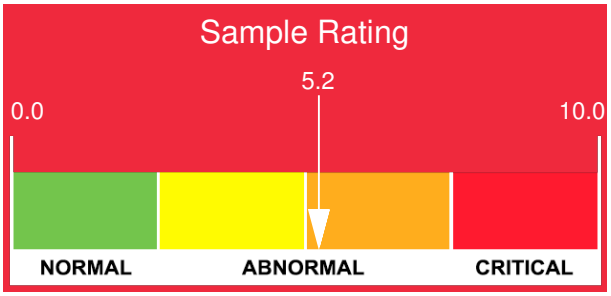
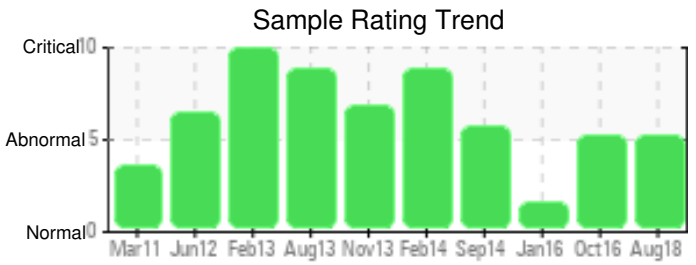




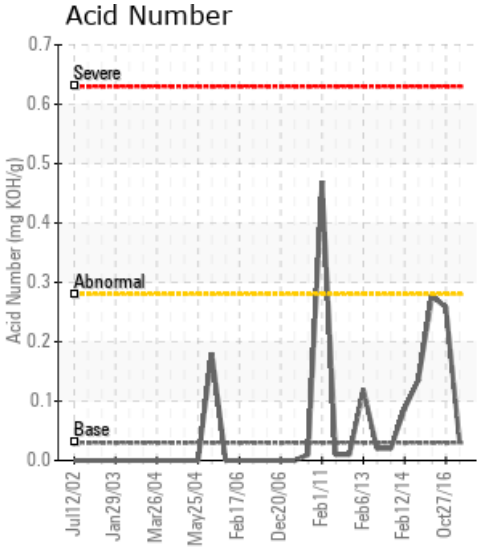
P1 HOT OIL BOILER

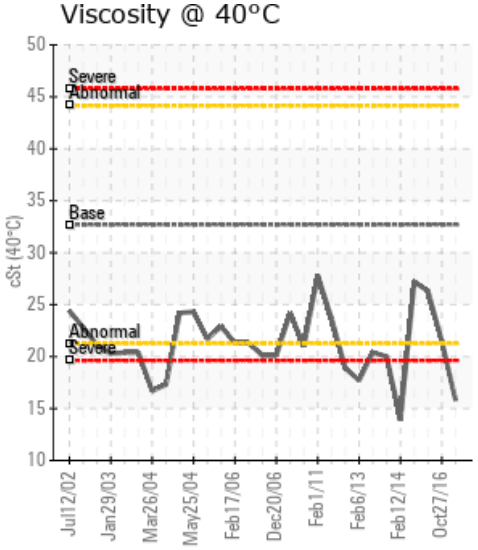
Customer: PTRHTF10083	System Information	Sample Information
KAO SPECIALTIES AMERICAS LLC 243 WOODBINE ST/PO BOX 2316 HIGH POINT, NC 27260 USA Attn: ROBERT WILLIAMS Tel: (336)878-4225 E-Mail: rwilliams@ksallc.com	System Volume: 7000 gal Bulk Operating Temp: 550F / 288C Heating Source: Blanket: Fluid: PETRO CANADA CALFLO AF Make: FIRST THERMAL	Lab No: 02242638 Analyst: Manny Garcia Sample Date: 08/28/18 Received Date: 10/02/18 Completed: 11/12/18

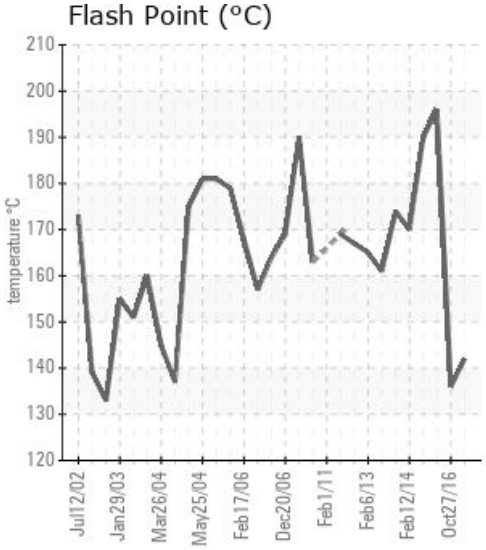
Recommendation: The fluid needs to be vented to release low boilers found in fluid & potentially restore the fluid properties. This is a large volume system & condition is clearly at very dangerous levels. If venting is not possible this system should be considered for a complete drain and re-fill with Calflo AF. As a potential, more economical solution, 20% of the 7,000 gallons of fluid could be taken out and disposed of & replaced with virgin Calflo AF to improve system fluid parameters. Please include the time on the oil & the time on the component during any future samples submitted.

Comments: The oil condition has not improved since the last sample was received two years ago. The viscosity has dropped to an ISO 15 which is half the design parameter of an ISO 32. The flash point is has dropped to 142oC which is 82oC below the design parameters of this fluid. The amount of low boilers keep increasing. CAUTION: A low flash point increases the risk of the fire point and autoignition temperatures. (GCD) 10% Distillation Point is abnormally low. (GCD) % < 335°C is marginally high.

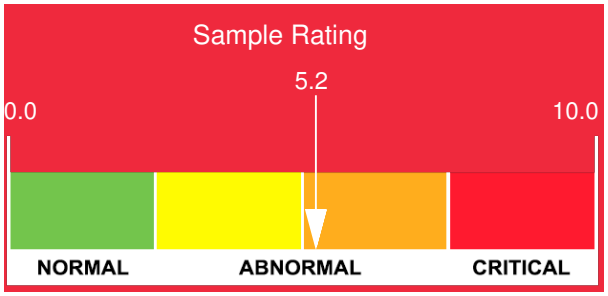
Sample Date	Received Date	Fluid Age	Sample Location	Flash Point (COC)	Water (KF)	Viscosity (40°C)	Acid Number	Solids	GCD 10%	GCD 50%	GCD 90%	GCD % < 335°C
	mm/dd/yy			°F/°C	ppm	cSt	mg/KOH/g	%wt	°F/°C	°F/°C	°F/°C	%
08/28/18	10/02/18	0y		288 / 142	16.3	15.8	0.031	0.370	616 / 324	773 / 412	881 / 471	11.35
10/27/16	11/08/16	10y	DISCHARGE PUMP	277 / 136	43.4	21.5	0.258	0.468	627 / 331	779 / 415	890 / 477	10.26
01/25/16	02/01/16	0y	BOILER LOOP PUMP DIS	385 / 196	36.1	26.3	0.277	0.702	670 / 354	785 / 418	895 / 479	4.73
09/10/14	09/19/14	0y	PUMP DISCHARGE	374 / 190	12.0	27.2	0.136	0.880	625 / 330	743 / 395	889 / 476	11.17
02/12/14	02/25/14	0y	EXPANSION TANK	338 / 170	11.2	13.9	0.087	0.385	573 / 301	741 / 394	868 / 464	20.24
11/19/13	11/26/13	0y	EXPANSION TANK	345 / 174	11.6	20.0	0.02	0.648	598 / 315	764 / 407	885 / 474	14.38
Baseline Data				435 / 224		32.7	0.03		693 / 367	790 / 421	887 / 475	2.5

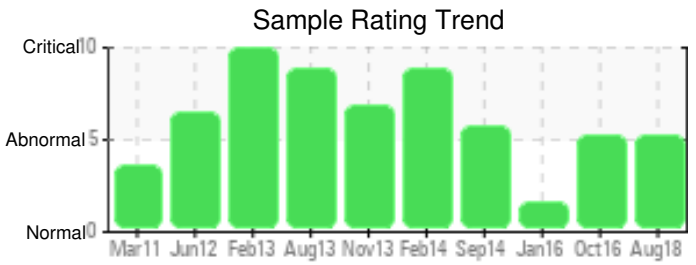






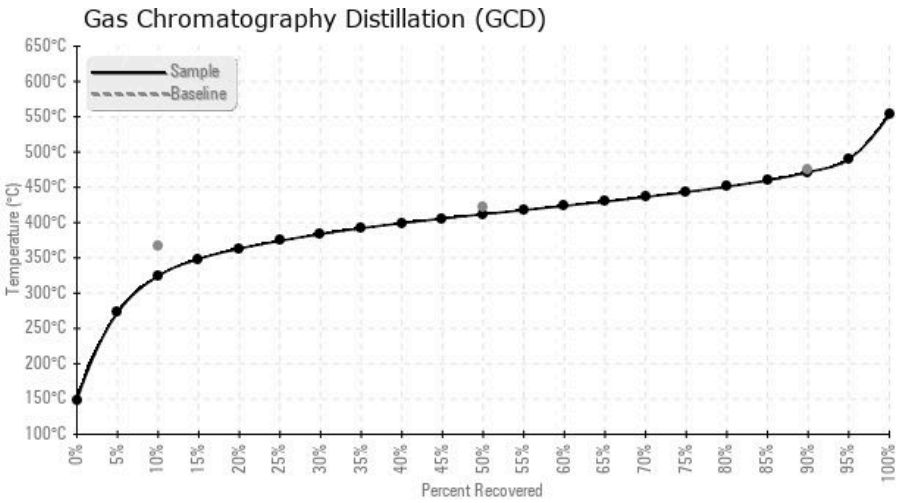
PETRO-CANADA LUBRICANTS

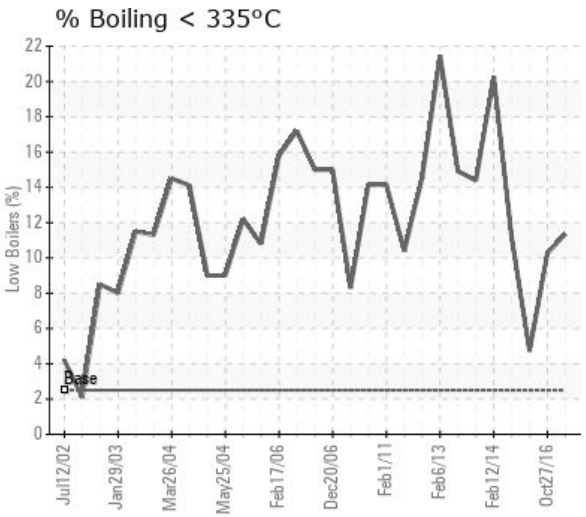




Sample Date	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin	Cadmium	Silver	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
08/28/18	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0
10/27/16	32	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	35	0
01/25/16	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47	0
09/10/14	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	37	0
02/12/14	26	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	30	0
11/19/13	9	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	21	0
Baseline Data			0	0						0			0	0					0				270	

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





Historical Comments

10/27/16	Fluid system should be 'vented' to bring the (GCD) distillation curve back down to normal values and assist in raising the flash point figures. Light silt visible in fluid sample. If the fluid is, in fact, 10 years+ or more, the system may require a complete cleaning with Petro-Canada Cleaning Fluid, Flush and re-fill with virgin Calflo AF. Cleaning will bring the internal components to bare metal and run more efficiently.Historically high Iron contaminant noticed in fluid. Water levels are at 43.4ppm/Viscosity is satisfactory/COC Flash Point is severely low at 136oC/(GCD) % < 335°C is marginally high. (GCD) 10% Distillation Point is marginally low/Contaminant levels are low, but pentane Insolubles levels are abnormally high/Very Light silt visible in fluid.
01/25/16	Water is in check and minimal; Total Acid Number is low; Viscosity is slightly low at 26.3 CsT; Flash Point is acceptable; Distillation curves are acceptable; Pentane solids are high and silt is light - recommend the oil condition can improve by filtering the oil during a convenient shut-down to get the oil cleaner. Wear metals are low.Re-submit sample in a year and include the age of the heat tranfer system and the age of the oil in the system
09/10/14	The fluid shows a certain amount of low boilers but is looking much better than the last sample. We suggest to perform venting of the low boilers to raise the flash point and maintain it via venting as part of a preventative maintenance action. Resample in 6 months. Pentane Insolubles levels are severely high. (GCD) % < 335°C is marginally high. (GCD) 10% Distillation Point is marginally low. COC Flash Point is marginally low.
02/12/14	It is very surprising how thermally degraded the oil is when the operating temperature is only 550F. The sample looks much worse than the previous one 3 months ago. The flash point is holding strong but the viscosity and distillation curve indicate a higher amount of lighter molecules from degradation present in the oil. We strongly suggest to consider a partial oil replacement to restore the properties of the oil and its safety, while looking into start-up procedure and operating parameters such as oil temperature entering and leaving the heater. investigating any condition indicating excess energy sent to the oil. (GCD) % < 335°C is severely high. (GCD) 10% Distillation Point is severely low. Visc @ 40°C is severely low. COC Flash Point is abnormally low. (GCD) 90% Distillation Point is marginally low.
11/19/13	The fluid still looks thermally stressed, so venting the low boilers and replacing the volume lost by adding fresh oil is necessary in order to prevent further decrease in viscosity and flash point. Pentane Insolubles levels are severely high. (GCD) 10% Distillation Point is severely low. (GCD) % < 335°C is abnormally high. COC Flash Point is abnormally low. Visc @ 40°C is abnormally low.