BULLETIN: MAINTENANCE MANAGEMENT IN THE PLASTICS

1 INTRODUCTION

In recent years, the plastics industry has acquired greater importance due to the increase in consumption and the supply of products made with this material. Globalization has led the plastics industry to set clear objectives regarding the continuous improvement of the transformation process of plastic resins, to optimize the performance of raw materials, process quality and efficient use of energy.

The main objective of maintenance programs for critical equipment in the production processes of the transformer companies is to prevent or correct operational problems in the different stages of the production processes. Your planning must go hand in hand with the importance of the equipment and its role in the production process, through a preliminary assessment, at the beginning of the production plan.

The purpose of this technical bulletin is to show readers the most recurrent maintenance in plastic resin transformer equipment, and the most common causes that generate the application of such maintenance, thus guaranteeing the reliability of the equipment and therefore the reduction of errors. operational, with the consequent increase in the quality of the products, in the shortest possible time.

2 A LITTLE HISTORY

In industrial maintenance theories, five generations are spoken of, from 1930 to the present day. Each generation represents an evolution of the previous one, although the latter coexist in time.

2.1 First generation

The maintenance in this first stage was limited to repairing what was broken, to greasing, tightening, cleaning and lubricating the components of the machines that were used. The machine operator himself was the one who was in charge of its repair. This type of **maintenance was fundamentally corrective.** This stage is between 1930 and 1950, times when robust, slow and relatively simple machines were used.

2.2 Second generation

It starts from the Second World War. This evolution arises from the demand for greater continuity in production and greater complexity in machines and equipment. **Systematic preventive maintenance then appears**. The equipment had to last as long as possible in optimal operating conditions at the lowest cost. This second generation also contains the repairs, both instantaneous and scheduled. Systems for planning activities and control of the work carried out are implemented, and from the 70s onwards, the use of computer tools for this purpose has become widespread..

2.3 Third generation

It begins in the 80s. Its objectives are focused on eight aspects:
(a) availability of equipment and systems, (b) reliability of the same, (c) optimization of costs, (d) increase in security, (e) increase in quality (ISO 9001 and ISO 9002 certifications appear), (f) increased awareness of preserving the environment (taking into account ISO 14001), (g) increased equipment life and (h) vigilance of current regulations. Preventive maintenance activities are no longer routine, but adjusted to the regulations or their usefulness. Predictive maintenance, RCM (Reliability Centered Maintenance) and TPM or Total Productive Maintenance appear. Management systems are massively extended to equipment, systems and facilities. The contracting of external maintenance services appears, as a cost optimization mechanism and a strategy for assigning maintenance to specialist companies.

2.4 Fourth generation

It integrates all the previous concepts and maintenance management is oriented towards customer satisfaction. The objective is competitiveness, and seeks the development of effective and efficient work methods.

2.5 Fifth generation

At the end of the 20th century and the beginning of the 21st, the exhaustible nature of energy resources becomes important; hence, energy efficiency plays a leading role in maintenance. In other words, maintenance management is focused on the study and management of the life of an asset or resource from the very beginning (with its acquisition) to its own end (including ways of disposing of it, dismantling, etc.).

3 MAINTENANCE: WHAT IS ITS GOAL?

All maintenance actions aimed at maintaining and preserving the proper functioning of the machinery are considered a relevant factor in the operation of the transformation and / or production processes, and are intended to increase the useful life of the equipment, at the same time to reduce costs (expenses) for unexpected breakdowns.

In addition, it meets other objectives, beyond avoiding, reducing and - if necessary - repairing the failures on the assets of the organization. Among them, it is worth mentioning the following:

- Avoid useless stops or machine stops;
- Avoid accidents and incidents, due to the use of equipment in poor condition;
- Avoid environmental damage;
- Increase safety for people;
- Preserve the goods produced in safe and pre-established operating conditions.
- Balance the cost of maintenance with that corresponding to the loss of productive income.
- Achieve efficient and rational use of energy.

4 TYPES OF MAINTENANCE

There are various classifications of maintenance management.

- Preventive Maintenance: refers to an intervention of the machinery before it exhibits problems. For example, the periodic review and cleaning of equipment, according to maintenance plans. The criterion to follow is to correct first what can cause permanent stoppages in the machine; subsequently, which may lead to defective parts; then, what leads to the greatest waste of materials, energy or others; finally, all those activities required to preserve the appearance and presentation of the machinery.

- Corrective Maintenance: is that which is carried out once the breakdown (or failure) occurs in the machinery or equipment. In other words, a repair is necessary to restore the production process. In these cases, the following steps must be followed: 1- Assess the damage caused by the failure. 2- Analyze the cause or causes of the failure. 3- Correct the causes of the failure. 4- Repair, adjust or change defective parts. 5- Make necessary tests and final adjustments.

- Predictive Maintenance: it is the most complex of all industrial maintenance. For this, the parameters of the machinery (temperature, energy consumption) are recorded periodically, maintaining a computerized control of the status of the systems. When these parameters change, the system predicts when the machine will fail and when would be the optimal time to perform a repair or replacement of parts before failure is reached.

5 MAINTENANCE ON INDUSTRIAL EQUIPMENT FOR PLASTICS

It is common in any plastics transformation plant, as well as in any other industrial process, to have to solve problems during production. However, addressing these issues in an inefficient, rapid and undocumented way leads to uncertainty and increased downtime, which in turn decreases product quality and profitability.

Hence the importance of a maintenance plan for each piece of equipment. For its design, it is essential to have the historical data of failures, in which their type and frequency are identified. For the equipment that is regularly used in the plastics industry, much of the literature refers to failures that are mostly associated with mechanical problems, power

failures, problems with molds, cleaning of the machine, setting the machine and / or problems with the air.

Since this is a very broad classification, it is convenient to group them into three large categories:

- Mechanical breakdowns. They are those stops related to some damage to the mechanical part, such as belt changes, unevenness of the machine, bearing change.
- Electrical faults. The components of the machines that cause these types of breakdowns are related to the electrical system, which require a change in electrical resistances or result in the motor stopping.
- Problems due to lack of lubrication. They are the stops related to the moving parts of the machines that need lubrication to avoid friction wear, as happens with chains or the mobile closing system.

This is what is known as an L.E.M. system, which is nothing more than a preventive maintenance program where maintenance activities are grouped into three specialties with a specific job:
- **L**: Lubrication Activities.
- **E**: Electrical and Electronic Activities.
- **M**: Mechanical Activities.

Most of the mechanisms that make up the plastics transformation equipment need lubrication, so these are the most numerous activities handled by the maintenance management of industrial equipment.

With regard to electrical activities, in general, they are not frequent. The reason is due to the fact that the greater wear that occurs in the equipment is due to friction, which does not affect the electrical system at all. Failures associated with electronic control and measurement instruments generally require corrective actions, and are mainly due to voltage changes, vibrations in electronic equipment, improper connections or even variations in temperature and humidity that favor the accumulation of static charges. that, when downloaded, disrupt the operation and alter the information of these instruments.

Finally, mechanical activities occur due to the failure of various elements due to friction - despite lubrication -, although pneumatic and hydraulic activities are also included.

Listed below are various specific actions - beyond general preventive maintenance on industrial equipment, as described - that must be followed to avoid failures in the extrusion process (and post extrusion processes, namely: film blowing, injection of parts, blowing of containers and extrusion of profiles).

6 EXTRUDER MAINTENANCE

This technique is based on melting, plasticizing and homogenizing a polymeric resin through an extruder and then passing it through the appropriate head to obtain the respective end-use product, according to the geometry of the head.

6.1 Cleaning the extruder:

This process includes the following activities:
a) The machine is turned on with resin, avoiding feeding until the helical channel of the screw under the hopper is empty.
b) The hoses are disconnected.
c) The head and filter are removed together, loosening the bolts that fix the head flange to the support of the mesh holder.
d) The screw is removed from the barrel by means of a special extractor and placed on a wooden trestle.
e) A copper or brass sheet should be used to remove most of the resin adhering to the screw.
f) Cleaning is completed with a copper or brass sponge, spraying with silicone to help remove the most adhered parts of resin. The screw must then be protected with a thin layer of silicone.

6.2 Cleaning the barrel:

A long rod with a steel wool brush or sponge attached to its end is used to remove the remaining resin adhering to the lower walls of

the jacket; with a similar tool lubricate the inside of the barrel with silicone grease.

6.3 Checking the pressure and temperature controllers:

The automated control system is verified by inspecting the operating pressure and temperature of the system, ruling out a sudden increase in the process control variables, which may lead to accidents and equipment damage.

6.4 Maintenance of screens or filters:

The set of screens or filters must be changed periodically; the obstruction increases with the continuous operation of the extruder, and can even interrupt the passage of the material. Normally, the screens or filters are damaged when removing the accumulated resin with the use of a knife or spatula; for this reason, it is not recommended to clean them.

6.5 Cleaning the mesh holder cavities:

To do this, the set of screens or filter must be removed (Figure 1); the resin that is not lodged in the holes of the mesh holder is removed with a sheet of brass. The oxidized resin that clogs the cavities of the mesh holder, must be burned with a burner.

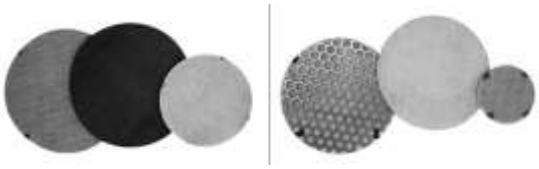

Figure 1. Extruder screens and filters

6.6 Head cleaning:

The nozzle and head are made of high precision parts; they cannot be hit, scratched or damaged and special care must be taken in cleaning them.

The cleaning of the head components must begin with the removal of the resin adhered to the piece, using insulating gloves. The remaining resin must be removed using a sheet of copper or brass, with the help of silicone grease. To finish the cleaning, a copper or brass sponge or brush should be used. Finally, silicone grease should be used to lubricate the parts.

7 MAINTENANCE ON FILM BLOWING

General extruder maintenance considerations apply to this and other post extrusion processes.

7.1 Cleaning the air ring:

The interval between cleanings of the air ring depends on the contamination of the environment where the extruder is installed, because there may be dust, particles suspended in the air, etc.

One of the ways to identify ring dirt is when films of varying thickness exceed the specified values. You should always wait for the ring to cool down before you can remove it; Dirty components should be cleaned with a brush or compressed air.

8 MAINTENANCE IN THE INJECTION PROCESS

8.1 Replacing the non-return valves:

This type of valve suffers great wear and therefore must be replaced frequently, since they generate pressure losses in the plasticizing chamber (Figure 2).

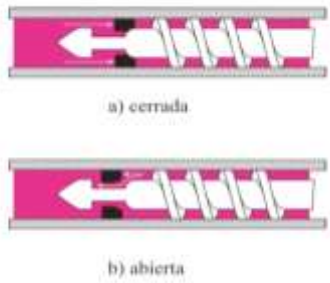

Figure 2. Non-return valve

8.2 Injection point:

To avoid clogging the molten material outlet cavities to the mold, continuous cleaning must be carried out at the end of each process, cleaning the spindle (screw) with a metal brush that removes all the remaining material that remains from the process. This

activity must be carried out with heat to speed up the melting of the material.

8.3 Cleaning the mold and the machine:

The sealing surfaces, lids, ventilation holes and separation planes of the mold must be carefully cleaned, using the appropriate cleaners and tools, for example, an industrial cleaning system of the **"dry-ice"** type (projection of a jet of particles of dry ice) can be very advantageous to speed up the process and the depth of cleaning, while avoiding the use of aggressive solvents. If the user does not have this type of cleaning system, the use of soft, non-abrasive cleaning cloths is recommended in order to reduce the chances of damaging or rounding sharp edges. Cleaning solvents should be used sparingly to prevent removal of lubricant from hard-to-reach areas.

8.4 Maintain control of the mold base:

At the base of the mold there is a device for cooling or plug that allows checking the absence of sediment or traces of corrosion in the cooling channels of the mold. In this case, it is recommended to clean all cooling ducts in the mold and perform a water quality assessment. Not only do you have to check the pH of the water in the cooling systems, but also the microbiological contamination that could corrode the microstructure iron of the mold. Likewise, the heat exchangers, the stem cavities, and the tubes that present sediment should be removed.

9 MAINTENANCE IN THE ROTOMMOLDING PROCESS:

Depending on the optimal operation of the rotational molding machinery adjusted to the most common problems, it is advisable to attend to the following activities to improve deviations:

9.1 Cleaning the nozzles on the flame burners:

It is done routinely, to avoid its obstruction and also wear, which will contribute to a better distribution of the flame.

9.2 Checking the condition of the transmission chains:

It must be inspected frequently; the nature of the operation in this equipment causes a pronounced wear in these elements, for which they must be replaced frequently.

9.3 Carry out external cleaning of the equipment and molds:

Continuous cleaning of the molds is recommended, mainly in the external part, to eliminate the accumulation of "coke" generated by the direct contact of the flame to avoid its deformation and oxidation.

10 MAINTENANCE IN THE BLOWING PROCESS OF PARTS:

10.1 Cleaning the cooling channels:

This task must be carried out periodically; because its obstruction - with the consequent failure of refrigeration - can affect the dimensional stability of the pieces.

10.2 Closing the mold

It must be verified that the faces of the mold close correctly, with adequate alignment, which must be periodically reviewed.

11 IN BRIEF

According to the causes that demand the maintenance of the equipment used for the transformation of plastic resins, the LEM system (lubrication, electrical or electronic and mechanical) is an excellent strategy to organize these activities, facilitating their implementation and maximizing effectiveness. of the plan.

For the definition and frequency of the maintenance plan aimed at extruders, blowers, injection and rotational molding equipment, the recommendations of the personnel who operate them, the plant engineers and the maintenance personnel of the companies are fundamental, if taken into account. account of the contribution that means a detailed knowledge of the functioning and operation of the machines.

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