



Southwest Spectro-Chem Labs

1009 Louisiana St. South Houston, TX 77587

(P)713.944.3694 (F)713.944.9881

www.weanalyzeoil.com

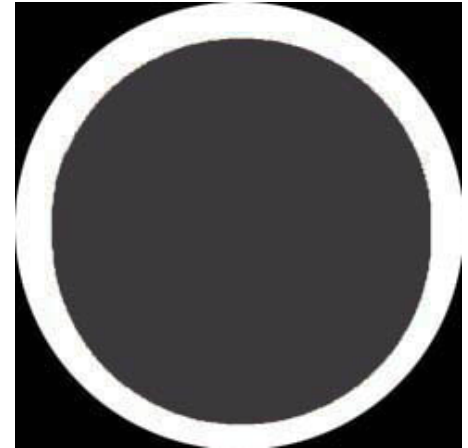
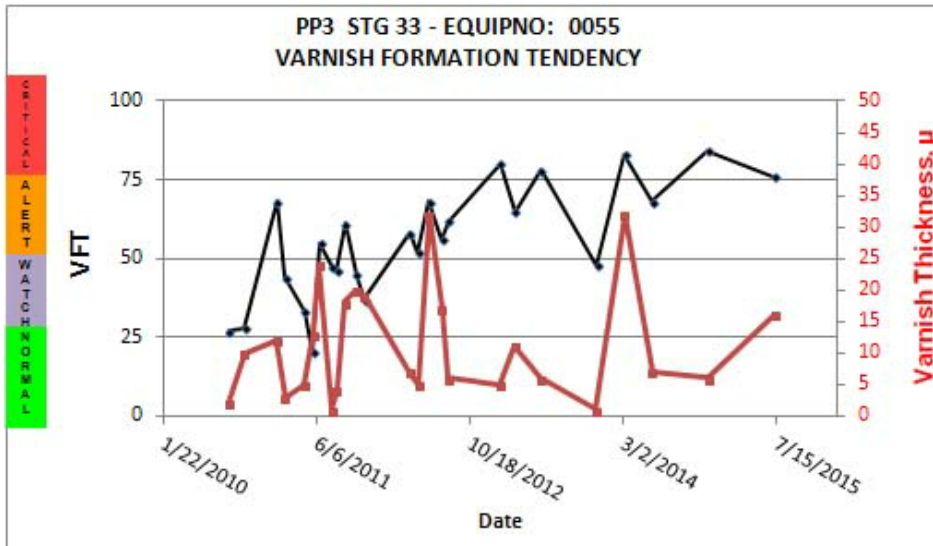
Varnish Potential

CRITICAL

VFT= 76

Varnish Analysis Report

SAMPLE INFORMATION			
CUSTOMER #:	123456	LAB SAMPLE #:	Z0001
CUSTOMER:	Southwest Spectro-Chem Labs	OIL USED:	FYRQUEL EHC
LOCATION:	PP3	TIME ON OIL:	N/A
UNIT:	STG 33	SAMPLE DATE:	07/09/15
DESCRIPTION:	GENERATOR CONTROL OIL	REPORT DATE:	08/04/15
EQUIP NO:	9999	ANALYST:	AZ



Comments:

The FYRQUEL EHC is a phosphate ester that produces phenols as it degrades. The new oil does not have any phenols or amine antioxidants. The numerical value of 853.9% increase of Phenols over the reference oil is in the normal range; however, the sample is showing some degradation. This degradation is further confirmed by the color of the patch, the dark residue is varnish. The color is within the CRITICAL range and is the major cause of the overall VFT of 76. Other factors such as particle count, TAN, oxidation and nitration appear concerning as well. Actions should be taken to improve these outcomes.

Recommendation:

Monitor the oil condition on a regular monthly schedule with routine oil analysis.

The following indicators should be monitored carefully.

Equipment Operational Indicators:

- * Servos may show buildup or sticking
- * Actuators may discolor or stick
- * Vibration from bearings
- * Seals may leak
- * Increasing wear metals
- * Increasing particle count

Tank and Pump Indicators:

- * Sight and level gauges may show brown stains
- * Reservoirs may show a "bathtub" ring
- * Debris buildup on pump casing and impellar
- * Buildup on heat exchangers
- * Filters and strainers collecting brown residue

Cleaning the oil by Electrostatic filtration or Balanced Charge Agglomeration should be considered.

Z0001

OIL MONITORING	RESULTS
Rotrode - Iron, ppm	0
Rotrode - Copper, ppm	0
FDRL	0.9
*FTIR - OXIDATION	4
*FTIR - NITRATION	4
TAN	0.54
KF Water, ppm	188
Particle Count	21/20/17
Viscosity @ 40°C, cSt	43.3
Viscosity Change,%	1.2

EMISSION SPECTROSCOPY DATA

BORON	0	SILICON	0
LEAD	0	SODIUM	273
IRON	0	BARIUM	0
ALUMINUM	0	CALCIUM	0
COPPER	0	ZINC	1
CHROMIUM	1	PHOSPHOROUS	9999
TIN	0	MAGNESIUM	0
		ANTIMONY	0
		SILVER	0
		TITANIUM	0
		VANADIUM	0
		POTASSIUM	42
		MOLYBDENUM	0
		NICKEL	0

VARNISH DATA	RESULTS
Membrane Patch Colorimetry	76
Linear Sweep Voltammetry (RULER) Phenolic %	853.9
Linear Sweep Voltammetry (RULER) Amine %	n/a

****Deposit Residue as Varnish Thickness**
 A precursor/varnish residue of 267 ppm calculates to 16 -microns maximum thickness. This represents an upper limit of 81 % of a typical 20-micron frictionless bearing clearance.

Category	Range, %
NORMAL	0 - 24
WATCH	25 - 49
ALERT	50 - 74
CRITICAL	75 - 100

* SWSC Labs normalized 0 - 4 Scale
 ** Close tolerances may plug with varnish.

What is Varnish in Lubricants?

Varnish is an oil-insoluble deposit composed primarily of organic residues and commonly defined by analyzed color intensity. Analytical data are combined to generate a single number representing Varnish Formation Tendency (VFT) of the oil, on a scale of 0-100.

Lubricants are examined to determine the condition of the oil, machinery and particulates using a variety of tests:

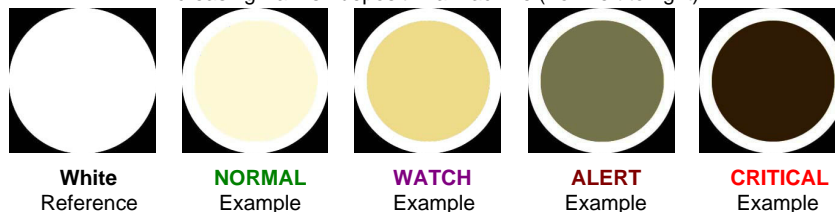
- FTIR** Measurement of Oxidation and Nitration of lubricant.
- Particle Count** A measurement of oil cleanliness.
- Metals** A report of machine wear, oil additive and contaminant metals in the lubricant.
- Viscosity** An oil's resistance to flow
- Water (Karl Fischer)** How much water is in the lubricant.

None of the above tests are used or considered effective in determining the VFT. These test data are provided to show the current condition of the oil, machine and particulates in the oil.

VFT can be determined using the following tests:

- Membrane Patch Colorimetry** See the examples below.
- RULER** Measures the remaining Amine and Phenolic antioxidants in the oil, compared to a new oil reference.
- Amine** Primary antioxidant protecting the oil from thermal and chemical oxidation and remains constant until all Phenolic consumed. (Acts synergistically with phenolics but can be used alone.)
- Phenolic** Secondary antioxidant, regenerates amine until consumed; however, can be the only antioxidant in some oils.
- Varnish Thickness Calculation** An upper limit estimate of the VARNISH deposit thickness in the Machine.

Increasing Varnish deposit in a machine (from left to right)



The actual color (yellow, orange, green, brown to black) is not significant, only the color intensity. The darker the color, the more serious the varnish problem.

Values of VFT provide a trend to project future VARNISH formation.

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