

Lubrication of Clarifier Drives

Why Oil is Preferred over Grease

By

Daniel E. Harker

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Walker Process Equipment
Division of McNish Corporation
Aurora, Illinois

Clarifier drives are expected to provide uninterrupted service for decades. Commercially available drives for the Water and Wastewater Industry generally pass the minimum test of proper design by demonstrating that they function reliably and, *if properly lubricated*, do not fail prematurely. Gear manufacturers or assemblers must reduce the risk of pitting and tooth breakage by proper selection of materials, but can easily pass on future problems with the gearing and bearings by neglecting proper design of a maintainable lubrication system.



The Consulting Engineer responsible for specifying minimum design features of a clarifier drive can provide added assurance by specifying a well-designed lubrication system. A drive unit must pass all criteria for sound design, and the designer must also take into account the realities of 20 or more years of exposure to weather and temperature alterations when selecting the type of lubrication system for the gears and bearings. The choices involve using systems that utilize either oil or grease as the means for lubrication.

LUBRICATION METHODS

Oil is the best and preferred choice for the lubrication of gearing and is universally recognized as the most reliable lubricant by gearing and bearing experts.¹ The concept of lubrication is based on providing a friction-reducing film, and liquid lubricants in the form of oil provide the optimum distribution of a film.

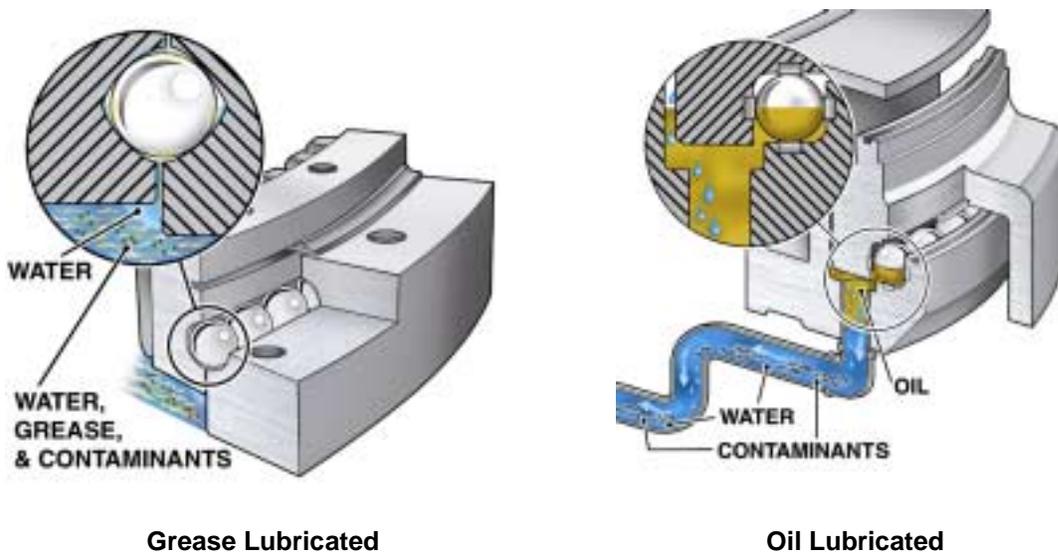
Oil, either petroleum based or synthetic type, because of its fluid properties, allows circulation of lubricant through the components of the gearing. The meshing action of the gear teeth forces lubricant up the face of the gear teeth and over components in order to provide the boundary layer film necessary for proper lubrication.

Grease formulations are usually petroleum oils thickened by dispersions of soap² and are used in situations where fluid lubricants are either difficult or cannot be retained. The thickener matrix (soap) in a grease formulation immobilizes the base oil and acts as a storehouse from which the oil bleeds at a slow rate. The semi-fluid nature of grease solves the problem of containment for commercially available bearings and for the suppliers of gear housings that may leak, but introduces other difficult properties for the user.

Grease formulations have a higher solidification temperature than oil of the same viscosity, so at low temperatures most grease formulations exhibit a low base oil separation rate that increases the risk of starvation increases. When base oil viscosity is high, for example in low temperatures then the base oil cannot separate out of the thickener.³ Without proper additives, grease can become virtually solid at low temperature causing bearings operating in this medium to simply cut a channel and run without any lubrication.⁴

CONTAMINANT REMOVAL

Contaminants are inevitable in any non-sealed lubrication system. Any void area in the gearing or bearing is subject to the formation of condensation caused by daily temperature fluctuations. In reality it is not possible to keep large turntable type bearings such as those applied to clarifier drives 100 percent filled with grease. As a result condensate and other contaminants become trapped in the matrix. Complete purging of grease from a large gear and bearing area is just not possible without disassembly and hand cleaning.



Contaminants such as condensation, dust or metallic particles, from either air-borne or from other sources, will settle in an oil bath but may be easily removed by draining and flushing without disassembly of the unit. The daily accumulation of condensate is easily drained from housings that are designed as an oil bath and may even be accomplished with an automatic condensate removal system. Also, maintenance of the proper lubricant level is possible and made easier in gear assemblies that utilize oil.

Grease must be periodically purged or replaced. Purging necessitates a housing of low volume and without dead-zones so new grease can displace old grease through the seals or through purge points when plugs are removed. Replacement of the grease that cannot be purged demands time-consuming disassembly, cleaning and re-packing by hand.

Removal of debris and condensate is a concern in grease-lubricated spur gear housings because it cannot be readily flushed out of the contact zone of gear teeth or bearing elements. Oil, on the other hand, flushes particles and debris from the contact zone and allows the daily accumulation of condensate to flow to take-off points.

USEFUL LIFE CONSIDERATIONS

It is not enough to reference AGMA and ANSI standards to assure a long useful life for a clarifier drive. Assuming a drive is initially designed, assembled and installed correctly, in the long run it is the maintainability of the gearing that will determine overall life. Oil is the best means of lubricating slowly moving elements of a clarifier drive. The manufacturer of a drive that is not confident that the gear housing will retain oil will use grease and pass a maintainability problem to the user.



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¹ Machinery's Handbook, Eric Oberg, Franklin D.Jones, Holbrook L. Horton and Henry H. Ryffel, Industrial Press Inc., 24th Edition, (C), page2218 Lubricating Oils.

² Machinery's Handbook .

³ "Bearing the cold," Motion System Design June 2001: 13-17.

⁴ Fundamentals of Gear Design, Raymond J. Drago, P.E., Chief Engineer Drive Systems Technology, Inc. Butterworths, (C), page 426, 'Lubrication'.