

# QUALITY IMPROVEMENT OF CERAMIC ITEMS BY REDUCTION OF GLAZE DEFECTS AND IMPLEMENTING LEAN TOOLS

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**Abstract:** To stand up in today's highly competitive world, manufacturers need to find a way to improve quality of product with optimum cost. The removal of the waste can improve the productivity of the company. The current work aims to address the problem of the Glaze defects. After a literature review of Some Glaze properties related research papers and Six Sigma techniques we get lots of input. The main goal of this project is to reduce the Glaze related defects and improve quality as well as improve productivity of company. The work is being carried out in Ceramic Company. Careful observation has been made from entire production process and finds the various critical points which may be crucial to done properly otherwise it results into glaze defects. The results of the application on the field are shown in terms of reduction of glaze defects and reprocessing cost of company, competitive on an international market, is now a reality for all companies and consequently the impact of globalization is even more tangible. That is why companies need to regain their efforts and reduce their production costs through waste disposal and productivity growth. SIXSIGMA, a tool created by Bill Smith while working at Motorola in 1986, improve the quality of the output of a process by identifying and removing the causes of defects and minimizing variability in manufacturing. Also we Start implementation of 5S which is useful tools for creating an effective work environment without bothersome and useless influences. For the raw material management we start implementation of KANBAN system which is very much useful to manage Optimum amount of inventory and reorder system without chance of stock out.






**Index Terms** -Six Sigma, Glaze Defects, 5S, Kanban.

## I. INTRODUCTION

In ceramic industry specially in bone china, most of quality related problem occurs due to glaze related defects such as: Glaze off, Pinhole, Grog, Chipping and Black spot. All these defects result into the reprocessing which involves two things first one is to re-glazing and second one is re-firing which results into very much high financial loss to company. Main aim of this study is to tackle these defects before second firing stage as well as reduce the chances of occurrence of these defects which provides huge financial saving to company. Second this is 5S, aim behind implementation of these tools is to make workplace more effective and efficient which ultimately results into the better working environments.

## II. SIX SIGMA FOR GLAZE DEFECTS REDUCTION TECHNIQUE

Mathematically, 'Six Sigma' represents Six Standard Deviations (plus or minus) from the arithmetic mean. As a program, it presents a "structured and systematic approach" to process improvement. Six Sigma is a set of techniques and tools for process improvement. It was introduced by engineer Bill Smith while working at Motorola in 1986. Reason behind using of this technique is it is one of the most powerful tools for removing the causes of defects and minimizing variability in manufacturing. There are five main steps in this process: Define, Measure, Analysis, Improvement, Control. We start with defining the objective, reduction of glaze defects and identified the major area of area on which we have to focus: Rubbing, Glaze & 2<sup>nd</sup> firing. These are main three critical processes which are mainly responsible for these glaze defects. In rubbing process if the rubbing is properly done then surface of rub ware becomes smooth or rough due to glaze cannot properly stick to rub ware surface which results in glaze off. After this in air blowing is not properly done then dust particles remain in rub ware and this stuck with glaze materials and results in the Black spot or Grog. If the glazing is properly done that also results in glaze off or uneven surface of materials. And at last if the car is not properly loaded it results in chipping and if the firing is not properly done also results in glaze off, Black spots and Grog. Also during this phase I classified the defects in main five categories as such: Glaze off, pinhole, Grog, Black spot and Chipping.

Glaze Defect chart		
 <p>Glaze Off</p>	 <p>Black Spot</p>	 <p>Grog</p>
 <p>Chipping</p>		 <p>Pinhole</p>

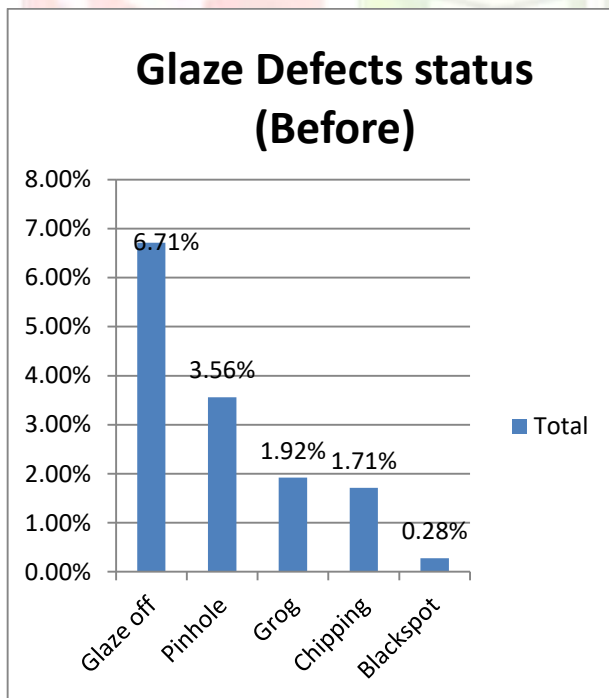
**III.OBJECTIVE OF THE PRESENT WORK**

Goal of this project is to reduce defects level up to 6% which ultimate to result in lots of saving in reprocessing cost. Six Sigma is lean manufacturing tool and technique that is applied and applied in this area. This technique helps the company to reduce the defects and saving of material men as well as time. This will helps the company to improve quality and Productivity.

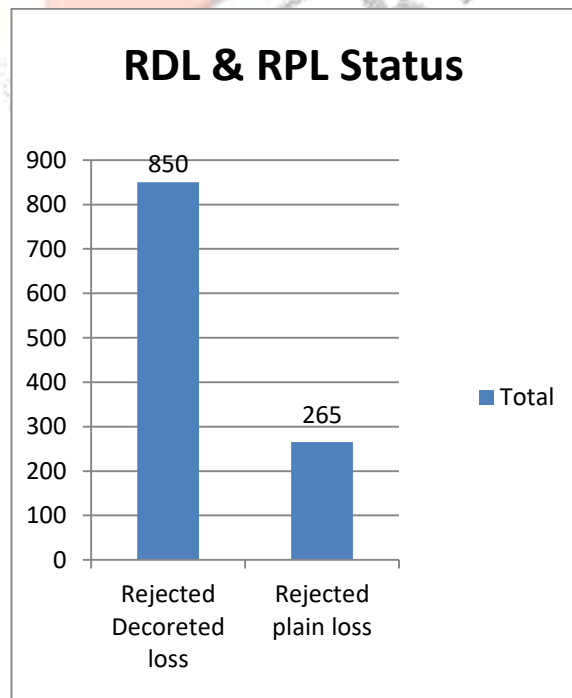
**IV.PROCEDURE AND DATA COLLECTION**

For the data collection first I have classify defects in five major categories like: Glaze off, Pinhole, Black spot, Grog & Chipping. According to these major defects I have starts data collections. This is data collection belongs to when I starts the project.

**Data collection of Glaze Defects**



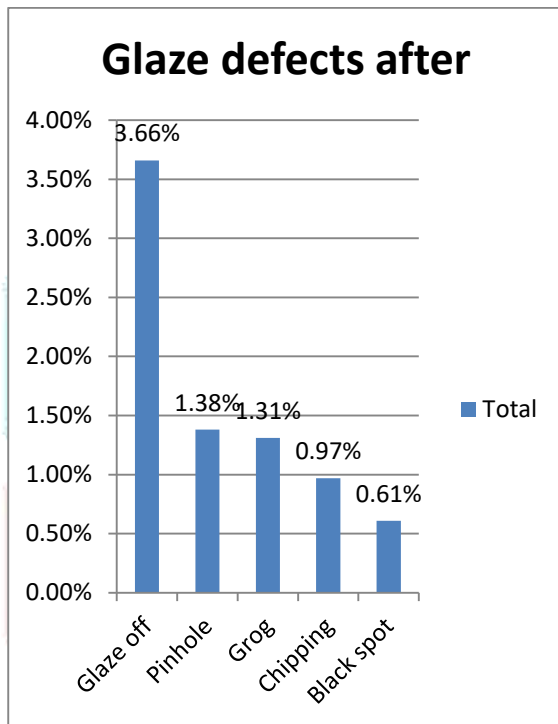
**Data Collection RDL &RPL**



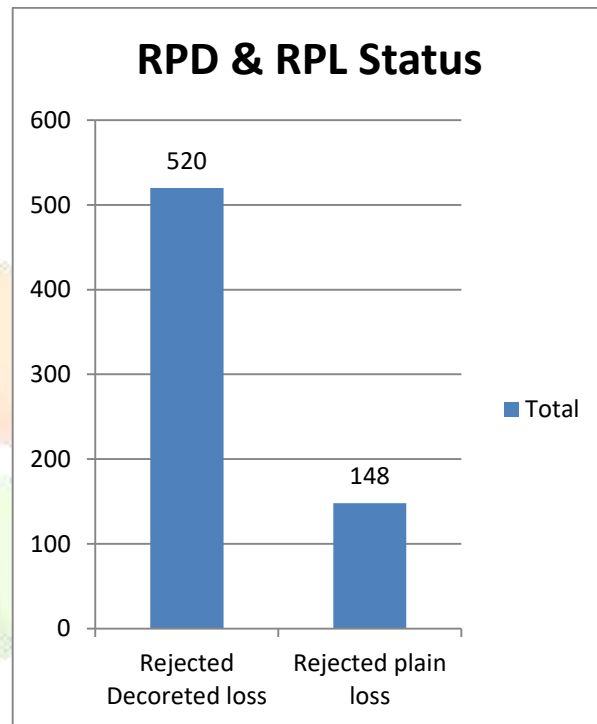
After detailed data collection I start to find the cause of defects. so Two out of four samples from clays fired up to 1070 °C under a fast 45 min cycle showed “black core” defects, while the remaining two samples had craters and gas bubbles in the glaze layer. The “black spot” is caused by incomplete oxidation of organic matter, while glaze defects are mainly caused by the late release of gas from decarbonation reactions when the glaze is melted. Dynamic Evolved Gas Analysis (DEGA) has been used to avoid these defects. DEGA shows that CO related with organic substances escapes at low temperature, while NO and NO<sub>2</sub> require further heating. SO<sub>2</sub> and CO<sub>2</sub> escape at relatively higher temperatures and are respectively associated to sulphides and/or sulphates, and carbonates. An increase of the firing cycle from 45 to 60 min is therefore suggested and the use of two low-rate heating stages: 1) 11 min from 520 °C to 590 °C to avoid “black core” defects; and 2) 8 min from 800 °C to 900 °C in the decarbonation zone, thereby eliminating glaze craters and bubbles, and also find the various other cause which are responsible for this glaze defects. This works only for black spot and pinhole. For chipping. Grog and glaze off material handling and car loading is the major cause. The major cause are identify at the end of this phase are shown by cause end effect diagram.

After implementing all the solutions we achieve following results which are shown by bar graph.

Data collection of Glaze defects



Data collection RPL & RDL



❑ **Before (When Project Starts)**

Approx. Rejection per day: **4500 Pieces** (Data Collect from format)  
 Approx. Rejection per Month: **135000 Pieces**

Total Reprocessing Cost: 135000 X 2.02 Rs  
 = **2,72,000 Rs per Month**

❑ **After (When Solutions Implemented)**

Approx. Rejection per day: **2360 Pieces** (Data Collect from format)  
 Approx. Rejection per Month: **70800 Pieces**

Total Reprocessing Cost: 70800 X 2.02 Rs  
 = **1,43,016Rs per Month**

Deducting the salary of extra 4 worker we use = **1,28,984– 21,500=1,07,484**

Total benefit obtain by reduction of re-processing cost is **1,07,484** Rs per Month

**V.5S IMPELEME**

1.1S Seri (Sort) – We sort out all the unnessury things from all the departments and give them a red tags.

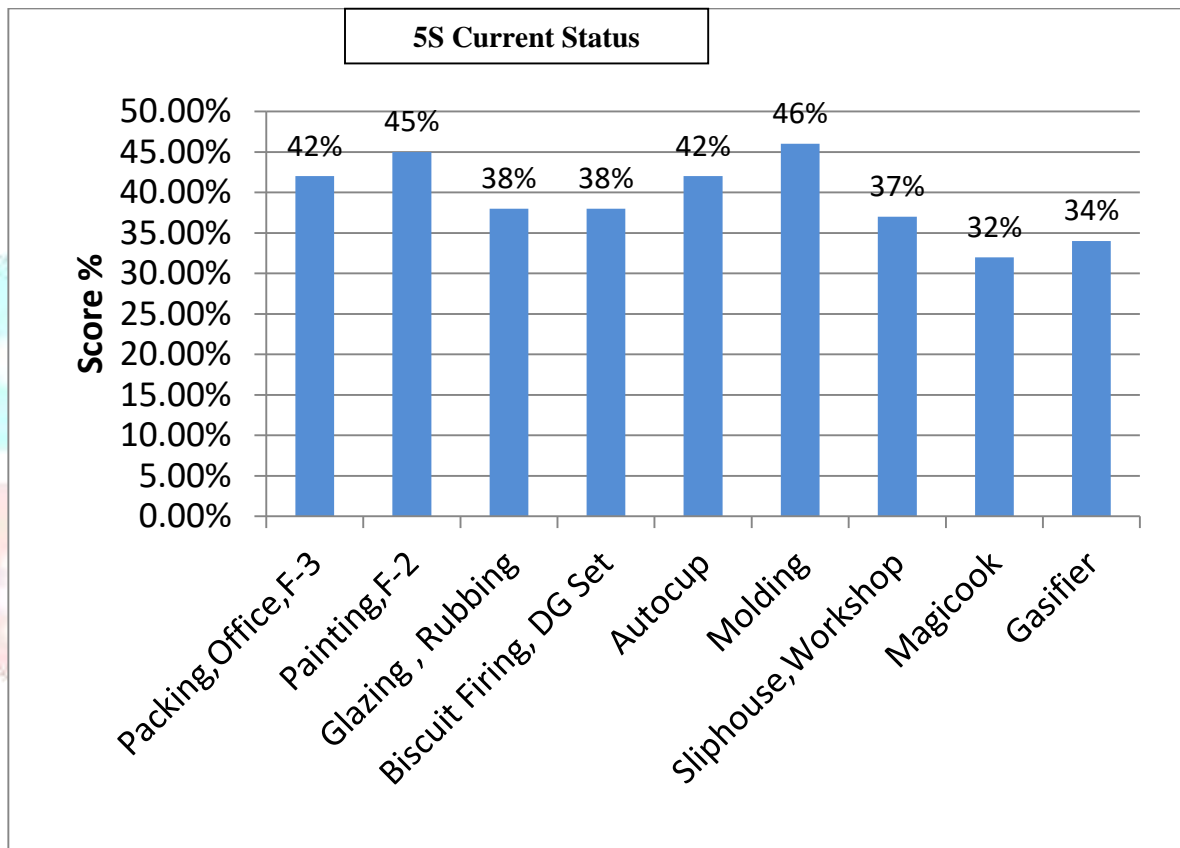
2.2S Seiton (Sort in order) – We properly arrange all those things which remains after sorting activity and prepare visual identification for all the things.

3.3S Seiso(Shine) – We celebrated a mega-cleaning day in which we clean entire plant and involving all the department’s all members from management to floor worker also. After this for regular cleaning we start a use of cleaning sheet and abnormality form.

4.4S Seiketsu(Standardize) – We do proper walk-way arrangement for this draw yellow marking in entire plant. And also starts the practice of Gemba boards, trend charts and Visual SOPs.

5.5S Shitsuke(Sustain) – We provides internal audit training to all the zone leaders and tell them to do audit to properly sustain these improvements.

This is the current status of 5S in over company. All this benefit achieve with status if we implement and sustain 100% then we become world class system.



After implementation of 5S in Company I achieve lots of tangible and intangible benefits.

**Tangible benefits**

1. Paper and cardboard waster =5400
  2. Plastic bags=1680
  3. Plastic waste (stickers)=2185
  4. Metal scraps=48000
- Total benefit obtain=57,265rs

**Intangible benefits**

1. Most of the company area is free of unnecessary materials and are effectively utilized
2. Materials are arranged systematically and not mixed, Hence searching time and product mixing has been reduced
3. New stacking method allows to store more inventory then before

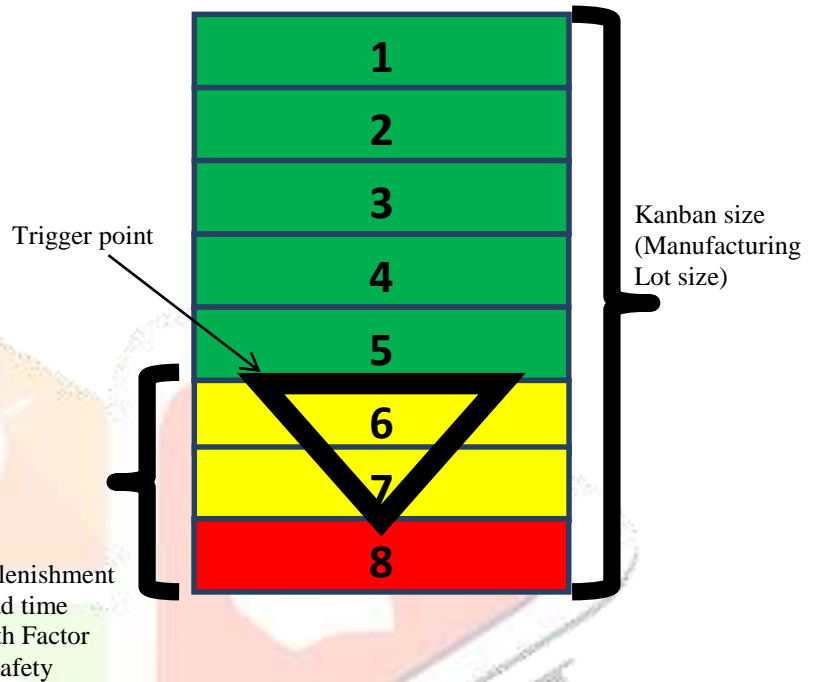
- 4. FG are arranged order wise and separate area is kept for delivery good, Hence truck loading time is reduced and there is Less Clutter at dispatch station

**VI. KANBAN**

Kanban implemented in slip house to properly manage the inventory of raw materials and maintain the smooth flow of replenishment of raw materials. Due to this lots of free capital space are free and reduce the wastage of raw materials.

We calculate the reorder level for every material and prepare a Kanban triangle according to that.

Reorder Level			
Bon Powder	Calcium	Chemical	Felt spur
24750	21681	15510	23166
Quartz	20 Microns	Ashapura	Ball clay
4884	11550	6534	2211
Bentonite	Barium	Acid	CR
2376	84	66	60
Calcite	Cobalt	Frit	Vitrobright
2970	16500	4400	786.5



**VII. CONCLUSION**

- We tackle the problem before 2nd firing stage ,so cost of firing was saved. Still we are working for to resolve the problem from glazing stage itself.
- Also due to this Project rate of RPL & RDL was reduce which will give more profit to company. Where in case of RPL, cost of products almost reduce to 50% of MRP & in case of RDL, cost of product almost reduce to 20% of MRP.
- At the end when we start the project the reprocessing cost was 2.72 lac per month and now after this project reprocessing is 1.29lac
- 5S implementation makes company more efficient and gives lots of intangible benefit & tangible benefit. Once it comes in routine it's the burden on workers will reduce and they will become more productive.
- Kanban implementation makes replenishment process smoother and Lots of free capital space as well as reduces the waste of materials due improper storing.

**VIII. ACKNOWLEDGMENT**

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