A Case Study On Six Sigma Approach To Detect Forging Defects In Forging Industry

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Abstract- *Through this paper a case study conducted at Trinity forging in Pimpri chinchwad. Through this study it was observed that the Scrap rate was more than Three percent PPm in Press shop .In the second phase the collected data was validated by collecting sampling during production hours, which helped in representing a true picture of defects occurred in manufacturing. Finally an analysis was done using six sigma Technique. Pareto diagram was used to identify. The measure defects ninety percent of total defects where due to under fill. Other rejection (overheat, Burnt, Bent) Forging cracks, Mismatch. These all Defects where occurred during forging operation .Some corrective measured was also suggested to overcome these defects. At the end it is concluded that the after proper use of forging lubricants and lubrication methods such as spray lubrication and mixture of graphite and water(1:15) if used as quenching medium may reduce the present defect rate*

Keywords- Forging, Pareto Analysis, Six sigma

I. INTRODUCTION

Forging is the process of shaping of heated metal by application of sudden blow steady pressure and makes use of characteristerics of plasticity of material. Traditionally forging was performed by smith using hammer and anvil. Using hammer and anvil is crude form of forging. The smithy and forged has evolved. Over centuries to become a facility engineered process, production equipment, tooling etc. some of the forging products are flange yoke, Rocker Lever, tube Yoke, Connecting Rod. Gear pinion, Crown wheel etc. In these process starting material has relatively simple Geometry, These material is plastically Deformed in one or more operations in to product of relatively complex configuration. In forging product has been elongated plastically. And usually exhibits better ductility. in direction parallel to that of plastic elongation. Through plastic deformation grain become oriented parallel to the elongation. Defects can be defines as the imperfection that's exceed certain limits.

1. Six Sigma

Six sigma (ϭ) Is Greek letter that represents the standard deviation of a simple population in the statistics . Measuring process capability, The standard deviation between the Process mean and the nearest specification limit. Is Designated in sigma units. Six sigma strategies is used to improve quality of the output of the process by identifying and removing the causes of the defects and minimizing variability in manufacturing and business process. Also we can reduce the defects by using corrective actions and preventive action associated with the statistical process control and associated with the six sigma. It uses a set of Quality management methods. Mainly imperical statistical methods and create special infrastrucal of people within the organization who are experts in the methods. Each six sigma project carried out within an organization follows a defined sequence of steps and has specific value targets for example: reduced process cycle time reduced pollution, Reduced costs, Increases customers satisfacation and increase profits

II. FORGING DEFECTS

1. **Cold Shut (Fold):** Two surface of metal fold against without welding completely
   Cause: sharp corner (less fillet), excessive chilling high friction.
   Remedy: increase fillet radius on the die.
2. **Unfilled section (unfilling and underfilling):** some section of die cavity not completely filled by the flowing metal.
   Cause: improper design of forging die or using forging techniques, less cut weight of billet, poor heating, position of billet, improper flowing of metal.
   Remedy: proper die design, proper cut weight and proper heating.
3. **Die shift (mismatch):** misalignment of forging at flash line or changes in thickness.
   Causes: Misalignment of die halves (in mm).
   Remedy: proper alignment of die halves. Make mistake proofing for proper alignment for e.g. Provide half notch on upper and lower die so that at the time of each alignment notch will match each other.
4. **Scale Pits (pits marks):** irregular depurations on the surface of forging.
   Cause: improper cleaning of stock use for forging. The oxide and scale gets embedded into the finish forging surface.

Remedy: proper cleaning of die during forging process.

5. **Flakes:** These are basically internal ruptures.
   Cause: improper cooling of forging. Rapid cooling causes the exterior to cool quickly causing internal fractures.
   Remedy: Follow proper cooling practices.
6. **Surface Cracking:**
   Cause: Excessive working on surface and too low temperature.
   Remedy: To increase work temperature.
7. **Improper grain flow:**
   Cause: Improper die design, which make the metal not flowing in final interred direction.
   Remedy: Proper Die Design.

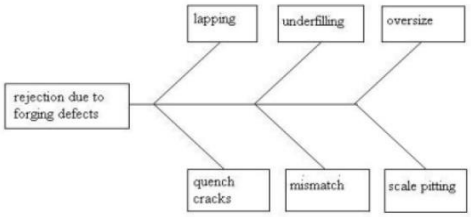

Figure 1 Forging Defects

Defect wise Pareto:

Defects	Rej. Qty	Cumm	%
Under fill	7549	7549	65
Other Rej.	1632	9181	80
Forging Crack	1182	10363	90
Mismatch	665	11028	96
Bend	306	11334	98
Scale pit	127	11461	99
Over heat or burnt	79	11540	100
Dent	7	11547	100
Total	11547		

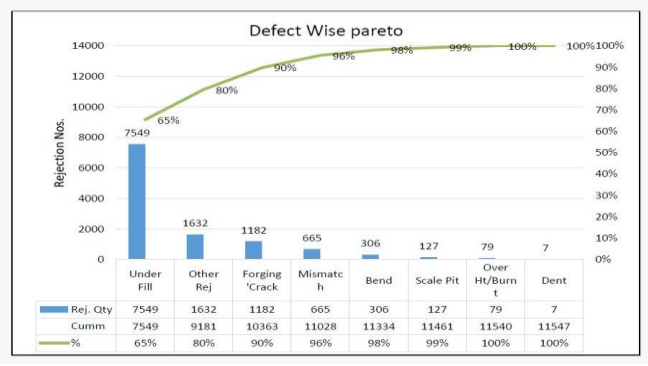

Figure 2 Defect Analysis using Pareto Diagram

Summary:

1. We have identified that major forging defects are under fill, crack, lapping, scale pit, mismatch and oversize. Industry is experiencing under filling and mismatch is major defects in the forging processes.
2. Few investigators have used basic quality control tools to investigate the forging defects and they are able to identify major defects, their causes and remedies to control the forging defects.
3. Scaling defects can be reduced by anti scale coating. and proper lubricants in a forging process. Also providing proper cleaning during forging process.
4. Forging process can be optimize to minimize the defects. By proper selection of parameters like temperature, Heating time and Billet weight.

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