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Enhancement of Die Life for Titanium Alloy Closed Die Forging

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Abstract - *Die forging is a manufacturing process by which metal is pressed, pounded or squeezed under great pressure into high strength parts known as forgings. In forging process the service life of die is very important due to economic reasons and finishing quality of productions.*

In forging industries, it was observed that the die life is less in titanium alloys forging as compared to others. The project concerns the possibilities of applying various die life improvement methods with the purpose to increase the die life in titanium alloy forging.

Key Words: Die Material selection, DIN 2714, Fatigue analysis

1. INTRODUCTION

Die forging is a manufacturing process by which metal is pressed, pounded or squeezed under great pressure into high strength parts known as forgings. Among all manufacturing process forging occupies a special place as it produces parts with excellent properties. Also forging gives superior quality products with minimum waste of material.

In case of titanium alloy forging it was observed that the die life is less as compared to forging of their metals. This is because of its low forgeability and low hot working temperature. As we know titanium alloy is one of the major material used in forging industries. They are used in aerospace, architectural, industrial and medical applications. Die material change of the die was selected as the method to improve the die life. Appropriate selection of die material is critical for acceptable die life.

This paper presents results of experimental investigation of the Die material change effects on die used in titanium alloy forging. Also a fatigue analysis of forging die was performed by using ANSYS software.

1.1 Objectives

The objectives of this project were,

- Selection of appropriate die material and manufacturing the die with the selected material.
- Fatigue analysis of the selected die by using ANSYS.

2. EXPERIMENTAL ANALYSIS

2.1 Die Material change

This part of the work included replacing of the die material EN24 with DIN2714. EN24 was the current die material used in the industry. The DIN 2714 is a Cr-Ni-Mo-V combination with high hardness and wear resistance.

Table -1: Forging cycles done with EN24

JOB	DIE MATERIAL	NUMBER OF FORGING CYCLES COMPLETED
TITANIUM	EN24	132 84 99 120 294
		Total = 729

A new forging die of DIN2714 was manufactured and compared with EN24. This comparison was based on number of forging cycles done without failure in the case of titanium alloy forging. Number of forging cycles completed with EN24 and DIN2714 are shown in Tables 1 and 2 respectively. The hardness of die material also plays a vital role in life of dies. The hardness value of DIN2714 is 360 HB, which was greater than EN24.

Table -2: Forging cycles done with DIN2714

JOB	DIE MATERIAL	NUMBER OF FORGING CYCLES COMPLETED
TITANIUM	DIN2714	480 660 600
		Total = 1740

3.SOFTWARE ANALYSIS

The software analysis was completed with the help of SOLIDWorks and ANSYS. In the earlier stage, assembled model of DIN 2714 forging dies with and without chromium nitride layer was created in Solidworks.

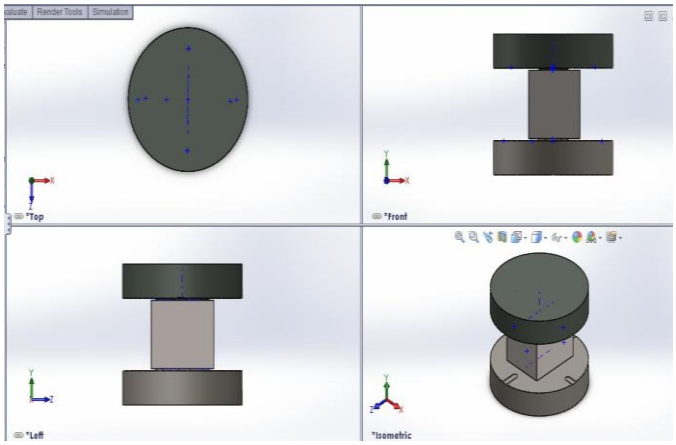

Fig -1: Assembled part

Figure 1 shows solid model of assembled part. After that, the fatigue analysis of this assembled models were done in ANSYS.

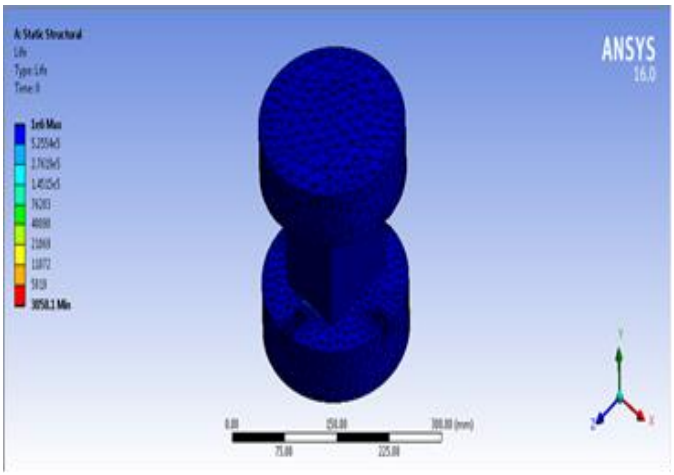

Fig -2: Fatigue life (Before Gas Nitriding)

Assembled model without nitride layer was used for die life calculation in pre nitriding condition. The obtained results are shown in figure 2. Figure 3 shows the fatigue life in post nitriding condition.

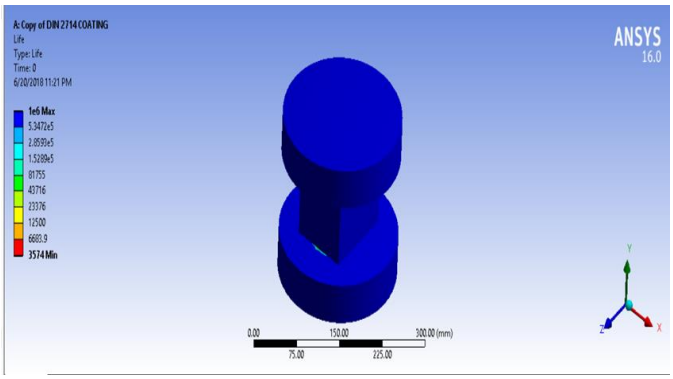

Fig -3: fatigue life (After Gas Nitriding)

4. RESULTS AND DISCUSSION

4.1 Die Material change

After the die material change it was observed that the number of forging cycles done with DIN2714 (1740) was higher than that with EN24(729). This is because of the presence Cr-Ni-Mo-V combination in DIN 2714 die material.

4.2 Software Analysis

In software analysis it was seen that the number of forging cycles in case of post nitriding (3574) was greater than pre nitriding (3058). The graphical representation between forging cycle and forging temperature was shown in figure 4.

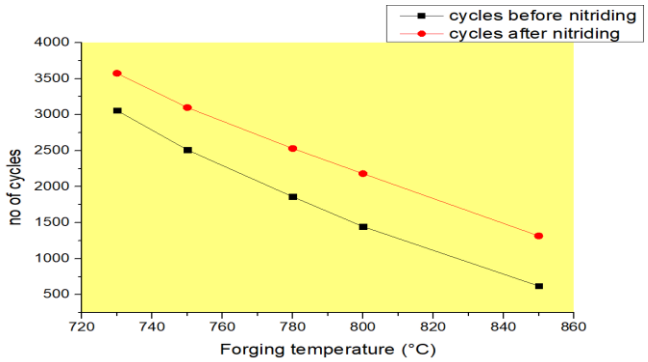

Fig -4: Forging temperature vs forging cycles

The variation of forging cycles with coating thickness was shown in figure 5.

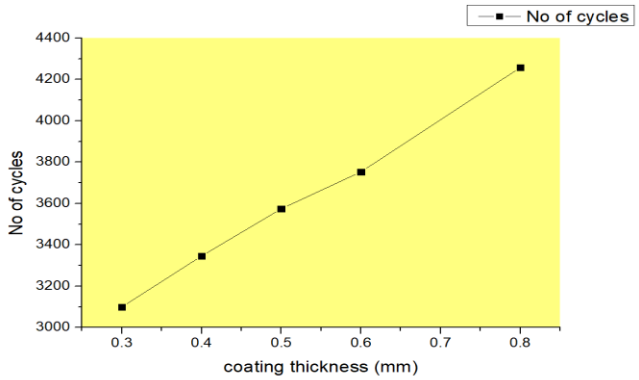

Fig -5: coating thickness vs forging cycles

5. CONCLUSIONS

Based on the results obtained, following are the conclusions of this project,

1. The die life in titanium alloy forging increased with die material change.
2. In software analysis there was about 17% of increase in number of forging cycles after Gas Nitriding.
3. It was observed that the number of forging cycles increased with increasing coating thickness.

REFERENCES

- Mayur Deshpande (2010), "Selection of die materials and Surface treatments for increasing die life in hot and warm forging", ERC for net shape manufacturing, The Ohio State University, 2010.
- Marek Hawryluk (2016), Wrocław University of Technology, Wybrzeże Wyspiańskiego 25, 50-370 Wrocław, Poland "Review of selected methods of increasing the life of forging tools in hot die forging processes", 14 July 2016.
- Mahendra G. Rathi, Nilesh A. Jakhade (2014), "An Overview of Forging Processes with Their Defects" International Journal of Scientific and Research Publications, Volume 4, Issue 6, June 2014.
- K Venkatesh, K Kiran Kumar, K Vedavyas (2017) "Improvement in Life of Forging Die by Using Ansys Software" IJRSET, Volume 5 Issue IX, September 2017.
- Bílik, J Pompurová, A. & Ridzoň, M (2012), "Increasing The Lifetime of Forming Tools", 8th International DAAAM Baltic Conference, Industrial Engineering 19-21 April 2012.