

THE STEPS FOR REMEDY DAMAGES BELOW WATER GEARS

Madura ANAMARIA, Nicolae CRECAN, Ioan MIHAILA
University of Oradea

Abstract

When a gear drive is submerged in seawater, the primary damage to critical components occurs through corrosion, specifically to rolling element bearings and gear elements. Underwater, this corrosion occurs at a relatively slow rate based on the water's oxygen content.

However, when a gear drive is drained of all water and not immediately and properly serviced, exposure to the atmosphere can result in corrosion damage within a very short period of time - in as little as 24 hours.

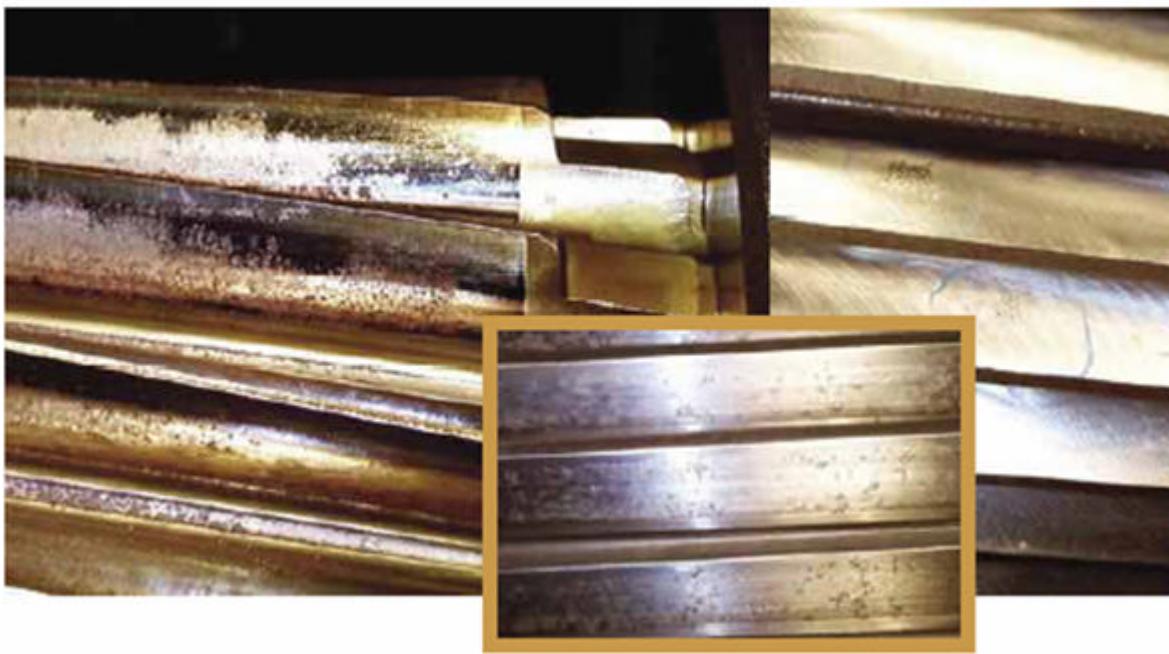
Affected Gearboxes

When a gear drive is submerged in seawater, the primary damage to critical components occurs through corrosion, specifically to rolling element bearings and gear elements. Underwater, this corrosion occurs at a relatively slow rate based on the water's oxygen content.

However, when a gear drive is drained of all water and not immediately and properly serviced, exposure to the atmosphere can result in corrosion damage within a very short period of time - in as little as 24 hours.

This condition elevates the risk of premature operational failure to unacceptably high levels.

We offer the step-by-step procedure outlined below, and if it's followed immediately after the gear drive is drained of contaminated water, it can render the unit operational for a significant period of time before unit rebuild is required.



Step-By-Step Procedure

- 1) Immediately upon draining the gear drive, remove all inspection covers and thoroughly flush with hot, fresh water (80°–100°C). Deionizer water, if it's available, is the optimal choice, and the unit should be consistently flushed with water not exceeding acceptable levels of chloride (0,02mg/25cm³). The primary consideration at this point is to limit accelerated corrosion damage that occurs when the gear

drive's critical components (bearings, gear elements and housing internal surfaces) are not coated with oil and are exposed to the atmosphere or chlorides contained in the water.

2) Flush the unit with low viscosity oil immediately following the freshwater flush. There are several flushing products on the market with relatively low viscosity that will penetrate close tolerance components, like rolling element bearings, and remove water and debris as the fluid is circulated throughout the unit. Some of these products include additives that actually absorb and remove water during the flushing process.



Temporary Service

3) During both water and oil flushing, maximum exposure of the flushing fluid to all gear drive critical surfaces and internal housing areas is required. Completely filling the gear drive with flushing fluid and immediately draining the fluid is the best way to get maximum benefit from the flushing. If it is not feasible due to gear drive size or location, the drive's internals should be thoroughly lanced through inspection ports. When lancing, do not direct lance at resistance temperature device (RTD) wires or at hydrodynamic bearings (sleeve-type Babbitt bearings). Direct impingement of flushing fluid under pressure on all accessible roller element bearings, gear elements and internal housing areas should be accomplished.

4) During flushing, the gear drive input shaft should be slowly rotated at regular intervals to permit the draining and lancing operations to dislodge any debris or moisture pockets that might be trapped in the gear mesh and/or rolling element bearings.

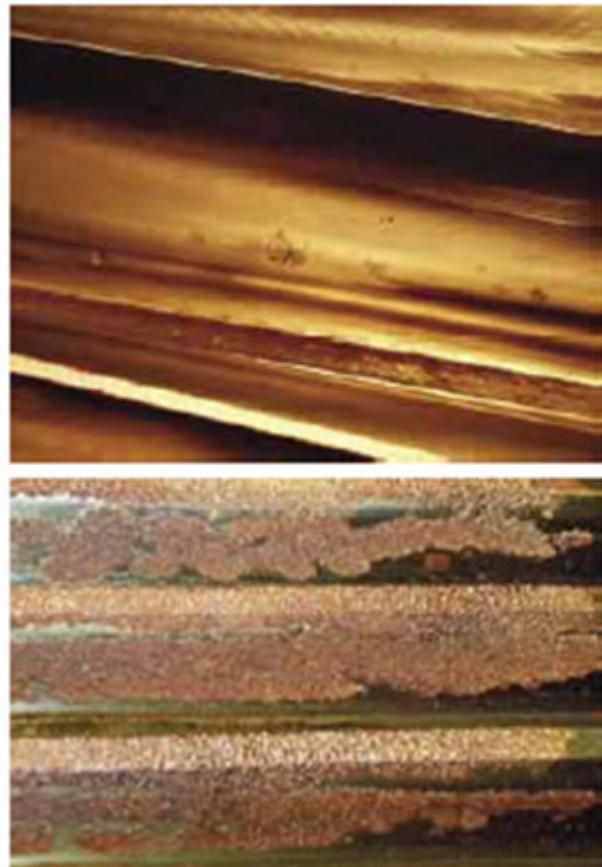
5) In the event that flushing oil is not immediately available, the unit should be flushed with fresh or deionizer water and then submerged in fresh or deionizer water. This prevents any rapid corrosive activity due to metal surfaces being exposed to air. When flushing oil is available again, repeat steps #1 and #2.

6) The gear drive lubrication system must also be cleaned and flushed in a fashion similar to the gear drive.

All water-oil coolers, unit piping, relief valves, pumps, motors and filters should either be disassembled, cleaned and reassembled or replaced as required. All electrical equipment including electric motors, switches and any other electrical devices should be either replaced or serviced in accordance with equipment manufacturer's recommendations to ensure safety of operation.



7) Once all cleaning procedures are accomplished, the gear drive should be operated as soon as practically possible. Prior to operation, lubrication oil should be circulated through the gearbox and the lubrication unit until the filter elements remain clean since last inspection. If a centrifugal oil purifier is available, circulating the new oil charge through the purifier will aid the removal of any residual water and debris that might be dislodged during the flushing or oil circulating process. After the lubrication oil shows clean in the filters, acceptable minimal levels of water and chloride contents should be verified by either taking an oil sample or replacing the oil charge that was utilized during the oil circulating process. If the chloride content level is above acceptable levels, subsequent gear drive operation at normal operating temperatures can result in accelerated metallic component corrosion.



8) Once the system is functional, the unit should be operated at the lowest possible speed and load conditions, depending on the nature of the prime mover. Any noted unusual noise or vibration will indicate significant damage, and the unit should be completely shut down and reconditioned by a quality repair facility. During initial operation, all regularly monitored parameters (oil pressures, oil inlet and outlet temperatures,

bearing oil temperatures, vibration levels, etc.) should be monitored and repaired compared to previously recorded parameters taken under similar operating conditions.

If there is no significant divergence in previous and current parameter magnitudes, the gear drive can be operated until such time that it can be removed from service, inspected and overhauled. This should be done at the earliest feasible opportunity.

Gear Drive Operations After Submersion

These procedures are intended to be used when gear drive operation is required in an emergency situation. During operation and prior to unit overhaul, gear drives should be closely monitored to ensure that premature bearing or gear element degradation is not occurring.

Periodic condition monitoring should be performed on an accelerated schedule to avoid potential equipment conditions that could result in unscheduled downtime or represent an undesirable safety condition.

References:

1. Aron, I., s.a., *Angrenaje conice cu dinti curbi*. Editura Casa Cartii de Stiinta, Cluj-Napoca, 1999;
2. Jula, A., s.a., *Proiectarea angrenajelor evolventice*. Editura Scrisul Românesc, Craiova 1989;
3. Minciuc, C., *Precizia si controlul angrenajelor*, Editura Tehnica, Bucuresti, 1984;
6. *** - www.thegearworks.com/tools