SIMULATION AND EXPERIMENTAL VALIDATION OF UNFILLING DEFECT FOUND IN CONNECTING ROD IN CLOSE DIE FORGING

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SIMULATION AND EXPERIMENTAL VALIDATION OF UNFILLING DEFECT FOUND IN CONNECTING ROD IN CLOSE DIE FORGING

Rohan K Soyaliya[1], Keyur V Parmar[2], Jayendra B Kanani[3]

[1]*PG student ,AITS Rajkot*

[2]*Mechanical engineering department, AITS Rajkot*

[3] *Mechanical engineering department, AITS Rajkot*

ABSTRACT

 Process of manufacturing of connecting rod in close die forging is studied. Defects found in connecting rod are unfilling, cracks, scale pits and lap. Unfilling defect contributed more toward rejection. To reduce unfilling defect, simulation is to be carried out in FEM based software DEFORM 3D, to visualize the material flow in die cavity. Temperature range is to be found during simulation in DEFORM 3D, where there is complete filling of material in die i.e. removal of unfilling defect. Experiments are to be carried out at temperature range to validate DEFORM 3D result.

Keywords: *Unfilling defect, Deform 3D,simulation ,temperature range.*

I.   INTRODUCTION

Forging is the process of shaping heated metal by application of sudden blow or steady pressure and makes use of characteristics of plasticity of material. It is carried out either hot or cold. Traditionally, forging was performed by a smith using hammer and anvil. Using hammer and anvil is a traditional form of forging. The smithy or forge has evolved over centuries to become a facility with engineered processes, production equipment, tooling etc. Hot forging is done at temperatures above recrystallization temperatures, typically 0.6 Tm or above, where Tm is melting temperature.

In forging the material is deformed applying either impact load or gradual load. Based on the type of loading, forging is classified as hammer forging or press forging. Hammer forging involves impact load, while press forging involves gradual loads. Based on the nature of material flow and constraint on flow by the die/punch, forging is classified as open die forging, impression die forging and flashless forging.

1.1 Open die forging: In this, the work piece is compressed between two platens. There is no constraint to material flow in lateral direction. Upsetting is an open die forging in which the billet is subjected to lateral flow by the flat die and punch. Due to friction the material flow across the thickness is non-uniform. Material adjacent to the die gets restrained from flowing, whereas, the material at center flows freely. This causes a phenomenon called barreling in upset forging.

1.2 Closed die forging: It is also known as impression die forging. Impressions are made in a pair of dies. These impressions are transferred to the work piece during deformation. A small gap between the dies called flash gutter is provided so that the excess metal can flow into the gutter and form a flash. Flash has got a very important role during deformation of the work piece inside the die cavity. Due to high length to thickness ratio of the flash gutter, friction in the gap is very high. Due to this the material in the flash gap is subjected to high pressure. There is high resistance to flow. This in turn promotes effective filling of the die cavity. In hot forging, the flash cools faster as a result of it being smaller in size. This enhances the resistance of the flash material to deformation resistance. As a result of this, the bulk of work piece is forced to deform and fill the die cavity more effectively – even intricate parts of the die cavity is filled.

II.   SIMULATION OF CONNECTING ROD

DEFORM 3D is FEM based software used for dynamic analysis. It will be useful to know about the flow of material in die cavity after simulation.

Simulation is carried out at different temperature to find out temperature range were no unfilling defect is found.
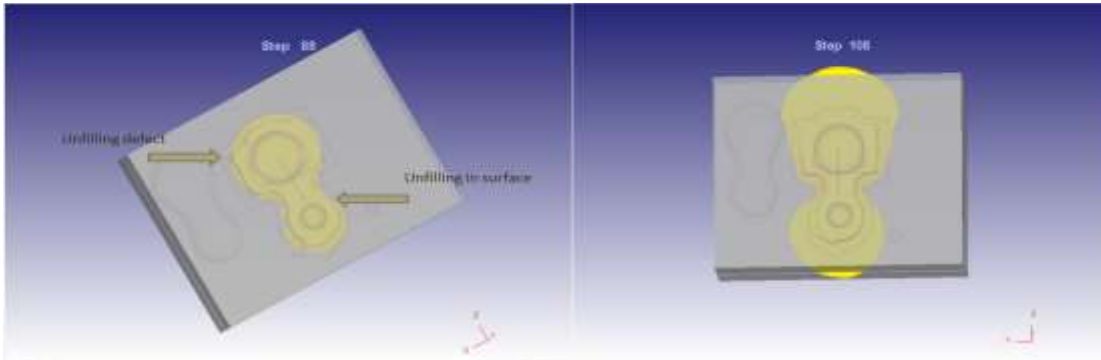
Simulation result are as follows:

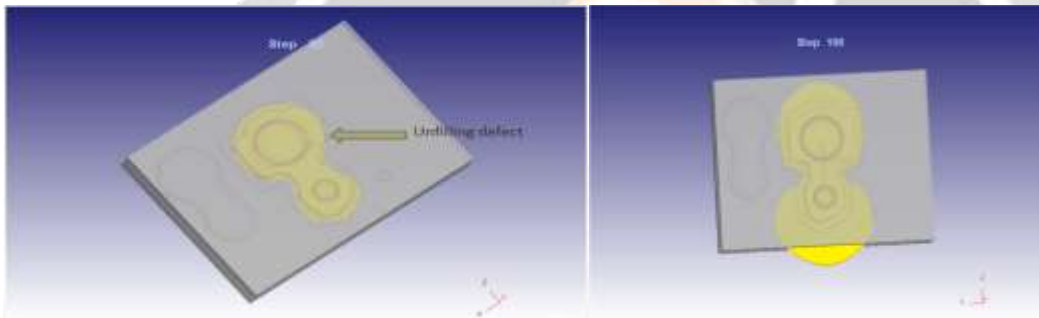   **Fig:simuation at 1150°c**   **Fig:simulation at 1200°c**

    Fig: simulation at 1100°c   **Fig: simulation at 1250°c**

Fig simulation at 1220°c

It is concluded from the above all 5 simulation that unfilling defect is found at 1100°c, 1150°c.no unfilling defect was found at 1200°c, 1220°c, 1250°c.so 1200-1220°c is the temperature range of EN9 material where no unfilling is found.simulation carried out was at finishing stage .Drop in temperature after rolling process is 20°c.soexperiments to be carried out in temperature range of 1220°c-1240°c.

III.   Experiment for validation of simulation result

After finding the temperature range from the simulation ,it is necessary to validate the result of simulation so 11 experiment at different 11 temperature are to be carried out.

Step1: Cutting the long rod of EN9 of 65×65mm into 11 billets using band saw machine.

Step2: Heating billets at different 11 temperature in oil fired gas furnace and measuring temperature using radiation pyrometer.

Step3: Carring out two step forging process i.e rolling and finishing.

Step4: After forging final inspection i.e visual inspection

Result: whether unfilling found or not

Table :experiment at different temperature and result

Forging temperature (^{o}C)	Result(after inspection)
1220	No unfilling defect found
1222	No unfilling defect found
1224	No unfilling defect found
1226	No unfilling defect found
1228	No unfilling defect found
1230	No unfilling defect found
1232	No unfilling defect found
1234	No unfilling defect found
1236	No unfilling defect found
1238	No unfilling defect found
1240	No unfilling defect found

Thus it is concluded from the experiment that no unfilling defect was found at all 11 temperature .

IV.   Conclusion

Simulation was carried out at different temperature in DEFORM 3D result found was that no unfilling was found in 1220-1240°c.so it is quite necessary to validate the result of DEFORM 3D .so experiments were carried out in temperature range at 11 different temperature. Result found was very satisfactorily no defects in all 11 temperature so experiments was validation for simulation result.

V.   References

Research Papers:
[1] Mahendra G. Rathi, Nilesh A. Jakhade, "An Overview of Forging Processes with Their Defects" International Journal of Scientific and Research and publication Vol 4 June 14'
[2] Piyush Gulati, Rajesh Kanda, JaiInder Preet Singh, Manjinder Bajwa, "Simulation and Optimization of Material Flow Forging Defects in Automobile Component and Remedial Measures Using Deform Software" International Journal of Mechanical Engineering and Technolgy,Vol 3, jan-apl 13'
[3] Meetinder Singh Sekhon, Dr. Gurinder Singh Brar, Dr. Sukhraj Singh, "A six sigma approach to detect forging defects in a small scale industry: A case study" International Journal of Engineering and Technical Research Vol 2, Aug 14'
[4] Md. Israr Equbala , Randhir kumar,Mohammad Shamim, R.K. Ohdard, "A grey-based Taguchi method to optimize hot forging process" 3rd International Conference on Materials Processing and Characterisation (ICMPC 2014)
[5] Takefumi Arikawaa,,Daisuke Yamabeb, Hideki Kakimotoc, "Influence of anvil shape of surface crack generation in large hot forging process" 11th International Conference on Technology of Plasticity, ICTP 2014, 19-24 October 2014, Nagoya Congress Center, Nagoya, Japan
[6] Aju Pius Thottungal,Sijo M.T, "Controlling measures to reduce the rejection rate due to the forging defect" International Journal of Scientific and Research Publication Vol 3, March 2013
[7] Christy Mathew, Justin Koshy, Dr. Deviprasad Varma, "Study of Forging Defects in Integral Axle Arms" International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 7, January 2013
[8] Basavasagar, Prof. Bharat S Kodli, "Forging simulation of Rocker arm using AFDEX software" International Journal of Engineering Trends and Technology (IJETT) – Volume 25 Number 4- July 2015
[9] Mahdi Maarefdoust, "Simulation of finite volume of hot forging process of industrial gear" 2012 International Conference on Networks and Information (ICNI 2012) IPCSIT vol. 57 (2012) © (2012) IACSIT Press, Singapore