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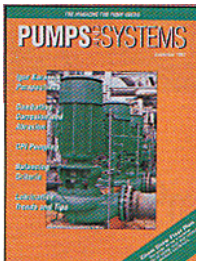


From December 1993

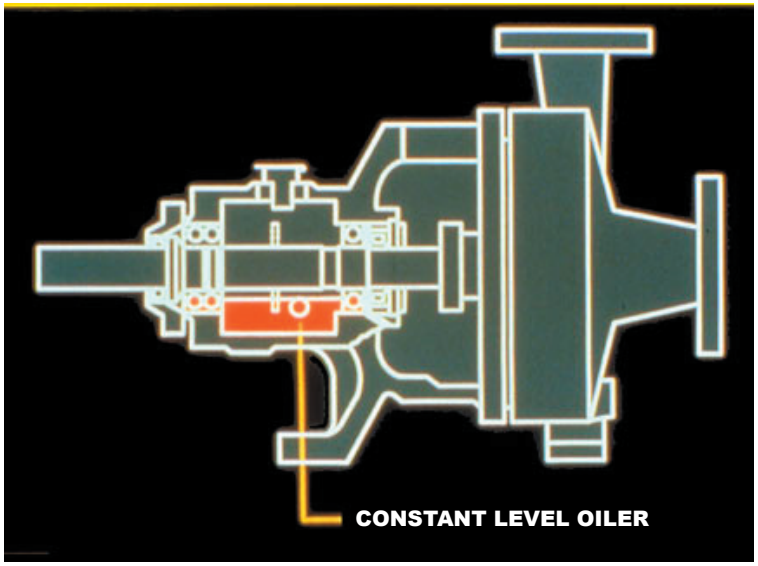
Bearing Lubrication Trends and Tips

Back when this article was first published bearing lubrication wasn't always treated as a high priority... ten years later, in some facilities, it still isn't.

Donald C. "Don" Ehlert

Bearing Lubrication in process pumps is performed by various methods, form traditional oil baths or sumps to pure or dry sump oil mist lubrication. Other less common methods include grease, circulating oil, and purge or wet sump oil mist. Through pumps are the workhorses of many industries (refining, chemical/petrochemical, and pump and paper), for some reason bearing lubrication is often not considered a high priority. However, concern for pump reliability is growing as a result of record keeping, increasing repair costs, and professional papers that continue to give lubrication issues attention.

Process pumps move product from one point to another through a piping system that may stretch several hundred yards or several hundred mils. Pump operation is normally remotely activated, 24 hours a day continuous, and performed in all types of weather with minimum operator involvement. These pumps endure tremendous abuse from the product being pumped and their environment.



Conventional oil sump application

Where Is He Today?

Having been in involved with lubrication equipment and technology for 34 years, Don Ehlert has had plenty of experience in system design, layout, installation and maintenance of lubrication equipment. When we first published this article in December of 1993, he had been working with Lubrication systems Company (LSC) in Houston, TX for 15 years, and was then serving as Senior Sales Representative. Today, the very personable Ehlert is still with LSC, but now he's the company's US North American Sales Manager. Contact him directly at dcehlert@lsc.com

A pump is built to certain specifications so it can with stand what is going through it and what is happening around it: but the bearings that allow the pump to run are made to handle loading conditions only, not ambient conditions. Bearings, usually out of sight and out of mind, are the heart of the pump. If a bearing is gone, the pump does not run and no product is pumped. An upset condition then occurs, which may cause any number of events, most of which are inconvenient and costly.

If bearing are the heart of a pump, then lubricant is the life blood; but too many process plants pay little or no attention to bearing lubrication.

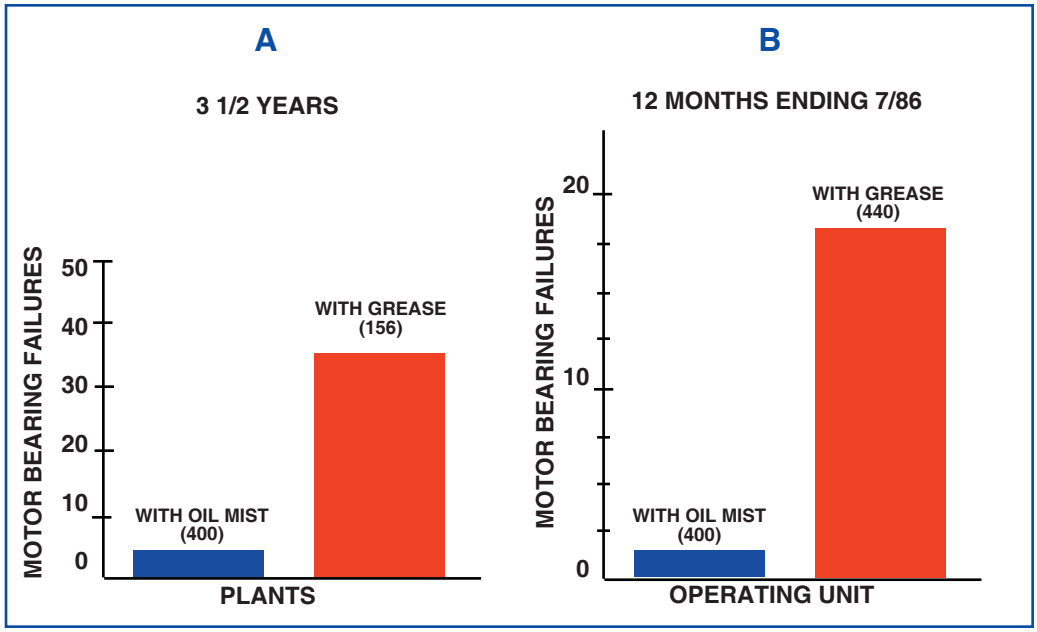


Figure 1. Effect of oil mist on electric motor bearing life:
(A) Compares failures at two plants run by the same company in different states.
(B) Compares failures in two process units in one plant.

Bearing Housings

Water is not the only culprit that shortens bearing life or contaminates oil. Thermal cycling caused by temperature changes tends to draw airborne contaminants into the bearing housing. Damaged or worn seals allow product to enter the housing and create severe problems.

After more than 18 years of working around pumps, I am still amazed at how contaminated oil can be while a pump is still running. I have pulled the plug on bearing housings expecting slightly thick an dirty oil to drain out - only to be surprised when sludge oozed out. This is not common, but it does happen. I've also seen a pump into the shop with charred paint on the outside and fresh, clean oil in the bearing housing. Needless to say the rolling elements of the bearing are beyond recognition. Some are welded together. Others are hollow with a hole in one side.

Plant maintenance departments have gone to great lengths to improve MTBF by installing special housing seals to keep contaminants out and by using synthetic oils with improved lubricating properties. Some shops have elaborate repair procedures that document all tolerances to make sure everything fits perfectly before assembly, and that require special seals and synthetic oil. I have heard of repair shops that guarantee several years of operation without an oil change when specified seals and oil are used. Everything these shops are doing helps: but other plants are achieving long MTBF simply by initiating good lubrication programs.

The Survey

To learn more about the everyday life of pumps, I took an informal survey, asking general questions about the number of pumps, standard method of lubrication, oil change interval, mean time between failure (MTBF), and average pump repair cost.

I received replies for 18 plants or individual operating units from across the U.S. and Canada. These include refineries, paper mills, and chemical plants from Texas, Louisiana, California, Washington, Montana, and western Canada. (See Figures 1 and 2.)

These plants have a total of 20,460 pumps. MTBF ranges from a low of 200 days to a high of six years. Repair costs are as low as $1,000 and as high as $7,500, with an average repair cost of $3,500. Three plants did not give a repair cost, and one of these plants did not provide an MTBF, which I assume is less than one year.

Lubrication methods for these pumps break down like this: 14,106 pumps use traditional oil baths, 5,388 pumps use pure oil mist, 508 use purge oil mist, and the remaining 458 used other methods, including grease and circulating oil.

Oil sump has the lowest MTBF, 200 days, as well as the highest, six years: however, five plants that are 100% oil sump have an MTBF of less than one year. These five have 7,215 pumps, and their average repair cost is approximately $3,000 per pump. The minimum of $1,000 was used for the plant that did not show an average repair cost.

Two plants with a total population of 850 pumps are 100% oil mist lubricated. Of the 850 pumps, 92% use pure oil mist. The rest use purge oil mist. MTBF for these two plants are 1.4 and 5.5 years. Out of the ten plants using oil mist, only tow have an MTBF of less than one year. These two facilities have small, modular-type oil mist systems without alarm features.

I was disappointed that more plants using oil mist did not respond to the survey. I believe that the totals would have been much different if they had. Several plants that recently converted from oil sump to oil mist have reported longer MTBF's and a considerable reduction in pump repair costs. Many plants I've dealt with dealt with over the years have had a drop in the number of mechanical leas failures after installation of oil mist lubrication.

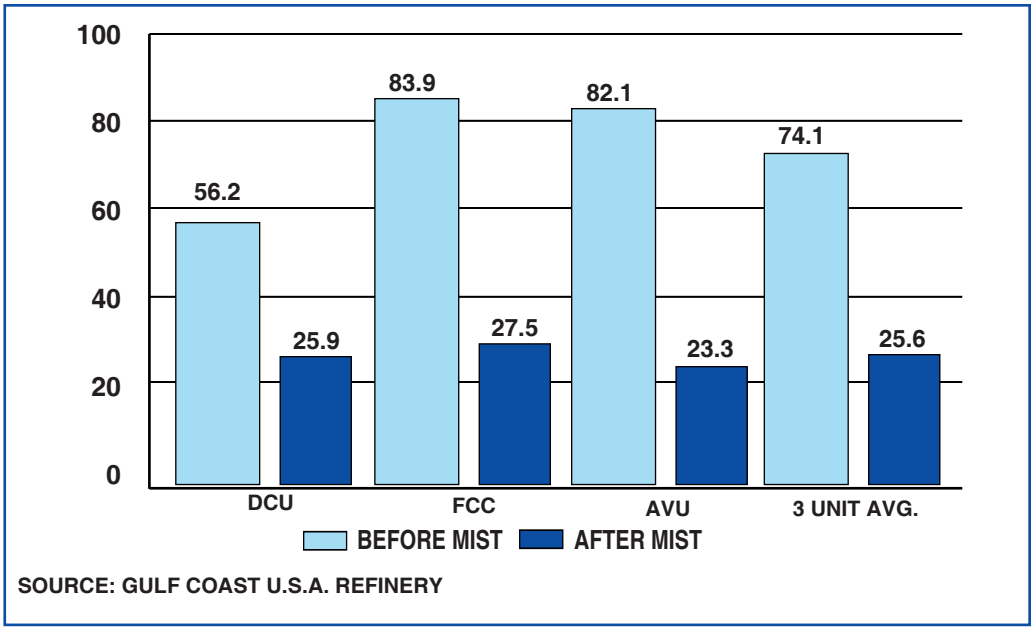


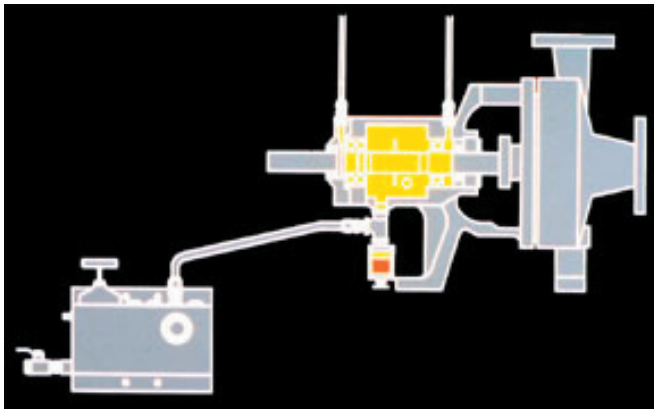
Figure 2. Annual pump bearing repair costs before and after installation of oil mist lubrication for three different process units within the same plant

Oil Change Interval

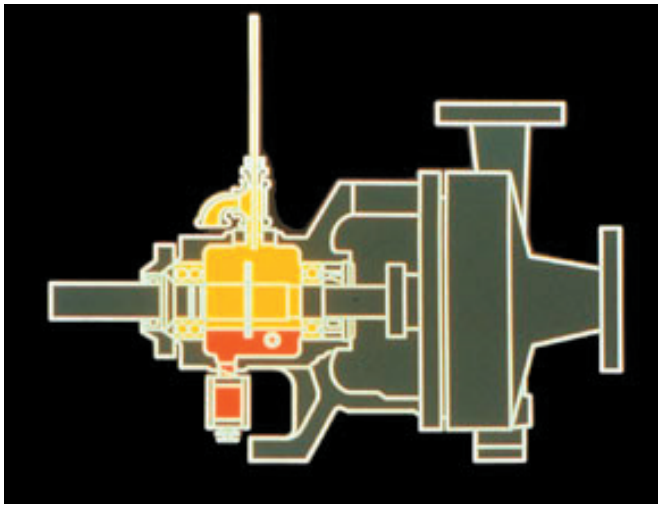
How often should oil be changed? This is a matte of opinion. Of the 18 plants surveyed, only 11 had routinely scheduled oil change intervals. Two plants use a quarterly schedule, for have a six month schedule and five are on annual schedules. Two plants recognize the importance of changing oil but indicated that it was seldom done if ever. Of course, the pumps on pure oil mist did not require oil changes. One plant with all pumps on oil bathe indicated a monthly interval, and the units had an average MTBF of less that two years. The plant with the longest MTBF (six years) is on an annual schedule, and the plant with a three-year MTBF is on a six month schedule.

Seals

Lip seals are used in about 60% of the pumps in the survey, across all industries that replied. Labyrinth seals are used in about 38% of the pumps. Oddly enough, people at every plant knew what type of bearing housing seals were used, and many gave exact numbers or percentages when asked for quantities.



Dry sump / pure mist application (API 610 7th Edition)



Wet sump / purge mist application

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Bearings, usually out of sight and out of mind, are the heart of the pump.

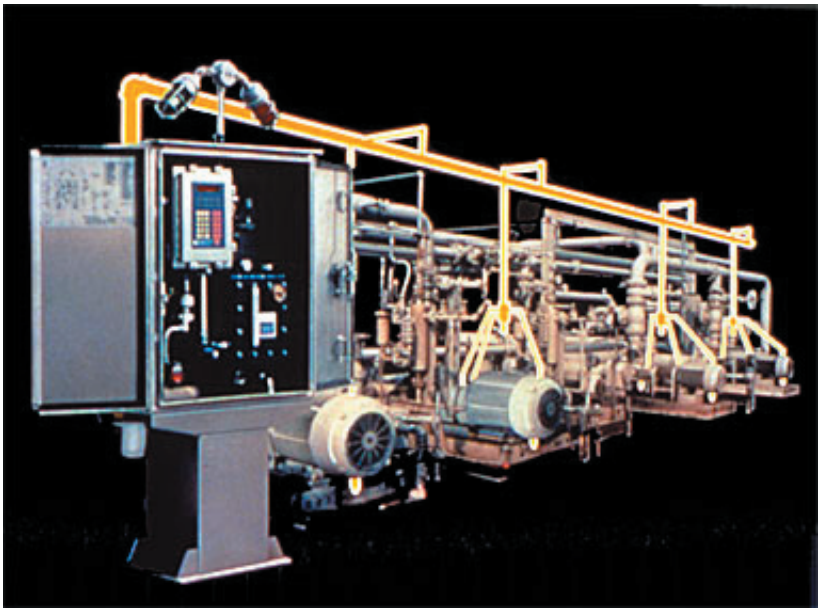
It is possible that replacement cost is a major factor in determining which seal to use, and lip seals tend to be most economical. All plants using pure oil mist except one use lip seals predominantly because a slight positive pressure is maintained in the bearing housing and there is no oil contaminate.

Lubricant

Fourteen plants use mineral oil exclusively. One plant uses synthetic throughout on pure and purge oil mist applications and has a two-year MTBF. Another uses synthetic through out in oil bath, and this plant had the shortest MTBF of all plants. Two plants use both type of oil, and their MTBF's are three and four years. Both of these plants are predominantly oil mist.

Oil Mist

Oil Mist is a dispersion of tiny oil droplets. 1 to 3 um in size, suspended in an air stream moving at about 24 ft /second.



These droplets are transported through a piping system to the point of lubrication, where they pass through an orificed fitting known as a recalssifier that controls the amount of lubricant being applied. The controlled mist, which looks like smoke, not only lubricates bearings, but it uses less lubricant than traditional oil sump. A recent study funded by the State of Texas determined that pure oil mist lubrication could extend bearing life by as much as six times over the traditional oil sump.

It should be noted that oil mist has an oil-to-air ration of 200,000 to 1. This is well below the lean limits of ammability, so it will not burn or support combustion. Oil mist is often referred to as a vapor, but it is not. It is an aerosol, and because typical R&O turbine oils are used in these systems, oil mist is not a volatile organic compound (VOC).

Opinions on oil mist lubrication are varied. Those who like it outnumber those who don't. Those who've had a bad experience with oil mist were probably involved in its misapplication or poor system installation.

The installation of distribution system is the most critical part of a completed oil mist system, with proper sizing of the reclassifiers a close second in importance. Some plants have experienced so many failures after the installation of oil mist systems that they have given serious consideration to taking the systems out and never using oil mist again.

The oil mist distribution system normally consists of schedule 40 galvanized pipe with malleable iron 150# screwed fittings. This is where problems with oil mist systems usually start. Anybody can screw pipe together, and often just anybody is hired to do just that. Oil mist will leak through very small gaps, and if proper procedures are not followed, every screwed joint will leak.

Another problem is traps or low spots in the pipe. If not properly sloped, the pipe will fill with oil and every pump on the system will fail. If you are considering an oil mist system, do not cut corners on system installations. It will catch up with you and eventually cost you or because of pump repairs an down time.

Conclusion

Obviously, there are no clear cut trends here. Pump life and performance vary widely, depending on product pumped, environment, and length of time in service. But same of the things happening out there in the field make a case for paying more attention to pump lubrication.

I've often heard that lubrication accounts for about 30% of all pump failures. If this is the case, there is a tremendous number of needless pump failures. From this survey of just 18 plants, only five had an MTBF of three years or longer, and seven had an MTBF of less than one year.

This is the most interesting point in this survey. Let's consider the five plants using 100% oil sump that have an MTBF of less than one year. Pumps in these plants totaled 7,215 with an average repair cost of $3,000. If we do some math, we are looking at five plants spending $21,645,000 annually on pump repairs. If we attribute only 30% of this cost to lubrication related failures, we are still looking at $6,493,000 being spent annually on lubrication-related repairs, and this averages out to $1.3 million per plant each year.

This amount could cover installation costs for 8 to 12 oil mist systems, and these systems could eliminate up to 90% or more of lubrication related failures. This could save these plants $1 million a year, on average, and provide a return on investment in less than 1l5 years. Heinz Bloch reached the same conclusion in a paper titled "Large Scale Application of Pure Oil Mist" (Ref. 1) **P&S**

Reference

H. Bloch. Large Scale Application of Pure Oil Mist. ASME Paper 80_C2/LUB-25. Presented at ASME Conference, August 1988.

TABLE 1. LUBRICATION SURVEY RESULTS

Plant	Pump Population	Quality and Type of Lubrication				MTBF	Average Repair Cost	Types of Bearing Housing Seals		
		Oil Sump	Pure Mist	Purge Mist	Other			Lip	Labyrinth	Other
1	3,000	3,000				<1 yr.	$5,000	X		
2	175	50		100	25	2 yr.	?	X	X	
3	200	20	120		60	<1 yr.	$1,000	X	X	
4	650		585	65		1.4 yr.	$4,500			X
5	900	900				<1 yr.	$1,200	X		
6	1,200	1,152			48	2.1 yr.	$3,500	X	X	X
7	800	800				6 yr.	$3,000			X
8	300	300				<1 yr.	$4,500		X	X
9	600	600				3.5 yr.	$1,000			X
10	2,500	2,500				<1 yr.	?	X		
11	1,230	922	246		62	1.3 yr.	$1,400	X	X	
12	40	25	15			<1 yr.	$5,000	X		
13	350	150	150	50		3 yr.	?	X	X	
14	300	268	30	2		4 yr.	$3,000	X	X	
15	515	515				<1 yr.	$3,750	X	X	X
16	4,700	2,280	1,410	235	235	2 yr.	$7,500		X	
17	200		200			5.5 yr.	$1,300	X		
18	2,800	84	2,632	56	28	2.6 yr	$6,500	X	X	X
Totals	**20,406**	**14,106**	**5,388**	**508**	**458**		**$3,500 Average**			