Article **Journal-Economic Systems**
June, 2021 Vol.5 No.8 19-24

Efficiency improvement through the TPM technique in a mining company

Mejora en la eficiencia mediante la técnica TPM en una empresa del ramo minero

SUAREZ, Martha†, ZAMORA, Martha and MARTINEZ, Lydia

ID 1st Author: *Martha, Suarez*

ID 1st Co-author: *Martha, Zamora*

ID 2nd Co-author: *Lydia, Martinez*

DOI: 10.35429/JES.2021.8.5.19.24 Received March 15, 2021; Accepted June 30, 2021

Abstract

This paper provides results of an investigation into the company engaged in mineral drilling in 2012-2013. The applied research project was the implementation of an operating system based on the Total Productive Maintenance (TPM) for the Maintenance Department as a pilot taking the machinery used to mine are boring. The implementation of TPM was using troubleshooting techniques, program improvement in the operation area, implementation, analysis of results, achieving an increased level of reliability and availability of equipment, thus increasing the useful life of machinery.

PM (operating system based on Total Productive Maintenance), Gantt Chart, Checklist, 5 "S" stand by (standby)

Resumen

En este trabajo se presentan los resultados de una investigación realizada en la empresa dedicada a la perforación de minerales en 2012-2013. El proyecto de investigación aplicada fue la implementación de un sistema operativo basado en el Mantenimiento Productivo Total (TPM) para el Departamento de Mantenimiento como piloto tomando como base la maquinaria utilizada para la perforación minera. La implementación del TPM fue utilizando técnicas de solución de problemas, programa de mejora en el área de operación, implementación, análisis de resultados, logrando incrementar el nivel de confiabilidad y disponibilidad de los equipos, aumentando así la vida útil de la maquinaria.

PM (sistema operativo basado en el Mantenimiento Productivo Total), Diagrama de Gantt, Lista de Comprobación, 5 "S" stand by (en espera)

Citation: SUAREZ, Martha, ZAMORA, Martha and MARTINEZ, Lydia. Efficiency improvement through the TPM technique in a mining Company. Journal-Economic Systems. 2021. 5-8: 19-24

† Researcher contributing as first author.

Introduction

The purpose of the article is to show the results of the implementation of the TPM (Operation System based on Total Productive Maintenance) and meet the objective of improving the productivity of an area in the company dedicated to mining drilling, specifically in the Maintenance department. , based on a diagnostica) methodology using fault detection techniques, improvement proposal and results of the application of the TPM technique, using a pilot test on four mining drills. Once the TPM actions have been implemented in the maintenance area of the mine drilling machines, a notable improvement can be seen in the number of failures. The reasons that motivated the investigation was the request of the company to improve the productivity of the Maintenance area.

Development Materials and methods b)

The Implementation of the TPM is a process that must be given maximum attention and seek the best possible advice Casanova (2012), since it is a long-term program of 3 to 5 years, in which a very high effort will be invested, not only of the managers, Benítez (1998), but of all the staff. The study carried out in the company dedicated to mining drilling is based on a pilot test where TPM was implemented over a period of 6 months in the maintenance department of mine drilling machines. The methodology applied to carry out this study is presented below:

a) Tourgone by areas: Using observation techniques, verification sheet, photographs and video.

b) Interview with Maintenance Manager: A discussion was held with the person in charge of the maintenance area, who expressed his expectations regarding the project that would be useful to them, stating that they were interested in having an operating system that would ensure greater efficiency and productivity in their daily work, which is why It was determined that an Efficiency Diagnosis for the Maintenance Department based on TPM and its implementation would be a project that would achieve the objective of detecting possible anomalies that were reducing the productivity of this area and would improve its efficiency. c)

c) Diagnosis of the current situation. All pertinent information about the operation of the Maintenance Department was collected for the detection of areas of opportunity.

The following areas of opportunity were found, which are described below:

The continuous progress of vehicle technology as well as technical maintenance processes have required this department to develop, which, however, is not up to the task. In line with modern requirements, the key point is that maintenance has not been properly managed to extend the useful life of the units, allowing a reduction in maintenance costs, improvement and modernization of its facilities, training plans and updating of knowledge in workers and others.

Stoppages in the processes, increases in cos of maintenance, its processes require excessive effort, it is inadequately organized the tools, their sections are not delimited, their workplaces are inadequate, the installed capacity is partially used, there is no culture of order as well as lack of interest on the part of those who make it possible to carry out maintenance activities (Figure 1)

Figure 1 Accumulation of material and undefined areas in the workshop

It was surveyed to collect information on the current state of the maintenance department, which is aimed at the personnel involved in

ISSN 2523-6350

maintenance, which included 10 people, 9 technicians and a manager, see Annex 1: Table 1.

Once the different sources of information on the current situation have been reviewed, the following is summarized:

- The mission, vision and objectives of the workshop are not defined.
- There is no adequate maintenance plan.
- Thes tools and equipment are out of date and increase downtime.
- The organization of tools and equipment is not adequate.
- The technical information that is available is acceptable, however it must be kept up to date.
- There is no use of any security policy for the worker, he does not have security accessories, signage, among others; resulting in problems that will be reflected over time in the worker's health, in addition, a plan for environmental care is not managed in which the collection, classification and treatment of solid, liquid and polluting material is contemplated.

d) DTPM implementation proposal design based on pilot test.Making a proposal for the Implementation of the TPM, before the Directors from the andcompany for his toprobation,

TPM implementation

The phases that were followed for the implementation of the TPM in the company's Maintenance department are presented below:

1. Preparation: The Management announces and trains its staff and creates a promotion organization, establishing policies and objectives, as well as designing the TPM Master Plan (duration: 2 weeks).

2. Introduction: The official launch of the project is made, the planning carried out is reported (duration: 1 week).

3. Implantation: Implement programs and activities to make production more efficient: Training and qualification required by personnel in maintenance, equipment operation. Each of the stages of the TPM program (Autonomous Maintenance supported by the 5's technique) is implemented.

With a pilot test focusing on the maintenance of four mine drills, carrying out activities such as registration and maintenance indicators, failure analysis, fish diagram, failure frequency, average operating rate of the drills, performance (duration: 20 weeks).

Consolidation

Details are fine-tuned and higher and higher goals are considered, improvements are made in work and equipment maintenance procedures (duration: 1 week and constant monitoring).

Implementation of the 5S quality methodology, as part of Autonomous Maintenance

SEIRI- Classify

Procedure: the first step to be followed by all personnel in each of their areas is the classification of all accessories (tools, equipment and supplies) in a rational manner. They must classify according to the following:

- Classification from accessories from frequent use
- Classification of accessories of not very frequent use.
- Classification of accessories of infrequent use.

Another way that is recommended is a red card (expulsion) is placed on each item that is considered not necessary for the operation. Next, these items are taken to a temporary storage area. Later, if they were confirmed to be unnecessary, these will be divided into two classes, the ones that are usable for another operation, and the useless ones that will be discarded. This sorting step is a great way to free up floor space by getting rid of things like: broken tools, outdated fixtures or tools, offcuts, and excess raw materials. This step also helps eliminate the "just in case" mentality.

SEITON- Order

Accessories that are frequently used in the workplace begin to be sorted, accessories that are not used very frequently in a place that is not far away but that does not interfere with work processes.

ISSN 2523-6350

And accessories that are not frequently used will be recycled or discarded. According to the following considerations:

– Delimit sections in the respective area: painting from floors delimiting

SEISO- Clean

Once classified and ordered, the oil, air, refrigerant leaks, parts with excessive vibration or temperature, risks of contamination, fatigued, deformed, broken parts, misalignment are detected.

These elements, when not taken care of, can lead to equipment failure and production losses, factors that affect the company's profits.

SEIKETSU- Standardization

Once the three stages have been approved, operational rules or standards are established in order to guarantee uniformity in the results.

SHITSUKE- Discipline

Discipline must exist and must be maintained by all personnel, by disciplining the personnel it will be possible without any effort to keep the facilities tidy, organized and clean; seeking to achieve higher standards in daily work.

I know recommends that the andemployees perform the following routine, see Table 2:

To work con the right clothing strict cleaning of the entire place, it should be noted that this stage is more of an inspection that is linked to the first two activities. You bebenefits from perform a good housekeeping and maintaining it is:

Problems that were previously hidden by clutter and dirt become apparent at the start of the day cleaning of the area.

Durante la jornada	• Realizar el trabajo de acuerdo a la orden de trabajo • Realizar los trabajos en los tiempos establecidos
Al finalizar la jornada	• Revisar la orden de trabajo • Ordenar y guardar la herramienta y equipo de trabajo • Limpieza del área de trabajo

Table 2 Standard activities for staff

Results

The results derived from the implementation of the TPM system in the maintenance department of a company dedicated to mining drilling are presented below, taking four mining drilling machines as a pilot test, during an implementation period of six months, Table 3:

Iindicator	Before TPM	With TPM
Number of faults	30	20
Ffrequency of faults	0.020	.010
Cup of average drill operation	50 %	95%
Performance	60%	90%

Table 3 Team effectiveness

Drilling machines

As seen in table 3, where mechanical availability can be seen, it corresponds to the percentage of time in which the equipment is available to operate and perform the function for which it is designed, in relation to the total time. According to this concept, it can be seen that before the implementation of TPM there were failures that did not allow the equipment to be in ideal conditions for its work, so the plant obtained an average availability of 50%. Once the TPM actions have been implemented in the mine drilling machine maintenance area, a notable improvement can be seen in the number of failures from 30 to 20, the frequency of decreased to 0.010, the same happened for the operation rate whose index improved from 50% to 95%, with an average return that went from 60% to 90%. The foregoing results in greater reliability and availability in the equipment and an increase in useful life.

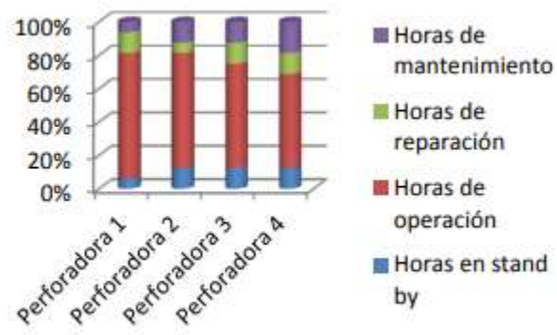
ISSN 2523-6350

Percentage distribution of times. The percentage distribution of times is shown below, where you can see the hours dedicated to: preventive maintenance, repair, operation and standby. Regarding the distribution of the time of the drillers before TPM, an average of 50% of hours in an 8-hour day was notably detected. Concentrates on Maintenance, repair and standby, with a percentage of 50% of the time spent on the operation of the machines.

In graph 2, it can be seen that when the TPM is implemented in a period of six months as a pilot test in the maintenance area, taking specifically the case of drilling rigs for mines, there is a notable improvement in the distribution of times dedicated to Repair, Maintenance and Standby for the aforementioned equipment, achieving a 35% increase in the average operating time of the drilling machines.

Kunio Shirose (2010), where he talks about the importance of the operators for the success in the implementation of the TPM. The equipment subjected to TPM increased its performance by 35%, correcting any anomaly found. Adaptations were also made with modifications mainly suggested by the operator and production supervisors, analyzed and approved by the work team as a whole. These modifications not only improved the efficiency of the machine itself, but also the area as a whole.

The control of the Global Effectiveness of the Equipment, allowed to identify the type of loss that affects the effectiveness of the machines allowing to attack the causes and solve the problems increasing the productivity. The TPM is not intended to be the solution to all the problems of the company, it is not the magic medicine that will fix everything. However, it managed to maximize the overall effectiveness of the equipment, minimize some losses and therefore help reduce costs that are caused by losses, stoppages, inefficient work, etc. Which will translate into profit for the company and all its ccollaborators.



Graphic 2 Percentage distribution of times for drills after TPM

Discussion. After six months of implementation of the TPM technique, there is a true commitment on the part of the company towards continuous improvement, together with the employees in the punctual follow-up of the strategies proposed as a solution. The implementation of the TPM helped the operators to support them with suggestions to improve the operating conditions, safety and maintenance of the equipment, as it handles it.

The support of the Management is of vital importance for the development of the project. Without this support, the success of the program is not assured, it is one of the cornerstones to bring the project to a successful conclusion, ideas also handled in the work of Casanova (2012), where he expresses himself about having a decisive commitment on the part of the company directors. The participation of all personnel and their training is essential so that the and company get ahead. It should be remembered that a company is made up of all the people who work within it, so if you want the company to grow, all its staff must grow according to Álvarez (2008).

Gratitude

We appreciate the support and facilities provided by the company to carry out the project consisting of the TPM implementation pilot test in the Maintenance department.

Conclusions

At the end of the implementation of the TPM technique in the maintenance department of this company, the following is concluded:

ISSN 2523-6350

a. The Department will have a more solid organizational structure that will provide support to provide a better service to the areas that make up the company, who request its services.

b. A systematic approach to identifying areas of opportunity that aids in the development and implementation of continuous improvement plans.

c. It was possible to maximize the effectiveness of the equipment, minimizing failures and thereby improving their profitability.

d. Better communication between the members of the work team and other departments, through the implementation of procedures that guarantee obtaining the level of satisfaction of internal customers.

e. The constant training of human resources is recommended, since it is a fundamental piece for the success and maintenance of the achievements obtained.

References

Álvarez Laverde, H. Kuratomi, I. The need to implement the TPM fundamental pillars (online) 2008. Available at: http://www.ceroaverias.com/centroTPM/articulospublicados/2001-4.htm

BeNitez Hernandez, LE (1998). Continuous Improvement through Total Productive Maintenance in: Business Class

Casanova Silva, Nestor (2012), "TPM in Asset Management", Revista Electroindustria (online).http://andmb.cl/electrical industry/article.mvc

Kunio Shirose (2010), ―TPM for Operators‖ (2010), Ed. Limusa

Lourival August Tavares (2004),

―Modern Maintenance Management‖, Ed. Limusa