2016 Maintenance Innovation Challenge

Membrane Dehydrator

PROBLEM STATEMENT

Dissolved water pose an engineering and asset risk of damaged mechanical components, as well as the additional costs from downtime, maintenance, and replacement. Managing dissolved water is an emerging concern where water soluble polyalkylene glycol (PAG) environmentally acceptable lubricants (EALs) are now used in Controlled Pitch Propeller (CPP) system of two USCG cutters. Existing centrifugal purifiers onboard and conventional filter carts are not able to remove dissolved water in the CPP oil.

Recently, one of the cutters experienced leaking blade seals that the dissolved water increase to 3.75% in the CPP oil. After replacing the blade seals, dissolved water needs to be reduced to normal levels to allow continued use of the CPP oil for normal operation.

WAY FORWARD / POTENTIAL BENEFITS

- Avoid costly replacement of water soluble EALs due to excessive water contamination
- Dehydrators are available in portable and fixed units
- Unit runs with a filter cart so it is much simpler, less expensive and compact compared to standard oil dehydrators or centrifuges
- Minimal moving parts, requires less maintenance
- Total automatic operation, suitable for remote applications
- Unlike vacuum purifiers, no complicated floats or drive
- Water is discharged into the atmosphere as water vapor – no contaminated water to deal with

TECHNOLOGY SOLUTION

The dehydrator is based on an amorphous fluoropolymer hollow fiber membrane module that is configured similarly to a shell-and-tube heat exchanger. Water-laden liquid lubricant follows across outside of the hollow fiber membrane while a vacuum is applied on the inside. The membrane dehydrator uses a vacuum to force water to permeate from the oil through the membrane. Technology functions by separating components in lubricating oil based on their size. As a small molecule, water permeates through the membrane at a much faster rate than the other species in the lubricant. Higher alkanes such as those formulated into lubricating oil, their large size and low vapor pressure makes it very difficult for them to go through the membrane. The permeated water is then discharged into the atmosphere as water vapor.

STATUS OF TECHNOLOGY

USCG procured two portable membrane dehydrators for the two cutters with PAG EAL in the CPP system. USCGC Hollyhock currently using the unit to remove high dissolved water due to leaking blade seals. Blade seals were replaced and after 50 hours of sump dehydration, dissolved water is reduced to 2.04% and will continue dehydration until dissolved water is reduced below 0.5%.