Reliability Milestones Reached by Plant-Wide Oil Mist Systems

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Oil mist lubrication is basically a mixture of clean, compressed air carrying with it a relatively small amount of atomized lubricating oil.

Typically called oil mist or oil fog, plant-wide systems were first developed in Europe in the 1930s for high speed spindle bearings in the textile industry. The technology migrated to the U.S. in 1948 where it was used in the steel industry. During the mid 1960s, plant-wide oil mist systems were introduced to the hydrocarbon processing industry (HPI) in Venezuela. Chevron and Exxon began using these systems in the U.S. in the late 1960s and early 1970s.

The early systems did not work flawlessly and to this day there are still large refiners that refuse to use oil mist technology because of its initial shortcomings. It is a fact that many early systems were installed and commissioned only to be shut down and even dismantled before much time had elapsed. We know several refiners in the U.S. and Europe that have completely removed systems from service because of their perceived lack of reliability. However, the reliability issues were largely attributable to improper installations of the piping system and could not be blamed on either the oil mist generator or the technology basis.

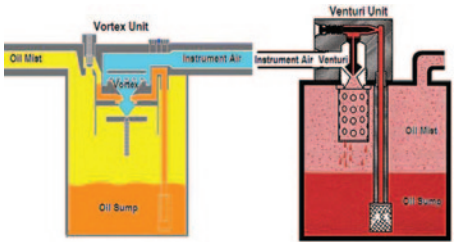

Figure 1: Vortex Venturi

Because it contains no moving parts, an oil mist generator is virtually trouble free. This component is configured to produce or generate oil mist by mixing air and oil in the proper ratio. A compressed air supply passes through a vortex, or venturi nozzle, (see Figure 1), creating a low pressure region that draws oil into a turbulent air stream. The turbulent air breaks the oil into three to five micron sized globules and then transports these atomized oil "particles" in a piping distribution system. The main distribution pipe is called the header. Branch lines or "drops" exit from the top of the header and ultimately lead to the equipment being lubricated.

The small globules or particles of oil can either fall out of suspension when air flow is slow, or wet out on the interior walls of the pipe when air flow exceeds the optimal flow rate. Air flow velocity in modern oil mist systems typically ranges from 20 to 24 feet per second and the oil mist lubricates equipment within a radius of 1,000 feet from the oil mist generator. The two issues affecting air flow are improper pipe sizing and incorrect installation procedures. Oil mist piping distribution systems are the most critical component in the entire system; a bad installation will prevent proper operation and reduce the reliability of the equipment being served by the system.

Installations came under scrutiny in the mid 1970s and it was then determined that changes could be made to improve the systems' reliability. With forward-thinking professionals and knowledgeable suppliers involved in the continued operation of these systems, the current installation specifications were adopted and put into place. Modern oil mist systems have a life of 20 to 30 years, with minimum maintenance and virtually zero repair issues to contend with.

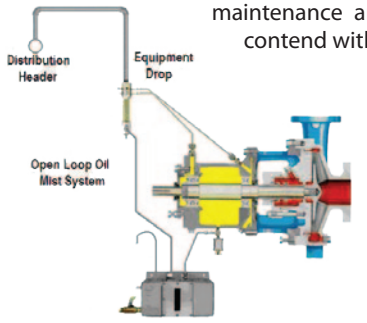

Figure 2: Open Loop System

The traditional oil mist systems are referred to as one-way or open loop systems (see Figure 2). This means oil mist is generated, sent throughout the distribution system to the equipment user and then disposed of. As of the late 1990s, hundreds of closed loop systems (see Figure 3) are being used. In these modern layouts, all excess oil is recovered and reused in the system. Closed loop systems are steadily gaining in popularity as end users want to ascertain that all environmental concerns are addressed when new facilities are constructed.

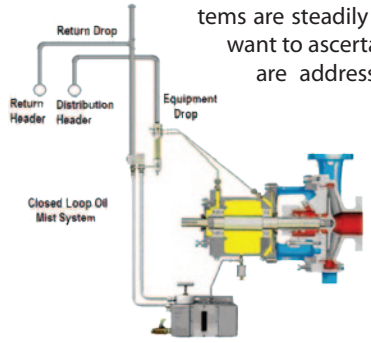

Figure 3: Closed Loop System

An additional advantage of the closed loop system is the distance the piping distribution system can be extended. Traditional one-way, open loop systems were tagged with a radius of 300 feet (~90-100 meters) from the oil mist generator. Open loop systems are easily extended up to 600 feet (~180-200 meters) with proper system design and suitable flow rates being calculated throughout the system. Now with the closed loop system, distances of 1,000 feet (~300-310 meters) or more are quite common (see Figure 4). The closed loop system allows for an orifice to be installed at the end of the distribution header to keep the flow at an optimum rate that allows excess oil mist (actually small globules of oil coalesced into liquid oil) to be pumped back continuously into the return header. All excess oil is re-

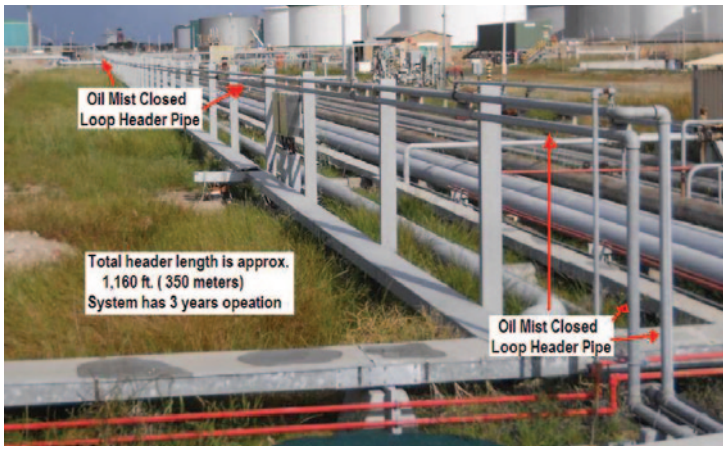

Figure 4: Tank Farm Closed Loop Header

covered in the return system and the only loss is carrier air, roughly one to three SCFM.

In addition to the horizontal runs being extended as noted above, there is also concern about runs of header in vertical structures and taking the flow up hundreds of feet. Oil mist installations on Continuous Catalyst Regeneration (CCR) towers provide superior lubrication to regeneration blowers that are at elevations of 280 feet (~85 meters) without a loss of oil mist density. Oil mist has been serving these vertical installations well for the past 10 to 12 years. There are two refineries in Romania that have oil mist on their CCR tower blowers, while all other rotating equipment located at grade is lubricated by the traditional oil sump.

As the demands for automation and greater reliability increase, the utilization of plant-wide oil mist systems is also increasing. Oil mist in the HPI has now spread throughout North America, Mexico and South America; there are also many systems in Australia, the Middle East, Singapore, Taiwan and Thailand. In the year 2000 time frame, HPI facilities in Italy, Spain and Portugal have begun adopting oil mist technology. While many of these are retrofit applications, the vast majority are grassroots facilities that are having oil mist systems designed in and installed as the plant is being constructed. In some instances, oil mist is initially used for storage of equipment that is delivered to plant sites months and, sometimes, a full year before plant start-up. As the plants are constructed, the oil mist storage system is later, and very easily, adapted for operational duty.

Figure 5: Oil Mist Generator console

Oil mist suppliers keep up with the market and monitor the annual growth of oil mist systems. Over the last decade, an annual growth of approximately 100 large-scale systems has been experienced. We should emphasize that these are large-scale systems (see Figure 5) with console-type oil mist generators, not the many thousands of modular units that presently serve two to 10 pumps and drivers on pump slabs or in tank farms. A recent survey of the refining industry has conservatively numbered large-scale systems worldwide at 2,400 to 2,500. With each system serving an estimated 35 to 45 pumps, the total equipment count would be in the range of 100,000 pumps. This number does not include off-site areas, such as tank farms and pump slabs that could have hundreds of pumps on oil mist. Moreover, the estimate is based on worldwide refining facilities only and does not account for the thousands of electric motor drivers that are hooked up to oil mist at reliability-focused user plants. Finally, petrochemical and chemical manufacturing plants also were not included in the survey and it would be fair to point out that many more thousands of pumps in these facilities are being served by oil mist lubrication.

Many individual application needs are addressed with a LubriMate oil mist generator. This small, closed loop unit has the capacity to serve one to two pumps and drivers (see Figure 6). At last count, these units have been produced at the rate of approximately 60 units per year for the last six to seven years. These units work well on isolated or "bad-actor" pumps when a large scale system is not cost justified or is not located nearby. The LubriMate is commonly retrofitted to existing equipment, such as pumps, motors, gear boxes and FD/ID fans incorporating two pillow block type bearings and a driver.

Interviews with reliability professionals that use oil mist throughout their facilities disclosed that bearing failures due to lubrication issues are a thing of the past. One such user in Australia with 15 large-scale, closed loop systems affirmed that his facility has not had a lubrication-related bearing failure in at least 10 years. Similar statements were also obtained from a number of U.S. oil refineries that have 50 to 60 large-scale systems in operation. One particular refiner on the U.S. Gulf Coast has more than 120 large-scale systems in operation, along with many modular units on pump slabs or off-site applications. In this instance, they serve more than 3,500 pumps and motors.

Oil mist systems serve equipment in extreme temperature locations, such as the very hot, often dusty climate in the Middle East, to the cold, often damp climate in northern Canada. An oil mist user in the Canadian province of Alberta has one of the largest populations of closed loop oil mist systems in a single facility, where temperatures drop down to -40 degrees in almost every winter season.

Figure 6: LubriMate Oil Mist Generator

Oil mist lubrication is being used worldwide in many HPI and non-HPI process facilities. As new facilities are being designed and constructed, the principals are including oil mist lubrication up-front to help meet their profitability goals for long-term operation and future growth. The use of oil mist lubrication to help meet reliability goals is certain to progress as the world's process facilities continue to develop.

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