International Journal of Advance Research in Engineering, Science & Technology(IJAREST),
ISSN(O):2393-9877, ISSN(P): 2394-2444,
Volume 2,Issue 5, May- 2015

REDUCTION OF DEFECTS IN HOT ROLLING PROCESS USING SIX SIGMA

***Grusha Kalyan*[1], *Priyanka Sharma*[2]**

[1]*Production Engineering Department, Government Engineering College-Bhavnagar, kalyangrusha@gmail.com*

[2]*Production Engineering Department, Government Engineering College-Bhavnagar, priyankatejpalsharma@gmail.com*

Abstract

The above titled project was carried out at a company where various products were made using forming process. During project it was found that defects were occurring in hot rolling process which was in satisfactory from quality point of view. For sorting this problem Six Sigma was used. The DMAIC methodology was carried out during this project, as a result of which number of defects was considerably reduced.

Keywords*- Hot rolling process, Six Sigma, defects, DMAIC problem solving methodology*

I. INTRODUCTION

Product produced in the company is hot rolled coils and the process used for manufacturing is hot rolling process. Hot rolling process is the process of plastically deforming metal by passing it between rolls. It is the most widely used forming process, which provides high production and close control of final product. During rolling metal is subjected to high compressive stresses as a result of the friction between the roll and the metal surface. The process of manufacturing the coil from the slab is described as; first the slab enters into the tunnel furnace from the caster. In this it is heated and then it passes through oscillating shear, thereafter it passes to descaler where the scale gets removed under the high pressure of water. Then the slab passes to finishing mill where its thickness is reduced and goes for laminar cooling at run out table. Finally, the strip gets coiled at the down coiler. But due to some reasons defects were occurring in the product which leads us for implementing Six Sigma.

Six Sigma is recognized as a problem solving method that uses statistical tools for basic process improvement [2]. Six sigma is now widely accepted as a highly performing strategy for driving defects out of a company's quality system [2].Six Sigma is defined as a set of statistical tools adopted within the quality management to construct a framework for process improvement [2].

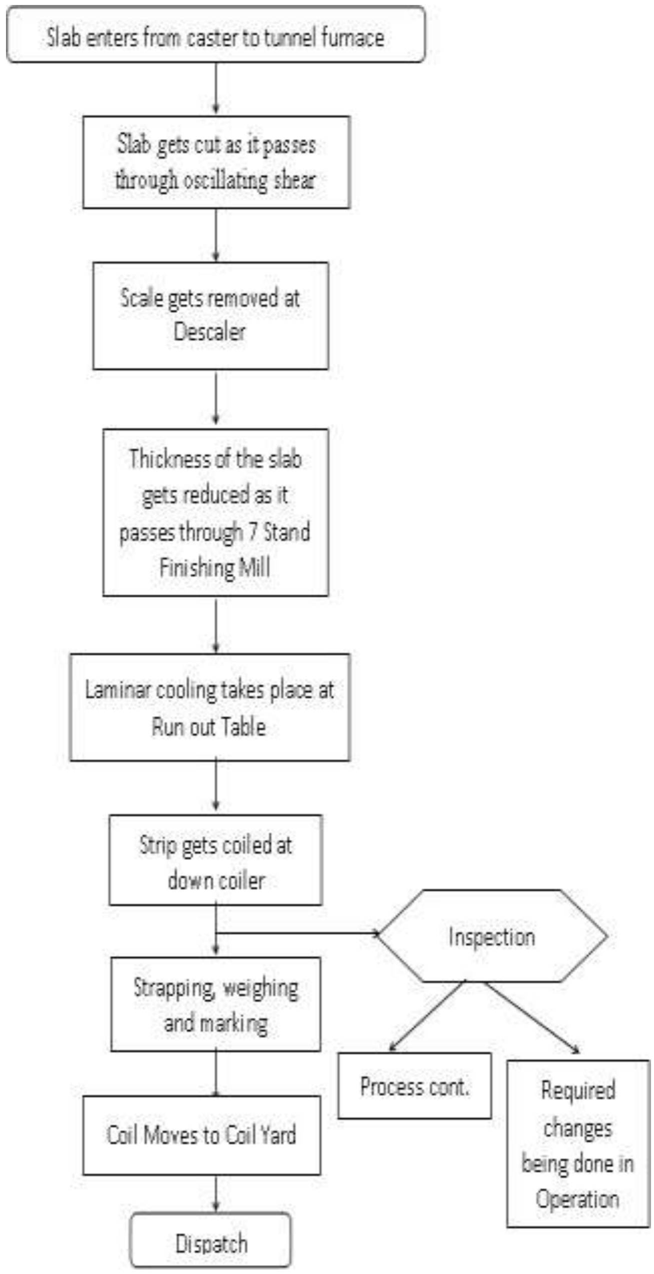

Figure 1. Flow diagram

International Journal of Advance Research in Engineering, Science & Technology(IJAREST),
ISSN(O):2393-9877, ISSN(P): 2394-2444,
Volume 2,Issue 5, May- 2015

II. IMPLEMENTATION

A. Define

In the define step, those attributes of the product are identified that are considered most important by the customers in evaluating the quality of the product. Good quality product is desired by the client or customers. As the customers want good quality products so if there is a defect in any of the product produced then it is not tolerable. In hot rolling process various defects are produced which dissatisfies the customer's specifications and causes great loss in the resources used. If the products produced are defective than it does not meet the requirements which causes big gap between desired and actual products produced. It was observed during the inspection that some coils were found to have defects in that. This poor quality coils produced are of no use and its just considered as a scrap. Great loss is there in the form of resources which are utilized to make the coil. Due to this rejection of the coils is also increased. This generation of defects is necessary to reduce the loss and improve the efficiency of the process and to produce good quality of coils to the customers. Through the reduction of defects customers are satisfied by getting good quality of coils.

B. Measure

The important processes influencing the CTQs are identified and performance measurement techniques are established for these processes. Measurement of processes and thus the defects arising in the product due to the processes is done.
Samples of the coils produced per day were taken to measure the occurrence of the defects per day. In the below data we can see the samples taken per day and in that sample size the number of defects produced is also seen. Online and Offline inspection of the coils was done. Offline inspection of the coils is carried out after every 10 coil produced.

Table 1. Sample data collected

No. of days	Coils produced /day	Sample size	Defects produced
1	284	24	
2	292	27	
3	279	24	3
4	247	15	
5	278	22	
6	243	14	
7	272	20	
8	215	9	
9	276	22	
10	217	9	
11	278	20	
12	294	25	
13	278	21	2
14	292	22	
15	294	25	
16	276	25	4

P-charts are prepared to find the defective units from the sample data taken during inspection. Coils are inspected every day and samples are taken for inspection. According to the samples taken defectives produced are as shown in the control chart. The UCL and LCL are shown in the chart.
The causes for occurrence of the defective can't be seen through this chart. Only the variation can be seen and known. In this chart it can be clearly seen that how many coils are inspected in a day and how many are defectives among them. No of defectives produced can be measured and the variation can be seen clearly.

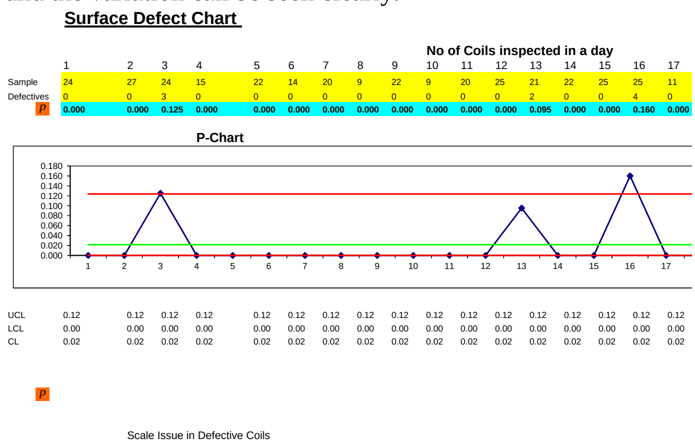

Figure 2. Control chart

C. Analyze

In the analyse stage, the key variables most likely to be responsible for variation in the process are identified to find the reason for generation of defects. In this stage analysis is done to find the root cause of the generation of defects.
To fine the causes for the occurrence of defects in hot rolling process we may apply Root - Cause Analysis.
It is the basic quality control tool through which the root cause of any effect can be easily determined.
The Japanese quality guru Kaoru Ishikawa is the inventor of the diagrams popularly known as fish bone diagrams. These diagrams look very similar to the bones of a fish, hence the name.
These diagrams are used to represent the various causes of an effect, a problem, or a quality characteristic. This is helping in finding the root cause of a problem.

Therefore, these diagrams are also known as cause-effect diagrams. The effect can be either a problem (a negative effect) or a desired outcome (a positive effect).

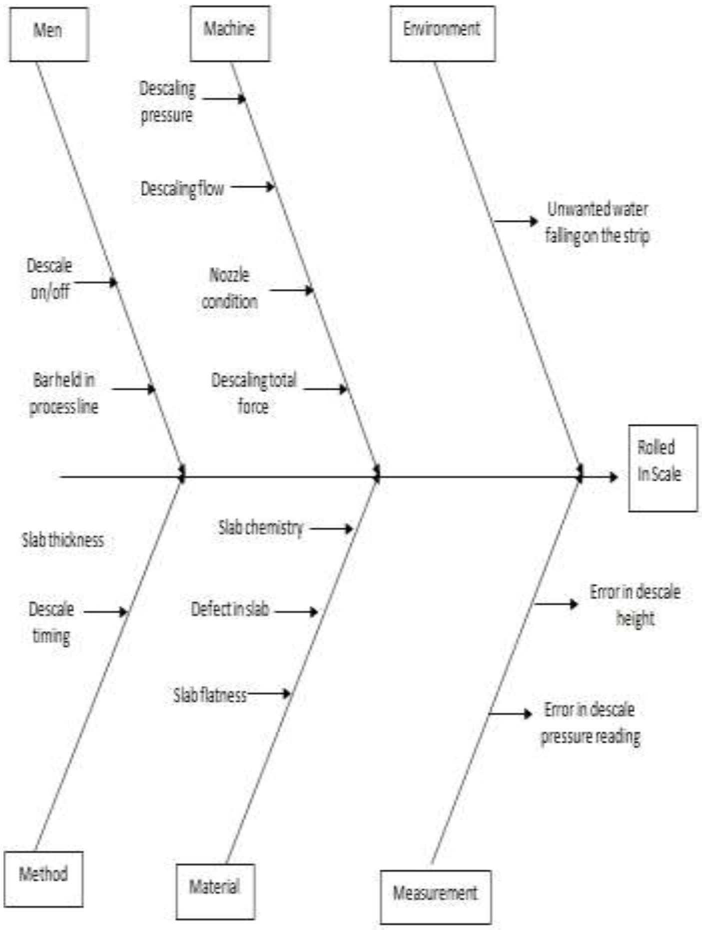

Figure 3. Root-cause analysis

D. Improve

In this stage mainly we have to overcome the causes of generation of defects. For this brainstorming is carried out in which we find the possible solutions for the causes.
Brainstorming is the simple technique in which few people come together and discuss on one topic and comes to one possible solution for the problem. In every industry this technique is usually carried out and applied. This is the easiest technique to find the solution for a problem.
The following are the recommendations to overcome the causes which were found in the analysis stage. These recommendations were found by going through brainstorming.
Recommendations to overcome the defects are as under

- Maintain high Descaler Pressure
- Workers must be trained
- Maintain Oxidizing atmosphere low temperature
- Correct method for the operation should be used.
- Supervision of all the components should be done regularly.
- Regular maintenance of descaler must be done for its proper working.
- Avoid falling of cooling water at FM and Pinch roll at DC.
- Remove excess water from ROT
- Water pressure necessary for cooling of the strip should be supplied
- Workers must be careful
- Workers must be trained and they must know what quantity for water is required so that excess water is not supplied and it does not cause any edge cracks in the coils.
- The material of the slab should not have any impurities or inclusions or voids present in it.
- The design engineer should make sure that the slab chemistry should have proper proportion of impurities and other grades of material.

E. Control

Control step is the last step in implementing Six Sigma and it is the most important step also as control part is involved in it.
Control means to ensure that the improvements are maintained over time. The modified process is subjected to vigil at regular intervals of time to ensure that the key variables do not show any unacceptable variations (beyond the specification limits).
Through regular auditing the improvements made in the process can be maintained within the specification limits and the process can be controlled

III. CONCLUSION

By applying DMAIC problem- solving methodology we have made some improvements in the process and controlled those processes. By doing these improvements it was seen that there were zero defects produced in hot rolling process. When the inspection of the coils was taken no coil was detected to be defective. This can also be clearly seen from the control chart made by taking samples every day and no coil was found to be defective.

Figure 4. Control chart

IV. REFERENCES

[1] Kunal Ganguly, "Improvement process for rolling mill through the DMAIC six sigma approach", International Journal for Quality research, UDK- 378.014.3(497.11) , Short Scientific Paper (1.03) Vol.

[2] Ploytip Jirasukprasert, Jose Arturo Garza-Reyes, Horacio Soriano-Meier, " A Case Study of Defects Reduction in a Rubber Gloves Manufacturing Process by Applying Six Sigma Principles and DMAIC Problem Solving Methodology", Proceedings of the 2012 International Conference on Industrial Engineering and Operations Management Istanbul, Turkey, July 3 – 6, 2012.

[3] Adan Valles, Jaime Sanchez, Salvador Noriega and Berenice Gómez Nuñez, "Implementation of Six Sigma in a Manufacturing Process: A Case Study", International Journal of Industrial Engineering, 16(3), 171-181, 2009.