



*An oil mist system provides this cooling tower gearbox with proper lubrication.*

# Improving Machinery Reliability with Oil Mist Technology

**What it is, how it is generated, how it works, and its benefits and justification**

**O**il mist is effective in improving machinery reliability by typically reducing bearing failures by as much as 90 percent.

Oil mist is an old solution for old lubrication problems. It was invented in Europe in the late 1930s to address a problem in the fibers industry. The high speed spindle bearings were failing at an unacceptable rate. Engineers deduced that the problem was not the bearings as much as it was the lubrication technology. Grease would not work in high speed applications and oil led to excessively high temperatures. Subsequently, oil mist lubrication was invented and the bearing problems were solved.

In the 1960's, oil mist came to the North America when it was introduced to the petroleum refineries and petrochemical plants. Companies such as Exxon and Chevron began

apply oil mist to their pump bearings. In the 1970's oil mist began to be applied to electric motors, which brings noticeable improvements in reliability.

## **Oil mist described**

Oil mist is generated by introduction of liquid oil and air into the sonic velocities of a vortex throat. There, the oil experiences the mechanical phenomena of shear forces and unstable vibrations of the high angular velocities of the air. Working together, these combined actions ultimately form oil particles or droplets 1 - 3 microns with air.

This oil suspension in dry, instrument air is a mixture of 1 part oil and 200,000 parts of air. It is a lean, fairly stable mixture and can be conveyed horizontally up to 600 ft in 2 in. galvanized, screwed piping under a pres-

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sure of 20 in. of water. It appears as a thin, cigarette smoke plume. Ambient temperatures do not affect oil mist during the 7 minutes maximum it takes for the oil mist to arrive at the bearings.

#### **Why it works**

One of the primary failure mechanisms of rolling element bearings is fatigue. Much of the fatigue is caused by dirt and wear particles that approximately the thickness of the oil wedge, hence the clearance of the bearing elements.

Because of the small size of the oil mist droplets, the dirt or wear particles that can cause fatigue will not remain in suspension with the oil mist but will drop out in the oil mist generator. As some have accurately commented, oil mist is the ultimate oil filter. There is another important factor as to why oil mist works as well as it does. In graduate research done by Texas A&M University, they discovered that, in some cases, pure oil mist deposits a wear resistant, carbonaceous, dry film on the wear surfaces of rolling element bearings. This layer was not found on bearings in conventional splash lubrication service.

One of the concerns of those not familiar with oil mist fear it because of what they think will happen if the oil mist ceases to flow while their machinery is in operation. They think that the bearings will fail immediately. Research and field experience have shown that, because of this carbonaceous layer, machinery can safely operate 8 hours without oil mist. Some users have operated safely for periods much longer than that.

Certainly, nobody would recommend purposely shutting down oil mist but there need not be the life or death sense of urgency that one would need with conventional lubrication methods.

#### **Forms of oil mist**

Oil mist can be applied in two formats: pure mist (dry sump oil mist) or purge mist (wet sump oil mist). With purge mist applications, the oil mist is applied to the vapor space above

the liquid oil in primarily gear boxes, oil reservoirs, and journal (plain) bearings. This is done to exclude water and other contaminants.

With pure mist applications, the mist replaces the liquid oil in rolling element bearing housings; there is no other lubricant going to the bearings. Often, users mistakenly believe that purge mist is better because it combines the benefits of both forms; it is a belts and suspenders insurance policy. In fact, pure mist has substantial benefits over purge mist as explained below. Most of the potential benefits are missed with purge mist.

#### **Benefits of oil mist lubrication**

There are numerous direct benefits of oil mist, not the least of which is that it reduces bearing failures by 90%. 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.

As cooling tower cells are shut down and as gear boxes go through the inhalation/exhalation cause by thermal cycles, water vapor is inhaled and subsequently condenses. This water causes devastating corrosion which will lead to premature gearbox failure.

Oil mist reduces lubricant consumption by as much as 40% for once through systems. If a closed loop system is used, the oil consumption is reduced by considerably more. Conservation happens because the oil is precisely metered to each bearing: the right amount at the right time. This reduction in oil consumption becomes critical when the lubricant is switched from mineral oils (about \$3/gal) to synthetic oils (about \$18/gal).

Because there is no liquid oil level and liquid friction, operating temperatures are about 20° F cooler. According to bearing manufacturers, there is an inverse relation between bearing life and temperatures: the higher the

temperature, the shorter the life. Another collateral benefit is up to a 3% reduction in energy consumption.

### **Environmental, health, and safety effects**

Environmental laws specifically exempt oil mist as a volatile organic compound (VOC). This means that oil mist is not a smog producing mixture. Remember that oil mist is not a vapor but a mixture of very fine oil droplets and air. In time, the oil droplets will drop out of the air.

Field measurements and testing never found measurements to be anywhere near close to the government-imposed individual limits. For the mixture to burn, the concentration would have to more than 1 to 250.

### **Economic justifications**

There is a relatively high payout and fast return on invested capital. Typically, the payouts are one to two years with one company reporting 7 months.

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 repair parts, reduces life cycle costs, and reduces the stress of operating a plant. It not only improves machinery reliability but frees up operators and maintenance personnel to perform their primary functions, to produce a quality product, and to help make the company a profitable business.

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