Measuring Surface Hardness

Surface Hardness is - per definition - the resistance of a material against penetration by a foreign body. Consequently, a correct hardness measurement indicates the area of the indentation caused by a specified force. With the **Vickers Instrument** (Fig. 1) a diamond tip - shaped like a pyramid - is pressed into the surface. The area of the impression is measured using a microscope, and the force (kp) divided by the area (mm²) is the measured hardness value (kp/mm²). The area of the indentation caused by the diamond can be evaluated very precisely using a microscope, as the displaced surface material does not raise the surface at the edges of the dent (compare with Fig. 2).

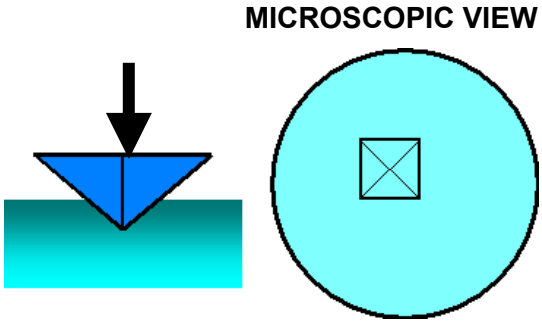

Fig.1: Measurement of the Surface Hardness with the VICKERS Instrument

This is the case with the **Brinell Instrument**. A tungsten-carbide sphere is used instead of the diamond and the raised surface around the indentation lets it appear larger than it actually is (Fig. 2). Because of this, and because the sphere flattens somewhat, Brinell hardness values tend to be lower for harder materials compared to Vickers.

So called “dynamic measurement devices” (e.g. the **Shore Instrument**) are based on the fact that the indentation caused by the tip of a little hammer which is dropped on a surface absorbs energy.

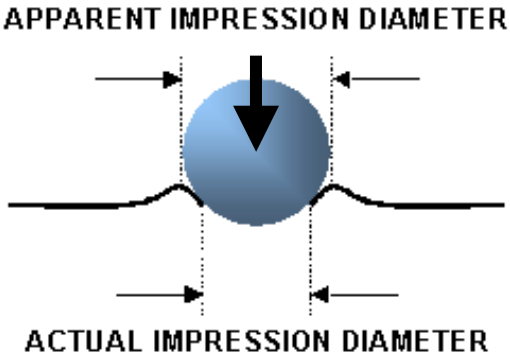

Fig. 2: Brinell Hardness Measurement

The energy lost is spent to displace the surface material. By comparing the height to which the hammer bounces back with the initial height, the energy can be calculated. The more energy is lost, the softer the material surface is. Instead of gravity, the **Leeb Instrument** makes use of a pre-stressed spring to accelerate the hammer. The loss of dynamic energy is electronically calculated based on the loss of velocity of the rebounding hammer as indicated by the electric impulses when passing an inductive coil. The drawback of the dynamic systems is that the results are depending on the damping properties (the hysteresis) of the material below the surface. Calibration curves have to be taken for each material separately, comparing the results with the Vickers Instrument.

The influence of surface hardness on roll wear is generally overestimated. Using an alloyed material with a hardness of 580 HV instead of the standard material with 550 HV would reduce the area of an impression by 5 percent and its diameter as seen under a microscope by 2.5 percent, only. The difference would be hardly noted.

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