EXPERIMENT 8

Subject: Hardness testing of metallic materials.

Objective: The main purpose of this lab work is to teach engineering students how heat treatment process and different cooling rates affect hardness value.

Theory: The hardness test is a mechanical test for material properties which are used in engineering design, analysis of structures, and materials development.

The principal purpose of the hardness test is to determine the suitability of a material for a given application, or the particular treatment to which the material has been subjected. The ease with which the hardness test can be made has made it the most common method of inspection for metals and alloys. Hardness is defined as the resistance of a material to permanent deformation such as indentation, wear, abrasion, scratch. Principally, the importance of hardness testing has to do with the relationship between hardness and other properties of material. For example, both the hardness test and the tensile test measure the resistance of a metal to plastic flow, and results of these tests may closely parallel each other. The hardness test is preferred because it is simple, easy, and relatively nondestructive.

Current practice divides hardness testing into two categories: macro-hardness and microhardness. Macro-hardness refers to testing with applied loads on the indenter of more than 1 kg and covers, for example, the testing of tools, dies, and sheet material in the heavier gages. In microhardness testing, applied loads are 1 kg and below, and material being tested is very thin (down to 0.0125 mm, or 0.0005 in.).

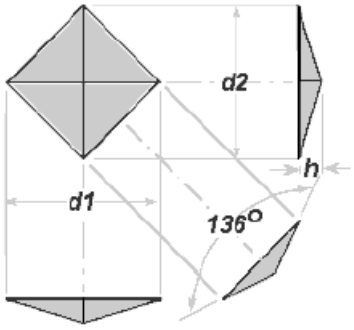
1) Macro Hardness Testers Loads > 1 kg

- Rockwell
- Brinell
- Vickers

2) Micro Hardness Testers < 1 kg

- Knoop diamond
- Brinell ball
- Vickers diamond pyramid

The term microhardness test usually refers to static indentations made with loads not exceeding 1 kgf or 1000 gf. The procedure for testing is very similar to that of the standard Vickers hardness test, except that it is done on a microscopic scale with higher precision instruments. The surface being tested generally requires a metallographic finish; the smaller the load used, the higher the surface finish required.



$$HV = \frac{2F\sin\frac{136^{o}}{2}}{d^{2}} \qquad HV = 1.854\frac{F}{d^{2}} \text{ approximately}$$

Figure 1. Vickers Principle

The Vickers Diamond Pyramid hardness number is the applied load (kgf) divided by the surface area of the indentation (mm^2)

F= Load in kgf

d = Arithmetic mean of the two diagonals, d1 and d2 in mm

HV = Vickers hardness

In this laboratory, we will measure and discuss the hardness values depending on the cooling rate of heat treated and non-treated steels with the Vickers microhardness testing method.

Figure 2. Vickers Hardness Test Machine

LAB Procedures

1. Grind and polish all specimens (a), (b), (c) and (d) taken from previous experiment.
2. Place the specimen with a cleaned surface facing the indentor on the anvil at worktable.
3. Focus the specimen surface for clean visibility by rotating the hand wheel at the worktable upwards and downwards.
4. Select the load specified (P) push button available on the right side at the hardness tester.
5. Measure hardness by Vickers microhardness tester.
6. Compare the hardness data and write a lab report.