INTRODUCTION

Paper machine dryer section bearings work under adverse conditions of high temperature, heavy load, and clouds of steam. These bearings can be satisfactorily lubricated by a recirculating oil system. In practice, these systems are very expensive, $150,000 - $200,000 is not uncommon, and system leakage becomes a chronic problem after a few years in service. Oil-Mist lubrication, (Fig. 1), which continuously provides a fresh oil film to the bearings, has been successfully tried on many mills and gives an alternative tool for dryer bearing lubrication (Fig. 2).

Initially, Oil-Mist lubrication ran into a road block due to plugging of spray mist application fittings. The presence of steam and high process temperature created a waxy sludge formation which restricted the mist flow through the fittings. Customers were reluctant to use synthetic oil due to high cost and undesirable stray mist.

Phase 1 of the project was to apply Oil-Mist to high temperature bearings and monitor the results. Phase 2 of the project was to approach oil suppliers to develop low cost, high temperature, mistable paper machine oil. Oil-Mist lubrication, together with suitable mistable oil, has created a success story.

In a recirculating oil system a flow rate of 0.5 to 5 L/min bearing, depending upon the bearing size and temperature, is common. When this flow rate is multiplied by a dwell time of 40 - 60 minutes, a tank of 13,680 to 27,360 liters (3,000 - 6,000 gallons) capacity is required. This means one has to start with an inventory of 14,000 - 28,000 liters of oil. To this huge reservoir, add components for filtration, cooling, pumping (140 - 550 L/Min.), metering for each bearing, sealing devices for each bearing housing and the system becomes an expensive package. Capital cost is high and may be prohibitive in many retrofit applications.

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Fig. 1— Oil Mist Lubrication.

Fig. 2— Dryer Environment.
MIST SYSTEM APPLICATION

Spray fittings (Fig. 3), (7), which convert mist into wet spray, are used for plain and anti-friction bearings on dryer rolls. Before experimenting with Oil-Mist on high temperature (95 - 150°C) bearings, a clue came from Heinz P. Block's experiences of Oil-Mist on process pumps whereby he was able to eliminate water jackets on many pumps by using dry sump and high temperature lubricants. (2)

By substituting Oil-Mist for re-circulating oil, bearings will be at a higher temperature threshold. Also, because of high surface temperature, some of the oil will be oxidized, carbonized and atomized. The safety lies in the continuous Oil-Mist operation which will replenish this carbonized oil-film. Spray action of oil on the bearing surface, through mist spray fittings, will flush clean the debris and cool the bearings with the outward flow of air.

LUBRICANT DEVELOPMENT & SELECTION

Oil suppliers were contacted to come up with a low cost, high temperature, ISO-150, mistable oil which will provide good oil film on the bearing surface and negligible stray mist. Mist properties were checked and confirmed by ASTM spec. D-3705. In spite of high load and low rpm ISO-150 viscosity was selected, as heavier viscosity lubricants tend to increase bearing temperature. Close monitoring of 5 installations for 1-4 years has convinced us that ISO-150 lubricant works, does the job, with no undue wear on bearing elements. In spite of the high temperature, oil oxidation stability provided by the oil suppliers, in actual practice some oil film will carbonize and form sludge/deposits. These deposits have plugged small orifices in application fittings. Oil company chemists cleverly solved the plugging problem by adding special additives/detergents in the lubricant. These improved lubricants produced minimal solid deposits, and the detergents did not allow the solid particles to stick to the orifice area. These lubricants were subjected to the Coking Panel Test, Fig. 4, developed by U.S. Steel (4) and results confirmed. The Sample A is with ISO-150 mistable high temperature lubricant and essentially clear. Sample B is obtained with commercial ISO-150 gear lubricant and shows dark oxidized deposits.

MIST SYSTEM INSTALLATION

Mist Generators, with all their instrumentation, are located where they will be easily accessible to the operator for calibration and servicing and where air, oil and electric power are available (Fig. 5). To simplify and save piping, one generator may be located on the front and back side to cover respective bearings, (Fig. 6). Bearings are lubricated through spray fittings, quantity and size depending upon physical dimensions and CFM requirements of the bearing (Fig. 7).
OIL-MIST COMPARISON WITH RECIRCULATING OIL

Oil consumption data is shown in Fig. 8. Theoretically, make-up oil required in a recirculating oil system and oil consumption in Oil-Mist should be similar. However, trouble starts when the recirculating system starts leaking after a few years in service. Peaks and valleys indicate drastic leaks before and after these leaks are rectified.

Bearing failure rates are similar (Fig. 9). Recirculating oil system performance is a little better in the first three years; however, bearing life suffers later on due to malfunctioning of the system because of seal failures. Cost comparison, Fig. 10, results clearly show the trend of Oil-Mist as preferred over recirculating oil.

CONCLUSION

Oil-Mist lubrication of high temperature bearings is a viable system. The development of a new breed of high temperature mistable lubricants played a key role in the success story.

Oil-Mist offers industry an alternative approach to a circulating oil package with a relatively inexpensive system.

Oil-Mist pressurizes the bearing housing slightly against the atmosphere and protects the bearing against the most damaging outside elements: steam, alkali fumes, and condensate, which are in the environment surrounding the bearings.

REFERENCES


Fig. 8—Oil consumption.

Fig. 9—Bearing failure.

Fig. 10—Cost comparison.