Design And Fabrication of The Forging Dies For Mechanical Power Press

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Abstract- *Forging is one of the most important process in manufacturing a large variety of products. It involves obtaining desired shape and size by subjecting the material to large plastic deformation. Mechanisms like plasticity and dynamic re-crystallization or a combination of both metals and alloys could be developed into one of the important future of hot processing for the manufacture of components for automobile, aerospace and naval applications. To achieve the goal there is need of press which can be used for forging while the die is at the required temperature. For this purpose a press of 5-ton capacity is specially ordered for conducting experiments to study forging of metal at different temperatures and pressures at different thickness reductions under forging conditions.*

In warm and hot forging, the dies are subjected to high contact pressures and temperatures. The selection of the die material, hardness and heat treatment is critical for increasing die life.

The service lives of dies in forging processes are to a large extent limited by wear, fatigue fracture and plastic deformation, etc. In hot forging processes, wear is the predominant factor in the operating lives of dies. In this study, the wear analysis of an open die at the final stage of a hot forging process has been realized. The geometry of the part to be forging dies was design in CAD model and maximum forging load was calculated, Determination of weight of base plate and Top die. FEM analysis on the work piece. The hot forging operation was carried out at a work piece temperature of 300°C in a 5-ton mechanical press. The die and the work piece materials were Mild Steel EN 19

Keywords- Mechanical power press, Forging Dies, Mild Steel EN19, Heat Treatment, Hardness.

I. INTRODUCTION

High rate production industries generally use press machines. Thickness can vary significantly, although extremely small thicknesses are considered as sheet and above 6mm are considered as plate. Thickness of the sheet metal fed in between is called its gauge.

Sheet metal is simply fed in between the dies of press tool for any press operation to perform. The reciprocating movement of punch is caused due to the ram movement of press machine. The press machine may be of electrical type, mechanical type, pneumatic type, manual type and hydraulic type. In today's practical and cost conscious world, sheet metal parts have already replaced many expensive cast, forged and machined products. The common sheet metal forming products are metal desks, file cabinets, appliances, car bodies, aircraft fuselages, mechanical toys and beverage cans and many more. Due to its low cost and generally good strength and formability characteristics, low carbon steel is the most commonly used sheet metal because high carbon composition gives high strength to the material. The other sheet metals used are aluminium and titanium in aircraft and aerospace applications. The before converting raw materials to a finished product we need an accurate design of the product and also data required for manufacturing. If the design is not accurate then defects will occur in the manufactured product, small mistakes in designing a product makes the manufactured product useless so more amount time is allotted for designing new product. aim is to apply the quality tools to find out the root causes of the quality problems related to manufacturing of mechanical seal. The modes of defects on production line are investigated through direct observation on the production line and statistical tools like Check sheets.

II. LITERATURE SURVEY

Ashish Bhateja studied the Effect on the hardness of Sample grades of mild steel after heat treatment processes. They found that for Mild steel hardness of material increases. After annealing specimen machine-ability properties increased.

Devnath khunte researched on an effect of heat treatment on mildsteel. In this work they conclude that the mechanical properties vary depending upon the various heat treatment processes. The tempered samples gave an increase in tensile strength and hardness than untreated samples.

Nadum Ibrahim Nasir Studied about the effect of heat treatment on the mechanical properties of mildsteel. In this research work they found that, after doing heat treatment on

steel capability of tensile strength has been improved due reducing the size of the granules.

J.R. Douglas and T. Altan, Characteristics of Forging Presses: Determination and Comparison of the forging dies, Proc. 13th MTDR Conference (Birmingham, England).

T. Altan and A.M. Sabroff, Important Factors in the Selection and Use of Equipment for Forging dies, improving the forging tolerances Précis. Met The Ohio State University.

III. OBJECTIVES

1. The main objective is design of forging dies for mechanical power press.
2. To understand the use of presses and presses tools in hot metal working.
3. Design of upper and lower die.
4. Preparation of dies by machining and heat treatment etc.
5. Selection and comparison of alternative die materials to extend life under the process condition

IV. METHODOLOGY

4.1 Selection of Materials

Press tools are generally made using HCHCr, Steel alloys with high carbon. But before that based on many factors like cost, strength, hardness, strain and many parameters selection should be made. The materials used are generally selected are, EN19 Mild Steel is used as supporting plate. Apart from that materials like , high carbide materials, chromium steels and high speed steels are also used.

En19: EN19 is a high carbon Alloy steel which achieves a high degree of hardness with compressive strength and abrasion resistance that are acceptable for many automobile applications such as heavy duty gear, shaft, pinion, cam shafts. It is neither externally brittle nor ductile due to its lower carbon content and lower hardness. For properities of En19 shown in Table No1,2.

Table No1 shows chemical properties of Mild steel En19

Carbon	0.35-0.45%
Manganese	0.50-0.80%
Chromium	0.90-1.50%
Molybdenum	0.20-0.40%
Silicon	0.10-0.35%
Phosphorous	0.035% max
Sulphur	0.050% max

Table No 2 Shows mechanical properties of mild steel En19

Conditions	S	T	U
Tensile(N/mm^2)	775-925	850-1000	925-1075
Yield (N/mm^2)	555	680	755
Elongation %	13	13	12
Izod KCV J	22	50	42
HardnessBrinell	223-277	248-302	269-331

Material Purchase

For doing this project material selection and material availability is very important.

Specimen Preparation

The first and foremost job for the experiment is the specimen preparation. The specimen size should be compatible to the machine specifications.

4.2 Key features of EN19

a. High quality alloy steel
b. High tensile steel
c. Good ductility and shock resistance
d. Good wear resistance
e. Can be induction hardened

EN19 is a high quality alloy steel with tensile strength. With a combination of good ductility and shock resistance, EN19is suitable for applications with very high loading such as engine gear boxes. Popular in the automotive sector it is possible to machine the material extremely accurately, in recent years EN19 has become an established material in the Oil & Gas sector. The material lends itself well to any application where strength is a primary consideration.

V. DIE DESIGN

Top Die design

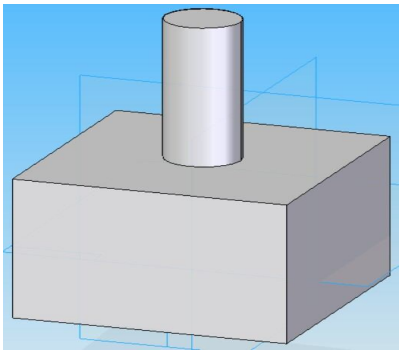

Fig 1 Shows Top Die Design

The complete die set consists of a punch, die and some other accessories which are described in this section later. Perfect alignment of punch and die is most important for satisfactory working of punch. Accessories of die set provides the require alignment and rigidity to the system and improves accuracy of the system performance.

Base plate Die Design

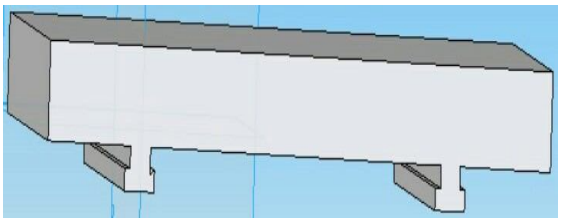

Fig 2 Shows Base plate design

It is also called die shoe. Its work as a support for the die block and it is rigidly fastened to the blaster plate of the press.

Machining of Mild steel EN19

EN19 is a high quality, high steel , alloy steel .usually supplied readily machineable in 'T' condition , it combines High steel strength ,Shock resistance, Good ductility and resistance to wear.

VI. HEAT TREATMENT ON MILD STEEL EN19

6.1 Normalizing

Normalizing is a heat treatment technique in which the specimen is heated up to its re-crystallization temperature and is kept at that temperature for the required soaking time. It is then cooled in air. In the case of EN19 Steel alloy, it was heated up to a temperature of 900^0C and is soaked at that temperature for about 60 minutes. It is then removed from the furnace and is allowed to cool in air.

6.2 Annealing

In the annealing process, the specimen is heated up to its recrystallization temperature, and soaked for the required amount of time. It is then allowed to cool inside the furnace itself. In the case of EN19 Steel alloy, it is heated up to 900^0C and soaked for about 60 minutes. It is then allowed to cool inside the furnace itself.

6.3 Quenching

Quenching is a heat treatment process in which the specimen is heated up to its recrystallization temperature, and soaked for the given period of time. The specimen is then taken and immersed in a quenchant immediately. The quenchants used were water, brine, and oil (SAE 40). In the case of EN19 Steel alloy. They are heated up to 900^0C and soaked for 60 minutes. After the soaking time, one specimen is immersed in water, another in brine and the third specimen is immersed in quenchant oil. Brine solution has the fastest cooling rate. Whereas, water and oil quenchants are slower, with oil being the slowest.

6.4 Tempering

Since quenching can lead to undesirable mechanical properties such as higher hardness, brittleness etc. due to the formation of martensite and fine grains. Another heat treatment technique is performed on the quenched specimens to restore its ductility. This heat treatment technique is known as tempering. In the case of EN19 steel, the oil quenched and water quenched specimens are heated up to 550^0C. It is then soaked for 60 minutes and then allowed to cool in air.

VII. FABRICATION OF TOP DIE AND BASE PLATE DESIGN

Fig 3 shows Fabrication of Base plate and Top die Design

it is a popular high ensile engineering steel with a tensile of 850/1000 N/mm². At low temperatures EN19 has reasonably A high quality alloy steel specification usually supplied as a high tensile steel grade to EN19 . This grade offers good ductility and shock resisting properties combined with resistance to wear. With these characteristics good impact properties. It is also suitable for a variety of elevated temperature applications. For maximum wear and abrasion resistance EN19 can be nitride to give a shallow depth wear resistant case. Flame or induction hardening can give a case hardness of 50 HRc or higher.

Material used and its Composition (mild steel EN19)

A representative composition of AISI4140 steel also known as EN19 (medium carbon low alloy steel) is utilized to produce ferrite martensite dual phases of varied proportions by inter critical annealing treatment followed by heat treatment to

different temperatures and rapid quenching. Mechanical test is essential part of any engineering activity. Mechanical test is applied to the materials, components and assemblies. It consists of measurement of fundamental properties or measurement of responses to particular influences such as load temperature, etc. Types of mechanical tests carried out in EN19 (AISI4140) material are tensile test, Impact test and Hardness test.

Assembly

Fig 4 Shows Assembly of Top Die and Base Plate Forging Specimen

Fig 5 Shows Forged Mild Steel

Pre heat carefully, then raise temperature to 850-1200°C for forging.

VIII. RESULTS

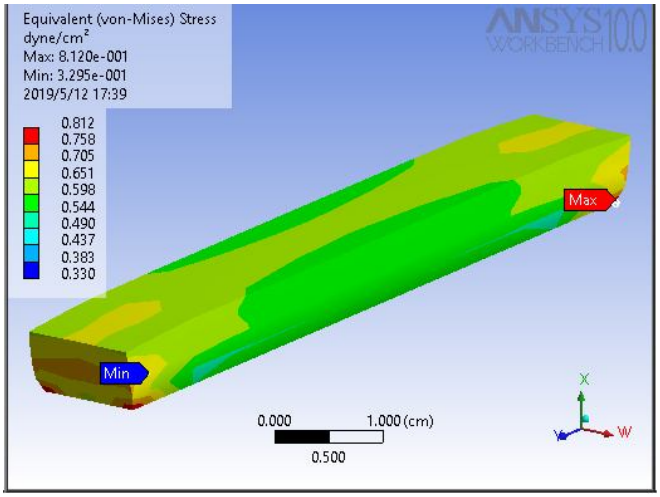

Fig 6 shows Equivalent von mises stress

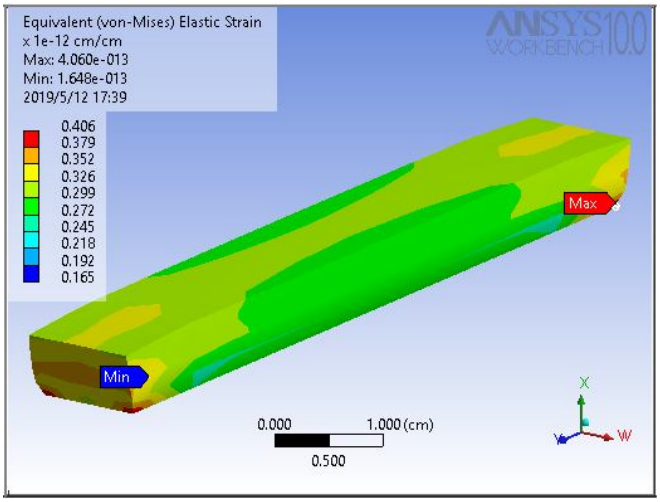

Fig 7 shows Equivalent von mises Elastic strain

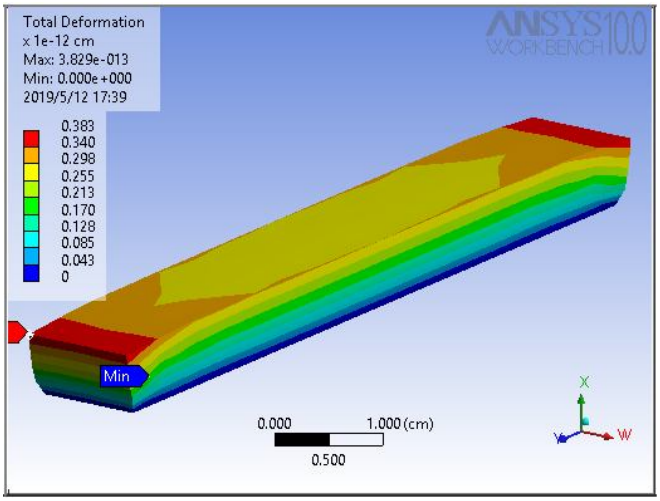

Fig 8 Shows Total deformation

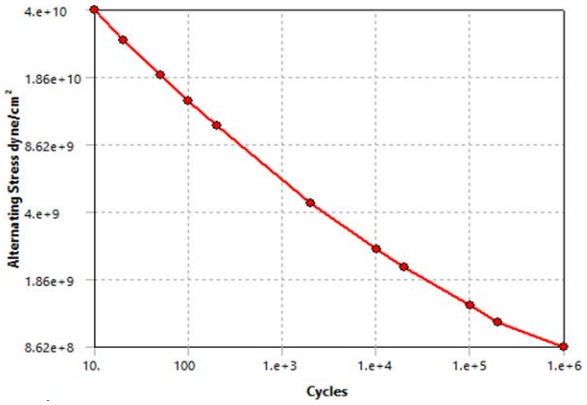

Fig 9 Plot of alternating stress vs. cycles

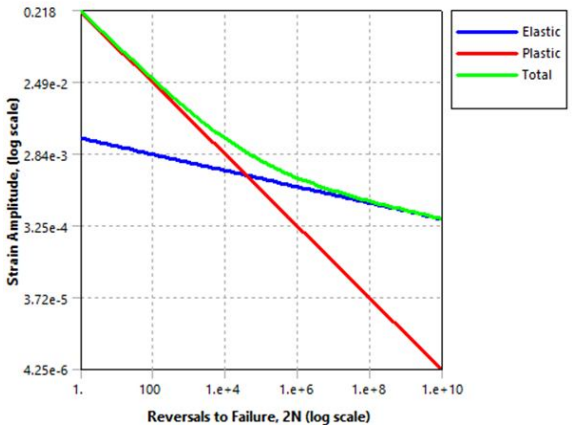

Fig 10 plot of strain amplitude vs. Reversals to failure

IX. OUTCOMES

a) Stress
b) Strain
c) Total Deformation

X. SCOPE

a) Forging improves excellent mechanical and metallurgical properties
b) All metal alloys can be forged to the close dimension accuracy and close tolerance
c) Relatively low life cycle cost
d) Increased product life and productivity

XI. CONCLUSION

We have fabricated forging dies for mechanical power press by using the mild steel EN19 with the better accuracy, design parameters such as weight of a material, maximum forging load. The selection of mild steel grade which will more beneficial for industrial point of view. Mild Steel that is. EN-19 and MS polish after Heat Treatment After heat treatment hardness of material change. Due heat treatment of annealing material becomes softer. Material compositions also changes due to heat treatment.

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