Forsythe Technology Inc.
9610 Long Point Road, Suite 206, Houston, TX 77055
Telephone: 713 468-1795 or 800 448-1795 Fax: 713 932-6874
e-mail: richard_slover@slovergroup.com

TECHNICAL NOTE

HIGH AIR CONTENT

BACKGROUND

When the fluid darkens rapidly and smells burnt or there are unexplained increases in the acid numbers, the cause can be air in the fluid. Air is not desirable because it can lead to more rapid degradation of the fluid, adiabatic compression (dieseling), spongy control, and/or pump wear.

The reasons for excessive air in the fluid include the following;

i) Air bubbles introduced into the fluid by higher than normal return flows or flows that return fluid to close to the pump suction.

ii) Air bubbles caused by low fluid levels in the reservoir as a result of higher than normal demand and/or slow make-up.

iii) Air in the fluid because of plugged or isolated vent or bleed lines for the pumps. This can cause pump internals to overheat because of the reduced lubricity and increased compressibility of the fluid. It can be more of a problem with pumps mounted vertically where the pump internals such as the upper bearing can be dry on starts or starved of lubrication during operation.

iv) Air bubbles formed by the subatmospheric conditions at the pump suction and possibly made worse by one or more of the following: cold fluid, dirty strainers, high main pump demand or sucking air at fittings, valves or pump seals.

vi) Fluid contamination leading to higher air release times that does not allow enough time for air to escape. Alternatively, an excessive foam layer that it is thick enough for the lower areas of foam to be drawn into the pump suction.

ROOT CAUSES

Return Flows

If the return piping is poorly located, such problems tend to be from day one. Typically the force of the returning flow pulls air into the fluid and it does not have time to get out. The causes for new equipment can be return lines located too close to the pump suction inlet or return lines that are not far enough below the lowest fluid level. There can also be excessive agitation of fluid in the return lines.

On established units, problems can turn up if the fluid levels are too low, if piping changes were made or if the air release time of the fluid has increased.

In addition, the reading of the level indicator should be checked against the actual fluid level because these have been off by a couple of inches. Note: Reservoirs are typically divided into compartments with internal baffles and weirs. This is so that the fluid path from the return to the pump suction is longer and therefore the fluid has a longer residence time. Consequently, too high a fluid level can also be a disadvantage if the returning fluid flows over the top of internal weirs and goes directly to the pump suction area.

Air Being Pulled In

Because most of the piping is welded there are fewer locations where air can be sucked into the pump suction lines. However, any place where is a gasket or an 'O' ring there can be in-leakage. This could be at the pump suction screen when these are located above the fluid and on GE systems one likely source is the ‘O’ rings around the indicator arm on the suction screen. Air ingress can also be at fittings for instrumentation or sample valves. Note that these will not normally leak fluid during operation because the pump suction conditions are often subatmospheric. Pump casing gaskets and inlet flanges should also be checked.

This is not a concern if the pumps are mounted in the reservoir and are submerged.

High Pump Inlet Vacuum

This is different to the previous problem in that it is not air ingress but rather dissolved air in the fluid being pulled out because of the subatmospheric conditions. The causes can include restricted pump inlet flows. This can be a result of dirty suction strainers or if the suction strainers have been replaced with ones having too fine a mesh.

It can also be the result of excessive fluid resistance if the fluid in the reservoir is too cold. This can be real problem in the winter time if the cooling water flow is not tempered or isolated. Water temperatures of only a few degrees above freezing are possible in northern areas or at high elevations.

Higher Air Retention

Fluids will normally release air but fluid degradation or contamination can affect the rate at which this happens. There are also significant differences in the air release times for the various types of phosphate ester fluids.

Fluid contamination can also increase the air release times with silicone based antifoams and sealants being one possible cause. There is a lab test that can be done, but it is not necessarily indicative of what is required for a particular system. This is ASTM D3427.

New fluids tend to have air release times between 1 and 5 minutes. The 'natural' fluids like Turbofluid 46XC are at the lower end and 'synthetics' such as Turbofluid 46 and Turbofluid 46B (Durad or EHB) are at the higher end. Used fluids can have values of 8 to 10 minutes.

However, what is acceptable is very dependent on the design used by that turbine manufacturer. Some OEM's have no limits for new or used fluids while others have limits for both. The requirements vary. For example, at one station the air release time has been up to 18 minutes without problems. However, this is very high.

TROUBLE SHOOTING

1. Check to ensure that pump suction strainers are clean and that they are the correct ones. Tighten all fittings and flange bolts on the pump suction side.

2. Ensure that the fluid is not too cold and when switching pump operation, ensure that pumps in parallel are not run together for more than a few seconds. Shut off the second one as soon as the pressure stabilizes.

3. Take fluid samples from good and bad units and have air release tests performed.

4. Look inside the reservoir to find out if any air bubbles are visible near the pump suction. Confirm that the level indicators are correct. Observations should also be taken during transient events such as pump changeovers or load changes. Fitting a viewport could be advantageous.

5. Measure fluid density or take transformer type syringe samples for gas analysis and therefore the air content. The samples must be taken on the pump discharge so care is required because of the high pressure.

6. Consider installing instrumentation to detect abnormal operating

conditions. Options could include a data logging vacuum sensor on the suction lines, a density device that can be installed in the tank or a density device on the pump suction lines.

CORRECTIVE ACTIONS

This will depend on what was found but include one, some or all of the following;

1. Keeping the fluid reservoir full.
2. Raising the reservoir temperature.
3. Tightening pump suction fittings or replacing seals.
4. Checking control and pressure relief valves.
5. Moving or lengthening return piping.
6. Fitting deaeration screens or internal baffling.
7. Reducing pump suction restrictions.
8. Elimination the use of non compatible materials.
9. Using a different type of phosphate ester fluid.

Summary, while a slight fluid darkening is expected excessive fluid darkening is not typical of GE and Siemens-Westinghouse systems. Consequently, action is required. In some cases the darkening is caused by color bodies that are not necessarily harmful so that no action is required, however this is not usually the case. Full fluid testing is required.

The above information is believed to be valid and correct but no responsibility can be taken for typos or dated material. Contact your suppliers for the most recent data. Also no warranties, express or implied, including warranties of merchantability or fitness for a particular use, are made with respect to the products described herein.

Nothing contained herein shall constitute a permission or recommendation to practice any invention covered by a patent without a license from the owner of the patent.

7/04