

Application Bulletin

Pall HNP021 Fluid Purifiers Eliminate Air Entrainment in EHC Fluids

Overview

Air entrainment in steam turbine electrohydraulic control (EHC) fluids is a common occurrence that causes a number of problems, including poor hydraulic control and localized overheating. Hydraulic control is negatively impacted by the increased compressibility of air entrained in the fluid. Overheating results from adiabatic compression of the air bubbles as they collapse, which generates local high temperatures and results in fluid thermo-oxidative breakdown.

Air entrainment is influenced by the air release properties of the EHC fluid. The longer it takes for the fluid to release the entrained air, the poorer its air release properties, and the higher the air release value on the ASTM D3427 test. New polyol-ester-based EHC fluid has an air release value of 7 minutes at 50°C.

The Challenge

A 700 MW power plant in Southeast Asia had an EHC system that was experiencing air entrainment problems. The key parameters of the system (listed below) indicated a greater than 30% increase in the air release value of the used fluid over that of the same fluid when new.

System Parameters

Oil volume	1,000 liters
System pressure	165 bar
Operating temperature	52 - 58°C
Air release value	10.1 minutes at 50°C



Pall HNP021 fluid purifier

The Solution

To resolve the EHC fluid air entrainment problem, the plant used a portable Pall HNP021 fluid purifier. This purifier employs mass transfer–vacuum dehydration, which involves the transfer of the liquid into a steady stream of dry air under moderate vacuum and temperature conditions. (The purifier uses the fluid process temperature to avoid exposure of the fluid to heat, which can degrade the fluid.) The result is the transfer of moisture and entrained gases and air from the fluid to the sweep air.

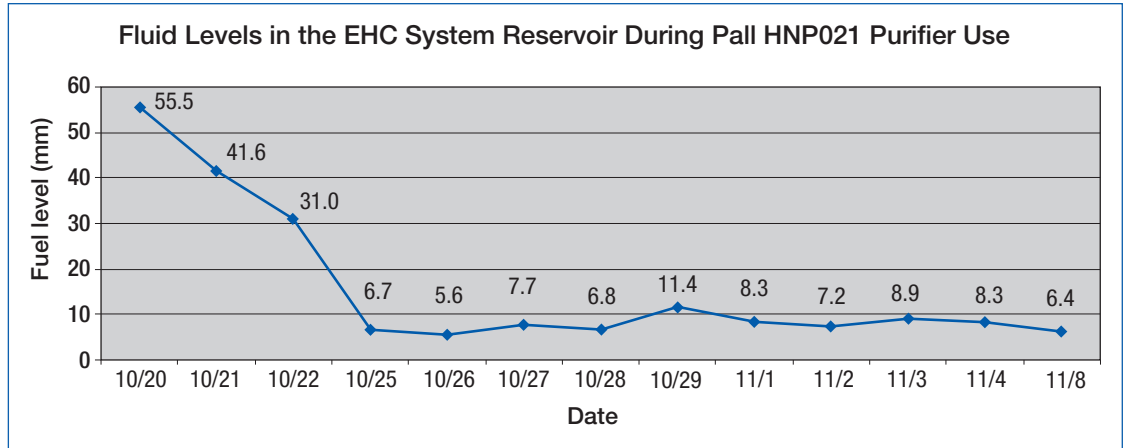
Pall HNP021 fluid purifiers are designed to remove 100% of free water and free and entrained gases. They also remove up to 80% of dissolved water and gases. Particulate removal is achieved using high efficiency Ultipor® III filter elements, rated $\beta_{x(o)} \geq 1000$, to polish the fluid before discharge back to the system reservoir.



The Benefits

The following graph shows the fluid levels in the EHC system reservoir over a period of 19 days during which the purifier was in use at

the plant. The fluid level in the reservoir is correlated with the amount of entrained air in the fluid.



Note: 1 mm = ~2 L of fluid. Zero (0) level does not indicate 0 liters of fluid volume. The actual oil volume is ~1,000 liters.

As the graph illustrates, the Pall HNP021 purifier removed ~100 L of gas within the first six days. After the gas was removed, the fluid level in the system reservoir remained stable. (During the test period, it was confirmed that accumulators were not being triggered and that there was no leakage from the system that might contribute to a decrease in fluid level.) These data demonstrate the effectiveness of the Pall HNP021 purifier in both removing entrained air and preventing air accumulation in EHC fluid.

To confirm these results and to alleviate concerns of plant personnel that the purifier may have been causing the fluid to drain or evaporate, the purifier was turned off for three weeks. As expected, the EHC fluid level in the reservoir increased gradually by a total of 56 liters without the addition of any fluid. This increase in fluid level indicated that without the use of the Pall HNP021, air bubbles accumulated as they became trapped in the fluid. The data from both tests were impressive, and as a result, plant personnel decided to purchase additional Pall HNP021 purifiers for two other EHC systems.



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