

# Analysis Mechanical properties of EN31 for Die block using various heat treatment

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**Abstract** - In this paper, study about EN31 steel material using various heat treatment found various properties for die block. Die is an important tool for fabrication of metal formation industries. During product formation failure of die material occurs. Failure of die material obtained due to improper selection of material for die block. Main objective for die block the selection of material is the main factor. On the die block during product formation various stresses are obtained like tensile strength, yield strength, heat treatment and impact. By taking various heat treatment like annealing, normalizing, tempering and hardening at 800,900 and 1000°C in various quenched media like oil and water and cooled by furnace and air cool to found out properties for die block.

**Key Words:** Heat treatment, tensile strength, yield strength, hardness, impact test

## 1. INTRODUCTION

Die is an important tool for deformation or fabrication of metal-formed products. Die is a work holding device, designed specifically for a particular design of a product. Die is rigidly held on the base of the press. To have good die performance and service life, the die should be optimally designed and precisely fabricated. The block or plate made from high quality steel and mounted on the bottom portion of the die set to which section or parts of the die. It is subjected to extreme pressures and wear conditions. Hence the die block is made of superior quality of tool steel. Tool steels are broadly divided into six categories like cold work, shock resisting, hot work, high speed, water hardening, plastic mould and special purpose tool steels. Among them, cold work tool steels are the most important category, as they are used for many types of tools, dies and other applications where high wear resistance and low cost are needed.

### 1.1 Problem statement

The mechanical properties of the dies are not optimized and die failure occurs within a short period of time. The die block gives satisfactory working life with hardness 60 to 65 HRC. generally dies may fails due to lower hardness of selected material. Failures of die in manufacturing operation generally results one or more of the following causes:

1. Improper design
2. Defective material
3. Improper heat treatment and finishing operations
4. Overheating and heat checking (crack caused by temperature cycling)
5. Excessive wear
6. Overloading
7. Misuse
8. Improper handling

### 1.2 Objectives

The basic aim of the project is to improve the mechanical properties of EN31 tool steel using various heat treatment processes

- a) Improve hardness of material in annealed condition.
- b) Improving Tensile Strength upto 760 N/mm<sup>2</sup>
- c) Improving Yield Stress upto 460 N/mm<sup>2</sup>

## 2. Literature review

The purpose of this literature review is to go through the main topics of interest. The literature reviews is concerned with heat treatment processes on EN31 tool steel and analysis of mechanical properties

1. **Iqbal Singh**, in this paper In this work different methods are studied for increasing the mechanical properties and Heat treatment method is used to find the mechanical properties of EN31 materials. And also know the effect of heat treatment on the mechanical properties (Tensile strength, Elongation. Reduction in Area, Proof stress, Hardness) of EN31 materials. In this work we come to conclusion that the values of Tensile strength, Proof stress, Hardness increases after heat treatment technique. And the value of Elongation. Reduction in Area decreases after heat treatment technique.[1]

2. **Pramila S. Chine**, in this paper Main objective is to study the effect on the hardness of three sample grades of tool steel i.e. EN-31, after heat treatment processes such as Annealing, Normalizing, and Hardening & Tempering. After selection of material & heat treatment processes further aims to perform mechanical & chemical analysis.[2]

3. **Sara Saad Ghazi** in this paper is to study the effect of conventional heat treatment and cryogenic treatment on wear resistance and mechanical properties of D3 tool steel. In this work conventional heat treatment and cryogenic treatment was done on cold work die tool steel type D3. In conventional treatment, the process involved heating the samples to the austenitic temperature (according to quenching medium) and then quenching them in still air, forced air, oil and polymer solution. In cryogenic treatment, the samples were cooled to (-198°C) and holding for (36hr). Vacuum atmosphere furnace was used to prevent oxidation and decarburization of the samples surface. In still air forced air quenching, the specimens were heated to (1000°C) and holding for (30 min), in polymer and oil quenching the specimen were heated to (950°C) and holding for (30 min). The samples were then tempered at various temperatures (200, 300 and 400°C). It was found that when the tempering temperature increases, the hardness decreases, strength decreases and impact energy increases.[3]

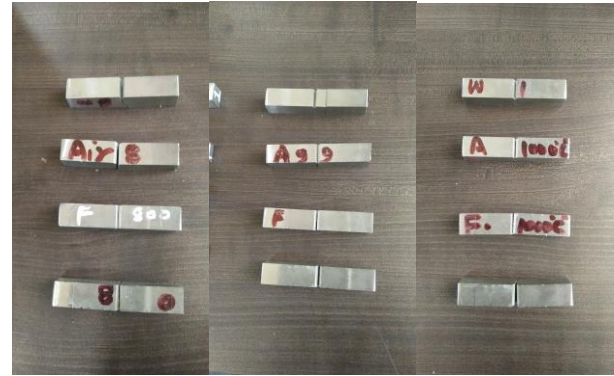


Fig -1: Impact testing specimen at 800°C, 900°C & 1000°C

### 3. CONCLUSIONS

Ultimately from above work we achieved desired properties of selected material at temperature 800°C with quenching medium as water. Properties at this stage are as: hardness is 63HRC, tensile strength is 851N/mm<sup>2</sup>, yield strength is 567.33N/mm<sup>2</sup>. Grain boundaries are very fine at this stage compared with other. In this way we introduced same properties of D3 grade steel used for die block, in EN31 steel and achieved cost economy. So we can conclude that this research is beneficial to all manufacturing industries by saving cost in raw material required for die manufacturing.

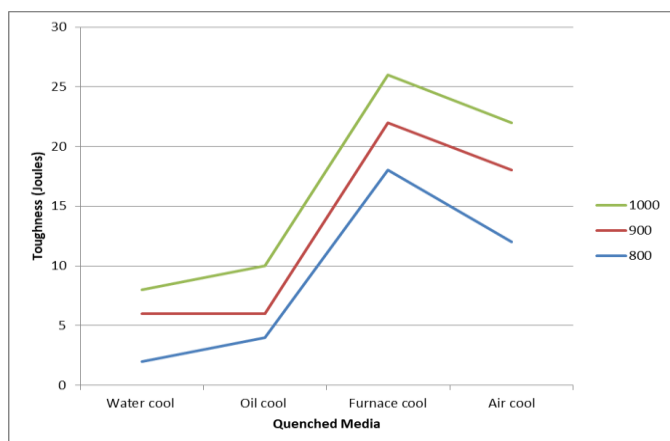
Also in this work different methods are studied for increasing the mechanical properties of EN31 tool steel. Heat treatment process is conducted to improve the mechanical properties (Tensile strength, Elongation, Reduction in Area, Hardness) and also know the effect of heat treatment on microstructure of material.

By Impact testing the toughness of EN31 material at different temperature but maximum toughness at 800 °C with furnace cooled media. At these stage toughness is 18 joule.

Table -1: Tested result for Toughness at 800°C, 900°C, 1000°C

Quenched Temperature media	800°C	900°C	1000°C
Water	2	4	2
Oil	4	2	4
Furnace	18	4	4
Air	12	6	4

Chart -1: Compare Toughness of different cooling media



### REFERENCES

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