

## [BLUE RIDGE LUMBER WEST FRASER / LSD ENERGY PLANT] BLUE RIDGE

**Customer: PTRHTF20093**  
 BLUE RIDGE LUMBER INC  
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 BLUE RIDGE, AB T0E 0B0 CANADA  
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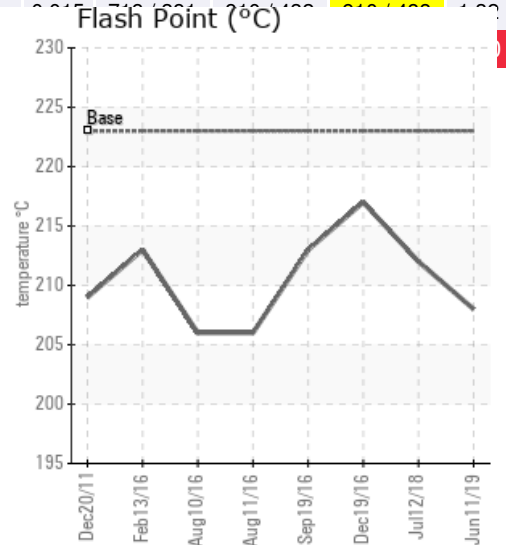
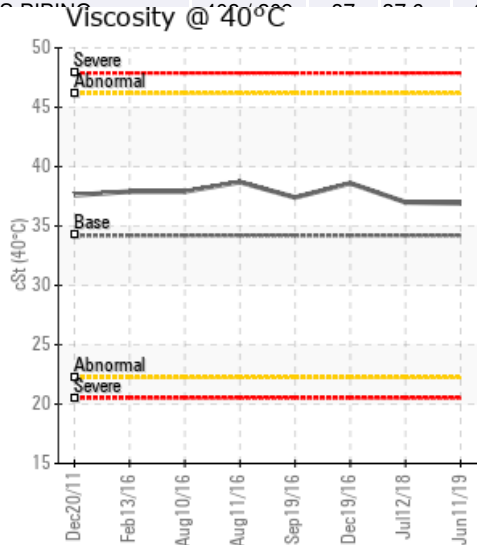
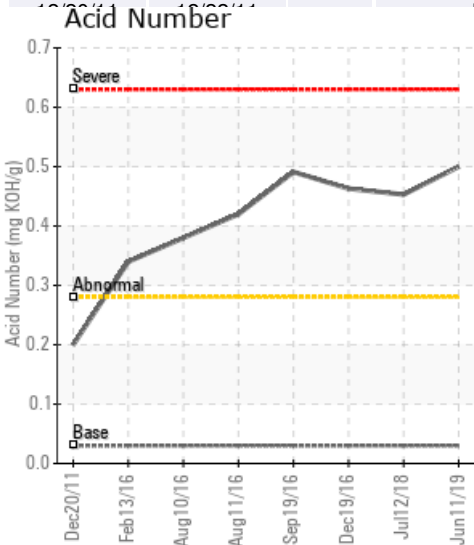
**System Information**  
 System Volume: 200000 ltr  
 Bulk Operating Temp: 482F / 250C  
 Heating Source:  
 Blanket:  
 Fluid: PETRO CANADA PETRO-THERM  
 Make: CLASSEN WIESLOCH

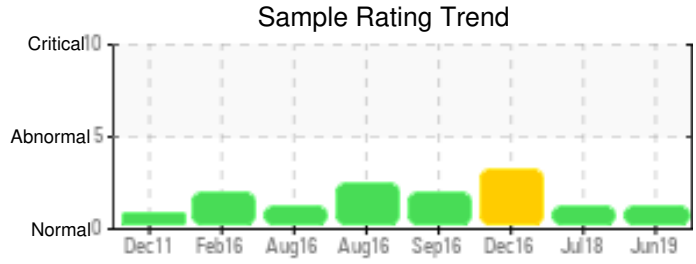
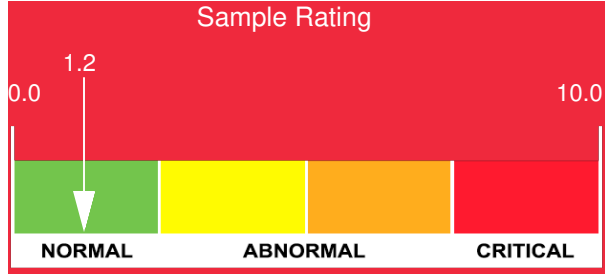
**Sample Information**  
 Lab No: 02291771  
 Analyst: Gordon Susinski  
 Sample Date: 06/11/19  
 Received Date: 06/18/19  
 Completed: 06/20/19

Recommendation: Based on the analysis results, it appears that the oil may have experienced acid number deterioration conditions. This may be due in part to the length of service on the oil (13 years indicated). 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. None of the other oil degradation products are indicated.

Comments: Acid Number (AN) is abnormally high.

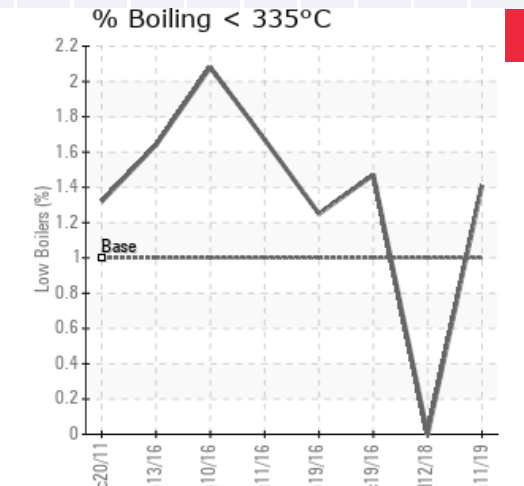
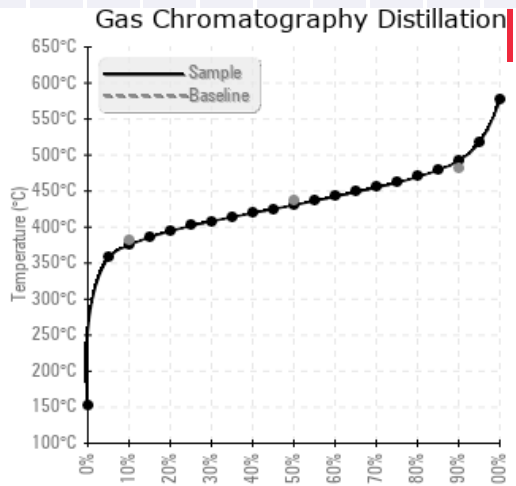
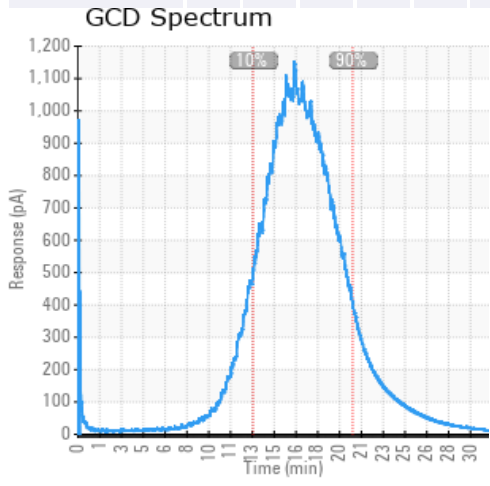
Sample Date	Received Date	Fluid Age	Sample Location	Flash Point (COC)	Water (KF)	Viscosity (40°C)	Acid Number	Solids	GCD 10%	GCD 50%	GCD 90%	GCD % < 335°C
	mm/dd/yy			°F/°C	ppm	cSt	mg/KOH/g	%wt	°F/°C	°F/°C	°F/°C	%
06/11/19	06/18/19	0y		406 / 208	26.0	36.9	0.500	0.043	707 / 375	807 / 431	918 / 492	1.41
07/12/18	07/17/18	12y	OIL COLLECTION ROOT1	414 / 212	139.9	37.0	0.453	0.065	724 / 384	789 / 421	897 / 481	0.00
12/19/16	12/22/16	10y	SUCTION PUMP #5	423 / 217	20.2	38.6	0.463	0.100	714 / 379	820 / 438	939 / 504	1.47
09/19/16	09/23/16	10y	OIL PUMP #5 SUCTION	415 / 213	185.7	37.4	0.491	0.090	716 / 380	817 / 436	933 / 501	1.25
08/11/16	08/16/16	10y	EXPANSION TANK	403 / 206	31.9	38.7	0.42	0.395	710 / 377	810 / 432	917 / 491	1.67
08/10/16	08/16/16	10y	PUMP #5 (SUCTION)	403 / 206	78.6	37.9	0.38	0.173	704 / 373	801 / 427	906 / 485	2.08
02/13/16	02/22/16	10y	PRIMARY, SUCTION SIDE	415 / 213	41.3	37.9	0.34	0.173	709 / 376	812 / 433	920 / 494	1.64





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
06/11/19	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07/12/18	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/19/16	12	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	6	0	0	23
09/19/16	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08/11/16	40	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	3	0	0	2
08/10/16	33	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02/13/16	83	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	1	0	0	1

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



### Historical Comments

07/12/18	Based on the analysis results, it appears that the oil may continue to experience oxidation. This may be due in part to the length of service on the oil (12 years indicated). The acid number continues to be above normal. 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. The oxidation level in the sample remains well above normal, however, it is remaining stable. Acid Number (AN) is abnormally high.
12/19/16	Based on the analysis results, it appears that the oil may have experienced some oxidation or possibly thermal cracking. The 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 feed 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. The Kinematic viscosity has increased slightly. 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. The Pentane Insolubles continue to increase. This analysis is for the determination of contaminants in used heat transfer oils, is 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. The results as a whole are just outside normal limits and may be an indication of the potential need for a system change out. Continue to monitor the system and resample as required. Pentane Insolubles levels are abnormally high. Acid Number (AN) is abnormally high. GCD 90% Distillation Point is severely high.
09/19/16	Based on the analysis results, it appears that the oil may have experienced the following deteriorating conditions - Oxidation. This may be due in part to the length of service on the oil (10 of 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. Depending on the volume of the system, the AN is above normal. 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. The final boiling point (FBP) is above normal. High boilers are normally associated with carbonaceous deposits in the system that can foul heat exchanger surfaces or plug small lines and can be the result of the oxidation process and the increase in the AN. Note the sulphur increase. Although below limits, the increase is significant. Note water increase. Although within limits, the increase is noteworthy. Acid Number (AN) is abnormally high. GCD 90% Distillation Point is abnormally high.
08/11/16	Samples from August 10 & 11 (Lab number 02091345 & 02091346) were analyzed at the same time. These comments will reflect the two results together. Despite the samples being taken 24 hours apart, there are some variations in the analysis results. These may be attributed different sample locations or sampling methods. According to the sample results, the oil has been in service for 10years. The acid number remains above normal. 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 feed 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. The Kinematic viscosity has increased slightly. 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. The Pentane Insolubles continue to increase. This analysis is for the determination of contaminants in used heat transfer oils, is 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. The results as a whole are just outside normal limits and may be an indication of the potential need for a system change out. Continue to monitor the system and resample as required. Pentane Insolubles levels are abnormally high. Acid Number (AN) is abnormally high.
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02/13/16	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 feed 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. The Kinematic viscosity has increased slightly. 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. The Pentane Insolubles continue to increase. This analysis is for the determination of contaminants in used heat transfer oils, is 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. The results as a whole are just outside normal limits and may be an indication of the potential need for a system change out. Continue to monitor the system and resample as required. Pentane Insolubles levels are abnormally high. Acid Number (AN) is abnormally high.
02/13/16	Petro-Canada makes no representation or warranty of any kind, either expressed or implied, as to the accuracy or completeness of the analysis and assumes no responsibility and shall have no liability whatsoever with respect to such analysis or any part of it. Petro-Canada is a Division of HollyFrontier Corporation.
12/19/16	All the tests show normal results at this time. If the intent of the sampling was to investigate a specific issue perhaps speak with your local technical service representative because based on the results the oil looks good. If it was just a routine sample for check-up, please re-sample in 6 months so we can keep monitoring the fluid.