

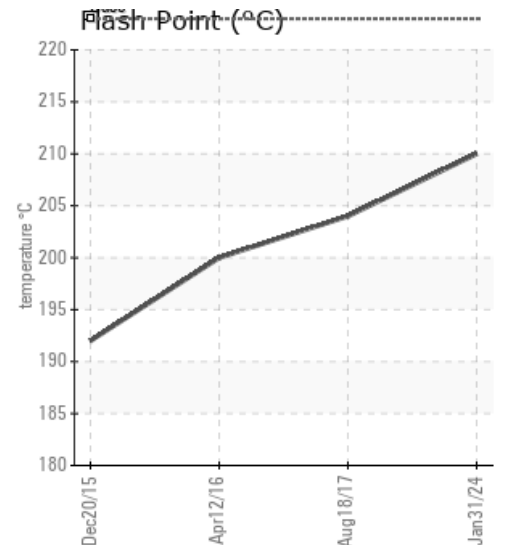
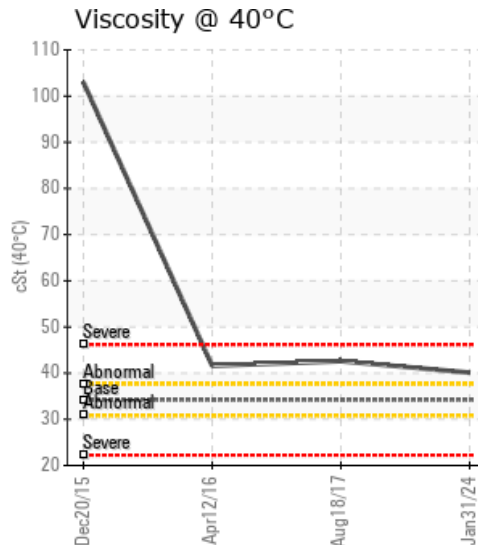
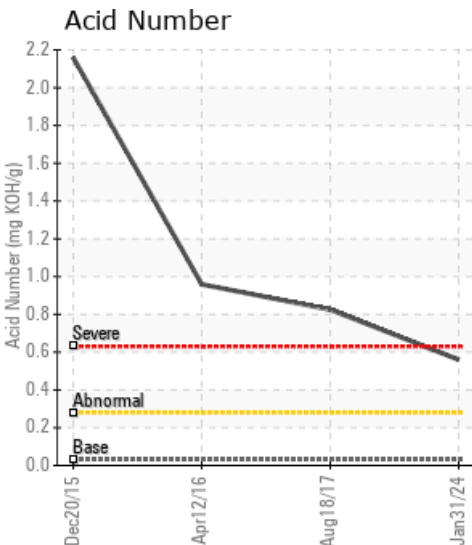
## [H.W.P] ENERGY SYSTEM CRN# H-0282-12

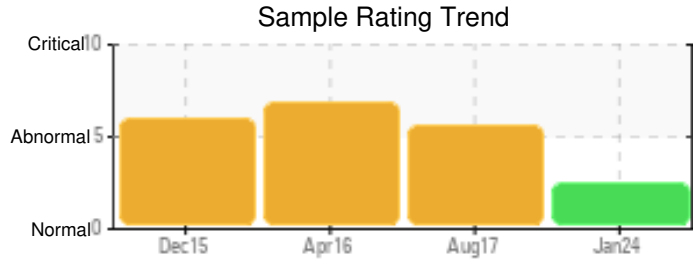
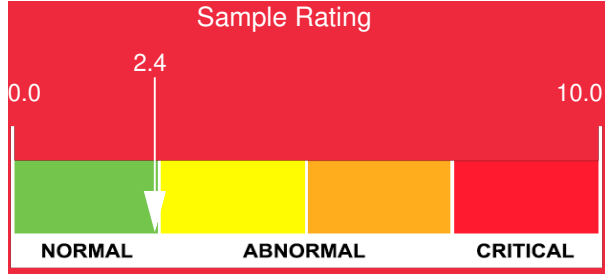
Customer: PTRHTF20045	System Information	Sample Information
WEST FRASER, HINTON WOOD PROD. 99 WEST RIVER ROAD HINTON, AB T7V 1Y7 CA Attn: Iona Gocool Tel: (905)391-1588 E-Mail: iona.gocool@westfraser.com	System Volume: 80000 ltr Bulk Operating Temp: 515F / 268C Heating Source: Blanket: Fluid: PETRO CANADA PETRO-THERM Make: WELLONS	Lab No: 02613598 Analyst: Peter Harteveld Sample Date: 01/31/24 Received Date: 02/05/24 Completed: 02/08/24 Peter Harteveld peter.harteveld@HFSinclair.com

**Recommendation:** The fluid is in a reasonable condition and suitable for further use. The analysis shows indications of fluid degradation via oxidation (mainly) and some normal thermal degradation. Indications of oxidation are elevated Acid Number, viscosity and 90% GCD temperature. If the system is equipped with blanket gas it is recommended to check proper operation of the blanket gas system. If there is no blanket gas present, it is advised to consider installation of N2 blanket gas. Indications of thermal degradation are a decreased 10% GCD temperature and a low boiler vapor content (GCD% <335C.) of 5%. For a fluid that has been in service for 21 years this is acceptable. It is however recommended to lower the low boiler vapor content by regular venting of these vapors to atmosphere. Please re-sample in 12 months.

**Comments:** Acid Number (AN) is abnormally high. (GCD) 90% Distillation Point is abnormally high. Visc @ 40°C is abnormally high.

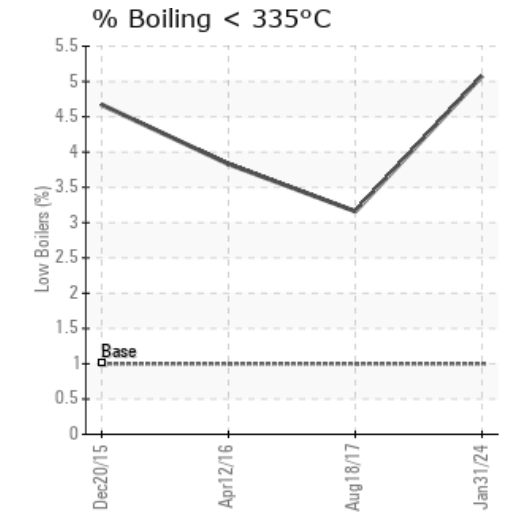
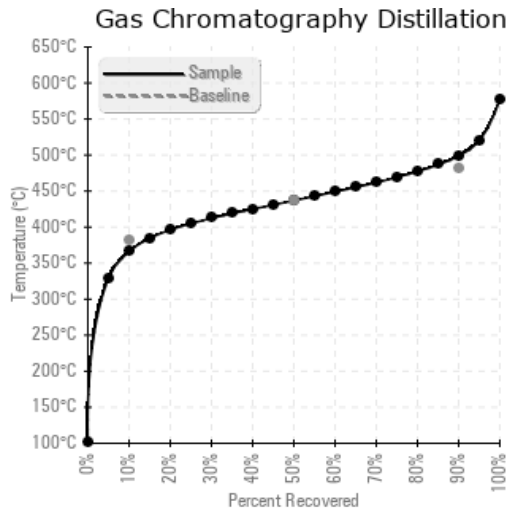
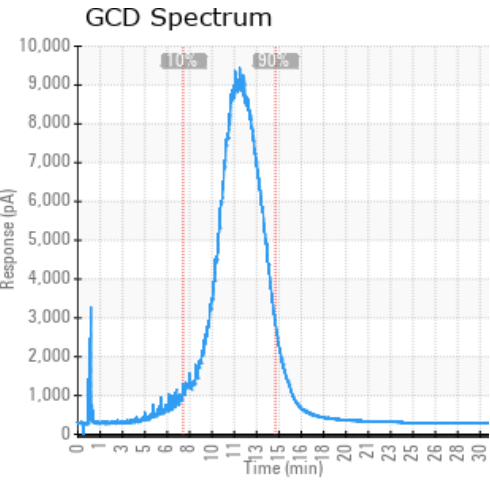
Sample Date	Received Date	Fluid Age	Sample Location	Flash Point (COC)	Water (KF)	Viscosity (40°C)	Acid Number	Solids	GCD 10%	GCD 50%	GCD 90%	GCD % < 335°C
	mm/dd/yy			°F/°C	ppm	cSt	mg/KOH/g	%wt	°F/°C	°F/°C	°F/°C	%
01/31/24	02/05/24	21.0y		410 / 210	140	40.1	0.56	0.349	691 / 366	818 / 437	930 / 499	5.08
08/18/17	09/08/17	20.0y	CIRC. FLOW/PUMP #2	399 / 204	32.5	42.6	0.825	0.701	705 / 374	824 / 440	932 / 500	3.16
04/12/16	04/20/16	23.0y	DISCHARGE OF PUMP	392 / 200	37.3	41.6	0.959	1.68	701 / 372	825 / 440	938 / 503	3.83
12/20/15	01/06/16	23.0y	RETURN OIL FROM KILN	378 / 192	78.2	103	2.16	11.3	690 / 365	814 / 435	917 / 491	4.67
<b>Baseline Data</b>				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
01/31/24	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08/18/17	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04/12/16	29	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	3
12/20/15	168	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	2	0	0	0	6	0	3	12
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	
08/18/17	Based on the analysis results, it appears that the oil may have experienced thermal degradation and oxidation. This may be due in part to the length of service on the oil (20 years indicated). Pentane Insolubles analysis is used to determine the contaminants in used heat transfer oils. It measures 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. 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 are for sludge and deposits to increase and corrosion to occur if the fluid continues to be utilized beyond its limits. FBP Increase indicates high boilers that are normally associated with carbonaceous deposits in the system that can foul heat exchanger surfaces or plug small lines. Pentane Insolubles levels are severely high. Acid Number (AN) is severely high. (GCD) 90% Distillation Point is abnormally high.
04/12/16	Observed improvements in the metal content, water, and viscosity from the previous sample. These improvements from the last sample to this sample could be due to system filtration, sweetening with new oil or from previous samples that may have been taken from improper locations. Also, despite being improved, the AN value and Pentane insoluble values are still above normal and indicate that the oil may need to be changed (23 years Indicated in oil service). Pentane Insolubles levels are severely high. Acid Number (AN) is severely high. (GCD) 90% Distillation Point is severely high.
12/20/15	Based on the analysis results, it appears that the oil may have experienced one or more of the following deteriorating conditions. This may be alarming due to the oil service listed as 23 hours. Acid number increase is likely due to the formation of oxidation by products. Oxidation is a chemical reaction between oxygen and the components of the oil whereby the hydrocarbon in the oil turns into weak carboxylic acids and other carbon-oxygen containing species. The higher the temperature, the worse the oxidation becomes and it will lead off of itself becoming exponentially worse over time when the additives are depleted. In a closed heat transfer system, the most probable place for fluid oxidation to occur is in the expansion tank (without an inert gas blanket). In an open system, the fluid oxidizes rapidly at its operating temperature. Different oils vary considerably in their resistance to oxidation largely due to the base oil used and the antioxidant additives used in the oil. To have an oxidized product after only 23 hours of service indicates that the system may not have been cleaned or flushed properly at the oil drain interval. Flash Point reduction is typically associated with thermal degradation of the heat transfer oil. (See explanation below/Pentane Insolubles: This analysis is for the determination of contaminants in used heat transfer oils & is to determine the amount of insoluble materials present in the oil such as such as oxidation by products, carbonaceous materials, sludge and system wear components. These contaminants, as a group are referred to as pentane insolubles. These components can settle in dead areas of the lubricant flow paths and eventually cause problems in the system by "sludging up". Again, this is alarming for only 23 hours of service. Perhaps some of the stagnant sludge type of material was dislodged during the oil drain service. Thermal degradation: In the presence of excess heat, the hydrocarbon molecules reach the breaking point of normally stable C-C covalent bonds and crack into lighter hydrocarbons chains. These chains, when formed may have lower viscosities, lower flash points and start to boil before normal high oil would thus, affecting the overall fluid efficiency in a negative way by requiring greater amounts of energy to produce the same amount of heat. As the oil thermally degrades it may deposit heavy carbonaceous material by baking on the tubes and form an as an insulation layer. These carbonaceous layers can flake away and produce hot spots on the tubes possibly resulting in a tube rupture. The carbon residues that get carried away can settle downstream and obstruct the flow in small lines. This process normally occurs over a period of years -- not hours. Viscosity increase in and heat transfer system is normally attributed to the oxidation process. This process increases the size of the molecules and increases the oils viscosity. After 23 hours of service, this oil appears to be degraded to a point whereby another oil drain service may be needed. I would consider a system clean and flush before another oil drain. Make sure that the sample has been taken from a representative point in the system and that the sample taking process is not responsible for the abnormal analysis results. Pentane Insolubles levels are severely high. Acid Number (AN) is severely high. Visc @ 40°C is abnormally high. COCC Flash Point is marginally low.

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