**Greasing with Accountability**
*by Goran Strand, Stora Enso*

Most grease-lubricated bearings fail to reach their life expectancy. This statistic is due to a number of reasons, one of which is the manual grease route, which unfortunately has properties similar to human beings. Man is not faultless – either as an individual or as a group – and makes errors regularly.

**Automatic Greasing**
To date, one of the objectives of maintenance departments has been to replace all manual greasing with automatic lubrication systems.
Automatic systems offer several advantages:

* Greasing with the correct amount of lubricant significantly reduces the consumption of grease when compared to traditional manual greasing. Several cases have reported grease consumption was reduced by 30 to 50 percent. Not only has this been documented by various automatic systems manufacturers, but an article in the Swedish magazine Underhåll and Driftsäkerhet (Maintenance and Reliability, February 2000) and a case study from VTT (Technical Research Center of Finland) carry convincing evidence.
* Automatic grease lubrication that provides reliable cycles and correct lubricant discharge may reduce the number of bearing failures by approximately 50 percent, which is supported by the VTT report.
* The automatic systems are closed, ensuring grease is isolated from the environment when it transfers from the lubricant reservoir to the bearings (no contaminated zerks).
* Automatic lubrication that is correctly designed, installed and maintained is reliable; therefore the impact of the human factor is virtually eliminated.

Unfortunately, the cost of implementing the system may be a hindering issue. When installed in process industries, automatic lubrication is costly - roughly estimated between 380 to 760 USD (300 and 600 EUR) per lubrication point.

**Current Manual Greasing**
Manual greasing is a daily task performed in process industries worldwide. It is carried out with simple tools, as a low-priority, routine task without status. This is industry’s standard practice to date!
Unfortunately, the problem with manual greasing is the frequency of faults. Manual lubrication is performed by human beings and humans make mistakes.

**Aviation’s View of Mistakes**
In some human activities, such as aviation, mistakes cannot be tolerated. Aviation demands specific routines and systems, which are created to increase safety and eliminate (or minimize) the human element where possible.
Aviation has adapted to the following conclusions: Human beings make mistakes; and mistakes cost money and may cost lives.
What are the similarities between the aviation industry and lubricating with grease? Both are large-scale routine activities performed daily by various people. In both activities, mistakes result in expensive consequences ruled by natural law.
What are the differences between the aviation industry and lubricating with grease? In the aviation industry, the potential consequences of human mistakes are obvious, immediate and may risk lives. In greasing, the consequences are costly and lives are very seldom at risk when we fail to lubricate. Unfortunately, they are not immediately obvious.

**Hidden Mistakes Lead to Costly Consequences**
The grease in a rotating bearing works only for a limited time and must be replenished while the lubrication film in the bearing is still in good condition.
If the grease in a bearing is not replenished in time, heat, oxygen in the air and mechanical stresses will degrade the oil and adversely affect the strength of the lubricating film. This will result in the initiation of a bearing failure, which will reduce the life of the bearing.
An obvious problem is that one is never aware that he may have missed lubricating a bearing. A working bearing that has not been lubricated for more than a month can still function without problems, and may not show any obvious symptoms of deterioration. When the bearing finally fails, it will be filled with good grease and no signs of a missed lubrication event will be present. Since the bearing was missed, several successful relubrication events have been made. Therefore, the life of the bearing was reduced and acceptance of the shortened life becomes the norm.
Being unaware of the mistake prevents corrective actions to manual greasing from being implemented, which leads to the following conclusions: Human beings make mistakes, and mistakes cost money.
The mistakes made by the lubrication technician are not immediately apparent. The mistakes unfortunately remain; otherwise a large difference would not be evident when manual greasing is replaced by automatic, as outlined in the VTT report. The lubricating film must remain perfect around the clock to prevent breakdowns in the bearings.
In the past, manual greasing was inferior to automatic lubrication when attempting to maintain uninterrupted production of a mill.

**Statistics of Manual Greasing**
Manual greasing is performed so often it must be looked upon as a statistical phenomenon. At our mill, we perform approximately 100,000 grease replenishments of bearings through zerks per year.
If our team of lubrication technicians exhibit superior performance and do not miss more than one nipple per 1,000 nipples, statistically there will be 100 missed bearings per year. These missed bearings are expected to cost the mill 126,000 USD (100,000 EUR) in increased maintenance costs and lost production. So, there is definitely a problem!
If the error level is decreased by a factor of 10, the mistakes will cost 12,586 USD (10,000 EUR) per year. Furthermore, if the level is decreased 100 times, the cost comes down to 1,259 USD (1,000 EUR) per year, which is acceptable. How can the error level be decreased by 100 times?

**Overgreasing: A Solution or Problem?**
If bearings are unnecessarily greased twice as often, some nipples can be missed without any perceived problem, because the missed bearings will, in all probability, be greased the next time.
If one bearing per 1,000 is randomly missed, the risk of the same bearing being missed consecutively is one in a million. Greasing at half the optimum intervals offers a solution to the problem of randomly missed zerks.
But will equipment then be overgreased? Overgreasing is considered to be one of the main causes of grease-lubricated bearing failures. Greasing at half the required interval demands a great deal of work and is bad practice.

**Electronic Greasing Aids: A Better Solution?**
The lubrication technician is provided with a handheld aid to use during the greasing route that indicates how much grease each lubrication point needs. As greasing occurs, the aid automatically reads the lubrication point number and registers the amount of grease pumped into the bearing. It also stores all of the data.
If the lube tech should miss one or more lubrication points, he will be alerted to this when the greasing route data is downloaded to a computer. He can then return and finalize the greasing route by lubricating the missing points. Not a single lubrication point will be missed. A professional lubrication technician using the new aid will guarantee this!
The correct procedure no longer depends on the skills of specific individuals. It can be accomplished by substitute lube techs, who may be standing in due to sickness or holidays.
During a greasing route, the new handheld tool will automatically register which lubrication points have been greased, when they were greased and the quantity they were greased with. At the base, the computer will show which lubrication points need to be greased to finalize the lubrication route. Guaranteed lubrication cycles will be achieved with statistic certainty, providing higher profit margins for the mill.

**The System**
The system that met our requirements was a radio frequency identification (RFID)-based manual greasing system, where each lubrication point is equipped with a special grease nipple combined with a transponder. With a built-in antenna, the grease meter communicates with the transponder.

In addition to the RFID unit and its antenna, this system has a metering module that calculates the grease quantity pumped into the grease nipple. The grease meter is also equipped with intelligence and storing capacity.

The entire system is controlled by a computer managed by lubrication technicians. The grease meter is connected to the computer via a communication and loading unit.

**How Does it Work?**
When it’s time to lubricate, the lubrication technician loads the current grease route into the grease meter, then walks his route and performs the necessary tasks. For each lubrication point, the meter displays the amount of grease the bearing needs and how much it receives.
The lube tech returns to the base and connects the grease meter to the computer. The stored information is downloaded to the computer, and the time of the download operation is simultaneously registered. The computer display immediately shows the status of the lubrication points in the grease route. It appears as a list with different colors for greased and nongreased lubrication points.

**The Economic Benefits**
The economic impact of greasing efficiently depends on three factors:

1. The number of mistakes made by lubrication technicians.
2. The physical consequences of missing a lubrication point. The more accurate greasing intervals, the greater the impact will be.
3. How much overgreasing is reduced when the correct amount of grease is applied at optimal intervals.

The first factor is difficult to estimate and depends on the organization and its personnel. The author estimates it to be one in 1,000, but likely more for most mills. With the electronic aid, this could decrease by at least a power of 100; meaning that the number of missed points will be less than one in 100,000.
The second factor is more easily estimated because it depends only on those powers of nature which have a degradable effect on lubricants. The author estimates it to be a ratio of 1:3, assuming a defective lubrication film will appear in one-third of the missed bearings. These bearings will have to operate on the defective lubrication film until the next lubrication route. This figure is presumably conservative.
If the current number of missed bearing is one in every 1,000, then it would be expected that 100 would be missed in every 100,000. By applying the electronic aid, this can be reduced from 100 to one. From this, it is apparent that the electronic aid could prevent 99 bearings from being missed. Of these 99, it is estimated that one-third would have premature wear resulting from the missed relubrication event.
This means that we can prevent at least 30 premature bearing breakdowns yearly by decreasing the human factor.
The improved reliability and the decreased maintenance costs can be estimated to several hundred thousand USD per year. This will also result in an improved environment (decreased grease consumption and waste handling).
Profits will also increase from reducing overgreasing which SKF Reliability Systems estimates as one of the main causes of bearing failures in this type of industry.
According to SKF, we can also save another hundred thousand USD per year from reducing overgreasing. The investment for the whole mill amounts to approximately 204,508 USD.
The described system (LubeRight) has been invented and developed by the Swedish company Assalub.

***Editor’s Note:***
Currency figures are noted at the exchange rate at the time this went to press. Conversions were obtained from http://www.xe.com/ucc/.
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