

FLUID TEST

Fluid Analysis and Hot Oil System Review for Press Platen Systems

by Jim Oetinger and Jed Seybold

In sawmills, plywood and veneer plants, and MDF and OSB mills, hot oil systems are often specified rather than steam because the temperature requirement of the materials, usually well over 500°F, would require high steam pressure, in turn necessitating heavy and expensive system components to handle the PSI. Not to mention the need for licensed operators, and the water treatment chemical expenses.

And there's an old saying in the thermal fluid business, "If you see the fluid, you've got a problem." So, you count your blessings when the system runs well and the fluid stays inside, where it's supposed to.

Of course, there are two sides to every coin. If you can't see the fluid, how do you know what condition it's in? Your heat transfer system may continue to chug along quietly even if the fluid is degrading. Only when the degradation becomes advanced enough might you detect a reduction in system performance.

The answer? Analysis of your heat transfer fluid.

Heat transfer fluids/hot oils very seldom go bad without help. Over 95 percent of fluid degradation is caused by equipment malfunction, poor design or operating errors. The other five percent is caused by incorrect temperature range matching. The system can appear to operate very normally for a number of years. Any problems that are the result of fluid degradation occur very gradually—the cold spots in the press start to affect product quality or the start-up after the annual shutdown takes three times as long as last year. Detecting changes in the condition of the fluid can help identify problems before they become serious maintenance issues.

Once the problems start, testing the fluid will only confirm that the fluid is bad and may need to be replaced. One test is not going to be useful in determining whether the fluid was contaminated, a valve was left open by mistake or the latest modifications weren't well conceived. The best practice is to test the fluid before the problems start.

Periodic testing (at least annually) establishes a history of the system. This history is vital since it separates the "normal" changes from the abnormal changes. New systems should be tested within the first 6-12 months of start-up to check for any serious operational or design issues that are already affecting the fluid's condition. Existing systems that have had a fluid change out should be tested within one or two weeks of start-up to quantify the effects of the previous fluid residue on the new fluid. These initial analyses create a baseline against which future tests are compared.

The ideal location for taking a sample is near the pump suction. The pump should be operating and the temperature above 180°F. Taking the sample from a dead piping leg, the expansion tank or the drain tank will lead to erroneous results. Samples should always be taken in the container that will be sent to the lab. If a sample is allowed to cool in one container before it is transferred into the final container, suspended solids will settle out and be left out of the final sample. The presence of these solids in a sample can be a strong indicator of a problem, so it is vital that all of the material that comes out of the sample tap be sent in for testing. If safety concerns prohibit hot sampling, a simple sample cooler can be fashioned from a modest length of copper coil and a bucket of water.

Because lubricating oil tests are well known, inexpensive and convenient, thermal oil samples are often sent to lube oil testing laboratories. The problem is that tests specified for lubes, which may include trace metals, particle counts and Ramsbottom/Conradson carbon, measure things that are

important for lubrication and hydraulic systems but *not* heat transfer. For example, thermal fluid pumps do not operate at high pressures and so do not have the close mechanical tolerances that can be affected by particles. Particles in thermal fluid are more of a nuisance than a threat. At worst, they form sludge which is independent of particle size. And because thermal fluids contain virtually no inorganic additives, any heating-based carbon solids analysis is not worthwhile.

There are three basic tests that should be performed to properly characterize the condition of thermal fluid. They are listed in decreasing importance:

Acid Number: This is the most important test because acids formed from fluid oxidation are the raw material for almost every bad thing that can happen to a press-heating system, from cold spots to fluid “gelling.” New fluid is shipped with an Acid Number of 0.01 to 0.04 g KOH/g sample. Setting an upper limit is tricky because the Acid Number will stabilize once the conversion from acid to carbon begins. In press-heating systems, carbon will typically begin to form at an Acid Number of around 0.2. However, given that the problem is irreversible once it starts, any successive increases should be checked out promptly.

Viscosity: Extremely high viscosity can reduce the heat transfer rates of the fluid and can also make the fluid unpumpable at ambient temperatures. In general, a fluid viscosity over 100 cSt at 40°C (about 100°F) will require a long time to thin out from a cold startup.

Distillation Range: When compared to new fluid or to previous samples, this test can determine whether a fluid has simply degraded or if it has been contaminated.

There are two tests that can provide additional information for troubled systems.

Suspended Carbon: This test measures the weight of carbon particles produced as acids degrade in the heater. There, particles remain suspended in the fluid while it is circulating but will form sediment (sludge) in low flow areas. These particles can clump and form blockages where excessive turbulence forces them together. The size distribution doesn’t matter; it’s the total amount that determines the extent of the problem. If the results indicate that there is more than 0.5 g of carbon per gram of sample, installing a side stream filter is usually recommended. The test is also sensitive enough to monitor the progress of a filtration program.

Water: Water does not remain undetected for long. Unlike lubricating and hydraulic systems, heat transfer fluids operate at a high enough temperature to flash any entrained water to steam. The volume difference between liquid and vapor will cause the expansion tank to overflow, and in addition may cause significant pump cavitation. Testing samples for water is recommended if the system has a oil/water exchanger installed for cooling. In this case any result over 100 ppm indicates that there is a tube leak.

Flash Points (both Open and Closed Cup) will change as the condition of the fluid changes, and in a pinch can be used to estimate whether the fluid has been overheated. The Closed Cup test is extremely sensitive to any increase in volatile molecules produced as the fluid ages. It is only meaningful if the results are compared with valid previous test results. The problem? There tends to be significant variability from test to test (swings of 6 percent are not uncommon), which make them unsuitable for establishing fluid condition on a consistent basis. A more stable and quantifiable test for detecting thermal degradation is the Distillation Range test.

Once the testing is complete, the data must be analyzed and discussed with the user—often the maintenance engineer or manager. This discussion requires not only a review of previous samples but also a knowledge of the process and equipment so that the appropriate questions can be asked and the reasons for any changes in the fluid quickly identified.

A few hundred dollars spent annually on proper fluid analysis, and the resulting system review, can result in many thousands of dollars worth of savings, not only from increased fluid life but also through increased plant production continuity and reliability, as well as plant and personnel safety.

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