

[DEASE DEVINE / LSD 12-27-81-18W6] CREW ENERGY SEPTIMUS PLANT SK-1500

Customer: PTRHTF20109
 Crew Energy Septimus Plant
 12-27-81-18W6
 8043-100TH AVENUE
 FORT ST. JOHN, BC V1J 1W2 Canada
 Attn: Dease Devine
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 E-Mail: dease.devine@crewenergy.com

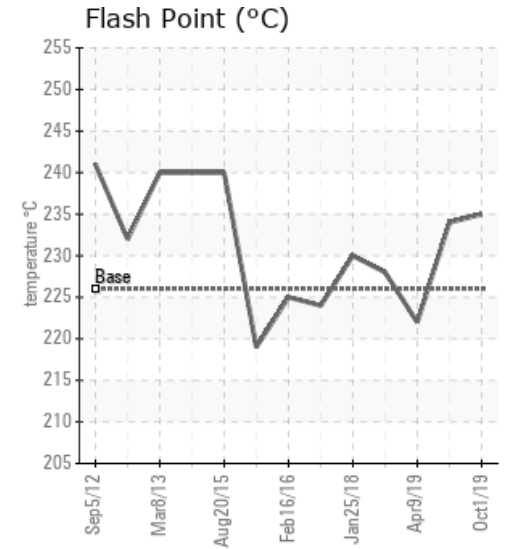
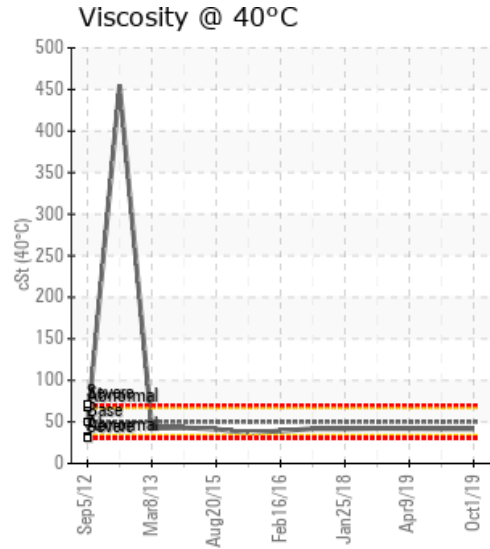
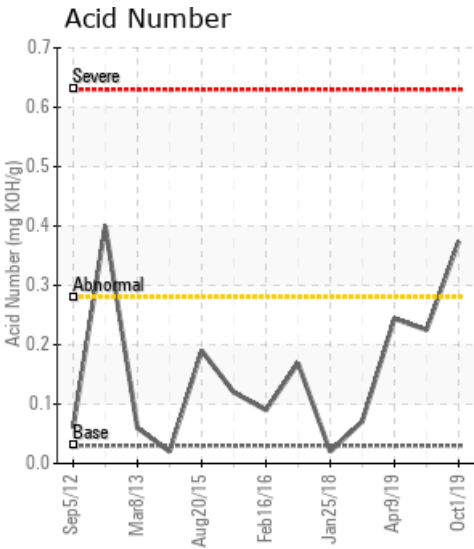
System Information
 System Volume: 24000 ltr
 Bulk Operating Temp: 356F / 180C
 Heating Source:
 Blanket:
 Fluid: SUNOCO SUN HEAT TRANSFER 21 PD
 Make: NATCO

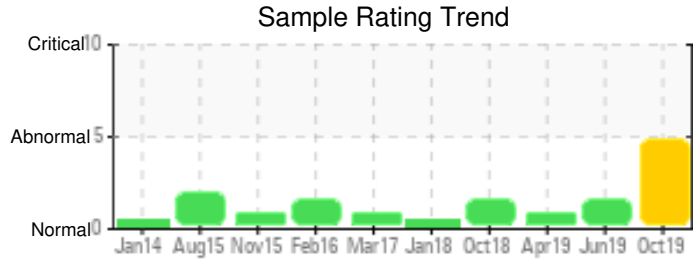
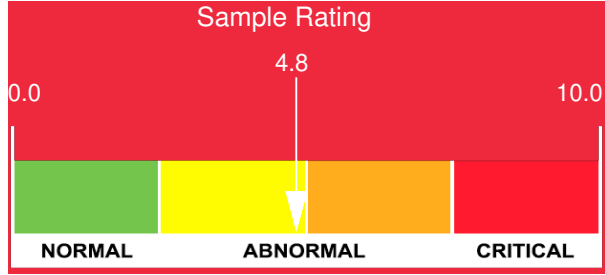
Sample Information
 Lab No: 02312939
 Analyst: Clinton Buhler
 Sample Date: 10/01/19
 Received Date: 10/07/19
 Completed: 10/21/19

Recommendation: Sample results indicate that the fluid is experiencing increased oxidation degradation as evidenced by the increased Acid Number- up to 0.374 from 0.225 3.5 months ago. The fluids increased flash point as well as the increased 10% and 90% GCD temperatures also support evidence of oxidation. The greatly increased Solids content (Pentane Insolubles) may also indicate insoluble oxidative by-products. Solids is also a concern as they can plate out and deposit across heat exchanging surfaces and cause an insulating effect, reducing efficiency. Sweetening of the system can be considered to keep the fluids acidity in check, but this is only a near term solution. Sweetening is generally recommended at an Acid Number of 0.4 in large systems such as this. The evidence of fluid degradation and solids content of 0.607% suggests that planning should begin to clean the system of solids through a cleaning and flush followed by a new thermal fluid fill. Please ensure that blanket gas is operational to ensure oxygen cannot enter the system. Once this is confirmed, please re-sample in 3 months to confirm fluid condition.

Comments:

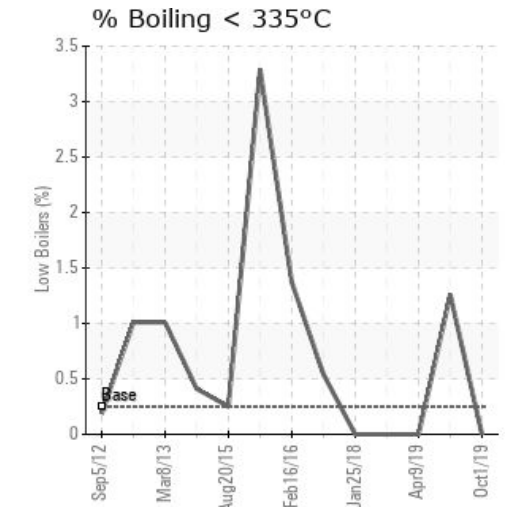
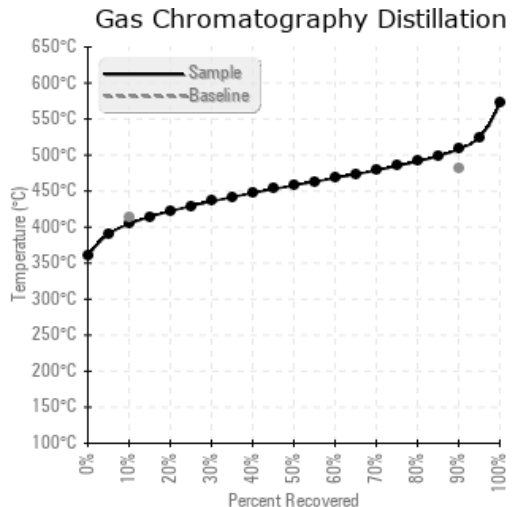
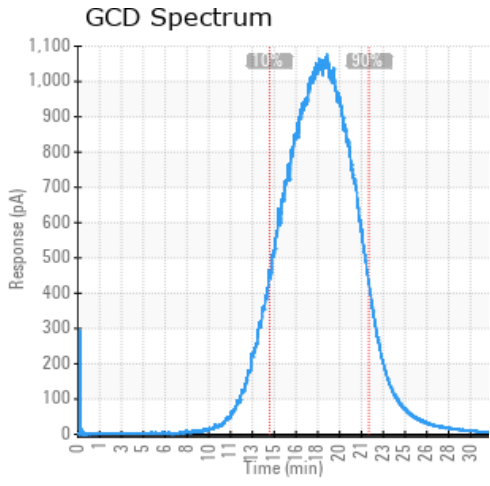
| Sample Date | Received Date | Fluid Age | Sample Location | Flash Point (COC) | Water (KF) | Viscosity (40°C) | Acid Number | Solids | GCD 10% | GCD 50% | GCD 90% | GCD % < 335°C |
|---------------|---------------|-----------|-----------------|-------------------|------------|------------------|-------------|--------|-----------|-----------|-----------|---------------|
| | mm/dd/yy | | | °F/°C | ppm | cSt | mg/KOH/g | %wt | °F/°C | °F/°C | °F/°C | % |
| 10/01/19 | 10/07/19 | 8y | | 455 / 235 | 2.7 | 41.7 | 0.374 | 0.607 | 760 / 404 | 856 / 458 | 947 / 508 | 0.00 |
| 06/27/19 | 07/08/19 | 8y | 12-27-81-18 | 453 / 234 | 27.3 | 41.8 | 0.225 | 0.306 | 722 / 383 | 824 / 440 | 920 / 494 | 1.26 |
| 04/09/19 | 06/05/19 | 8y | PUMP DISCHARGE | 432 / 222 | 23.3 | 42.0 | 0.244 | 0.312 | 735 / 391 | 832 / 445 | 925 / 496 | 0.00 |
| 10/17/18 | 11/07/18 | 7y | | 442 / 228 | 12.9 | 42.2 | 0.071 | 0.404 | 737 / 391 | 834 / 445 | 923 / 495 | 0.00 |
| 01/25/18 | 03/12/18 | 0y | | 446 / 230 | 1.5 | 41.7 | 0.02 | 0.350 | 731 / 388 | 800 / 426 | 892 / 478 | 0.00 |
| Baseline Data | | | | 439 / 226 | | 50.0 | 0.03 | | 777 / 414 | | 900 / 482 | 0.25 |





| 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 |
|---------------|------|----------|--------|----------|--------|------|-----|---------|--------|----------|---------|--------|-----------|----------|------------|----------|-----------|---------|-------|-----------|---------|--------|------------|------|
| 10/01/19 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| 06/27/19 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| 04/09/19 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 10/17/18 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 01/25/18 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 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

| | |
|----------|--|
| 06/27/19 | Sample results indicate that the heat transfer fluid is suitable for continued service. Percent boil-off has increased slightly since last analysis (1.26%). As a good practice, periodic venting of any low boiling vapors from the expansion tank is recommended. Please re-sample in 12 months (GCD) 90% Distillation Point is marginally high. (GCD) 10% Distillation Point is marginally low. |
| 04/09/19 | The fluid is in good condition and suitable for further use. The 90% GCD temperature is elevated but this does not affect performance of the fluid. Please re-sample in 12 months. (GCD) 90% Distillation Point is marginally high. |
| 10/17/18 | Sample results indicate the fluid is suitable for continued service. Please note solids content of 0.404%. This is nearing the warning limit of 0.5%. Consider filtration of fluid to reduce solids. Reduced viscosity may be related to their being some Teresso 32 mixed in the system. Re-sample in 12 months Pentane Insolubles levels are abnormally high. (GCD) 90% Distillation Point is marginally high. |
| 01/25/18 | Resample at the next service interval to monitor. All component wear rates are normal. The water content is negligible. There is no indication of any contamination in the fluid. The AN level is acceptable for this fluid. The condition of the fluid is suitable for further service. |

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