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'Providing Tribological Solutions'

'VSG' 'THE GREEN GREASE'
WICKET GATE GREASE LINE PLUGGING

INTRODUCTION

Many stations use an automatic grease lubrication system to ensure that the wicket gate bearings and the regulating mechanisms receive sufficient lubrication. It is important that the right amounts at the right times are delivered because too much can be wasteful and too little can lead to failures or at the least, wear, corrosion and/or higher forces to move the gates. Too little can also mean that what grease is being provided stays in the supply lines too long. The grease also seals out dirt and water as well as help prevent corrosion of the bearings and journals so a slight excess is considered to less likely to cause subsequent problems.

Wicket gates are generally lubricated 1-4 times a day and the other mechanisms twice a week. Take care reducing the frequency without proper feedback or monitoring such as the operating system pressures or linkage/arm forces. This is because a plugged grease system can be labor intensive to clean and worn bearings and/or journals (shafts) expensive to replace or repair.

GREASE LINE PLUGGING

Central greasing systems are much like oil systems with a grease reservoir as a container, typically a keg or drum, a pump, a grease metering system (valve blocks) and a distribution system. There will also be a relief valve. Filters are not used but there might be metal mesh screens in the line downstream of the pump.

The systems at hydroelectric stations are different than typical industrial systems because the lines can be very long and at the some end points at the bearings the greases are subjected to a water stream. Also, because they are indoors the ambient conditions are moderate with expected operating temperatures of 10°C (50°F) to 30°C (86°F). This is important because low temperatures can cause grease mobility issues and higher temperatures can speed up oil separation and/or oil degradation.

Once any issues with the grease pump, relief valves passing, air in lines, follower plate stuck or missing and lines being damaged are eliminated, high pressures because of grease line plugging can be the result of the grease being too difficult to move. The root cause can be one or more of the following;

Grease too stiff in first place: Generally use a Grade 0 or 1 but this is only a rough guide to true mobility. In general a higher NLGI (National Lubricating Grease Institute) Grade is better for the bearings and water washout resistance.

Grease too hard to move: Must be sufficiently mobile. Check USX mobility and/or Lincoln pumpability. Too high a base oil viscosity or a poor quality base oil with a low VI (viscosity index) can contribute to excessive pressures. These can then cause more oil separation.

Oil Separation: Some greases, especially under pressure, release the oil. This then leaves the thickener (sometimes a soap) behind that plugs the lines.

Solids Separation: The use of solids like moly, graphite and PTFE can be a problem if they separate out over time or get caught on metal screens. Generally avoided. If unstable additives are used these can also drop out and contribute to line plugging.

Constrictions: Over time deposits can form in the lines or valves. These can be from the grease, dirt and/or corrosion. Lines also get dinged so a periodic replacement program could help and some stations use nylon rather than copper tubing.

Another factor, especially when switching greases, is compatibility. Because different grease thickeners might have been used as well as various oils and additives the mixed greases can sometimes react. While less of a problem at the low temperatures of this application, the consequences can be mixtures that can be stiffer or softer. If stiffer they can be harder to pump and even if softer there can be concern about increased oil separation or water washout. Verify compatibility before use and in some cases an intermediate grease compatible with both can be used for a few greasing cycles.

In addition, excessive grease pressures can be the result of plugged bearing clearances. The cause can be silt or hardened grease because of insufficient greasing.

While the application appears simple a few utilities have detailed specifications for wicket gates. Basic ones just copy some parameters for a grease that worked in the past while others have performance provisions to avoid specific problems. Many such problems were related to grease mobility that can contribute to line plugging. Unfortunately, few of the existing wicket gate grease specifications appear have updated recently to take into account new requirements and new products. This is not thought to be because there are fewer problems but rather inappropriate cost accounting and diminished tech support available to the stations.

PREVENTION

Use greases that meet all of the following performance requirements;

Apparent Viscosity (ASTM D 1092) - 2,000 poise max at 20 s^{-1} & 0°C (-18°F)[1].
NLGI Grade (ASTM D 217) - i.e. Grade 0 or 1 [1,2,3].
Oil Separation (ASTM D 6184) - 10% max[3].
Lincoln Pumpability, pressure after 30 seconds kPa Max - 2,800 @ 0°C (-18°F)[1].
Role Stability (ASTM D 1831) 4 hours @ 25°C (77°F) - 20% change[2].
USX (US Steel) Mobility - Flows 10 g/min minimum at 0°C (-18°F).
Water Washout (ASTM D 1264) - 6% max @ 79°C (174°F)[1].

The above are regarding plugging because there are other required characteristics.

References
1. Hydro-Quebec PAEM 89501
2. Ontario Hydro M-652-84
3. MIL-PRF-18458C, 'Grease, Wire Rope - Exposed Gear'.