MEASUREMENT OF SURFACE TEMPERATURES OF TOOLS AT CUTTING SPEEDS OF 1-800 m/sec

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Izvestiya VUZ. Fizika, No. 3, pp. 173-174, 1965

Cutting speeds of hundres of m/sec have become commonly used only in recent years. The temperature at the contact between the materials is one of the main factors governing the wear of the tool. Several measurements have been reported [1-3] on contact temperatures in friction and grinding, but these results cannot be transferred to cutting, because the normal load in that case may be hundreds of kg, with contact times of only 10^{-2} to 10^{-5} sec.

Kronenberg [4] has measured the temperature at the rear face of the tool with an inserted thermocouple; the rise was found to be small, but the results were considered only as preliminary.

We have measured cutting temperatures for various metals at surface speeds of 1-800 m/sec, the detector being the natural couple provided by two tools of identical shape and operating conditions made of R18 high-speed steel and T15K6 hard alloy, these being insulated one from the other. The tools are connected through the material during the cutting time (usually 10^{-4} to 10^{-5} sec), and the temperatures at the contacts (taken as the same for both) produce a potential difference at the cold ends.

The metals were zinc, aluminum, brass, copper, and steel 3, which were driven at speeds up to 100 m/sec with a motor; the range 100-800 m/sec was covered by shooting cylinders from a gun. The output pulse was amplified and recorded by an oscilloscope, which was calibrated with pulses of known height, as in [3].

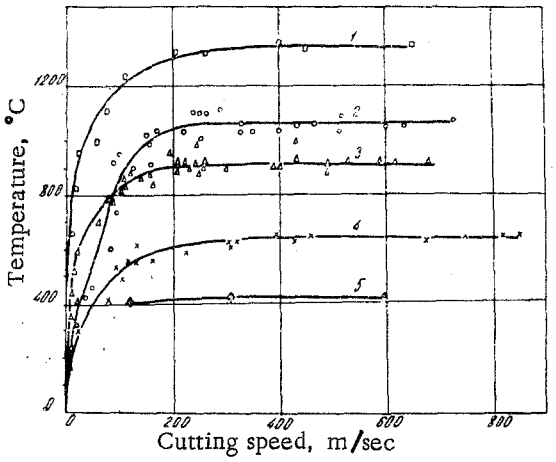

Fig. 1. Contact temperature as a function of temperature for: 1) steel, 2) copper, 3) brass, 4) aluminum, 5) zinc.

Figure 1 shows the contact temperature as a function of speed for these metals. There is a more or less rapid rise to the melting point of the more fusible metal of the pair, which thereafter remains unaltered. There was no marked relation of temperature to depth of cut.

The melting point of the steel (about 1500°C) is above that of R18 high-speed steel (about 1300°C), so the hard alloy should give a contact temperature of about 1500°C and the R18 about 1300°C; the over-all voltage thus corresponds to a temperature in this range, as Fig. 1 shows.

Bowden and Persson [2] found no surface melting because the thickness of the melted parts was too small to be readily observed by metallographic methods. Low temperatures were found in [4] because the measurements were made at some distance from the cutting edge.

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31 December 1964

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DIELECTRIC CONSTANT OF SINGLE CRYSTALS OF LITHIUM HYDRIDE

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Izvestiya VUZ. Fizika, No. 3, p. 175, 1965

The literature carries no evidence on the dielectric constant ε of LiH crystals, which is needed in order to estimate the wavelength λ of the proper modes of the lattice.