Investigation of Maintenance Methods

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Abstract

Cleaning, lubrication, overhaul, calibration and experiments conducted by maintenance personnel make up maintenance tasks. It is essential that an active maintenance planning be implemented in order that production functions could carry on uninterruptedly. In this study, the concept of maintenance and some information has been provided as for maintenance techniques.

Keywords: Maintenance, preventive maintenance, predictive maintenance, total productive maintenance.

Bakım Yöntemlerinin İncelenmesi

Özet

Bakım personeli tarafından yapılan temizlik, yağlama, ayar, muayene ve deneyler bakım işlerinin kapsamını oluşturmaktadır. Üretim faaliyetlerinin kesintisiz bir biçimde devam edebilmesi için de etkin bir bakım planlamasının uygulanması gerekir. Bu çalışmada bakım kavramı ve bakım yöntemleri hakkında bilgi verilmiştir.

Anahtar Kelimeler: Bakım, koruyucu bakım, ketirimci bakım, toplam verimli bakım

1. CONCEPT OF MAINTENANCE

Maintenance is a cluster of processing that is composed of planning, implementation and control levels that enable the production system to operate in accordance with plan and programs; and keep it under expected labor standards (Ayyildiz, 2000; Sivri, 1986; Capkur, 1989; Baz, 1995; Goktas, 1997; Adali, 1998). Maintenance is also the processing that are conducted so as to keep system, machine and equipments under acceptable standards with a view to controlling and preventing unexpected malfunctions and potential pauses as much as possible so that production activity could go on regularly according to the plan (Kocaalan, 1980). Moreover, maintenance is all of the measures that ought to be taken in order to preserve the function and activity features of technical systems and/or regain the lost features (Kartepe, 1991). Maintenance is enabling the system to operate efficiently minimizing the effects of breakdowns or preventing the breakdowns (Ayranci, 1997).

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In enterprises, there may not be a separate department in order to implement maintenance processing under certain conditions. However, it is mandatory that maintenance function be present in order to carry on with production. Since that there are major factors that compel the managers to improve maintenance functions. These factors are as follows: a) increase in mechanization as a result of more investment, b) more automation, increase in the complexity of machines, c) increase in the types of spare parts and maintenance equipment, d) increase in pay, e) competition with other enterprises, f) a higher production quality, g) the requirement that delivery dates should be more regular (Kocaalan, 1980).

Labors included in the scope of maintenance can be summarized as: maintenance of machines and mechanic parts; maintenance of electric or electronic appliances and makeup; lubrication and control; maintenance of equipment in stockings or store; maintenance of adjunct service systems; maintenance of transportation vehicles; building and territory maintenance; removal of wastes and disposal of junk (Celebi, 1997).

Implementation of production in accordance with programs is dependent upon operating machines and systems uninterruptedly. Therefore, it is imperative that a regular relationship be provided between production planning and maintenance planning (Baz, 1995).

As the production system enlarges or amount of production increases, the importance of repair and maintenance applications increases, relatively. Breakdown of several major machines in a production line composed of hundreds of machine tools may disrupt the whole system with successive impacts. To some extent, it is possible to compensate for the absence of machines under maintenance or dysfunctioning in production on order. Nevertheless, in mass production and especially process production, the effects of breakdowns on production are quite significant. It takes long to restart normal production level after the repair (Kobu, 1996).

The breakdown in repair-maintenance activities has negative effects on production process, efficiency and accordingly on costs. These effects may be listed in order as follows: 1) the machines and the operators and personnel working with them remain unoccupied, 2) indirect labor and general production costs increase and affect unit costs negatively, 3) in custom manufacturing, customer needs are not met on time, sales decline, 4) delays and unoccupied time in other departments considered related to the department where breakdown has occurred, 5) the rate of waste increases and quality declines, 6) losing customers or paying compensation due to not delivering the orders in time (Kobu, 1996).

2. THE PURPOSE OF MAINTENANCE

Sometimes, maintenance may be perceived as repairing the machine in the event of breakdown. Indeed, the fundamental aim of maintenance ought to be to keep the equipment under operation even prevent the breakdowns before they occur. Generally, in any production system, the biggest cost comes out during the downtime of the breakdown machine tools. Breakdown in a machine leads to the inoccupation of the whole production line which pause the production. In that case, labor force costs continue and due to the damage it has caused on the equipment production costs increase and the enterprise's competition strength in market falls (Baz, 1995; Sevim Korkut, 2005).

Because the fundamental aim of the enterprises is to realize the maximum production through minimum costs, the continuation of production is compulsory. The downtime brought on by the breakdown causes big production loses. So, any breakdown should be repaired immediately (Alisar, 1992).

The purposes of maintenance are affected by factors such as job types, time and environment etc (Alisar, 1992). Considering this, the fundamental purposes of maintenance can be listed in order as such: 1) to keep the machine in a level in which it can operate efficiently and in quality, 2) not to let unexpected interruptions brought on by breakdown and thus enable the production to happen in a regular way, 3) to decrease the costs brought on by breakdowns applying planned maintenance, 4) to enable continuity during the envisaged time in line with the operation life span of the machine, 5) to keep spare part stockings belonging to machines in the optimum level (Sarac, 1991).

3. ANALYSIS OF MAINTENANCE METHODS

Generally, maintenance methods are studied under two categories, one being unplanned maintenance (breakdown maintenance) and the other one planned maintenance (preventive maintenance, predictive maintenance**,** total productive maintenance) (Baz, 1995; Gucin, 1999).

3.1. Unplanned Maintenance

In this method, maintenance is conducted as long as a breakdown occurs. A breakdown that might come out in a machine left on its way causes other breakdowns, too. Through that method, the equipment and parts of the machines are repaired and put into a functioning state as soon as possible by means of processes such as replacing parts, repairing and correcting in case of any interruption, breakdown or production pause (Alisar, 1992;Gucin, 1999).

3.1.1.Breakdown Maintenance

This method is a repairing application in order to return the equipment to its previous normal functioning state after a breakdown (Ozturk, 1999; Bayram, 1998). One of the most important problems in breakdown maintenance planning is to decide on the size of maintenance team. When the maintenance team's size

is large, repair time gets shorter. However, this condition causes the repair team to be unoccupied, and accordingly labor force costs increase (Baz, 1995). Because when a breakdown will occur is not known, it is hardly possible to make real a production plan. When the machine stops due to an unexpected breakdown, the spare machine steps in, otherwise, the work is paused till the maintenance is completed. On the other hand, keeping a spare machine puts much burden on the enterprise both in terms of storing and capital (Ayranci, 1997; Ozturk, 1999; Bayram, 1998). Though it is thought that maintenance costs will probably decline in case of breakdown, if a breakdown occurs at an unexpected time, production stops and sometimes the factory is maintained for a long time at an unexpected time (Unal, 1987; Davis, 1995).

3.2. Planned Maintenance

This is the process of stopping the machines and conducting their maintenance at set intervals in line with the recommendations and experiences of the firm or the workers (Ayranci, 1997). In the enterprises, before the breakdown occurs, its signs are recognized and precautions in the scope of planning are taken in most circumstances, in planned maintenance, these precautions are taken in all respects, as planned maintenance is a multi-faceted organization including breakdown maintenance, too (Alisar, 1992). Planned maintenance system is formed by the maintenance department. In this stage, important responsibilities fall to maintenance department. These responsibilities are; extending the life span of parts, identification of parts' life spans and the regular replacement of worn-out parts (Kocaalan, 1999).

3.2.1. Preventive Maintenance

This is a planned maintenance method developed in order to minimize all the operating machines and equipment breakdowns in enterprises to the least extent. It is based on the principle that predetermined maintenance processes are conducted within pause time by pausing machines and equipment at set periods (Ayyildiz, 2000; Capkur, 1989; Baz, 1995; Alisar, 1992). It is equipment inspection and testing that enable the avoidance of premature equipment failures, and what extend the equipment life are lubrication, cleaning, adjusting, and minor component replacement (Tomlingson, 1993). This is realized based on a plan drawn up so as to decrease breakdown frequency (Karaoglan et al, 2007). In which maintenance times the machines will be maintained by pausing them is determined considering the experience of maintenance team, previous performances of machines, working hours and the maintenance intervals and methods indicated in technical machine books (Ayranci, 1997).

All preventive maintenance programs are based on time. That is, maintenance layouts are based on operation hours or time used. More developed preventive maintenance programs include repair, maintenance, adjustment and re-establishing (Mobley, 1990). Predetermined standard time is used in

personnel numbers and different conditions in terms of conducting the tasks and in the identification of process time with a view to using the present labor/time number in a more balanced manner (Anonymous, 1972).

Despite the differences in systems and shifts in enterprise policies, all preventive maintenance programs aim; 1. to expose the conditions that may damage the systems or interrupt production by conducting the periodic controls of systems and equipment, 2. to enable the normal continuity of production by conducting certain adjustments and repairs taking precautions before such conditions come into being (Anonymous, 1972; Anonymous, 1978; Anonymous, 1971).

Preventive maintenance program is formed basing on such measurements as machine and equipment location arrangements, capacity conditions and maintenance and production loses. Considering that information, firstly, preventive maintenance periods are set for each machine with minimum costs, and then with a model developed, preventive maintenance periods are revised and some changes are conducted for each machine or machine groups. Maintenance instructions are formed according to the recommendations included in manufacturing firms' equipment documents and the experiences of the enterprise attendants and according to the breakdown and wear-out periods of the machines (Alisar, 1992).

Preventive maintenance programs are prepared in accordance with production programs. In that way, on one hand, immediate pauses in production and cost increases are prevented on the other hand, maintenance service is enabled to work efficiently because the systems will continue with uninterrupted production. Moreover, great loses stemming from sudden breakdowns and breaks can be prevented (Kocaalan, 1999).

There are certain steps that should be followed while preparing a preventive maintenance plan. These steps are as follows: 1) It is necessary that all units, tools and systems included in preventive maintenance plans be coded according to a certain coding system. For this coding process, the enterprise can both use its own private coding criteria and standard coding criteria. 2) Appropriate form systems are developed in order to identify time, cost, spare parts cost taking the size of preventive maintenance plans into consideration. 3) In which period of the year these preventive maintenance operations will be conducted and which controls, tests and trials will be conducted at that period are identified. 4) Some tables and guidelines are prepared that will determine the frequency and the duration of pauses especially in preventive maintenance operations that require pauses. 5) In order for the maintenance team that will ensure the preventive maintenance operations to be conducted properly to be trained well, necessary training programs are prepared and the attendants are informed of to which position they will be appointed for maintenance and what they will be doing (Unal, 1987).

3.2.2. Predictive Maintenance

Within the framework of the program drawn up taking the features and the working conditions of the machine into consideration, certain parameters are measured and controlled without pausing production. By evaluating those measurements, some idea is obtained as for the working conditions of the machine and if there is a breakdown, its development is observed. Fault identification process is realized based on various criteria as dependent on the parameter that has been measured and followed. After the identification of the fault, necessary spare parts are provided and production is paused and the maintenance is completed within the least amount of time possible and production is resumed again (Ayranci, 1997; Ozturk, 1999; Bayram, 1998). Because the part that will cause problem has already been perceived, this prevents the breakdowns that will cause immediate pauses besides providing a prospective maintenance-repair program. The purpose is to prevent the breakdown even before it has come into being (Celebi, 1997). Various parameters such as vibration, temperature, pressure, leaking, lubricant quality and noise are exploited while following the working conditions of the machines. Vibration is the most likely parameter to provide much and detailed information about different potential damages in machines. In new and recently maintained machines, the vibrations above the normal level reach stabilized and low levels when the machine comes to a stabilized condition as a result of wear out and adjustments. The vibration figures considered to be normal start to increase as the breakdown starts. The source of the breakdown is identified by using certain measurements and frequency analysis in this stage when the operation goes on. A program is drawn up for maintenance following the vibration development course of the fault and the part or the parts that should be replaced are ordered. As the function is paused on the programmed day, the breakdown on the machine is repaired as soon as possible, and then the work is resumed after completing the necessary repairs and cleaning (Ayranci, 1997).

3.2.3. Total Productive Maintenance (TPM)

TPM has still been applied by many firms successfully for years in the world. While it is conducted by engineering, production, maintenance, purchasing, stock control units, it requires the interest and contribution of all workers (Bozoglu, 1998; Karamanli, 2003). TPM is necessary for the development of maintenance functions in an organization including all human resources (Al-Hassan et al., 2000). It is a maintenance system that could be applied to enable production tools to work with no loss and no fault constantly challenging the upper limits of quality and efficiency (Bozoglu, 1998). It aims zero equipment pause and zero quality fault in production system (Sevim Korkut, 2005).

The largest definition of TPM contains those five points (Ozturk, 1999; Bayram, 1998; Bozoglu, 1998; Nakajima, 1988):

1. Exploitation of equipment most efficiently, that is, it aims total production
2. It forms Total Productive Maintenance system including maintenance prevention, preventive maintenance and repairing concentrated maintenance.
3. It requires the participation of maintenance team, operators and equipment designers.
4. It includes all personnel from the top management to the bottom.
5. It encourages and improves efficient maintenance based on small group activities of users.

TPM is widely defined as "efficient maintenance fulfilled through total participation". The concept of total bears three meanings including the principal features of TPM (Ayyildiz, 2000; Celebi, 1997; Ozturk, 1999; Nakajima, 1988).

1. Total Equipment Efficiency: includes economic profit and efficiency,
2. Total Maintenance System: ensures the development of maintenance prevention, repair ability and preventive maintenance,
3. Total participation of all personnel: indicates user maintenance that will be conducted by operators through small group activities.

As can be understood from the definition of "total", the success of TPM requires not only the participation and support of maintenance personnel but that of all personnel with the management team leading, as well (Ozturk, 1999; Hubar, 2004; Robinson and Ginder, 1995). For instance; in TPM, machine operator is responsible for the maintenance of machine as well as the operation of the machine (Al-Hassan et al., 2000). TPM aims to change enterprise culture by developing human resources and equipment. Human resources are improved by providing education and responsibilities. Operators should be able to conduct user maintenance, maintenance people should be able to conduct high quality maintenance, and engineering team should be able to conduct equipment design that doesn't call for maintenance (Ayyildiz, 2000; Nakajima, 1988).

4. CONCLUSION

Machine breakdowns may alter production plan and may cause financial losses. However, timely maintenance may prevent above metioned problems since appropriately done maintenance significantly cut down the cost of labour, material and energy while increasing the quality of the products.(Ayyildiz, 2000; Sevim Korkut, 2005).

Without timely maintenance it is hard to plan the production process accurately. In addition,plants need to stock enough spare parts in order to intervene to the breakdown instantly. On the other hand, in "planned maintenance" production interruption can be minimized, the life span of parts can be extented, manufacturing can be processed as it was programmed and cost of breakdown and maintenance can be reduced .

In order to accomplish error and breakdown-free production process, enterprises should adopt a timely maintenance program that includes practices such as lubrication, accuracy controls.etc.

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