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Quality Improvement By Root Cause Assesment A Case Study

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Abstract:

Root-cause recognition for quality related problems are key consideration for manufacturing processes. It has been a very painstaking engineering problem specially in a multistage manufacturing, where large number of processes and activities are performed. Whilst,it can be easily implementedon in indivsual or group of activities in any manufacturing processes.Kaizen is objected towards decreasing in different types of losses i.e. Failure Loss/ B, Minor blockage, idling loss, Setup loss etc.So as to improve quality.In this report, root-cause assesment methodology has been taken into consideration to eradicate the rejection of product manufactured by the industry and increasing the life of product. Diffferent type of RCA tools have been used to find out the reasons of product failure and various problems in tubular strander which is used in wire industry to make wires.Remedies of these troubles have also described in this report. A detailed study has described the effectiveness of the proposed research.

Keywords:RCA(Root Cause Assesment) FBD(Fish-Bone DiagramTQM(Total Quality Management) SR(Stress Relieving) Tubular Strander Machine(TSM).

1.Introduction

RCA is the method to find out the basic failure of any equipment or process in progressive way. RCA once applied ensures that problems will not generate back.RCA helps to stay in quickly changing market by analyzing the basic reason of failure by reviewing the event thoroughly from every angle.It can analyse all the problems related to quality.RCA is the method of interpreting the contributory factors of problem occurrence in way an engineering approach.

1.1.Basic Terminology Adopted In RCA

Unfavourable occurrence

Hurdles

Brainstorming

Adjoining Cause

Resources

Circumstances

Basic reasons

1.2.Various Techniques Used In RCA

Fish Bone Diagram(FBD)

WW Analysis (WWA)

Current Reality Tree (CRT)

Multi Variance Analysis(MVA)

Brainstorming Sessions(BS)

1.3.Root Cause Assessment Methods

Contributory factor analysis

Transformation Analysis

Barrier analysis

Risk pyramid Analysis

Employee performance assessment

1.4.Distinction Between RCA Tools And RCA Methods

RCA Tools are the techniques to obtain effective solutions of the problem by ensuring the non-occurrence of the problems again.

RCA Methods are the ways to know how the provided solutions will give clear understanding of meeting the targeted goals.

1.5.When To Use RCA

There are many ways to solve a problem.RCA is a very planned approach to review the problem step-by-step and find out,why something has occurred and what are the ways to prevent its occurrence.RCA is a lengthy and time absorbing process.But one has to apply this to ensure better quality of product.

1.6.Root Cause Assesment Process

1.6.1.<u>Team Formation</u>

A group of experienced and knowledgeable persons is formed.Size of group is taken as 2 to 7.

1.6.2.<u>Brain Storming(Maximum Solutions)</u>

Ideas are collected from all the team members by discussions.All type of Causes of problem is found out by the rigorous discussions

After above phase there is Separation of causal and non-causal factors.Result of above discussions isolates the reasons of failure in contributing and non-contributing categories.

1.6.3.<u>Pyramid Construction</u>

A pyramid is constructed to find out the final to initial failure's cause in a precedence manner.It is done till it cannot be traced further.Each cause must be related to its preceded cause.

Once this excersise is done and analysed,team finds out the changes that has to be incorporated to prevent the regeneration of causes.

1.7.Phases Of RCA Application

Recognise the matter

Formation of team

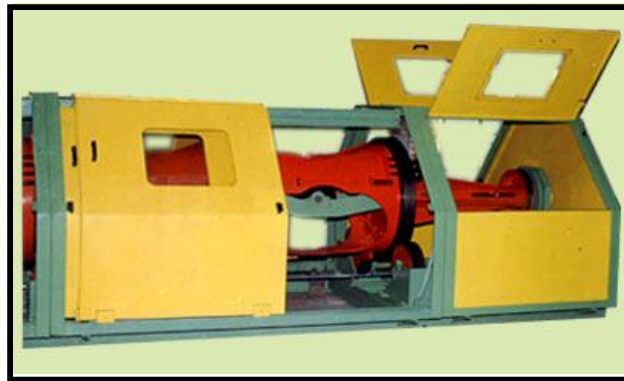Describe the physical phenomenon of reason

Use 2H3W technique.

Take every cause into consideration

Classify all logical and illogical issues.

Bifurcation of physical cause and human error cause.

2.Case Study

Study was done at wire fabrication machine plant. It produces variety of wire making machines.Focus is done on Tubular Strander Machine(TSM).

Figure1:Tubular Strander

Various problems in the machine were

Exessive Vibrations and noise

Fracture in Frame

But, no root causes were observed. It was challenge to find out the basic reason behind above mentioned problems

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2.1.Probable Causes Of Fracture

Stresses developed due to poor machining.

Improper method of fabrication.

Centrifugal force due to High Speed.

Low quality of material.

Figure 2: Fracture In Tube

2.2.Probable Causes Of Vibration And Noise

Improper balancing

Improper installation

Lack of proper maintenance

Metal to metal contact of mating members.

Fishbone Diagram has been used to incorporate multiple pobable causes with a individual effect. The diagram is formed to identify and organize the possible causes for a particular effect. After deciding the possible causes of the problem, root cause was identified.
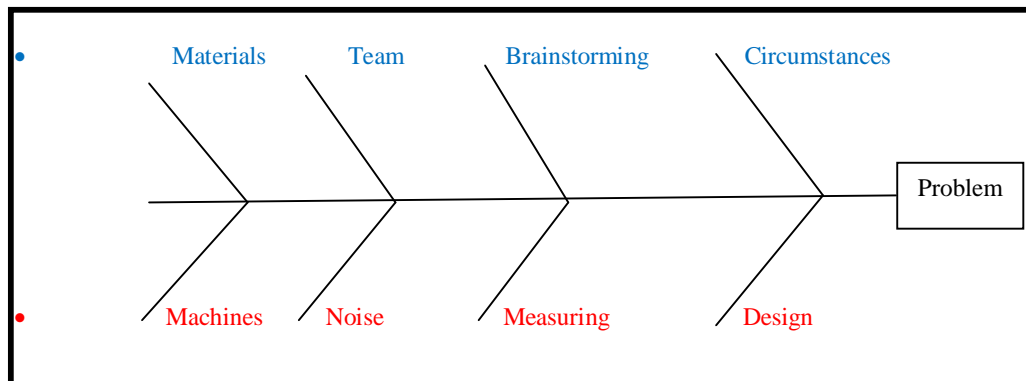
Figure 3:Fishbone Diagram

2.3.Acknowledgment of root cause

The root cause or most fundamental reason that led to the failure has to be identified. By analyzing the FBD. the following root causes were identified

Fracture in tubular strander machine was due to residual stresses by poor fabrication.
Vibration occurred due to "out of centre" running of pipe.

2.4.Solutions Of The Problems

From RCA following remedies were found out

Internal residual stresses were removed by various heat treatment processes such as hardening,carburizing,annealing etc

Out of centre running of machine can be eliminated by complete dynamic balancing of pipe with the help of balancing machine so that vibration as well as quality of the product can be improved.Which will ultimately help in reducing the formation of fracture.

Noise can be reduced by using suitable alloy(hylem) rollers inplace of metallic rollers.

2.4.1.Removal Of Stresses

Stress removal is applied to both ferrous and non-ferrous alloys with the aim to remove internal residual stresses due to various improper manufacturing methods.Else further processing will lead to undesirable distortion and the service problems will appear like stress corrosion cracking.

Different steels can be given two types of stress relief:

Treatment at   170-220°C removes high stresses after hardening without reduction of hardness

Treatment at 550-700°C provides total stress relief.

2.4.1.1.Advantages

By Stress removing and normalising metals and alloys processed further easily and having good service conditions. They improve the machinability and better service, eradication of fracture.

2.4.1.2.Stress Can Also Be Removed By Resonant Vibration Method In Which

The work pieces are subjected to low frequency, high amplitude vibrations for a small period of time based on the weight of the work piece.But it is not suitable for extrusion or cold worked jobs.

2.4.2.<u>Balancing</u>

The eccentric rotor will transmit the vibrations to the bearing ,foundation as well as the nearby machine which is very harmful and that is why proper care has to be taken of,for smooth running.

Unbalance force is directly related by following formula

F α v^2

F=Force due to Unbalancing

v=Speed of rotor

Continuous exposure of vibration leads to damage of the machine,badly affecting its accuracy and performance.So dynamic balancing has to be done.

2.4.2.1.Causes Of Imbalancing

2.4.2.1.1.Manufacturing Causes

Density

Porosity

Voids

Blow holes

Misshapen castings

Eccentric machining

Poor assembly

Rotational Stresses

Aerodynamic

Thermal changes

2.4.2.1.2.Assembly – Causes Are

Stack-up of tolerance

Keys and Keyways

2.4.2.1.3.Installation Causes

Corrosion,

Wear,

Distortion, and

Deposit build up.

2.4.2.2.Corrections

When unbalance has been identified and quantified, the correction is straightforward. Weight has to be either added or removed from the rotating element. The ultimate aim being to reduce the uneven mass distribution so that the centrifugal forces and hence the vibrations induced in the supporting structures are at an acceptable level

2.4.2.3.Effects

There are many documented "good effects" associated with a well balanced, smooth running rotor. Included among these are:

Lesser vibration

Reduced noise

Reduced structural stress

Less operator fatigue and annoyance

Improved machine life

long bearing life

Improved product quality

Increased personnel safety

Improved productivity

Lesser Operating costs

Extra machines are not required "just in case" of breakdowns. Spare capacity is kept to a minimum. Energy consumption is reduced.It's the foremost preliminary step for proceeding with any research work writing. While doing this go through a complete thought process of your Journal subject and research for it's viability by following means:

Read already published work in the same field.

Goggling on the topic of your research work.

Attend conferences, workshops and symposiums on the same fields or on related counterparts.

Understand the scientific terms and jargon related to your research work.

3.Result Analysis

Product of the company on which RCA applied is Tubular Strander. One of the problems observed during present work is

3.1.Fracture Occurring In Cradle Tube

By evaluating the RCA sheet, many brainstorming session and technical discussions with the team members, the following root causes of the above said problem was found

Fracture in TS occurred due to internal residual stresses generated by prior fabrication process.

3.1.1.Solution Of The Problem

From brainstorming, RCA sheet and literature reviews following solution was find out of the above stated root cause.

Internal residual stresses generated in pipe due to fabrication process can be removed by stress relieving.

SR can be done either by heat treatment or by Resonant Vibration Method.

3.2.Vibration And Noise In Machine

Second problem generated is Vibration in machine.

In the TS vibration is the second major problem. By analyzing the RCA the following root cause of the above said problem is found:

Vibration is occurring due to eccentric running of cradle i.e. complete balancing of the rotor is not done.

3.2.1.Solution Of The Problem

From RCA and literature reviews following solution was find out of the above stated root cause.

Eccentric running of tubular strander machine can be avoided by complete dynamic balancing of pipe by fully automatic balancing machine so that vibration as well as quality of the product can be improved. This will also be helpful in reducing the formation of cracks.

4.Kaizen Activity

Numbers of Kaizen activities were taken up for improvement in quality. Some of these activities are discussed below:

Switch over from metallic supporting rollers to Hylem rollers

Figure 4: Hylem Roller Application

Figure 5

Steel rollers cause a huge noise when rotor rotates at high speed (750 rpm) because there is metal to metal to contact between cradle and supporting rollers.

To reduce the noise a layer of hylem is used on the steel roller. Circular shape of hylem is cut from hylem sheet. Hylam Sheet also known as Phenolic Laminated Sheets, Bakelite Sheet, Tufnol Sheet. Phenolic Resin Bonded Cotton Fabric Laminates (SRBF) has an exhaustive range of Industrial Laminates Paper & fabric base Bakelite Sheets in electrical & mechanical variety.Phenolic Resin Bonded Cotton Fabric Laminates are used where mechanical strength, wear resistance and resilience are more important than electrical insulation. Typical applications of fabric laminates are gears, textile shuttles,

bearings, pickers, bushes and marine application. Different grades are offered to suit specific applications. Hylem grade F107 is used in the industries.

So the results of a RCA are typically utilized to guide and direct changes to processes, the environment, and human behavior in order to prevent or reduce the probability that the adverse event will occur in the future.

5.Conclusion

The conventional Root Cause AssesmentTools and Methods provide some planned approach to the process of human event problem solving. This empirical study shows as to how they can be used and how it can be communicated to others with full appreciation. How the solutions will prevent the problem from recurring. The Root Cause Tools and Methods could be utilized according to prevalent conditions and situations of Man, Material, Machines, Systems and Processes.

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