

# Maintenance based on conditions of Machinery and Equipment in the Ceramic Industry

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**Abstract** – This paper investigated how plants develop leading-edge maintenance to reduce downtime due to maintenance. This increases the quality and productivity, avoiding delay in delivery of products and satisfying customer needs. In addition to the TPM-Total Productive Maintenance, there is another system based on the conditions of maintenance of machinery and equipment, performing maintenance when needed, which can be called the Routine Maintenance. This system avoids the maintenance based on the estimated useful life of equipment that can perform maintenance prior to the time necessary, and after the break. A quantitative survey conducted in factories of ceramic plates, and identified the high potential need for implementing a system of routine maintenance.

**Keywords:** Routine Maintenance, Productivity, Reduce Downtime.

## I. Introduction

This paper presents what is to expand the technology developed maintenance companies, thereby minimizing human errors in perceptions about the symptoms that have the equipment in operation, useful life prediction of possible stops or accidents.

For this purpose, we introduce the concept at the beginning of the necessity of developing and maintaining equipment in operating performance, followed by a description of the importance of human participation and its limitations emphasize the need of automation technology where the sensitivities, knowledge or experience would not be able to predict possible failures that occur or may occur in the future moments.

We also present the results of the survey of some companies in the ceramic industry, and at the end of the existence of great potential in these industries to implement a system of routine maintenance, which consists in maintenance at the right time, leading to increased productivity, quality, avoiding delays in product delivery, allowing for the improvement in operating income on a scale that is of utmost importance at this time of change as a result of the acceleration of economic globalization and competitiveness developed internationally.

## II. The Production Process of Ceramic Plates

The process of manufacturing the ceramic plate is composed of several steps being executed sequentially until the final product [1]. The manufacturing process of

ceramic products "traditional", among which are included in the floors and walls, usually develops in three successive stages:

- a) preparation of raw materials (mass);
- b) conformation of the piece;
- c) additional treatments to give the desired final product properties, such as submitting it to the drying and burning one or more times.

Figure 1 shows the flow chart showing the manufacturing process of ceramic plates.

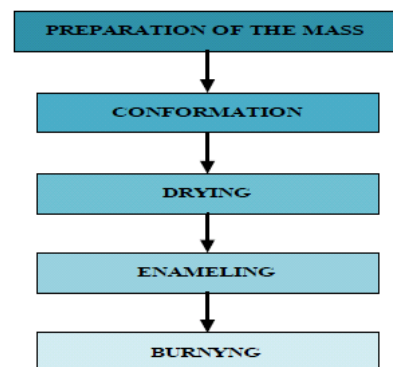


Fig. 1. Flowchart of the production process of ceramic plates.

First the dough preparation process is the goal of reducing the size of the particles of solid material (grinding of clays), in view of the increased surface area to improve the speed of reaction of certain raw materials

and will achieve ideal characteristics for use [2]. The grinding step is performed by ball mills (Figure 2).



Fig. 2. Mill balls.

Suspension resulting from the grinding step, will be eliminated one part of the water until it reaches the moisture content required for each process. The most common method is to spray drying. (Figure 3).



Fig. 3. Atomizer

Among the different methods used to mold parts for ceramic industry, which uses the pressure, the hydraulic press (Figure 4) is the most widespread, since it is achieved with two primary objectives in all manufacturing, which are large production efficiency, ease of automating and good characteristics of the finished products [3].



Fig. 4. Hydraulic press

The ceramic plate is conformed once subjected to a drying step in order to eliminate the water in, looking for

defects which are not produced [4]. Typically in industrial dryers (Figure 5), the heat required to effect the drying of the parts is introduced predominantly by convection, and these hot gases can be generated in a furnace and / or air recovery of the oven.



Fig. 5. Vertical convection dryer

In enameled products, the next step is the drying of enamel (Figure 6). This is the application by different methods, one or more layers of glass with a thickness between 75 to 500 microns in total, which cover the surface of the piece. This treatment is performed to give the product burned a number of technical and aesthetic properties.



Fig. 6. Line enaming

After step enaming, the burning takes place the glaze. The burning of the ceramic plates is one of the most important stages of the manufacturing process, since it largely depends on the characteristics of the ceramic product, such as mechanical strength, dimensional stability, chemical resistance, cleanability, fire resistance etc.. The rapid burning of these plates is carried out currently in roller kilns monoestral (Figure 7).



Fig. 7. Oven to the rolls.

### III. Improved equipment performance and Increased Productivity with Maintenance of Technological Innovation

With all the transformation and evolution that we are living today, it is essential that we anticipate and adapt to changes, accompanying all this technological development, so that they remain in the market know only the industries that manage their resources to form a business structure capable of surviving the new times [5].

The modernization and / or improved maintenance technology is one of the key factors for achieving this goal.

Technology development and equipment maintenance technology will bring innovation to the production system, mainly by giving too much importance on technology management, so that together you get a sudden increase quality and productivity in the company [6].

Without the development of a software, you can not deploy an effective maintenance program, not allowing waste caused by such equipment, unexpected stops and manufacture of defective products.

Technology development and equipment maintenance technology, is developed in the design phase and manufacturing, however, improved maintenance technology can also be implemented in the operation phase, which may contribute to the better performance, which is precisely the goal this work [7].

### IV. Analysis and discussion of results

According to information obtained in the survey / questionnaire was identified, according to Tables 1 and 2, the maintenance activities undertaken by the companies of this branch act predominantly (95%) in the corrective and preventive maintenance.

TABLE I  
TYPE OF MAINTENANCE ADOPTED BY THE COMPANIES SURVEYED

Type of maintenance applied	Freq.	Freq. Relative (%)
Unscheduled Corrective / Preventive	8	95
Corrective unscheduled / scheduled / preventative / predictive	2	5
<b>Σ</b>	<b>10</b>	<b>100</b>

TABLE II  
PLAN TO SEEK A MAINTENANCE MANAGEMENT FOR EXCELLANCE IN BUSINESS

Are there any plans to seek a maintenance management for excellence in business?	Freq.	Freq. Relative (%)
Yes	3	25
No	7	5
<b>Σ</b>	<b>10</b>	<b>100</b>

Knowing that the ratio of cost of unscheduled corrective maintenance to predictive maintenance is 2 to 1, it is necessary to encourage companies in this sector, a search for improvements in operating profit from greater efficiency of the entire production system, and save the industrial park at a cost compatible, making the implementation of a program of maintenance management in pursuit of excellence, leaving the current phase "parent" to phase "innovative."

### V. Potential for Productivity Improvement with Routine Maintenance

Analyzing the situations in which companies are in this field of activity, we note that there is great potential to bring benefits to the implementation of routine maintenance, as follows:

- Ability to plan, through the diagnostic information obtained by any system, this compound maintenance planning and production, set in the real conditions of perceived needs, added to the delivery of planning applications [8].
- Significant reduction in manpower and material maintenance applied to the entire production process, making it possible to predict the times to perform maintenance.
- Reduction of errors in the identification of failures by humans through the substitution systems [9].

d) As a consequence of the items described above, we obtain the increase in operating performance and revolutionary consequent increase competitiveness and profitability.

Table 3 shows the survey conducted the study for monitoring the main points of each part of the production process with the possible application of routine maintenance in industry-shaping of ceramic plates.

TABLE III  
SURVEY OF MONITORING POINTS FOR MAINTENANCE

Sector	List of monitoring equipment
Preparing the Pulp	<ul style="list-style-type: none"> <li>* Hoods - Check temperature and vibration.</li> <li>Conveyor belts * - Check scrapers, massive leaks and drives. * Diaphragm Pumps - Check leaks, temperature and noise. * Slurry Pump - Check leakage, operation of the hydraulic circuit. * Sprayers - Check crown, nozzles, leaking, belts. * Vascas overhead and underground - check for leaks, and the reducing conditions. * Fans - Check bearings and belts. * Balance - Check operation and leaks in the funnel. * Pickup powder - Check drives, bearings and belts, filters and sleeve. * Belts - Inspect gear of conveyor belts. * Diaphragm Pumps - Check leakage, temperature. * Mills - Check operation of the court and leaks, check conditions and tightening of belts, check hoses, caps, pins and quick couplers. * Sprayers - Check temperature of the engine, check measuring instruments, electrical panels * - Check bank of capacitors and circuit breakers. * Vascas overhead and underground - Check level sensors. * Motors - Check connection boxes, heating and bearings. * Banks capacitors and circuit breakers - Check condition.</li> <li>* Presses - Cleaning and general regulation of the car feed, pulleys, bearings and guides car, check the columns of the row; Check cleaning and molding operation; Check oil level of car gear lubrication feeder; Make inspection and regulation systems security; check oil level of the presses; check the nitrogen pressure, check oil spill; Make cleaning sensors and connection boxes, checking instruments signaling, checking cables, resistors and terminals, check engines. * Electrical Panels - Check bank of capacitors and circuit breakers. * Central oil recovery - Check temperature and engine. * Hydraulic system - Check operation and leaks. * Motors - Check connection boxes, heating and bearings. * Grounding - Check and repair if necessary grounding of the engines and equipment. * Timing of the presses, * Central Hydraulics - Make cleaning, examine noise and leaks, recovering oil - cleaning, checking noise and leaks. * SMU Filters - Making inspection and cleaning. * Retrievers - Inspect brushes and replace if necessary; Inspect belts, inspect and regulate turners. * Presses - Check and adjust slack in the dish; Make oil filter presses; Check accumulator pressure; Check hydraulic oil temperature (heat exchanger); Check extractor; Check pressure and flow main pump. * Electrical Panels - Check status of fuses, gutters, and wiring, relays and measuring instruments *</li> </ul>
Conformation	<ul style="list-style-type: none"> <li>* Presses - Cleaning and general regulation of the car feed, pulleys, bearings and guides car, check the columns of the row; Check cleaning and molding operation; Check oil level of car gear lubrication feeder; Make inspection and regulation systems security; check oil level of the presses; check the nitrogen pressure, check oil spill; Make cleaning sensors and connection boxes, checking instruments signaling, checking cables, resistors and terminals, check engines. * Electrical Panels - Check bank of capacitors and circuit breakers. * Central oil recovery - Check temperature and engine. * Hydraulic system - Check operation and leaks. * Motors - Check connection boxes, heating and bearings. * Grounding - Check and repair if necessary grounding of the engines and equipment. * Timing of the presses, * Central Hydraulics - Make cleaning, examine noise and leaks, recovering oil - cleaning, checking noise and leaks. * SMU Filters - Making inspection and cleaning. * Retrievers - Inspect brushes and replace if necessary; Inspect belts, inspect and regulate turners. * Presses - Check and adjust slack in the dish; Make oil filter presses; Check accumulator pressure; Check hydraulic oil temperature (heat exchanger); Check extractor; Check pressure and flow main pump. * Electrical Panels - Check status of fuses, gutters, and wiring, relays and measuring instruments *</li> </ul>

Hydraulic system - Conduct external cleaning of the engines. \* Presses - Conduct external cleaning of the engines. \* Central oil recovery - Perform engine cleaning. \* Motors - Check the connection box.

\* Dryers - Check chain lubrication; Make cleaning baskets Check noise reduction and the mainstream, check for leaks; Check drives; Check the fan belts and bearings; Checking measuring equipment and control of burners Inspect belts (NUE). \* Electrical Panels - Check bank of capacitors and circuit breakers; Check and clean sensors, check engine instruments and signaling. \* Motors - Check connection boxes, heating and bearings. \* Grounding - Check grounding of the engines and equipment. \* Electrical Panels - Make internal and external cleaning; Check status of fuses, wiring and gutters; Check relays and measuring instruments.

\* Compensate's - Check operation and adjustments. \* Machine loading - Check and adjust belt and rollers. \* Screen printing - Make inspection operation and check for leakage of compressed air; Make cleaning and inspection guides, belts, pulleys, springs and stepper motors; Check operation of fans. \* Engobing machine - To inspect the operation; Check bearings, rollers and drives. \* Vertex - Make cleaning baskets, check noise and vibration, check drives, belts and check current; Check drive.; Cleaning, regular sensors, check engine, check instruments signaling \* Fans - Check bearings and belts. \* Booths of water - Check and adjust nozzles, hoses and records. \* Compenser's - Check condition of roller and belt guides as well. \* Scrub - Check operation and efficiency. \* Pumps - Check leakage, and hydraulic operation. \* Transfers - Check wear chains, endless, messengers and centering, and also drives; - Check and adjust engine sensors and limit switches. \* Machine loading / unloading - Check Drive, guides, belts, messenger, Chuck; Check and clean wiring and regular sensors; Check wear and alignment of the slides. \* Traction Pulleys and belts - Check wear. \* Hydraulic system - Check engine. \* Electrical Panels - Check bank of capacitors and circuit breakers, electric motors \* - Check connection boxes, heating and bearings. \* Grounding - Check and repair if necessary grounding of the engines and equipment. \* Brushes - Make cleaning and checking wear. \* Vasca - Check and record covers.

\* Fans - Check the bearing temperature and vibration. \* Compensate's - Check and adjust the belt rollers. \* Machine loading and unloading - Make the entry and exit inspection (drive) roller; Check drive, guides, belts, messenger, Chuck .. \* Carpets output of the furnaces - Check wear. \* Oven - Check operation of the emergency drive, check chains, messengers, clutches, bearings, noise, temperature, \* Transfers - Check wear chains, endless, messengers and centering. \* Hydraulic system - Make cleaning and checking noise and leakage. \* Handler - Check bearings and belts. \* Compensate's - Check condition of roller and belt guides, and also, do cleaning and adjustable sensors. \* Sander roller oven - Check drive. \* Cematick - Check bancalino, rolls, belts, chains,

Drying

Enameling

Burn

pulleys and shafts. \* Traction belts and pulleys - check wear. \* Electrical Panels - Check bank of capacitors and circuit breakers; Make internal and external cleaning, check fuse status, gutters, and wiring, check relays and measuring instruments. Machinery output \* oven - Check and clean wiring, regular sensors, motors and check. Electric Motors - Check connection boxes, temperature and vibration. \* Batteries - check operation. \* Temperature Controllers - Check operation.

## VI. Conclusion

This paper presents a study on the maintenance industries producing ceramic plates and found that some companies have shown the existence of some efforts to monitoring and diagnosis in a still very shy and low result.

Thus, we saw the great potential for application of the Routine Maintenance, to obtain extraordinary benefits that can be expected with its introduction and implementation.

Therefore, emphasis is given to industries that adopt this business model of a system that for a more effective management of machinery, equipment and plant production sector in general. For this to be done, it must also identify all the constraints of production systems and provide the material resources necessary for change, managers and maintainers will have to be treated as important players in this process, thus seeking a better economic result and financial companies.

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