Abstract:

Oil mist lubrication is a well proven technology which has been widely used in the Hydrocarbon Processing Industry for over twenty years. Globally, there are more than 100,000 pieces of equipment being lubricated with this best practice lubrication method.

In this presentation, we will introduce oil mist technology for applications in the Power-Gen Industry, specifically for Cooling Towers, where we will show how the benefits gained over the years by refineries employing this technology can be adopted by power generation facilities.

Centrifugal Pumps, Electric Motors and Gearboxes are all suitable for being lubricated and/or preserved with Oil Mist, and the benefits of implementing this technology can be very attractive for all industries that employ large amounts rotating machinery. As Increases in MTBF can be substantial and lubrication tasks can be automatized, important savings can be made.

Introduction:

Cooling towers are used in some electric power generation plants, to remove heat from the water used in the cycle of a steam turbine, in conventional steam or combined cycle power generation plants.

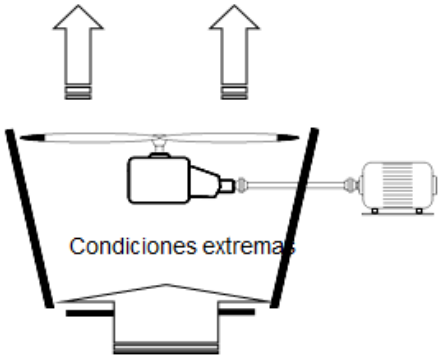
From the mechanical point of view, various possible configurations that include an electric motor with a gearbox, that can provide changes in speed and direction of rotation to the blade or blades of fans in a cell, will be considered in the present study. Depending on the configuration of the cooling tower, we find a wide variety of designs, all containing between 3 cells up to 10 or more.

Normally, in a cooling tower installation there are 2 or more centrifugal pumps providing recirculation of the cooling water.

Conventional power plant cooling tower, comprising of 8 cells

From the lubrication point of view, the mechanical equipment that presents the greatest risk of breakdown is the speed reducer. It is important to mention that the breakdown of a gearbox in a cooling tower carries with it high maintenance costs, where cranes, scaffolding, etc are required to perform any intervention; there is also a risk that some of the gearbox lubricant could mix with, and contaminate the cooling water.

On the other hand, the environment it which cooling tower gearboxes are installed is not ideal, since it is immersed in an updraft of heavily moisture laden air. If the gearbox is not hermetically sealed, as is the case with the vast majority of older gearboxes and some newer designs, the possibility of high water content in the oil is very likely, which will substantially increase the probability of failure through problems with lubrication.



The location of the gearbox in the cell means water contamination of the gear oil is a common occurrence

In the same way, although with less exposure, electric motors and centrifugal pumps operating in a high moisture environment, and the entering of this bearing housings, also leads to a reduction in the life of the equipment, according to the widely published life extension tables related to water content.

With the application of oil mist lubrication, a widely known technology in the Oil & Gas Sector for over 40 years, many problems associated with moisture and contamination in general can be avoided. To date, there are more than 100,000 pieces of equipment served by this type of lubrication in many oil refineries and other plants around the world.

One of its most common applications within the refining sector, is in cooling towers, since the use of oil mist lubrication helps extend the life of mechanical elements, mainly in gearboxes, but also in electric motors and centrifugal pumps. Other advantages of this type of application are:

- The ability to automate some lubrication tasks (to automate all lubrication tasks requires a more complete system).
- Achieve small energy savings by optimizing pumps and electric motor lubrication.
- Optimize the consumption of lubricant
- Improve safety, since operators need not perform manual tasks in hazardous areas nor work at height.
- Reduce risks and exposure of workers to Legionella. This type of disease is common in facilities such as cooling towers, and the workers who are going to carry out work there must be completely protected, which significantly raises the costs of maintenance.

Development:

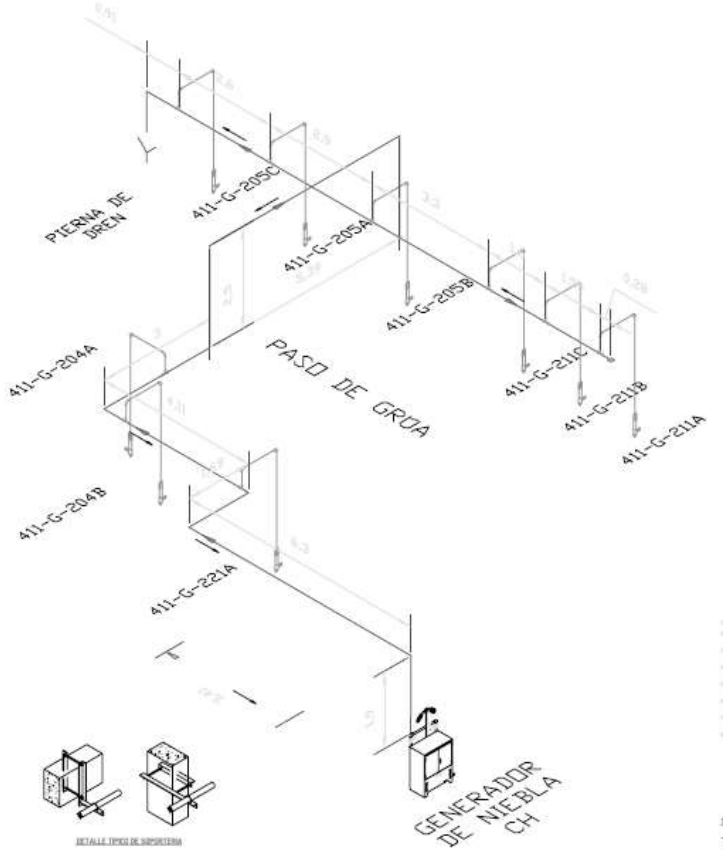
In this work we propose that you consider this lubrication technology, as "state of art" to lubricate dynamic equipment in cooling towers. This method of lubrication can be perfectly adapted to existing equipment, as well as specified as the preferred method of lubrication when you design a new installation.

A mist lubrication system is capable of serving up to 50 or more equipments within a radius of 150 meters from the point where the oil mist is generated, so normally a single system is sufficient to meet of the electric motors, gearboxes and pumps for a large cooling tower.

An oil mist lubrication system has a mist generator console, where it generates a mist of air and oil which is transported through a network of 2" pipes to the required lubrication points. There are no moving parts in the mist generator, so it is unlikely that the generation and supply of mist will be interrupted. Likewise, when it is necessary to perform maintenance, each console has two mist generators, main and auxilliary, and a system of monitoring and control of the variables of the system in real time.

Oil mist is made up of a mixture of 1 part of oil to 200,000 parts air, and the average size of the oil particles is 3 µ.

Once the mist is generated, it is transported to the various points, where it is applied as either pure or purge mist, depending on the application:



Engineering diagram for an Oil Mist System in a Cooling Tower.

This system attends 3 centrifugal pumps, and 6 gear boxes.

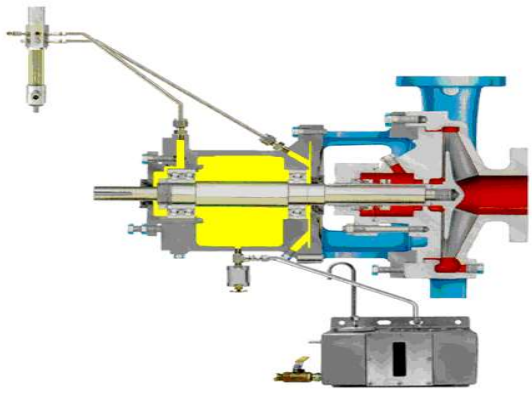
Pure mist: Normally applied to ball or roller bearings, usually in centrifugal pumps and electric motors. In this application the oil level or grease is removed, and oil mist is applied to perform the functions of lubricating, cleaning, cooling, and protecting sufaces against corrosion.

When comparing the main lubrication functions in typical equipment such as a centrifugal pumps or a electrical motor, it's possible to observe that Oil Mist Lubrication has many advantages in every area; being able to constantly lubricate, clean, cool and protect all internal parts from corrosion, both in normal pump operation and in Stand-by mode.

This can be summarized in the following chart:

Lubricating Oil Function	Oil Level Lubrication / Grease	Oil Mist Lubrication	Observations
Lubricate	Normal	Excellent	Mist as a gaseous media can reach all contact points, providing superior cleanliness than that achieved with Oil Level Lubrication or Grease.
Clean	Regular	Excellent	Oil Mist provides a positive internal pressure, preventing dirt from getting to into the housing. Also, wear debris are dragged away from working areas.
Cooling	Normal	Excellent	Mist provides a reduced friction coefficient, generating less heat and at the same time a cooling effect. Mist enters the system at a temperature of approximately 20°C and prevents heat from building as it passes through the housing.
Protection against corrosion	Regular	Excellent	Mist maintains a positive internal pressure in the bearing housing, even when the equipment is in stand-by mode, always providing protection to the internal parts.

On the other hand, if you use the ISO 281/2 2000 Bearing Design Life Calculation to calculate the life of bearings, you will find that life can be extended by 4-6 times if pure oil mist lubrication is used, since the lubricant will be cleaner, which will result in longer bearing life.



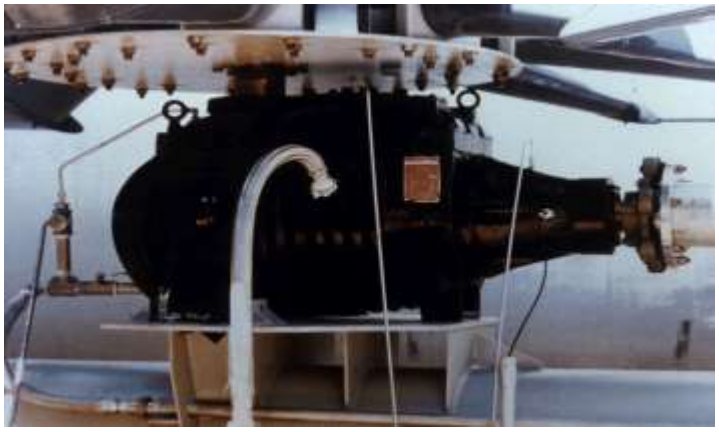
Pure Mist application in a Centrifugal Pump:

All the yellow-shaded area is permanently pressurized with oil mist, which provides better lubrication, cleaning and cooling.

Electric motors lubricated by pure oil mist in cooling towers.

Lubrication tasks are completed automated.

Purge Mist: Normally used when there are plain bearings or gears. In these cases, the oil level cannot be removed, since it is necessary for the formation of HD and/or EHD films. But by applying oil mist as a purge for preservation we create a positive pressure that prevents the entry of external contaminants. This application would be recommended for gearboxes in cooling towers, since it would generate a positive internal pressure with the mist, which prevents the entry of water vapor during the gearboxes breathing cycle and normal operation.



In purge mist on cooling tower, angle gear boxes, users typically experience a 75% reduction in gear box failures. This improvement is directly attributable to the slight positive pressure of the oil mist.

When you compare the life of gearboxes with different types of lubrication methods, you will find a substancial improvement when using purge oil mist, since the water content in the lubricant will be lower than in the conventional method of lubrication.

Another very important advantage with the use of purge mist is the fact that the seals located in the upper part of the gearbox are kept lubricated by oil mist thereby extending seal life and operational efficiency by helping to avoid the entry of contaminants. When gearboxes are lubricated in the traditional way, these seals not are properly lubricated, especially when the gearbox is out of service, thereby reducing useful life and increasing the chances of contaminants entering the system.

Conclusions:

In the Hydrocarbon Processing Industry, an estimated 10,000 pieces of equipment in Cooling Towers are being lubricated or preserved with oil mist. This includes equipment such as gear boxes, centrifugal pumps and electric motors, with excellent results. There is a relatively high payout and fast return on invested capital. Typically, the payouts are one to two years.

Oil mist is a proven technology that significantly reduces bearing failures, reduces maintenance costs, improves machinery availability, reduces energy consumption, reduces the need for warehoused spare parts, reduces life cycle costs, improves the safety of the workers, since that several lubrication tasks are atuomated and maintenance interventions are decreased, and reduces the stress of operating a plant.

We suggest that this technology could be considered for existing and new cooling towers in the Power Generation Industry.

Authors:

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