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QUALITY IMPROVEMENT TECHNIQUES FOR REJECTION CONTROL IN HEAVY ELECTRICAL MANUFACTURING INDUSTRY - A CASE STUDY

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ABSTRACT

Baffles are provided to guide the steam and condensate flow for efficient heat transfer and to support the tubes at regular intervals for vibrations free performance. The holes are drilled to very close tolerance to reduce the vibrations. The variations in the ligament size of the baffles were examined using the statistical quality tools like Fishbone Diagram, PDCA Cycle and Control Charts, etc. Proper Statistical Process Control starts with planning and data collection. Statistical analysis on the wrong or incorrect data is rubbish, the analysis must be appropriate for the data collected. Be sure to PLAN, and then constantly re-evaluate situation to make sure the plan is correct.

The key to any process improvement program is the PDCA Cycle.The fishbone chart organizes and displays the relationships between different causes for the effect that is being examined. This chart helps to organize the brainstorming process.

The major categories of causes are put on major branches connecting to the backbone, and various sub-causes are attached to the branches. A tree like structure results shows the many facets of the problem. The method for using this chart is to put the problem to be solved at the head, then fill in the major branches.

People, procedures, equipment and materials are commonly identified causes.This is another tool that can be used in focused brainstorming sessions to determine possible reasons for the target problem. Finally inferences drawn by using these tools and also suggestions offered for reducing the levels of rejection to a great extent.

KEY WORDS: Baffle, Fish Bone Diagram, Ligament, Pdca Cycle, Rejection

INTRODUCTION

Quality Improvement is a formal approach to the analysis of performance and systematic efforts to improve it.Quality Improvement can be distinguished from Quality Control in that Quality Improvement is the purposeful change of a process to improve the reliability of achieving an outcome.Nonconforming items are rejects.

A reject is tallied when an entire unit fails to meet acceptance standards, regardless of the number of defects in the unit. This includes defective products or unacceptable outcomes.

Quality in manufacturing requires the practices of statistical process control (SPC) for controlling and managing a process through the use of statistical methods. Thus, SPC will be able to reduce the probability of passing problems to the customers.

SPC has a distinct advantage over other quality control techniques, such as final inspection, which utilize human resources for detecting and correcting problems at the end of the production cycle. It emphasize on early detection and prevention of problems. It is also aimed at continuously improving the process to manufacture quality product for achieving high customer satisfaction.

Objectives of the Study

1) To understand how to reduce and control variations of a product or process.
2) To take a decision concerning which parameter affects the performance of a product or process.
3) To identify the reasons for rejection and evolving a systematic procedure by using Fish Bone
4) Diagram and PDCA Cycle.

Problem Definition

The problem that encounter with varying ligament sizes are due to the changes in the pitch dimensions of the holes in the longitudinal and lateral directions, which is a critical dimension for this study. As it is high pressure heat exchanger the pressure in the tubes are high leading to breakage of weak ligament due to vibrations. The diameter of the hole is another influencing factor in the variation of the ligament size.

METHODOLOGY

The following Statistical tools are used to carry out the study.

Fishbone Diagram

Ishikawa diagrams (also called fishbone diagrams, herringbone diagrams, cause-and-effect diagrams, or Fishikawa) are casual diagrams causal diagrams that show the causes of a specific event. Common uses of the Ishikawa diagram areproduct design and quality defect prevention, to identify potential factors causing an overall effect. Each cause or reason for imperfection is a source of variation. Causes are usually grouped into major categories to identify these sources of variation.

PDCA Cycle

PDCA (plan–do–check–act or plan–do–check–adjust) is an iterative four-step management method used in business for the control and continuous improvement of processes and products. It is also known as the Deming circle/cycle/wheel, shewhart cycle, control circle/cycle, or plan–do–study–act (PDSA). A fundamental principle of the scientific method and PDCA is iteration—once a hypothesis is confirmed, executing the cycle again will extend the knowledge further. Repeating the PDCA cycle can bring us closer to the goal, usually a perfect operation and output.

REVIEW OF LITERATURE

M. Arasu, C. Vijay Kumar, and M. Vignesh Kanna [2] : deals with the reduction in process defects and consequent improvement of the quality in the pinion manufacturing cell in manufacturing shop. Reducing the rejection cost or reducing the cost of poor quality is the major initiative for any organization. Reducing the cost of poor quality always enables extraordinary gains to the organization. It directly drives increase operating profit margins, reduce cycle time, increase employee's productivity and improve customer satisfaction. Quality improvement techniques such as Pareto analysis and Why-Why analysis are used to propose improved method to reduce the in-process scrap.

A. A. Mahishi, Dr. M. Y. Khire [3]: describes about theProductivity which is an important word in manufacturing. Rejection effects productivity, so there is need to analyze the same. Rejection analysis means systematic recording and critical examination of the root cause of the rejection and control effectively to reduce the same. The main aim of rejection analysis is to maintain the quality of the product at the standard level along with reducing the efforts behind the production activities.

DISCUSSIONS & RESULTS

Fish Bone Diagram

The Fishbone Diagram (Fig-1) is a tool for analyzing process dispersion. The main goal of the Fishbone diagram is to illustrate in a graphical way the relationship between a given outcome and all the factors that influence this outcome. Brainstorming tool is used to identify potential root causes to problems. Because of its function it may be referred to as a cause-and-effect diagram.The main objectives of this tool are:

1) Determining the root causes of a problem.
2) Focusing on a specific issue without resorting to complaints and irrelevant discussion.
3) Identifying areas where there is a lack of data.

The possible source of variation of the dimensions in ligament sizes of a baffle is mainly due to Men, Machine, Material and Method. The sub causes for each of the above were identified as shown in the above cause and effect diagram.

The main cause due to men has been broken down into sub causes such as new operator, operator, Improper Inspection. These sub causes are again broken down into further sub causes such as by passing the problem by the operator at the time of inspection, lack of motivation to the operator .It is due to the incompetent operator who is also new to the machine and untrained.

The main cause, material, has been broken down into sub causes. The sub causes include change in material and suppliers. These sub causes are further broken down into too many suppliers, and improper vendor identification.

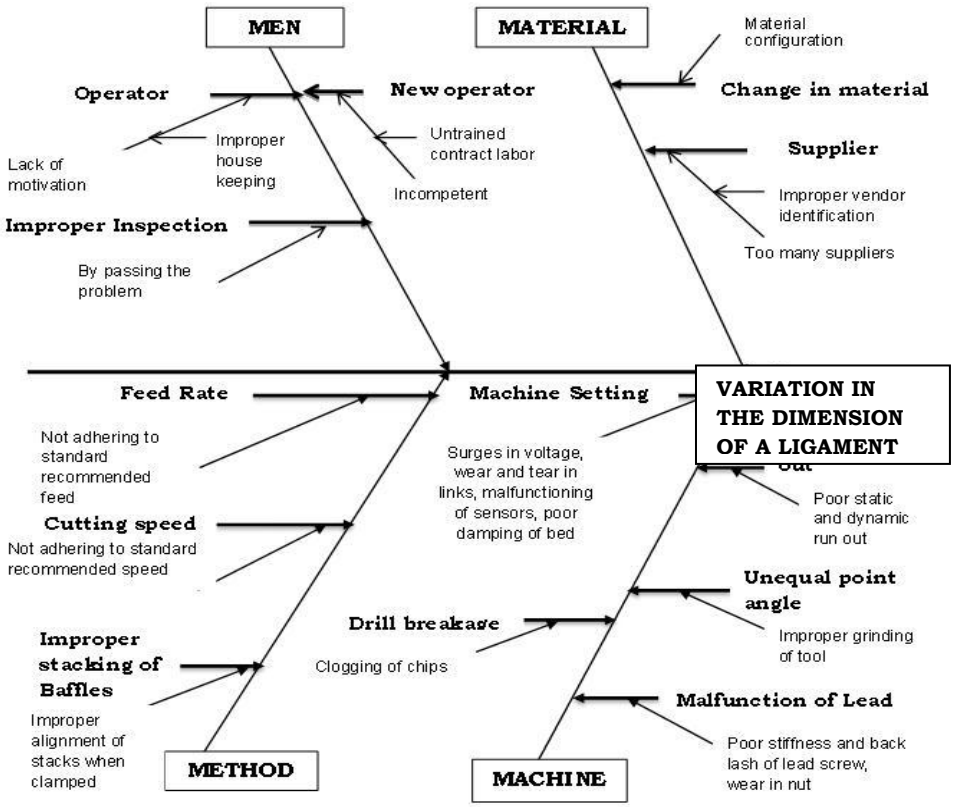

Fig.1: Fishbone Diagram/Cause & Effect Diagram

The main cause due to machine is broken down into Machine setting, spindle run out, un equal point angle, drill breakage and malfunction of lead screw. These sub causes are again broken down into further sub causes such as surges in voltage, wear and tear links, malfunctioning of sensors, poor damping of bed, poor astatic and dynamic run outs, improper grinding of tool clogging of chips, poor stiffness and back lash of lead screw and wear in nut.

The main cause of variation in dimensions are due to method adopted is fragmented into feed rate, cutting speed and improper stacking of baffles. These sub causes are again broken down into further sub causes such as not adhering to standard recommended feed and speed and poor alignment of stacks when clamped.

During brain storming session it is revealed that the major cause of variation of the dimensions in ligament sizes of a baffle is due to Machine when compared to other causes like Men, Material and Method.**6.2 PDCA Cycle**

Plan Stage

The basic purpose of this plan stage is to evolve plans to improve the performance characteristics of the product under study to reduce the difference between customer needs and process performance. This is to ascertain the reasons for rejections that are occurred in heat exchanger due to the variations in the dimensions of the ligaments of a baffle and finding the ways and means of fixing them by using control charts and diagnostic tools. In order to achieve the above objective a systematic approach is required like, deciding about the sampling frame, sampling unit, sampling element, subgroup number and sampling size.

The next step is to identify which variables to measure that is responsible for rejection of a baffle. The ways and means of collecting attribute data like number of defectives and number of defects required for rejection analysis also needs to be planned.

In this stage a plan must be established that clearly shows what will be control charted, why it will be control charted, and how it will be control charted, what type of control charts to be plotted and from whom the data has to be collected. All the above methodology as detailed in the plan stage scrupulously followed before undertaking the study.

Do Stage

This is the stage where the methodology has to be finalized with respect to the sources of data collection and plotting the charts by using the required software for the analysis of the data. The sources of data are required to be collected through Questionnaire, Direct observation, Brain Storming, referring past records of the 06 HE & F shop.

Using this data Cause and Effect Diagram, Control Charts are to be developed by using Minitab Software (15 and 16 versions).The aforementioned methodology implemented while executing the present study.

Check/Study Stage

The control charts have to be analyzed critically by studying the control chart pattern of variation has to be studied in depth and observations have to be made. Any variations in the process due to the chance causes and assignable causes of variation are to be identified. Process capability study has to be carried out to see whether the process is able to meet the specifications or not.

Revised control limits have to be plotted if the process does not stay in statistical control for regulating future production. The pattern variation that has been followed by the control charts analyzed and deductions are made with respect to assignable causes and chance causes of variation. Whatever procedure evolved during the check stage was adhered for analyzing the data as obtained from different sources of data.

Act Stage

In the act stage suggestions are to be offered by the researcher to the management of the organization in order to overcome the problem of rejections .In this connection a brainstorming session has to be conducted at top level for making policy decisions to formalize process improvements resulting from analysis of the above study. In this Stage a decision is to be made regarding the implementation of the recommendations.

After implementation if the results are positive, then the proposed plan is continued. However evaluation is has to be carried out by obtaining customer and process feedback at regular intervals of time for full-scale implementation. The study was successfully completed in all respects by adopting the procedure as mentioned in the act stage without any deviation.

OBSERVATIONS

Irregular HoleSize

1) While collecting the data the following reasons were identified regarding the variation in the dimensions of a hole leading to change in the ligaments of a baffle.
2) Loose hold (ii) unequal point angle (iii) large length of lip (iv) excessive feed rate (v) poor lubrication

low Position Accuracy

It is observed that the variation in dimensions is due to Spindle run out, Low alignment accuracy and Run out while cutting.

Drill Breakage

Drill breakage may occur due to inaccurate machine and too much of deformation of work material. It is also noticed that Drill breakage is due to frequent changes in the relief angle of the drill bit. Drill breakage is also due to chip packing and inability to enter into the material. Sometimes the drill breakage has occurred when the work piece is not held horizontal to the work table.

SUGGESTIONS

In order to overcome the problem of variation in hole diameter due to loose hold of the drill bit in the tool holder. It is advised to check tool holder and run out. The problem of oversize hole is due to the unequal point angle and varying length of lip height of the drill bit will be rectified by regrind and check precision of the angles of the drill bit and it is also suggested that to change the bearings of the spindle periodically to prevent run out of drill. When Flutes of the drill bit are congested with chips, ensure flutes are kept free from swarf or chips during the drilling operation.

The problem of irregular hole size can be rectified by checking tool holder and run out from time to time while performing drilling operation.

Whereas unequal point angle and large length of lip angle of the drill bit can be resolved by Regrinding and checking the precision of the angles of the drill bit.

The problem of excessive feed rate can be reduced to a minimum by reducing the feed rate as required. The problem of poor lubrication can be overcome by introducing an oil hole drill for deep hole drilling in place of existing general lubrication process.

Drill breakage can be avoided by increasing the rigidity of the machine and clamping the work and by ensuring the tool rigidity before performing the drilling operation. The tools need to be re grind to correct relief angle of the drill bit. Proper care has to be taken in selecting the drill geometry. The problem of Drill breakage can be dodged by keeping the work piece horizontal to Table and also it is recommended to use bush drill while performing drilling operation.

CONCLUSIONS

Rejection analysis is a systematic recording and critical examination of the root cause of the rejection and control effectively to reduce the same. The main aim of rejection analysis is to maintain the quality of the product at the standard level. Statistical Process Control (SPC) is the application of statistical methods to monitor and control of a process to ensure that it operates at its full potential to produce conforming products.

Under SPC, a process behaves predictably to produce as much conforming products as possible with the least possible waste. Hence, statistical quality control tools like Fishbone Diagram and PDCA cycle were used successfully in revealing the causes of variations and necessary suggestions offered in reducing the number of rejections. After implementation of suggestions the rejection rate came down considerably to the utmost satisfaction of the customer.

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