UNIT V MATERIALS TESTNG

5.2 HARDNESS TESTS

Hardness is a surface property and is defined as the resistance of a material against permanent deformation of scratch, cutting, indentation or mechanical wear.
In various hardness tests, the indenters are used to introduce indentation on the surface. The shape of indenters may be a spherical ball, a cone, or a pyramid. Various hardness test methods are given as below:

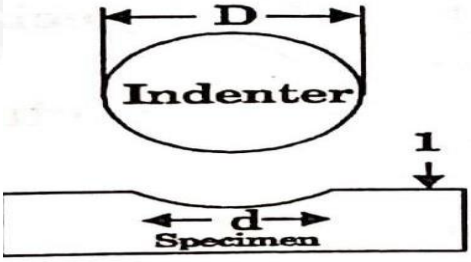
1. Brinell's hardness test
2. Rockwell's hardness test.
3. Vicker's hardness test
4. Knoop's hardness test .

Brinell Hardness test.

Principle:

A harden steel ball of diameter D is used as an indenter.It is pressed on the surface of the specimen by applying load for 10- 15 secs.Indentation is formed on the surface of the specimen.

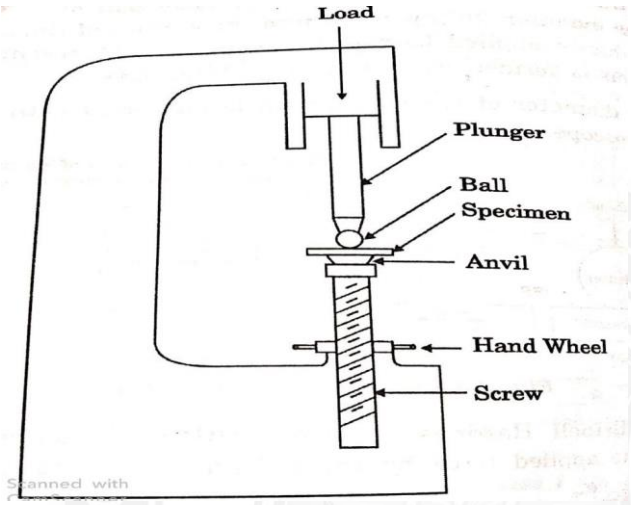
Indenter



Test procedure:

1. A test specimen is placed on the anvil .It is raised with the elevating screw until it touches the indenter

2. The indenter is pressed into the surface of the specimen by a gradually applied load.
3. The load is applied for 15-30 secs.
4. The indenter makes an impression on the specimen.The diameter of the impression is measured with the optical microscope.
5. Then we can find the harness number by using formula.



Brinell hardness test showing load, ball diameter, indented diameter and its thickness.

The Brinell Hardness Number (BHN) is then calculated as below after measuring d by an optical microscope.

Brinell Hardness number

$$BHN = \frac{2P}{\pi D(D-\sqrt{D^2-d^2})}$$

Where P-load applied

D- Diameter of steel ball (mm)

d- Diameter of indentation

Advantages

- Brinell hardness test can be performed on irregular or rough metal surfaces also. The care of the surface is not important in this test as in the Rockwell and rebound test.
- This hardness test is simple to perform and is less sensitive than any other test.
- The hardness of objects with heavy weight can be tested with this process.
- Tensile properties and results of the test can correlate.

Disadvantages

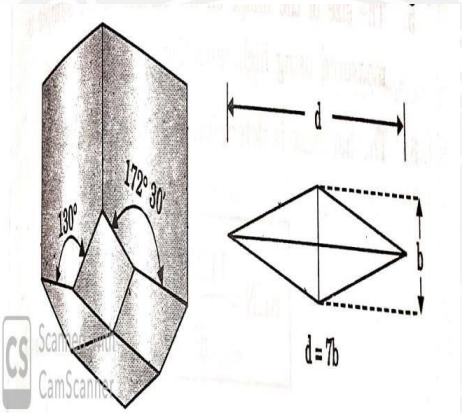
- The test cannot be performed in objects of small size due to a large indenter impression.
- It is also not appropriate for thin items as the test cause deep penetration

- A lot of time is required to perform the test due to the slow test process
- The test required a lot of concentration because the chances of error in measurements are high as it is done manually.

Knoop Hardness test

Principle:

A diamond pyramidal shape with transverse angle of 1300 and longitudinal angle 1720 30' is used as an indenter.



Test procedure:

1. A test specimen is placed on the anvil. It is raised with the elevating screw until it touches the indenter
2. The indenter is pressed into the surface of the specimen by a gradually applied load.
3. The load is applied for 15-30 secs.
4. The indenter makes an impression on the specimen.
5. Using the built-in **optical microscope**, measure the **length of the long diagonal** of the indentation
6. Then we can find the harness number by using formula.

$$KHN = \frac{14.299P}{d^2}$$

P-load applied

d-diameter of the indentation

Precautions:

1.Micro hardness require extra care in all stages of testing.

2.Good polishing of the surface is required.

Advantages:

1.The diagonals of the square indentation can be measured more accurately.

2.This method is suitable for hard materials as well as for soft materials.

3. There is only one type of indenter, which can be used for all Knoop methods.

4. The test is non-destructive, and there is only very minor damage to the specimen surface

Disadvantages and Limitations:

1.The accurate measurement of indenting size is very difficult and it requires high polished surface.

2.It consumes time for measurement.

3.The long diagonal of Knoop indentation is affected by elastic recovery for loads less than300g

4.The process is rather slow (compared with the Rockwell method).