14th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2010, Mediterranean Cruise, 11-18 September 2010

THE ECONOMIC JUSTIFICATION OF THE AUTOMATIC LUBRICATION USING

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ABSTRACT
The task of every well-organized function in the maintenance of lubrication, which is to achieve lower costs to workers in the maintenance and lubricants and spare parts. Manual lubrication system components tribomechanical persisted, despite the great efforts and poor ergonomic conditions for acting of lubrication, but in recent years is much more marked appreciable progress of improving lubrication by introducing of automatic lubrication systems in almost all industries throughout the world.
Inadequate lubrication are now the most common reasons for early termination tribomechanical components, which can certainly cause further damage to the machines themselves. Much of the damage can be avoided by choosing an appropriate method of automatic lubrication systems, choosing the appropriate dosage and method of lubricants for specific conditions of exploitation.
The aim of this study was to indicate the economic adequacy of applying automatic lubrication system tribomechanical components.
Key words: the economic adequacy, the automatic lubrication, tribology, the lubricant

1. INTRODUCTION

The development of tribology and its application in machine elements and systems in general, began in early 70's of last century with a suddenly increase in exploitation mode machines. The development of technical progress required an increase strength, speed and load, to maximize the productivity of labor. Mechanical systems and components are working in sharper models of labor. At this stage, and time distance, began with attention to the causes of failure, and sometimes to the sudden shortening of their projected labor resources [5]. The nature of tribology processes is natural and inevitable is that mechanical elements hackney out during operation. In some cases, the problem of increasing resistance to abrasion was solved by selecting the higher hardness of steel. For a long time steel is considered, by analogy, resistance to hackney out, and was later replaced by lubricant materials, thus reducing hackney out and tear problems long solved by selecting the appropriate lubricant. From the aspect of improving lubrication in recent years more and more emphasis is on the constant increase in materials and lubricants performance.
The lubrication can be defined as a procedure by which introduces a layer of lubricant to reduce friction and detrition of materials between the two surfaces, which are in relative motion [4]. This process includes the following activities:

- the permanently cleaning of lubricants,
- the checking the amount of lubricants,
- refilling lubricants if is necesarry,
- replacement of lubricants, and others.

Choosing the proper lubricant, in the first place, depends on load, speed, temperature, and conditions in the work environment. The appropriate lubricant with the right lubrication system ensures consistency and dispensing lubricants are best for a particular use. The demission of machines will be avoided and the cost of system maintenance will be drastically reduced.

2. THE SYSTEMS FOR AUTOMATIC LUBRICATION

Frequent delays in production caused by inadequate lubrication can be largely prevented by applying some of the units for the automatic lubrication system. The lubrication systems constantly and reliable dosing appropriate lubricant and quantity to the required system components. At the same time, it protects against corrosion and external contamination, and with the selection of proper lubricants extend service life of machinery and equipment. Lifetime lubricated components, which will be extended and maintenance costs reduced. On systems such as fans, motors, pumps, compressors, blowers conveyors and other hard to reach places, these systems ensure continuous, without maintenance, longtime lubrication for the period from 1 to 24 months. The most common are now in: steel making, mining, energy, petrochemical industry, automobile industry, food industry and so on. [3].

The fact that 1 g of excess oil or grease which is spill out, as a result of improper lubrication or incompetence, can pollute the water sank, indicating only to the environmental aspect of the seriousness of the process of lubrication. Properly designed lubrication systems can greatly contribute to reduce these losses and preserve our environment and economic resources.

In Fig. 1 was shown the economic aspect of an automatic lubrication savings compared to manual, for the period of lubrication of about ~ 1 year for 100 lubrication points. Savings lubrication for the specified period ranging up to 25 %, which means that the investment cost of installing such systems can be compensated through annual maintenance [7].

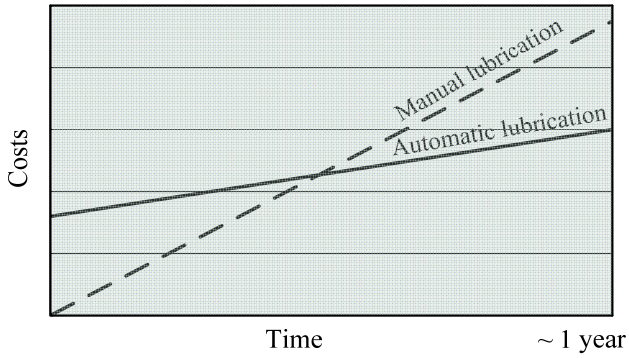

Figure 1. The automatic lubrication savings compared to manual on an annual basis points to 100 lubrication points

3. THE MATERIALS AND WORK METHODS

In several examples, with determinate number of lubrication place, a simple calculation will show the economic validity of automatic lubrication system compared to conventional manual lubricant. In details will be given possible advantages of this form of lubrication, in which they will be compared and analyzed two ways of lubrication in the following examples:

- the lubrication of 60 lubricating points at an altitude of more than 3m and
- the lubrication of 80 lubricating points, on the belt conveyor bearings.

An example of delay due to inadequate lubrication with the stated cost of production will prove on replace of roller bearings located at a stone crusher.

4. THE RESEARCH RESULTS OF ECONOMIC VALIDITY OF APPLICATION OF AUTOMATIC LUBRICATION

The automatic lubrication systems meet the highest standards, both in terms of safety and health at work of employees and in terms of environmental protection. The advantages of automatic lubrication systems to the manual are:

- a constant dose over time a certain amount of fresh lubricant,
- the reduction of maintenance costs of machinery and mechanisms,
- the efficient and safe work of machines and mechanisms
- avoidness of sudden delay and cancellation,
- the increase of the safety of all employees in the maintenance,
- savings in time and energy and so on.

The requirements of customers of such equipment are concentrated mainly on the quality of management, reliability and maximum productivity in the most difficult working conditions, because the slightest error can cause delays of machines and mechanisms and the high cost of repairs. With these systems, lubrication is achieved by significantly reducing wear of rotating elements that are in direct contact. They lubricate even the areas hard to reach and prevents pollution caused by dust, moisture and other contaminants. Thus providing a lubricant between the sealing surfaces which are in relative motion between each other. Delays in production caused by improper lubrication can largely be prevented by applying some of the units of automatic lubrication systems.

4.1. The economic aspect of lubrication of lubricating points at an altitude

For the purpose of performing manual lubrication on 60 lubricating points, which are located at an altitude of more than 3 meters, lubrication should be performed every 2 weeks. Two workers are need to perform this lubrication and they will be perform lubrication each day 2 to 4 hours. This means that the total time required for the lubrication of the year amounted 8 h x 26 days=208 h/year. It should be noted that this is the effective working time, this time in the case of more precise calculations should be added to the preliminary final time for a break and others required time.

In contrast to manual lubrication, for example, using "Perma CLASSIC" units for automatic lubrication to 60 lubricating points, it is necessary to replace the oiler only once in 12 months. Two workers on the replacement of these units should be work 4 h/year, relatively, a total of 8 h/year, etc. Fig. 2.

The advantages of automatic lubrication in the case of lubrication of 60 lubricating points which are located at an altitude higher than 3 m in relation to manual lubrication are the savings in time for the lubrication performance of 96 % per annual, relatively, savings of about 200 h/year, etc. Fig. 2.

The risk of injury of lubrication doer at lubrication performance at an altitudes higher than 3 m, with an automatic lubrication (replacement cartridge alignment) for this case would amount to 3.85 %.

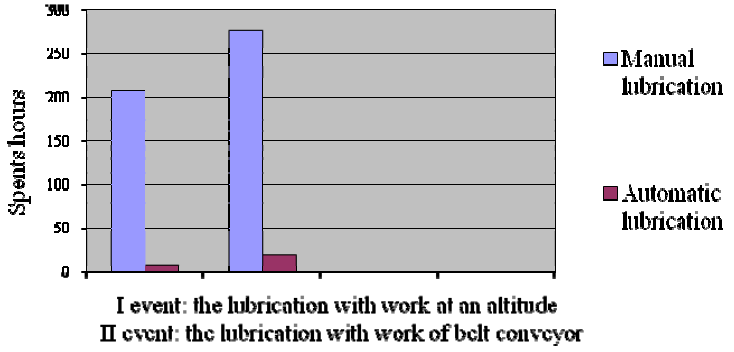

Figure 2. Examples of the economic justification of automatic lubrication compared to manual

4.2. The economic aspects of lubrication belt conveyors

The principle of work of individual machines and mechanisms that are lubricated is such that there are high at an altitude and in hard to reach places. The performance of lubrication at an altitude has a high

risk of injury of lubrication doer, and the fact is that in practice all of these points lubricated with minor precautions. For example, the lubrication of bearings conveyor belt is very dangerous! There is a substantial risk of a fall of workers who perform lubrication! Automatic lubrication can significantly affect the reduction of workplace injuries of employees who perform lubrication and up to 90 % [7].
For the purpose of performing manual lubrication at 80 lubricating points on the bearings of belt conveyers should be performed lubrication every week, which still means 52 times per year relatively, in 4 minutes for each lubricating point. Total spent time required to hand lubricant amounted to in this case 277 h/year, etc. Fig. 2.
In contrast to manual lubrication, for example, with the use of "Perma" CLASSIC" units for automatic lubrication on 80 lubricating points which are on the bearings of belt conveyers, it is necessary every 3 months (or 4 times a year) to replace the cartridges. Time required to replace these units is about 4 minutes for each lubricating point, while the total time spent to replace these units amounted to 21 h/year, etc. Fig. 2.
The advantages of automatic lubrication for bearing lubrication case of belt conveyors to 80 lubricating points in relation to manual lubrication are the savings in time for the lubrication performance of over 92 % per annual relatively, savings of about 256 h/year, etc. Fig. 2. In this case, the delays and costs of belt conveyers will be avoid only for lubrication of 256 h x 40 €/h =10,240 €/ year.
The risk of injury lubrication doer on performance lubrication of bearings on belt conveyors, with automatic lubrication (replacement cartridge alignment) for this case would amount to 1.92 %.

4.3. The economic aspects of the replacement bearings to the crusher

An example of the economic aspect will be shown on the example of changing the bearings (spherical roller bearing, D=340 mm, n=1.000 ^{o}/min) at the stone crushers. Strong vibrations, a considerable presence of dust with ambient temperature variations, lack of lubricant for permanent congestion of supply lubricants etc. affect the appearance of constant delay (5÷8 h delay +1.500 € fixed costs). In this case, the total minimum cost of downtime amounting to (5 h x 375 t/h x 10 €/h) =18,750 € to that value should be added and less money in circulation to 1,500 €.
An alternative to avoid all this would be a choice of "STAR Permian SF05 lubricant" for roller bearings, while four would be used with LC-lubricator unit M120, with the period of discharge, 2 x 1 month and 2 x 3 month.

5. CONCLUSION

The use of automated lubrication systems for more lubricating points on examples of roller bearings and other tribomechanical pair, can reduce the risk of accidents at work of employees from 96÷98 %, while significantly reducing the appearance of: waste materials, create dust, noise creation, etc.
In the more studied examples of effective working hours spent to perform an automatic lubrication and comparing them with manual lubrication, it was concluded that they can make substantial savings in time required to perform an automatic lubrication for 92÷96 %, which indicates that the maintenance workers in these moments we can engage in other more necessary areas.

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