Study of Quenching process implemented in Automobile industry and to learn the factors affecting the microstructure and resulting hardness

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Abstract

Quenching is the rapid cooling of a workpiece air to obtain certain material properties. A type of heat treating, quenching prevents undesired low-temperature processes, such as phase transformations. It is done by reducing the window of time during which these reactions are both thermodynamically favourable, and kinetically accessible; for instance, quenching can reduce the crystal grain size of both metallic and plastic materials, increasing their hardness.

The process of quenching is a progression, beginning with heating the sample. Most materials are heated to between 815 and 900 °C (1,500 to 1,650 °F), with careful attention paid to keeping temperatures throughout the workpiece uniform. Minimizing uneven heating and overheating is important to obtain desired material properties.

The primary goal of this project was to study the different martensitic structures after quenching process and its resulting hardness. In most of the automobile industries Vickers Hardness is checked for the Hardness test. In order to obtain optimum hardness, the respective BIW part should be properly Heat treated. If heat treatment is not done properly then it results in lowering the resulting hardness of the quenched part. Industry tries not only to achieve Martensitic microstructure but also great strength to the part with optimum hardness.

Method

Part after quenching is cut at different location to test the hardness. Mainly Rockwell Hardness and Vickers Hardness tests are carried out. Rockwell hardness testes the surface hardness while Vickers hardness tests the core hardness of the material. Hence for Vickers Hardness cross section area is taken into consideration and hence sample is prepared.

While cutting the sample with hand held cutting machine, care is taken that the metal should not get heated to high temperature and cutting is done slowly and uniformly. After this we need to cut the sample into memory card size on cutting machine. While doing this continuous flow of mixture of water and coolant should be on piece and the piece should not be burnt.

For sample preparation (mold making) Mounting Press machine is used. It helps to keep the sample in position to bear load for hardness testing. After the mold is made, it is naturally cooled to avoid any minute change in the properties. After it is brought to room temperature it is polished on different grades of polish paper and to give it mirror finish. After mold is polished and mirror finish is obtained, it is ready for VHN testing.

To get VHN readings, we need to select appropriate load according to properties and material and optical zoom. Currently we are using 1000 gm of load and 400x optical zoom. To take readings we need to focus on the metal surface where there are no scratches and is clean. Then, load is applied. It has three steps Loading, Dwell and unloading. Now we have got diamond indentation on surface. After zooming and focusing the diagonals are measured with the help of cross hair. After both diagonals are measured the reading will be shown on display. The range of hardness of VHN is 400 – 550.

Results

Following results were obtained after deduction of the outcoming hardness value

Factors affecting the hardness-

1. Overheat part- If during heat treatment part is heated above 950℃, we will not get desired microstructure and it will also hamper the hardness
2. Underheat part- If during heat treatment part is heated below 900℃, we will not get desired microstructure and it will also hamper the hardness
3. Bottoming of die- If bottoming of die is not done properly, there is insufficient contact between die and the blank part cooling will not be done properly, which will not complete the quenching process hence reducing the hardness.
4. Sample cutting- while cutting the sample, make sure proper cooling is done material will go under tempering process hance reducing the hardness of the material.

References

1. Mechanical Metallurgy by *George Dieter.*
2. Principles of Materials Science & Engineering, by *W. F. Smith.*
3. Engineering Metallurgy, by *R.A. Higgins.*
4. Light Alloys. Metallurgy of the Light Metals, by *I. J. Polmear.*
5. Deformation and Fracture Mechanics of Engineering Materials, by *R.W. Hertzberg.*