High demulsibility lubricant is used in steel mill back-up roller bearing lubrication for cold mill and hot mill steel production in rolling mill applications. Some oils that are used in these applications are referred to as SD (super demulsibility) which can come at a premium price causing the use of a wide range of fluids that may all be high in viscosity but varied on demulsibility.

ENGINEERING REPORT:

Improving **Rolling Mill Lube Oil Performance** and **Useful Life**

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One of the key characteristics of a Morgoil® * type fluid is that it has excellent demulsibility and can function very effectively in the presence of gross free water. Manufacturers of steel mill equipment (ie Danieli, Morgoil®) commonly specify fluid brands and trade names that are qualified and recommended for use in these applications. Steel mills encounter very high amounts of water and particulate in these lube applications. The mill might have a single tank for oil return and supply or there might be a twin tank setup where the return tank is a settling tank connected to a supply tank. From the return/settling tank free water is regularly drained. It is a common practice to drain hundreds of gallons of water per day or shift depending on the condition of the bearing seals and chocks.

Vacuum Dehydrator installation

The oils are formulated for excellent demulsibility, the ability to shed water, in the presence of gross free water. The demulsibility is a function of quality base stock and the oil's ability to remain chemically stable. One blender defines the maximum suitable water level as 500 ppm (0.05%) to ensure optimum lubrication, viscosity and useful oil life. In the field we usually encounter rolling mill oils with the appearance of chocolate milk or mud (cloudy) with water levels from 3000 ppm (0.3%) up to 150,000 ppm (15%). Once the oil begins losing demulsibility and the "emulsified" water increases the oil may be replaced based on analysis data, or left in the system until the mill experiences bearing failures ($30,000 each). Depending on the amount of water in the oil the viscosity will change. In an extreme case oil analysis reports revealed that ISO 460 oil viscosity with 7000 ppm was 445 cSt and with 133000 ppm had dropped to 330 cSt.

When the viscosity drops the lubricating film is compromised yielding thin film. Thin film can lead to greater risk of particulate contamination damage and metal to metal contact between bearing and bearing housing. As the lubricating film becomes thinner between the rolling surface and the housing there is an increase in heat which can vaporize the water and cause further damage to the bearings and oil. The combination of high "emulsified" water and high particulate levels create a perfect storm for bearing failure and reduced oil life. We have proven targeting, achieving and maintaining ISO cleanliness codes below recommended maximums can yield greater reliability, minimize component damage and extend useful oil life. The same can be said for controlling water contamination.

A suitable target ISO cleanliness code is 18/16/14 but typical ISO codes for these systems can range between 24/23/20 and 21/20/18. System filtration is usually cleanable strainer baskets with large perforated holes or pleated cartridge elements with wire mesh media unless the cleanliness has been addressed by adding finer side loop filtration.

> "The combination of high '**emulsified**' water and high **particulate levels** create a perfect storm for **bearing failure** and **reduced oil life.**"

In addition to the increases in emulsified water caused by oxidative oil degradation, the particles and free water can combine loosely to increase the amount of water in the oil that will not readily demulsify. The free water can act as a powerful solvent looking for molecular partners, and can form loose bonds with the suspended particles. The suspended particles can invite more water into the oil in which they are suspended. An emulsion is a bond that can be chemically strong and unbroken by settling. Vacuum dehydration, including high efficiency particulate filtration, must be applied to properly address the whole water issue of dissolved, emulsified and free water. Removing water and particles with vacuum dehydration will improve demulsibility and fluid cleanliness of the oil for better bearing lubrication, increased bearing life and longer oil life. Other benefits include reduced roll stand leakage, reduced oil consumption, eliminating the need for decanting and

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reduced environmental impact. Traditionally centrifuges have been used to remove free water, but do little to treat the emulsified and dissolved water that causes damage in bearings and shortens useful fluid life. Centrifuges also require frequent maintenance and are often neglected with heavy demands on maintenance personnel.

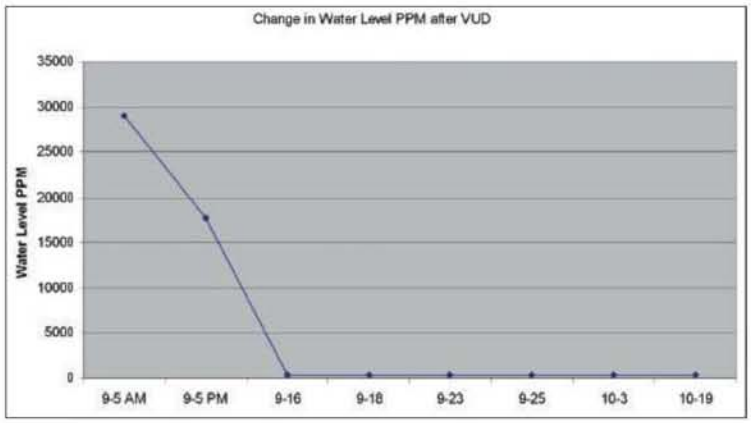
High demulsibility oils are relatively chemically stable and not looking for molecular partners, but the Hydrogen in water is actively seeking partners (H-O-H), and is the friendliest molecule that the oil encounters. Likewise, many suspended particles in the oil are looking for molecular partners and join with the water. The particulate contamination in the oil is the catalyst that intensifies the entrainment of the water in the oil along with the increase in emulsified water that is caused by continuing degradation of the oil, which is accelerated by the increase of emulsified water. The rising levels of water not only lead to an increase in the rate of oxidation but also contribute to the formation of various acids that form as the oil molecules breakdown. The acids attack and degrade the seals, hoses, pumps and metal surfaces.

When there is a high percentage of water in the oil (free, emulsified, and dissolved) the immediate concern is for controlling the free and emulsified water and particulate contamination as these do the most damage to bearings. A parallel target should be minimizing the ingress of the free water through leaky seals and chocks to minimize regular decanting of free water and lube oil losses that occur as oil is carried down the drain while draining water.

Water in rolling mill oil is inevitable and defining success is important in the battle to extend the life of bearings through proper lubrication and extend the life of the oil. Striving to achieve and maintain low levels of water and particulate in the oil, both quantifiable goals, will increase reliability and ultimately improve bottom line profitability. Proper care of the oil can help justify the use of premium oils and rise above the maintenance mediocrity of accepting high water and particulate as the norm. Increasing oil prices have put the cost of replacing lube system oil in the range of $100,000 to $300,000 depending on the system volume and type of oil used. The oil is the lifeblood of any system and should be treated as such since proper oil condition can be the difference between uptime and unplanned downtime.

In a recent application a Hy-Pro Vacuum Dehydrator was installed on an 8,000 gallon rolling mill lube reservoir to prevent frequent bearing failures experienced by the mill at $30,000 each. The VUD had an immediate impact reducing water levels from 29,000 ppm (2.9%) to 17,735 ppm (1.7735%) during the first day. Within two weeks the water level of the system had stabilized at 383 ppm (.0383%). Since the water was reduced to acceptable levels the mill has not had a bearing failure. Prior to the installation of the VUD the mill was decanting water every shift. The VUD was installed on the decanting line and the daily practice of decanting the reservoir was ceased, decreasing oil consumption by 25,200 gallons (~$201,600 annually). The mill is no longer topping off lube reservoirs, oil consumption is limited to roll stand changes and roll stand labyrinth seals are no longer leaking. The oil lost during decanting would accumulate in a sealed retention pond from which it had to be periodically skimmed/reclaimed. After installation of the VUD pond oil recovery efforts and costs are way down.

In another successful application Hy-Pro installed a Vac-U-Dry V20 model vacuum dehydrator with high efficiency glass media elements on a 12,000 gallon single tank Morgoil® system where the water concentration was over 7,000 ppm (0.7%) emulsified. The oil was dark and had the appearance of chocolate milk. The mill was regularly draining free water from the reservoir which contained residual oil. The Vac-U-Dry was connected to the reservoir drain line and the free water was no longer to be drained. Within two months after the installation the water concentration had dropped from 7000 ppm (0.7%) to < 30 ppm (0.003%). In recent discussions mill personnel commented that when viewing the oil in the lube window in the bearing supply line "it actually looks like oil again". This mill is no longer draining free water thus saving valuable maintenance time and not losing oil which is common in the decanting process. Oil analysis reports indicate that the oil is no longer operating under alert conditions for water concentration. Particle counts also showed the fluid cleanliness trending toward acceptable levels.



Today's advanced vacuum dehydrators are designed for 24/7 unattended operation, equipped with automatic water drain and a large particulate filter element to improve oil cleanliness while removing all forms of water in oil (free, emulsified or dissolved). Maintenance intervals for vacuum dehydrators are much longer than other technologies easing the burden on maintenance personnel. In addition to addressing the contamination issues it is also important to combat the sources of water and particulate contamination if possible. Achieving optimum oil health requires the removal of water and particles as the particles are a catalyst for increasing the amount of entrained water that leads to increased oxidation, the formation of acids and low viscosity. Hy-Pro equipment has been used in the reclamation of rolling mill lube oil where oil that had been condemned was reclaimed to extend the fluid's useful life.

*Morgoil® is a registered trademark of the Morgan Construction Company

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