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Research Article

STRESS ANALYSIS OF IMPACT LOADS, CRACK PROPAGATION, BREAK AREA MICROSTRUCTURE STUDY ON D6 MATERIAL USED FOR LUG FORGING DIE

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ABSTRACT

Optimization of tool study is one of the important aspects in forging to estimate life cycle of the die in production criteria to increase production rate. In some occasion's tool material may crack or break due to non-uniform loading conditions acts on the surface area of bottom die. Complex closed die forging must have to optimise in more ways to get ultimate production rate without failure of tool. Present paper discusses the damages in critical areas by analysing the bottom die using Ansys software to note the stress areas on the bottom die. The paper further discuss practical possibility if crack propagated and damaged microstructures for better clarification about the die making materials. The practical approach study gives good optimal life study of the materials used in forging techniques. The process carried out on 1 ton hammer loads for lug die as a case study.

INTRODUCTION

The originating defect should not have been present and was due to poor melting and forging practice, which was largely rectified between the time of manufacture (1971) and the incident (1989). The growing crack was missed on multiple inspections in service. Strength-wise, forgings outperform machined components, too. Even though parts machined from bar stock may not suffer from the effects of voids and inclusions, they still do not possess the integral strength of forgings, because the grain flow is interrupted at machined surfaces. In many instances, unusual shapes like a propeller nut can be forged "near-net" with the added benefit of cost savings due to reduced machining. There are many conventional ways to cut costs-reducing drafts, tolerances, reviewing process options, substituting lower-cost materials, making property tradeoffs, and more-that should be considered to achieve the most cost-effective forging. However, optimization of a forging design should be all-inclusive for best economy [1].That can be acceptable, if they do not interfere with the utility or service of a part. Laps, seams, bursts, hot tears, and thermal cracks are typically considered to be manufacturing defects. However, whether these manufacturing defects are a contributing factor in an in-service failure is a separate question that would need to be confirmed during a failure analysis. A discontinuity or flaw only becomes a service defect when it interferes with the intended function and expected life of a part. This distinction is important in failure analysis, because a discontinuity or imperfection may be present, even though the failure is attributed to a different root cause. The distinction between a manufacturing imperfection and a manufacturing flaw is thus critical in determination of root cause. Manufactured components typically contain geometric and material imperfections, but whether the imperfection caused failure and could therefore be a defect should be determined in many situations by analysis [2].

Objectives

1. To check improved internal qualities due to compressive deformation in die surface area.
2. Burnished surface and controlled surface quality.
3. Crack propagation study after impact.
4. Micro structural studies of damaged part.

Impact analysis

Analysis has been carried out by using ANSYS 15.0 for stress surface area of impact conditions in the impression of bottom die to check the Figure below shows the total deformation of the bottom die for load applied, the maximum deformation was found to be 0.000183mm at the corners of the die

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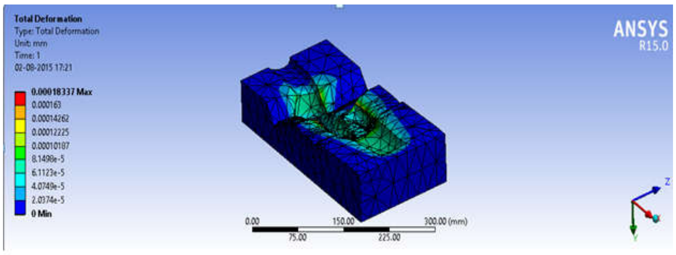
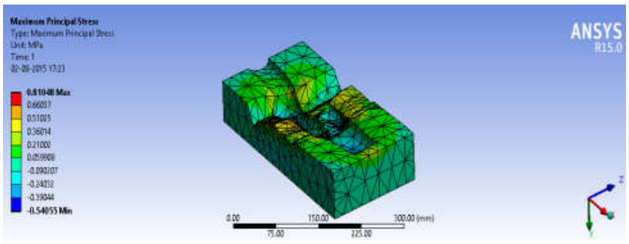


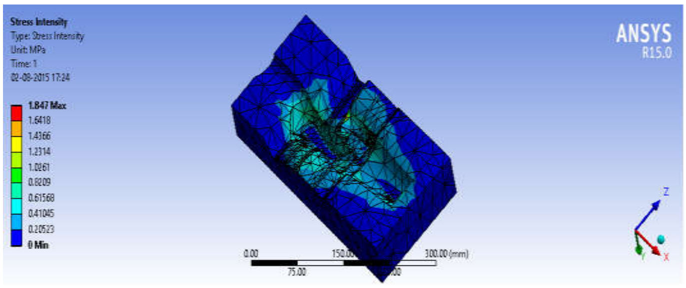
The deformation formed at the walls of the impression with multiple cycles of impact. After the impact of 100 cycles the deformation will be 0.01 at cold condition of one pre heat. By random checkup of getting deviated deformation applicability will be more in hot condition which described in previous research paper i.e0.1mm in cycle



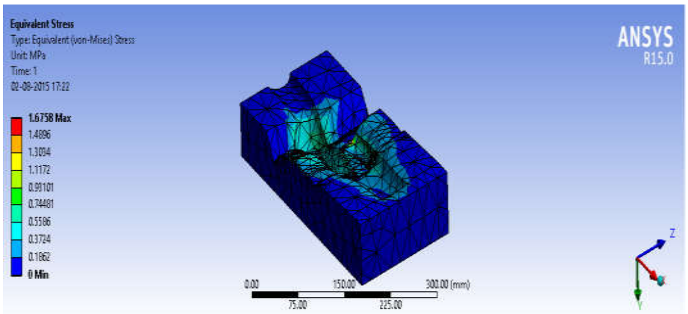
Deformation of die

Figure shows the variation of maximum principal stress along the bottom die, the maximum principal stress was found to be 0.81MPa at the edges of the die. Pressures are more looking at the neck and bottom portion of the component area where the die becoming de-formed. The level of deformation have to be observe in practical condition to get damage area correction for modeling.

***Principal stresses**:* The stress intensity across the die with maximum of 1.84MPa



Stress intensity: the equivalent stress variation across the die and maximum of 1.67MPa was found.

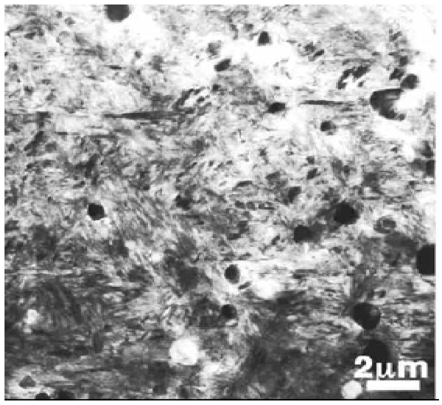


Hot forging temperatures of different metals and alloys

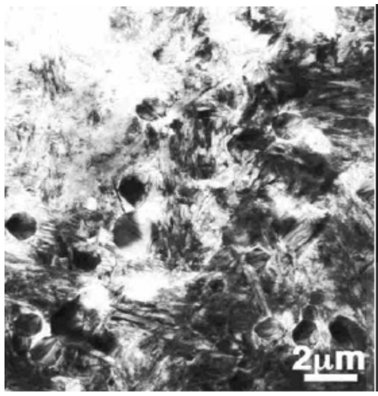
Metal or alloy	**approximate range of forging temperature, ∞C (∞F)**
Aluminum alloys (least difficult)	400–500 (750–930)
Magnesium alloys	250–350 (480–660)
Copper alloys	600–900 (1110–1650)
Carbon and low-alloy steels	850–1150 (1560–2100)
Martensitic stainless steels	1100–1250 (2010–2280)
Maraging steels	1100–1250 (2010–2280)
Austenitic stainless steels	1100–1250 (2010–2280)
Nickel alloys	1000–1150 (1830–2100)
Semiaustenitic PH stainless steels	1100–1250 (2010–2280)
Titanium alloys	700–950 (1290–1740)
Iron-base superalloys	1050–1180 (1920–2160)
Cobalt-base superalloys	1180–1250 (2160–2280)
Niobium alloys	950–1150 (1740–2100)
Tantalum alloys	1050–1350 (1920–2460)
Molybdenum alloys	1150–1350 (2100–2460)
Nickel-base superalloys	1050–1200 (1920–2190)
Tungsten alloys (most difficult)	1200–1300 (2190–2370)

The above tables taken in to consideration for the hot die forging, close die preparation where the sustainability of the material D6 has to observe. For the optimization of die life cycle the used die applied for maximum pressure on the component in 1 ton hammer to study the micro structure and crack propagation of the material.

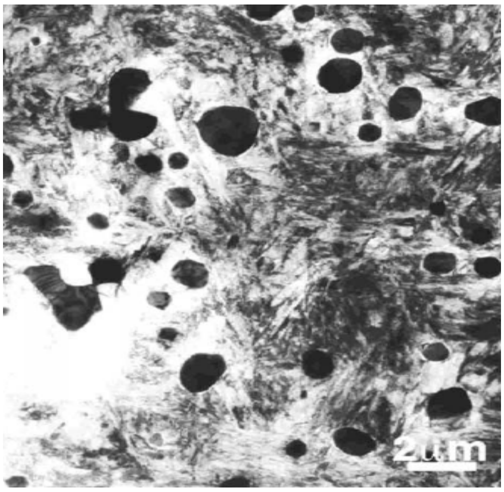
SEM analysis of cracking dies for the material D6



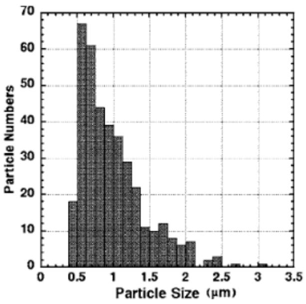
The above figure shows the cracking section of die at 2micron range where the die is made of material D6 at initial breakdown with pre heat treatment after 100 cycles of hammer strokes. In the SEM analysis we observed the carbon deposits with some porosity problems because of unusual and conventional process of pre-heating.

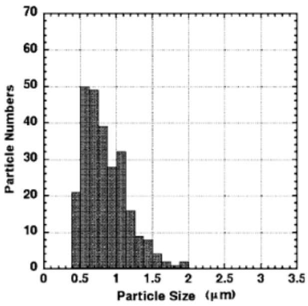


The above figure shows the cracking section of die at 2micron range where the die is made of material D6 at final breakdown with double cycle stroke of crack edge for SEM analysis. By observing the above SEM image some ductility and non-elasticity observed in this. After the crack propagates at the damage section after second preheat with 500 strokes the property of elasticity has to regain for carbon deposit after heating.



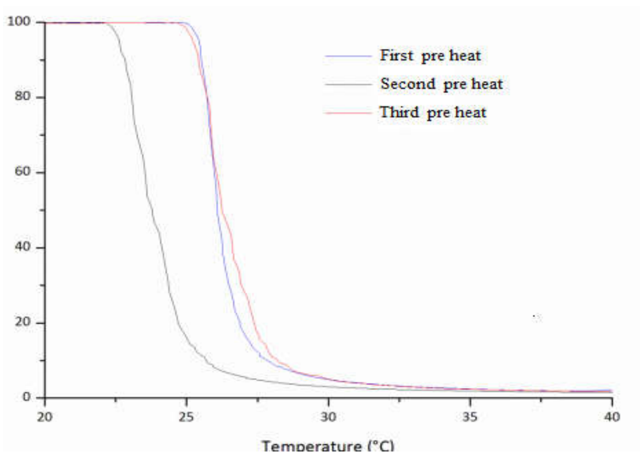
The above figure shows the cracking section of die at 2micron range where the die is made of material D6 at initial breakdown at the second area of heated die. This shows the application of necessity in case study of various components dies which is having complexity.





Treated,2. Non-treated

The above graph 1 shows the variation in particle numbers to variation in particle size which is changing alternately due alternate change in micron size when the material is treated with heat.



The above graph 2 shows the variation in particle numbers to variation in particle size which is changing alternately due alternate change in micron size when the material is without the heat treatment.

When the die is subjected to some impact load there is some formation of crack proportion. The above graph shows the variation of die material along three stages that is when subjected to first preheat, second pre heat, third pre heat. The variations are shown in the above graph clearly.

DISCUSSIONS

During the impact analysis we had obtained several factors like deformation, principal stresses, stress intensity and equivalent stresses are considered. At some static load conditions the die is subjected to some deformation. The minimum deformation is 0mm and after the static loads the maximum deformation obtained is 0.00018mm. When the die is subjected to some principal stresses the minimum value obtained is 0.54055Mpa and the maximum value is 0.81048Mpa. The die is subjected to some stress intensity and the minimum value obtained is 0Mpa and the maximum value is 1.847Mpa and when finally the during the condition of equivalent stresses the minimum value is 0Mpa and the maximum would be 1.6758Mpa.

CONCLUSIONS

1. The knowledge of these values is the key to optimizing the failure and cracking of die when it is subjected to some impact load. This is, however, impossible without verified models, which is done by impact analysis.
2. The first application of the numerical simulation involved load application model. It described the load varies in cracking die during the static impact load. Using this model, the cracking and failure analysis of the die is obtained, the optimum layout cracked die during het treatment and the non- heat treatment is obtained.
3. Above observations gives the usage of D6 material for complex die preparation and the cycles of usage and draw backs at 1 ton hammer load. This leads more optimization needed with different dies making with D6 material.

References

1. Tulsyan, R., Shivpuri, R., and Altan, T., "Investigation of Die Wear in Extrusion and Forging of Exhaust Valves", ERC for Net Shape Manufacturing, Report No. B-93-28, 1993, The Ohio State University.
2. Altan, T., Oh, S. and Gegel, H., "Metal Forming: Fundamentals and Applications", ASM, 1983
3. Altan, T., Ngaile, G. and Shen, G. "Cold and Hot Forging: Fundamentals and Applications", ASM International, 2005.
4. Roberts, G., Krauss, G. *et. al*., "Tool Steels", ASM International, 1998
5. Archard, J., "Contact and Rubbing of Flat Surfaces", *Journal of Applied Physics*, Vol. 24, 1953, pp. 981-988.
6. B. Painter, R. Shivpuri, and T. Altan, "Prediction of Die Wear During HotExtrusion of Engine Valves", *J.*

Materials Processing Technology, Vol. 59, Nos. 1-2, 1996, pp. 132.

7. Kang, J., Park, I., Jae, J., and Kang, S., "A Study on a Die Wear Model Considering Thermal Softening: (I) Construction of the Wear Model", *Journal of Materials Processing Technology,* Vol. 96, 1999, pp. 53-58.
8. Behrens, B.A., "Finite Element Analysis of Die Wear in Hot Forging Processes", CIRP Annals- Manufacturing Technology, Vol. 57, 2008, pp. 305-308.
9. D.H. Kim, H.C. Lee, B.M. Kim, K.H. Kim, "Estimation of die service life against plastic deformation and wear during hot forging processes", *Journal of Materials Processing Technology,* Vol.166, 2005, pp.372-380.
10. Deshpande, M. and Altan, T., "Die Materials And Coatings For Hot Forging Of Steel In Mechanical Presses", ERC for Net Shape Manufacturing, Report No. ERC/NSM-10-R-06, 2010, the Ohio State University.

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