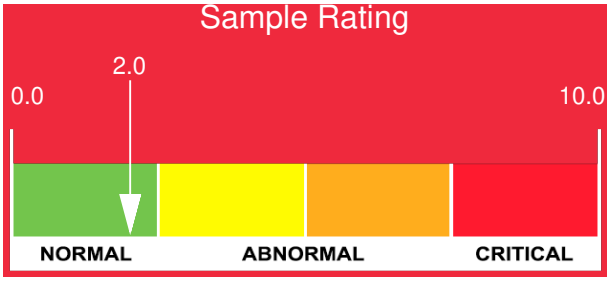
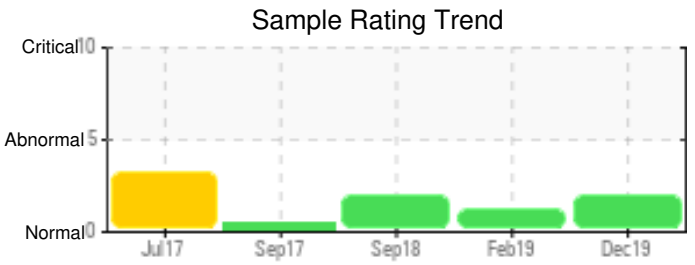




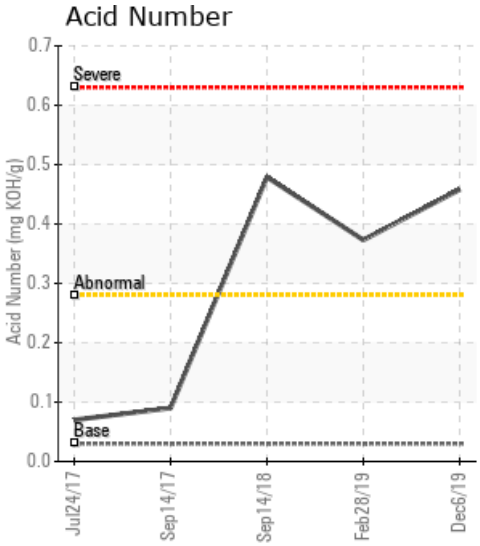
[LSD NW 25-74-18-W5] THERMAL OIL

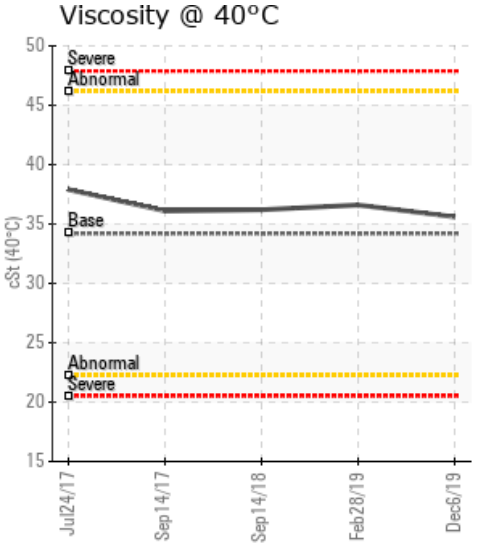
Customer: PTRHTF20076	System Information	Sample Information
TOLKO HP Division 18022-HWY 2 HIGH PRAIRIE, AB T0G 1E0 Canada Attn: Dean Lamberton Tel: E-Mail: dean.lamberton@tolko.com	System Volume: 250000 ltr Bulk Operating Temp: 545F / 285C Heating Source: Blanket: Fluid: PETRO CANADA PETRO-THERM Make: SALTON	Lab No: 02326463 Analyst: Gordon Susinski Sample Date: 12/06/19 Received Date: 12/11/19 Completed: 12/18/19

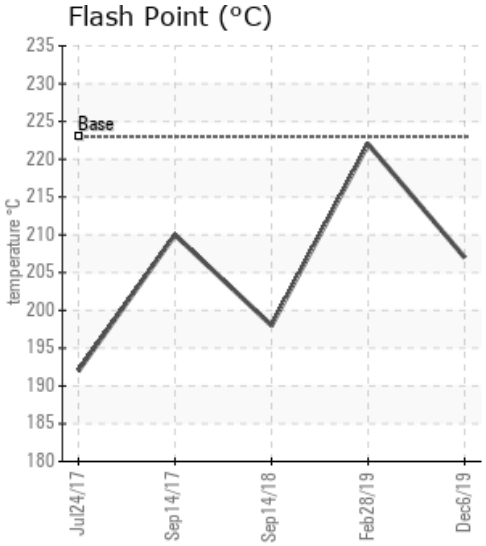
Recommendation: Based on the analysis results, it appears that the oil may have experienced one or both of the following deteriorating conditions: Oxidation and thermal degradation. This may be due in part to the length of service on the oil (15 years indicated).The acid number is above normal limits (.458) 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 from this point forward. Tendencies are for sludge and deposits to increase and corrosion to occur if the fluid continues to be utilized beyond its limits. In addition to the increase in acid number, the GCD 90% results remain above normal and are normally indicative of, and associated with carbonaceous deposits in the system that can foul heat exchanger surfaces or plug small lines.

Comments: Acid Number (AN) is abnormally high. (GCD) 90% Distillation Point is abnormally high.

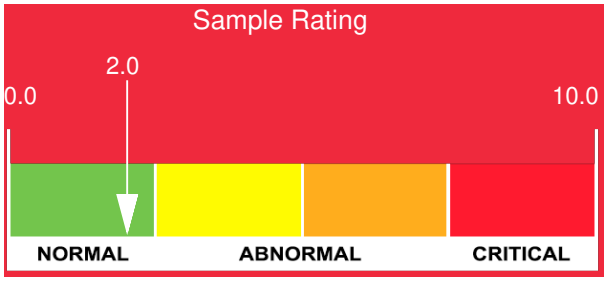
Sample Date	Received Date	Fluid Age	Sample Location	Flash Point (COC)	Water (KF)	Viscosity (40°C)	Acid Number	Solids	GCD 10%	GCD 50%	GCD 90%	GCD % < 335°C
	mm/dd/yy			°F/°C	ppm	cSt	mg/KOH/g	%wt	°F/°C	°F/°C	°F/°C	%
12/06/19	12/11/19	15y	PRIMARY SAMPLE STATI	405 / 207	142.6	35.6	0.458	0.110	705 / 374	815 / 435	932 / 500	2.50
02/28/19	03/06/19	0y	PRIMARY PUMPS	432 / 222	112.8	36.6	0.373	0.064	699 / 371	801 / 427	902 / 483	2.37
09/14/18	09/18/18	14y		388 / 198	16.3	36.2	0.479	0.088	721 / 383	815 / 435	919 / 493	0.00
09/14/17	09/19/17	0y	FURNACE	410 / 210	7.0	36.1	0.09	0.176	705 / 374	805 / 429	908 / 487	1.47
07/24/17	07/27/17	9y	MAIN RETURN LINE	378 / 192	274.6	37.9	0.07	0.685	713 / 379	816 / 436	920 / 494	1.44
Baseline Data				433 / 223		34.2	0.03		720 / 382	817 / 436	900 / 482	1.00

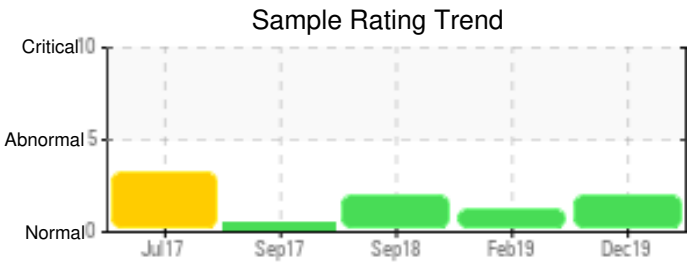






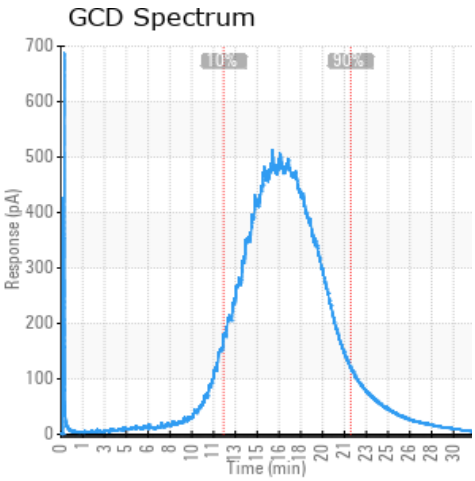
PETRO-CANADA LUBRICANTS

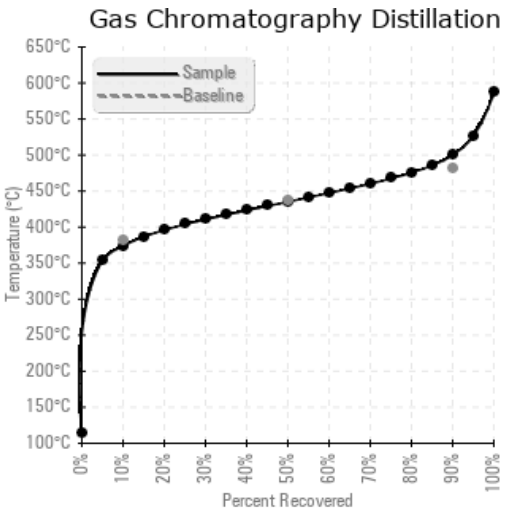


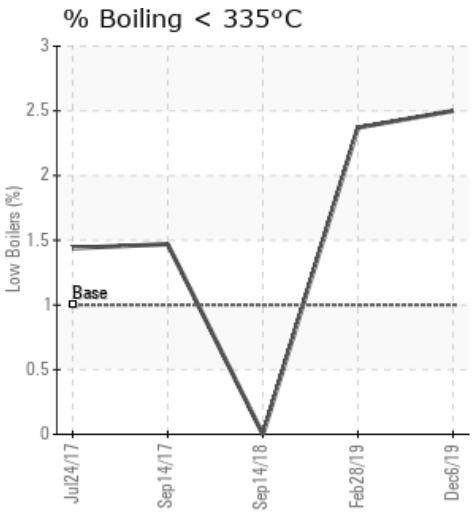


Sample Date	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin	Cadmium	Silver	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
12/06/19	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/28/19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
09/14/18	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09/14/17	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07/24/17	20	0	0	0	0	0	0	0	0	0	0	0	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

02/28/19	The previous oil sample indicated that the oil in service is >14 years old. Although it is reduced from the last sample, the acid number is still 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. Reductions of this nature could be due to sweetening the system. Acid Number (AN) is abnormally high.
09/14/18	Based on the analysis results, it appears that the oil may have experienced one or both of the following deteriorating conditions: Thermal degradation and oxidation. This may be due in part to the length of service on the oil (14 of years indicated). The acid number is abnormally high and is a measure of the acidic compounds in the oil. The increase from the previous sample is significant but is not entirely supported by other analysis results. 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 90% GCD Increase is an indication that high boilers are present in the oil and are normally associated with carbonaceous deposits in the system that can foul heat exchanger surfaces or plug small lines. The current results indicate a warning stage for large systems that oxidation and some thermal degradation may have taken place. Sweetening (partial oil replacement) can be undertaken and may prevent further system fouling and postpone costly unplanned shutdowns. Acid Number (AN) is abnormally high. (GCD) 90% Distillation Point is marginally high.
09/14/17	Results are normal.
07/24/17	It is our understanding that this system has not been operational for several months. As such, we cannot be sure of the quality of the samples taken due to the unknown operating condition of the system. Pentane Insolubles are well above normal. This determines the amount of contaminants in used heat transfer oil, and is used to determine the amount of insoluble materials such as oxidation by products, dirt, It is our understanding that this system has not been operational for several months. As such, this period of time may have an effect on samples taken. Based on the single results reported, we can determine the followingPentane Insolubles are well above normal. This result determines the amount of contaminants in used heat transfer oil, and is used 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. In addition to this, there are higher than normal GCD 90% results. These high boilers are normally associated with carbonaceous deposits in the system that can foul heat exchanger surfaces or plug small lines and are associated with the pentane Insolubles. The C.O.C. flash point is the lowest temperature at which the fluids vapour will momentarily ignite when contacted by an ignition source. Reduction is typically associated with thermal degradation of the heat transfer oil or possibly contamination. In summary, It appears that there may be some material present in the system that could be affecting the test results. If the results accurately depict what the system heat transfer oil looks like, (due to down time, length of service, etc.) then it may be necessary to investigate cleaning the system to remove the contaminants, or look at a complete oil change. Pentane Insolubles levels are severely high. (GCD) 90% Distillation Point is marginally high. COC Flash Point is marginally low.