

Filterability of Circulation Oil

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Yankee Unit of PM Oil Circulation

The “Oil is oil” notion failed again, when Operators filled ISO 220 industrial gear into the Yankee Unit of newly commissioned Paper Mill. OEM specified ISO 220 paper mill oil, recommended in-service oil Target Cleanliness of ISO 19/17/14 and Differential Pressure < 2Bars across the in-line filter. This case-study makes the point that “finished lubricant is an engineered product formulated for specific application” and discusses that some oils are not just filterable as well as share quick on-site test methods to identify such oil.

The Problem

The 10 micron in-line filters were getting plugged due to particle contaminants carried in the circulation oil and therefore rapidly replaced. Whenever a new filter is installed, Pressure Differential (PD) of 2 Bars is readily attained but in just a couple of hours/days rises to 4.5 Bars, thus necessitating another filter replacement.

Usually to sustain adequate oil flow, Operators increase oil pump pressure which was not good for the pump life.

PC analysis carried out in May 28, 2014 on oil samples extracted from – 1) *Drain Plug, Pump Inlet side of oil tank*, 2) *Drain Plug, Return Line side of oil tank* and 3) *Main Return Line entering oil tank*; on the average showed ISO 22/20/17. Effort to improve in-service oil Cleanliness, using Filter Cart failed because that ISO 220 gear oil was **“not filterable”**. The circulation oil in use was ISO VG 220, 5EP, heavy-duty Industrial Gear Oil.

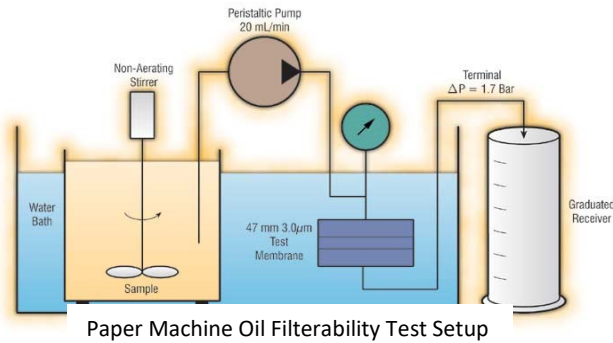
Discussion

The filterability characteristics of a fluid can be defined as its ability to pass through a filter without giving rise to undue pressure drop which will lead to loss of useful life [1]. With poor filterability fluid, the filter blocks quicker than anticipated. For the case-study under review, during Circulation-Cleaning, the Filter Housing was left in place while the in-line filter element was removed to eliminate pressure drop; at that time the PD measured <1 Bar. Thereafter, new 10 micron in-line oil filter was installed and PD rose as much as 5 Bars within 96 Run Hours.

The Filterability Test is based on volume that can be vacuum filtered through a 47mm, 1.2 micron analysis membrane at room temperature before blockage.



Inlet & Outlet Gauges measuring 6 Bars and 10.5 Bars respectively across the Oil Filter of the Yankee Unit Oil Filter



Filterability Index, FI

FI = Volume Passed to Blockage/Surface Area of Membrane

$$FI = \text{Vol. (ml)} / 9.6 \text{ cm}^2$$

Where FI > 70 Good, FI = 30 – 70 Acceptable, FI < 30 Poor

Simplified practical demonstrations of good or poor filterability can be achieved by any of these Screening Methods:

1. Customize the Test Setup for MPC (Membrane Patch Colorimetry) using the side-arm conical flask connected to the vacuum suction pump and filter 1 Liter of the test oil through a 46mm x 1.2 micron pore size cellulose filter at room temperature. The filtered oil volume, when flow ceases, is used to compute the FI.
2. For on-site checks, using a 50ml syringe attempt to filter 1 Liter of the test oil, at room temperature through a 46mm x 1.2 micron pore size cellulose filter held in place by a Filter Holder. In method option, each 50ml of the test oil is pushed through the filter manually until flow ceases due to blockage.

Experience gathered during weeks of filtering the ISO 220 industrial gear oil indicated that wrong circulation oil may be in place. This was confirmed by Laboratory Filterability test aimed to simulate pressure drop across a filter carried out for the ISO VG 220, 5EP industrial heavy-duty gear oil which produced FI < 30. As long as that gear oil remained as the in-service PMO, the desired PD of 2 Bars remain unachievable. This assertion is informed by the contributing effects of EP additives present in the oil's formulation, significantly reducing its filterability and correspondingly increasing the PD across any filter it flows through. The very strong adhesive property of the EP additives in that gear oil formulation, clinging tenaciously to every contacting surface it encounters.

Conclusion

In replacement, different ISO 220 oil formulated as premium circulation oil for Paper Machine application was used. Filterability Test produced FI > 70 which was evaluated as good for its application. The paper machines now run on that PM220 oil and Process KPIs are met with budget savings. In addition to routine oil analysis inclusive of Water and ISO Cleanliness monitoring by Particle Count ISO 4406 Method; RULER testing tracks depletion of anti-wear additives (presently at 43.5% of its Fresh Oil) for optimization of in-service oil life.

References

1. Machinery Lubrication - "Filterability Testing of Paper Machine Oil", by Mike Day, Pall Corporation
2. Machinery Lubrication - "Best Practice Lubrication for Paper Machines", by Russ Hink, SKF

Key Word: Components – Paper Machines