

# ***Implementing a Preventive Maintenance to Complement Standards 6.3 and 7.1 of ISO 9001:2008***

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**Abstract** — *The recycling process turns materials that would otherwise become waste into valuable resources, and it's know many companies around the world do this process to produce a raw material that will be used to create new products, for example the battery recycling industry. This industry used damaged batteries to produce as raw material to manufacturers of lead products such as batteries, ammunition, balance weights, automobile industry, construction industry and batteries. In order to get a place in the market companies implement some quality standards that will gain them a certification with a quality organization like International Organization Standardization (ISO). ISO is a standardization system that works with the quality of a company to achieve a standardized process. This project evaluates standards 6.3 and 7.1 of ISO 9001:2008. This standard could be implemented on any company but in this particular case it will be implemented to a battery recycling company.*

**Key Terms** — *Battery Recycling, ISO 9001:2008, Maintenance, Standardization.*

## **INTRODUCTION**

Companies around the world need quality to make reliable products. Some companies use certifications like ISO (International Standardization Organization) in order to establish that their product is made with higher standards that make the same some a reliable one. Through this design project you will see how The "X" Maintenance & Engineering Co. implements a preventive maintenance to complements with the ISO 9001:2008 standards that correspond to engineering and utilities, but the main purpose of

those standards is the infrastructure (6.3) and the (7.1) planning of product realization.

In order to complement with this standards the company should implement an aggressive preventive maintenance (PM) system to reach a zero defects process for product realization. To gain this the company used important tools that were key for the success of this design project. A goal of 20% of downtime reduction was trace by the company but due to the success PM that was implemented a 26.37% was obtained. This successful PM will be explained on along this design project.

## **RESEARCH DESCRIPTION**

The aim and scope of this research is to implement standardization on any engineering maintenance department based on the way that it's execute an engineering and at the same time basing this service on the ISO Standards. Having ISO standards on any company will open them to worldwide markets because of the prestige that brings these quality tools to it.

## **RESEARCH OBJECTIVE**

The main objective is to standardize the services that are delivered to the different areas on the company receiving maintenance. The expectation of this design project is to create a quality culture on any maintenance service no matter if the service is done internally or externally.

## **RESEARCH CONTRIBUTIONS**

One of the more important contributions that this design project will give to a company or factory will be the addition of a quality

environment in which every service will be delivered with higher standards and with dedication.

## **LITERATURE REVIEW**

ISO has developed over 19,000 International Standards on a variety of subjects and some 1,000 new ISO standards are published every year. The full range of technical fields can be seen from the listing International Standards. Users can browse that listing to find bibliographic information on each standard and, in many cases, a brief abstract. The online ISO Standards listing integrates both the ISO Catalogue of published standards and the ISO Technical programme of standards under development [1].

### **ISO Standard 6.3 – Infrastructure**

The organization shall determine, provide and maintain the infrastructure needed to achieve conformity to product requirements [2]. Infrastructure includes, as applicable,

- Buildings, workspace and associated utilities,
- Process equipment (both hardware and software),
- Support services (such as transport, communication or information systems).

### **ISO Standard 7.1 - Planning of Product Realization**

The organization shall plan and develop the processes needed for product realization. Planning of product realization shall be consistent with the requirements of the other processes of the quality management system [2]. In planning product realization, the organization shall determine the following, as appropriate:

- Quality objectives and requirements for the product;
- The need to establish processes and documents, and to provide resources specific to the product;
- Required verification, validation, monitoring, measurement, inspection and test activities

specific to the product and the criteria for product acceptance;

- Records needed to provide evidence that the realization processes and resulting product meet requirements. The output of this planning shall be in a form suitable for the organization's method of operations.

### **Planning To Complement with the Standards**

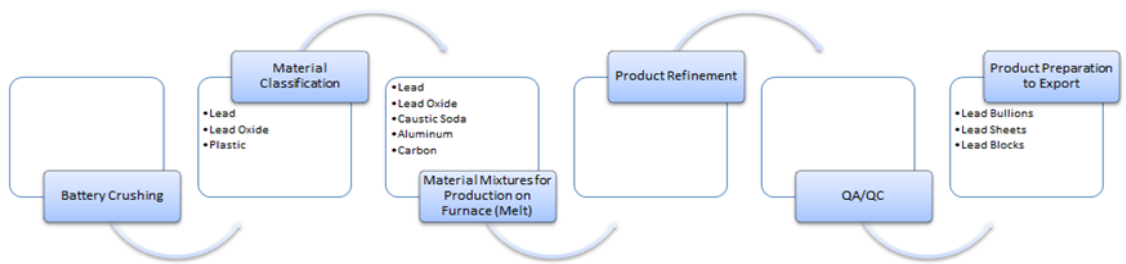
First Step – Internal Auditory: The right thing to do is to make an internal auditory to see where the company at. After getting the results of this auditory (just the one that the company is interested) some methods to solve the issues or the non-conformances to ensure customer satisfaction.

### **Goals and Strategies**

Goals are the knowing the results from the internal audit one of the main actions to follow is to implement a preventive maintenance (PM) system in the battery crusher machine, due to its sensitivity to the process (refer to flowchart below to understand the process).

As seen on Figure 1 (Battery Recycling Process Flowchart) the company process start from the battery crushing. They obtains their raw material from this machine and if they don't have a substantial stock of all this materials (lead, wet lead oxide, dry lead oxide) the production can be delayed or stop. There are two ways in which this machine can be damaged; one is from a bad operation, and the other one is from a mechanical failure, but this one mentioned can be avoided or improved with a preventive maintenance.

As has been mentioned before our main goal is to implement a PM that will be in hands of the engineering department using tools as; 5S, Plan-Do-Check-Act (PDCA)[3], Computer Software, 5-Why and the main management (plant manager).



**Figure 1**  
**Battery Recycling Process Flowchart**

They have to ensure that the machine works perfectly or close to it and have the fewer possible failures occurred by shift (this can be done with a series of checklists and reports of anomalies of the machine).

### Strategies

The best way to start the solve of this problems is with coordinating a meeting weekly with the engineering or maintenance staff (industrial mechanics, mechanical engineers, electrical engineers, management staff, etc.) to let everyone know the results of the internal audit and the goals to solve non-conformities. In addition, one of the intentions of the meeting is to receive ideas from the industrial mechanics, because they are the one that works directly with the machinery but only in a corrective way. One of the techniques used to get the plan done was a nominal group technique.

### METHODOLOGY

First, every member of the group gives their view of the solution, with a short explanation. Then, duplicate solutions are eliminated from the list of all solutions, and the members proceed to rank the solutions as 1st, 2nd, 3rd, 4th, and so on. As a first option obtained that the best plan to follow is to every day (three times a day, once by industrial mechanics shift) make an inspection of the machine to ensure the best performance of it and to detect the potential of anomalies.

To start with the changes proposed above the high management and the engineering/maintenance staffs decide to put two industrial mechanics by

shift doing three shifts in a day. The machine operates twenty-four seven, three of these hours by day (one hour by shift) will be used to do the inspection (the document to fill is the one show on Table 1) and correct the anomalies. Also another two checklists will be used for the preventive maintenance on the battery crusher; one is for lubrication of all bearings of this machine and other for the change in hammers that are the responsible to get the battery crush. Those needs to be change every two months because of the continuous operating time causing wearing on them. A picture of the machine is shown on Figure 1.

### Check the Changes

There is a notable change after the implementation of the new system, but the engineering/maintenance staff of the "X" Recycling Company still compiling data to demonstrate to the top management that there is a change in culture and a reduction in the anomalies causing that the machine have less stop hours in a production week. Then a directional indicator specifying that the machine is getting better was found.

### Act to Keep Changes

After understanding that the techniques applied to ensure the machine good operation and maintenance the engineering staff will standardize the preventive maintenance creating a (SOP) after demonstrate that the implemented strategies worked.

**Table 1**  
**Battery Crusher Preventive Maintenance Checklist**

PREVENTIVE MAINTENANCE CHECKLIST  
AREA: BATTERY CRUSHER  
TO BE FILL BY MECHANICS ON DUTY  
FREQUENCY: ONCE PER SHIFT  
SHIFT: \_\_\_\_\_

pto	Areas to be Verified	Performed?		Observations	Comments
		YES	NO		
1	Rubber Condition of Small Conveyor				
2	Rubber Condition of Large Conveyor				
3	Verify Rubber Alignment of Small Conveyor				
4	Verify Rubber Alignment of Large Conveyor				
6	Verify 2" x 1-1/2" Pump (Pump Should Be Working Properly)				
7	Verify 6" x 6" Pump and Lead Oxide Tanks (Pump Should Be Working Properly)				
8	Translation Screw (Oxide, Lead, Plastic), Electric Motors & Transmissions				
9	Paddle for Plastic Translation				
10	Alignment/Adjustment of screws on 250 HP Electric Motor and Battery Crusher Damper				
11	Verify grease and adjustment of the screws of the Housing Bearings located on Battery Crusher				
12	Verify adjustment of all the screws located on Battery Crusher Hammers Area				

	NAME	SIGNATURE	DATE
Check By			
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This will ensure that the existing industrial mechanics and new ones maintain the reliability in the PM for the machine. The staff can gain this with the training of the associates involve in the machines PM.

Also the engineering staff creates an anomaly report using the principles of the 5-Why to get to the root cause analysis. The staff meetings will stay happening weekly to ensure that everyone stays in the same course and to discuss the anomalies founds to solve them (5-Why to get the Root of the problems).

### Lean Techniques

One of the techniques used on this process and that soon will be implemented on all the factory is the 5S [4] technique used worldwide. It's a Japanese technique that uses five steps:

- Sorting – This one consists on the elimination of all unnecessary tools, parts, and instructions.

- Straightening or setting in order – this means that There should be a place for everything and everything should be in its place.
- Sweeping or shining or cleanliness - Keep the workplace tidy and organized.
- Standardizing - Work practices should be consistent and standardized
- Sustaining the discipline or self-discipline - Maintain and review standards

### ANALYSIS AND RESULTS

After the implementation of the quality techniques and tools that were previously mentioned on this project, the following results were obtained.

#### Analyzing the Implemented Changes

All the data and results obtained from the different types of checklists that were implemented in order to create a zero defects operation on this particular machinery will be discussed on the following sections.

### PDCA Technique

- Plan - First of all, the maintenance department will attack the area with the most registered anomalies site wide.
- Do - The maintenance department will collect additional data to match the registered anomalies to figure out if the data is genuine with visual inspection and analyze the data to get to the root cause of the issue.
- Check - The department will analyze and verify the inspections that are carried out (Battery Crusher Preventive Maintenance Checklist) to avoid failure in this process to achieve a zero defect operation.
- Act - The department needs to standardize the process with SOP's once the maintenance total operation is fully certified based on the profits that demonstrate the effectiveness of the maintenance process.

### Battery Crusher Preventive Maintenance Checklist

After the implementation of the mentioned checklist (see Table 1) to attack the anomalies on this machinery in order to gain a zero defects

operation all the data obtained was classified depending on the observations and comments that the mechanics write down during a one month of testing period. The results can be seen on the below graph (Figure 2).

Figure 2 shows us that the biggest offender is the small conveyor with 32 classified observations. As mentioned the data was collected from observations and comments that the mechanics write down during a one month of testing period on the Battery Crusher Preventive Maintenance Checklist. After having these results a Pareto Chart should be done in order to classify the next area to attack in order to make the machine to reach its most efficient point simultaneously achieving an efficient operation.

The Pareto chart below (Figure 3) demonstrates again that our major offender is the small conveyor on the battery crusher hitting the top with a 41.6%. The next offender is the 2" x 1-1/2" acid water pump with a 15.6%. As seen on the Pareto chart the maintenance department will need to focus on the other offender and so on.

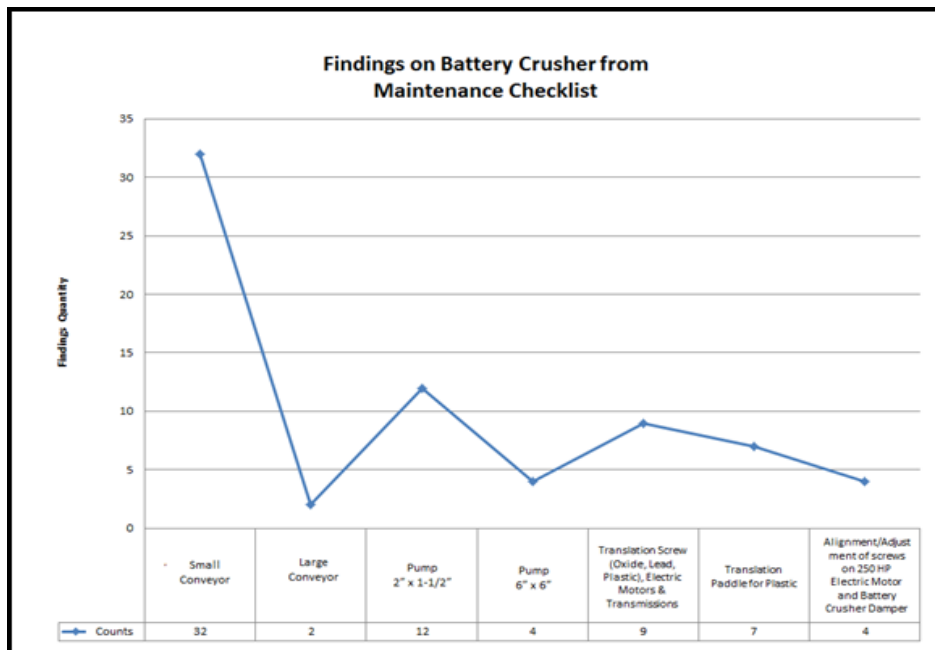
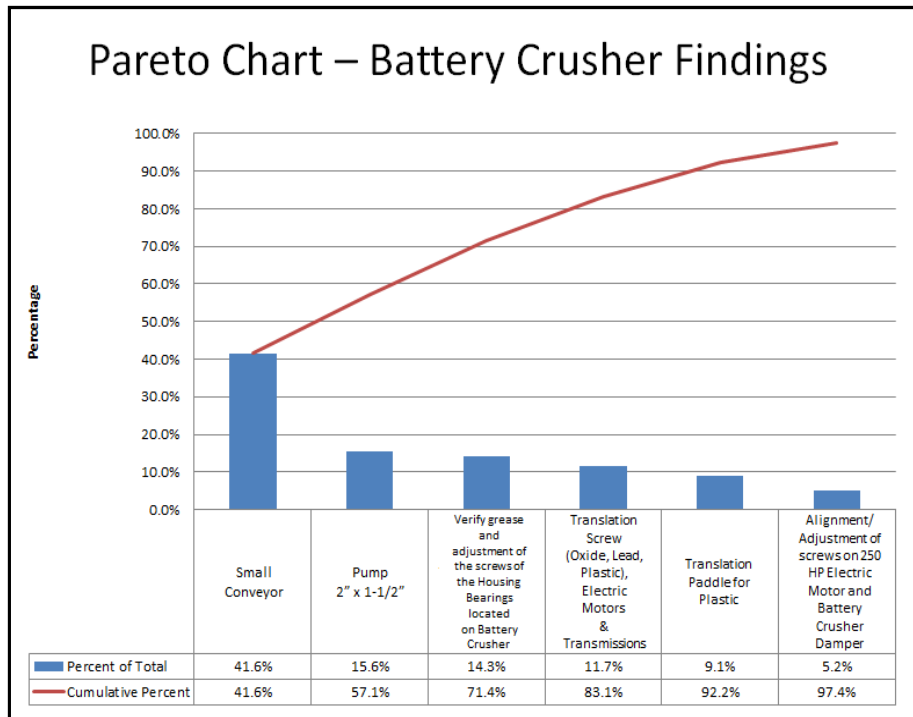
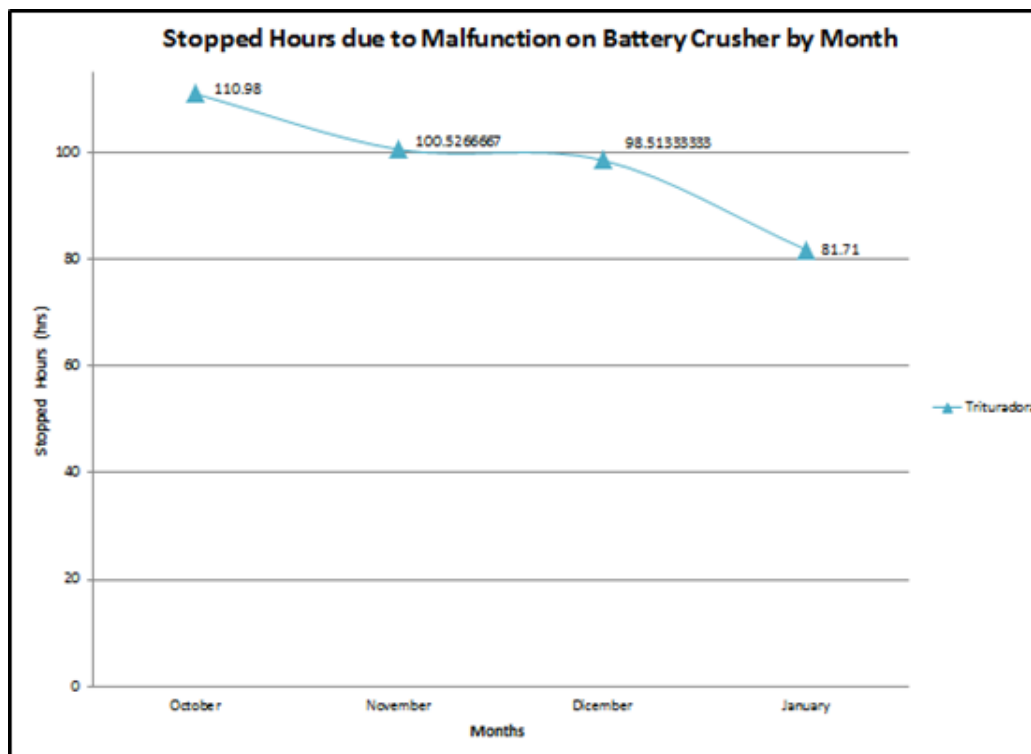


Figure 2  
Battery Crusher Preventive Maintenance Checklist Findings



**Figure 3**  
Pareto Chart for Maintenance Checklist Findings



**Figure 4**  
Stopped Hours of Production Due to Malfunction on Battery Crusher

## **Stopped Hours due to Malfunction on the Battery Crusher**

To figure out if the aggressive inspection that is being conducted on the Battery crusher is being effective, data from four months will be tabulated in order to see the inspection effectiveness. The next graph (Figure 4) shows us the stopped hours due to a malfunction from October 2010 thru January 2011.

As seen on the above graphic (Figure 4) data from October 2010 thru January 2011 could be found. We have that in the first month of implementation (October 2010) there were 110.98 of stopped hours due to malfunction on the Battery Crusher, but it could be seen that those hours decreased due to the aggressive inspection in the machine. The maintenance department traces a 20% goal of reduction on the stopped hours per month and based on the numbers that are observed on the graphic the department has achieved a 26.37% of reduction on a four months basis.

## **CONCLUSIONS**

Based on what it has been demonstrate along this design project it can be seen that the outcome is considered satisfactory. The study was conducted and focused on the improvement of a battery crushing machine for the lead batteries recycling factories. All the techniques applied during the project were performed for two purposes; the first one was to solve the issues that The "X" Maintenance & Engineering Co. were having with their Battery Crushing machine and the second one was to complement with ISO 9001:2008 standards 6.3 and 7.1 [4].

One of the many important tools that were key for the success of this design project was the Table 1 (Battery Crusher Preventive Maintenance Checklist). This one was the responsible of all the data collected to attack the defects that were causing the downtime on the machinery. As it can be seen on the Figure 4 (Stopped Hours of Production Due to Malfunction on Battery Crusher) a reduction on downtime can be observed on the

machine since the implementation of the checklist and an aggressive PM program.

It could be appreciated that with all the preventive maintenance presented on this project, The "X" Maintenance & Engineering Co. is not just improving their quality, they are complimenting with ISO 9001:2008 specially with standards 6.3 and 7.1. Quality in any company will significantly cooperate on the success of the same one at the same time opening opportunities around the globe.

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