Study of Various Factors Related to Quality in Forging Industry

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In recent scenario every manufacturing organisation is concerned with quality of the product in order to remain ahead of its competitors and be first preference of customers. It is important that finished product meet standard specification. In this paper the various parameters that affect forging has been studied so that the solution can be provided for improving the process which will increases the quality of the product. The problems faced by the manufacturer during the forging process are taken into considerations and the factors which are responsible for the problems are identified. With the help of statistical tools like cause and effect diagramand pareto diagramit is possible to explore possible causes of defects through brain storming session and to determine the causes which affect the quality of product.

Keywords: ***Defects In Forging, Cause And Effect Diagram***

I. INTRODUCTION

Forging is the working of metal into a useful shape by hammering or pressing. The drop forging industry has been an important partner of the automotive industry and thus of a vivid branch for a very long time. On the one hand this intensive focus guarantees a high level of capacity utilization in the forging industry, on the other it leads to a strong dependence and to considerable economic pressure.Quality product is very important because customer's satisfaction is derived from quality of products and service rendered. Moreover stiff competition in the national and international levels demand better quality of product and service. In this project quality problems of the company are taken in to consideration. This requires need to understand the type of quality problem faced by industry and what is the impact of the problem on the productivity of the company. According to A S M Handbook (1988) it includesmany processes to be performed like heating of billet to required temperature, hammering orpressing the heated billet in multi impression dies, trimming the forged component to remove flashand coining to have final dimension .

Fiyikawa (2000) stated that in order to achieve required mechanical properties most of products for automobile are forged with micro alloyed steel .Usually, the shapes of forging products are complex, and many defects are induced during the process of forging such as under-filling, lining etc. There are many imperfections that can be considered as being defects, ranging from those traceable to the starting materials to those caused by one of the forging processes or by post forging operations. Some classifications of defects in forging operations can be found in the literature, but generally the representation of possible defects is too poor. Furthermore, the defects are often based on very rough rules. Therefore, a more comprehensive work is required to classify defects related to forging. Defects can be defined as imperfections that exceed certain limits. In other words, there may be imperfections that are not classified as true "defects" because they are smaller than allowances in the applicable specifications. Classification of process parameters that affects forging is also provided with descriptions of defects observed from the forging processes. The factors like, under-filling, rough surface, lining, pitting, cracks and overlap etc has been identified and their effect on the quality of product is studied, and with the help of quality tools the possible solution have been provided.

II. LITERATURE REVIEW

Mostforging operations are carried out hot, although certain metals may be cold-forged. In this paper the process parameters that affect forginghas beenanalysed. Analysis will furtherbe utilized to find the solution for improving the process in order to increase the productivity.

The pressure applied during semi solid forging, forced the metal to accommodate closely to the die surface, thereby paving the way for the components to exhibit improved hardness. During this research, only three factors namely forging temperature, load and friction between die and work piece were considered.

The analysis of six cylinder crankshaft produced by hot forging shows that more than 80% of rejection and rework are due to forging defects like overlap, underfilling, pitting, foreign body and shop scrap. Corrective measures are being suggested to overcome the forging defects of the 697 integral counter weight crankshafts. Finally, few remedial measures andsuggestions have been provided for the existing crankshaft production line in the forging shop and controlling vital few forging defects will help reduce the present rejection rate.

During the introduction of materialThyrotherm 2999 EFS SUPRA;which is especially designed for hot forming applications with intensive thermal and mechanical impacts on the tools, to the market application tests have been carried out with various customers in many different forging operations ranging from press and hammer forging to high speed forging. The report describes the results and the experience gained in these tests and proves that the use of Thyrotherm 2999 EFS SUPRA directly contributes to an improved tool performance.

The various forging defects that occur in a forging industry that causes high rejection rates in the components are identified and this paper describes the remedial measures that can reduce these defects in the hot forging. The investigation was done with the help of quality assurance department within the industry. The various defects that occur in the components during forging are identified. The result indicates that the rejection rate in the company was more than five percent of the total productions made each month. The defects in the forged components include the under-filling, scale, cracks, mismatch etc. In this paper the different factors for effective forging are studied and the remedial actions that required for controlling the rejection rates due to forging defects .

III. PROBLEMS IN FORGING INDUSTRY

Any forging industry there are many problems which are faced by the manufacturer. These problems are generally responsible for the rejection of the product in the market. Few of the problems faced by manufacturer are listed below

1 under-filling
2 poor surface finish
3 lining
4 pitting
5 cracks
6dent
7 overlap
8 Eccentricity

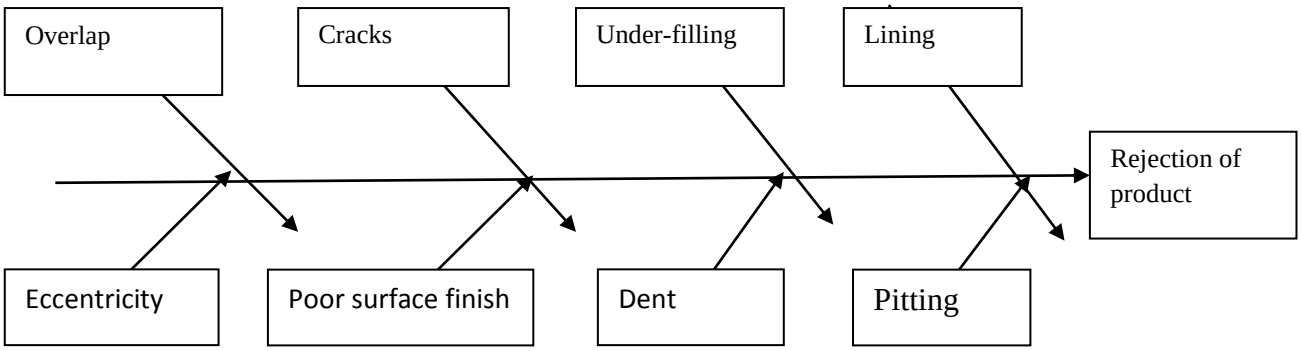

Figure 1. Trivial many defects responsible for rejection of product

Bagchi (1997) suggested that statistical tools like cause and effect diagram and Pareto diagram can be used for problem solving and quality improvement. The analysis of data, information and use of statistical tools are mainly focused over here for continuous improvement practice by cause and effect analysis through process improvement and identifying most promising factors for rejection.

As shown in figure 1, the important factors which areresponsible for the rejection of the forging product have been identified; these factors affect the quality of the products and results in the rejection of the product from the market or from the quality department of the organization. So in order to control the quality of the product or in order to meet the required specifications of the product it becomes necessary to identify these defects and take corrective action.

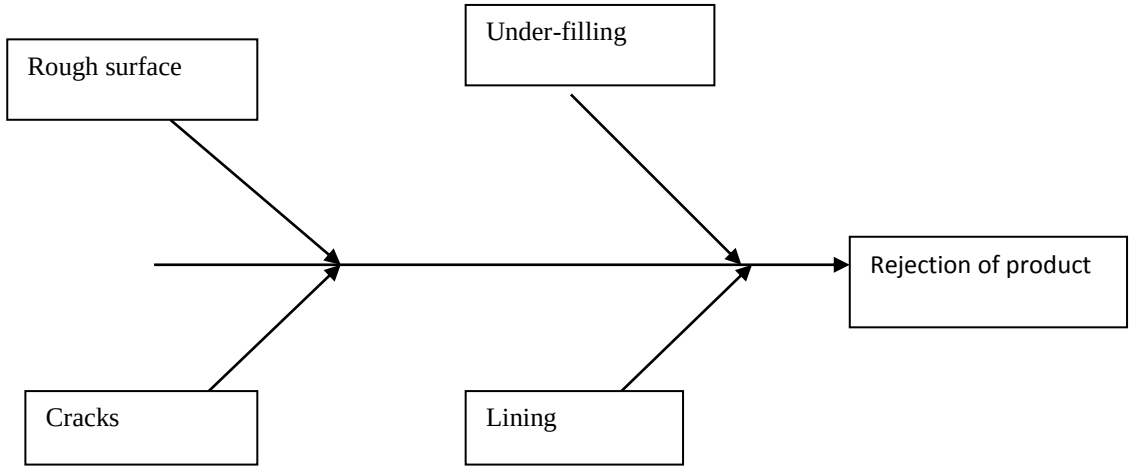

Figure 2. Vital few defects responsible for rejection of produc

Grant and Leavenworth (2000) stated that Pareto diagram helps to separate out the vital few fromthe trivial many to decide which of the defect to work out first . Analysis of information and dataunder this system is therefore a key to the system effectiveness, based upon Pareto (80-20) rule andhis theory which states that 'the vital few and trivial many'. 80-20 rule states that 80% effects are due to 20% causes, and if these 20% defects are controlled then 80% problem will be solved. Trivial many are represented in Figure 1 and vital few are represented in Figure 2.

Cause and effect diagram is used for analysis here because its strength lies in analyzing relationship in a structured way by using causing and their component which helps in focusing to root rather than symptoms. Thus four out of eight defects, which are the most promising factors for rejection of product, are under filling, lining, rough surface, and cracks, because most no. of products are rejected due to these type of defects. And these defects are highly responsible for increasing the rejection rate of the organization.Cumulative percentage of rejection due to these defects raise up to 80% which makes study of root causes for these defects more important.

Rework of product: As lot of expenditure is incurred during the production,so rework of the defective products become necessary to overcome these problems in orderto keep proper balance between total expenditure of organisation and total profit of organisation.

So total rejected products are identified and number of these rejected product taken into consideration which required rework. Rework data of forging product is taken for three months from August 2015 to October 2015 as shown in Table 1.

It represents monthly production data, rework data, data of forging defects which can be rejectedif not reworked and percentage of rework data. And after this the factors which arehighly responsible for rework are identified.

Table 1, shows the monthly production rate of forging industry and also shows the number of products which required rework due to under-filling, rough surface, lining, cracks and pitting etc. After calculating the total number of rejected product per month, the percentage rework is calculated.

Table 1. Rework data of rejected product

month	Production	Under-filing	Rough surface	Lining	Cracks	pitting	Total	% rework
Aug,15	2575	58	32	19	7	3	119	4.62
Sep,15	1855	44	29	17	5	2	97	5.22
Oct,15	2186	48	30	16	6	4	104	4.75
Total	6616	150	91	52	18	9	320	4.83
% contribution		46.87	28.43	16.25	5.6	2.81		

The data related to rework of the product showed in above table is collected from forging industry during production and then these data is correlated with its production volume and percentage rework is calculated and percentage contribution of each factor responsible for the rework of product is calculated. Overall rework of product for three months due to forging defects is 4.83%.

Table 2. Ranking of defects

Defects	Priority
Under filling	1
Rough surface	2
Lining	3
Cracks	4
pitting	5

Ranking is given to the each defect according to their percentage contribution for the rejection of the product. As shown in table1, the under-filling have major effect on the rejection of product so 1 priority is provided to this defect, and rest off these defects are provided priority accordingly.

Based on the rework of these products the cause and effect diagram is shown below and the factors which are responsible for the rework of product are considered.

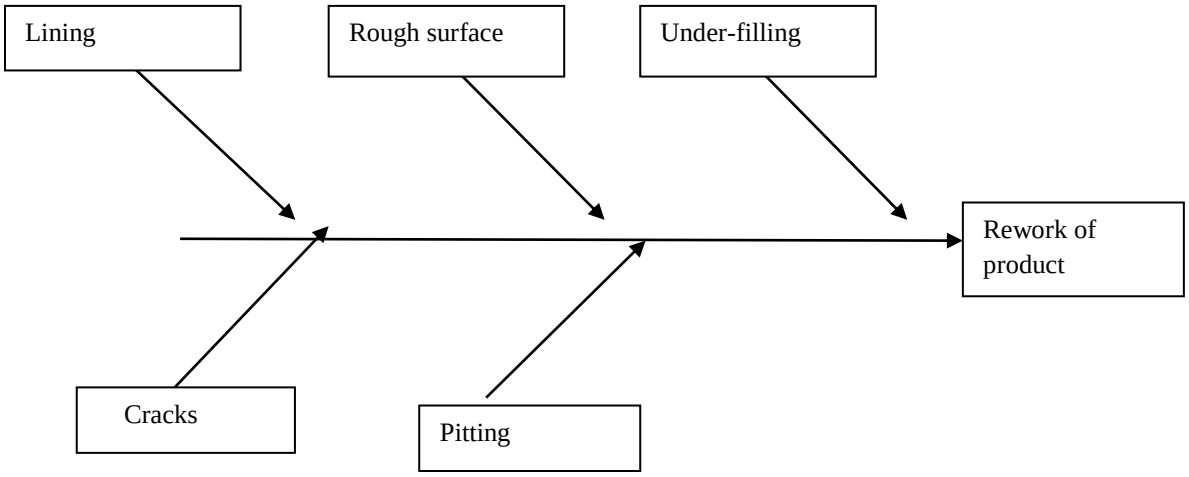

Figure 3. Trivial many defects responsible for rework of product

As shown above, there are various defects which are responsible for the reworking of the forging product. These defects individually plays effective role in reworking of the forging product [5].

But there are some defects which are highly responsible for the reworking of the forging product these are,under-filling, rough surface and lining. In order to reduce the reworking rate of the product it becomes necessary to analyse these defects and find the root cause of these defects. Cause and effect diagram for analyzing the vital few reasons of reworking are represented in figure 4. These factors are known as vital few because these are less in number but plays vital role in reworking of product.

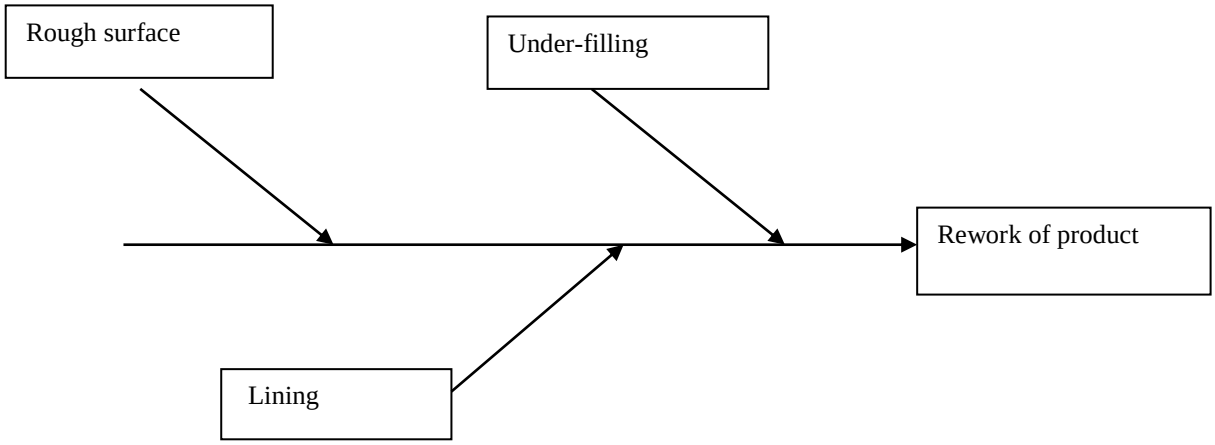

Figure 4. Vital few defects responsible for rework of the product

The factors which have greater impact on the reworking of the forging product are identified and cause and effect diagram is made. Table 1,the factor which have more percentage contribution towards the rejection of the forging product is considered in this cause and effect diagram i.e. under-filing, rough surface and lining etc.

Table 3. Actions required to overcome vital forging defects

FORGING DEFECTS	CORRECTIVE ACTION REQUIRED
Under-filling	The centre of lower die and centre of blank piece must coincide with each other, and preheating of blank piece should be done properly.
Rough surface	The machining of work piece should be done at lower speed and with low feed rate.
Lining	There should be no local hardening in the raw material, it should be controlled during the composition of material.
Cracks	Air should be blown off properly during the solidification of the material.
Pitting	Remove the scale from the surface of forging product through preventive maintenance of descaler.

IV. CONCLUSION

The analysis of forging product with the help to improve the quality of product. The maximum rejection and rework of product are due to forging defects like under-filling, rough surface, pitting, lining, cracks. The maximum numbers of forging products are rejected due to these defects which raise the need of preventing these defects. Table 1 shows the percentage contribution of each defect in the rejection of forging product. In three months total percentage contribution of under-filling in reworking of product is 46.87%, and that of rough surface and lining is 28.43%, 16.25% respectively. And finally the some corrective suggestions have been provided to overcome these defects in table 3. After applying these suggestions the rejection rate is reduced due to which the quality of product is improved.

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