubles levels are severely high. Acid Number (AN) is severely high. Visc @ 40°C is abnormally high.