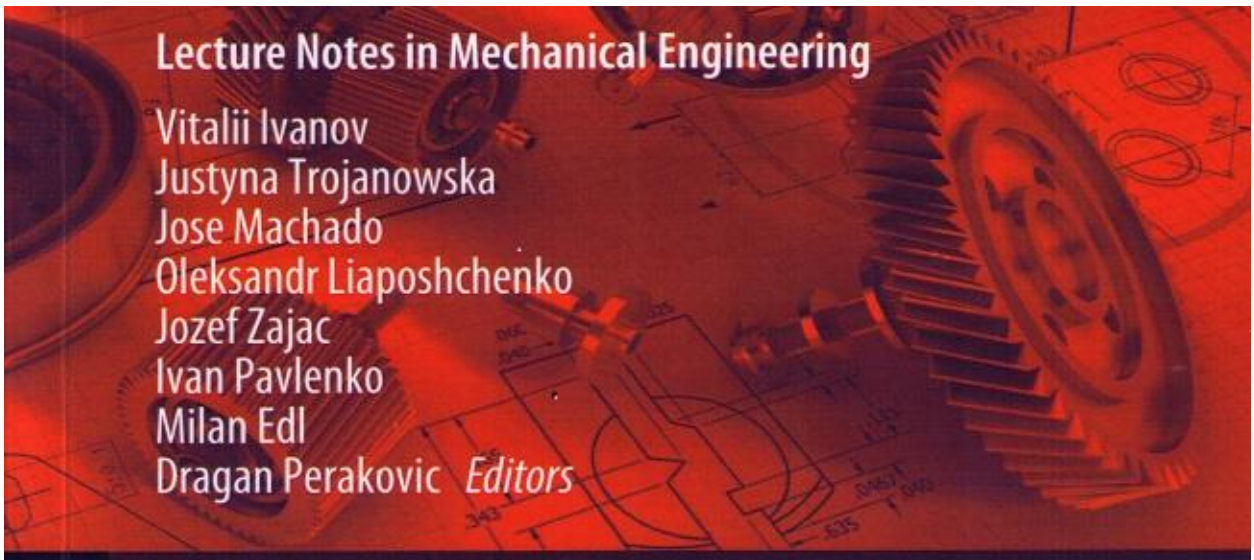

Lecture Notes in Mechanical Engineering

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Cutting Stone Building Materials and Ceramic Tiles with Diamond Disc

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Abstract. During the repair and restoration of buildings, ceramic tiles and blocks of Al_2O_3 and ZrO_2 are often cut. At present diamond abrasive discs are widely used for these purposes. The cutting process is accompanied by a considerable heat release and heating of the diamond disc. At a temperature of about 600°, the tensile strength of a disc is reduced by a factor of 2 and graphitization of diamond grains occurs. Thus, when cutting stone and building materials with a diamond disc, the disc heating temperature should not exceed 600 °C. In the work, mathematical modeling of the diamond cutting disc heating on a metal base was performed while cutting ceramic materials to determine the time of continuous operation to a critical temperature of 600 °C. The simulation results obtained showed the dependence of the heating temperature of the disc on the diameter of the latter, the speed of rotation, the minute feed, the grain size and the thickness of the disc. It is shown that by selecting appropriate process characteristics the time of continuous operation can be of the order of 10–12 min without the use of forced cooling.

Keywords: Diamond cutting disc · Disc temperature · Ceramics ZrO_2

1 Introduction

In the process of repairing and restoring buildings, it is often necessary to [illegible] structures that have great destruction. At the same time, auxiliary [illegible] introduced into the walls, foundations and floors, in which they have to cut [illegible] and sockets where reinforcing elements are inserted.

Such works are often performed in shell limestone, concrete, granite, [illegible] cutting or making cuts to the required size with a cutting disc made of [illegible] diamond and cubic boron nitride (SD and CBN). The cutting of solid building [illegible] is carried out with diamond discs and CBN disc, the rotational speed of [illegible] consequently, the cutting speed is 35–50 m/s. Due to the high intensity of the [illegible] process and intensive micro-formation, the cutting process is accompanied by [illegible] nificant heat generation.

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increases by fractions of a degree per revolution. This means that convective [illegible] exchange with an air has a powerful cooling effect.

Almost all elements of the cutting modes affect the temperature of the [illegible] although in the varying degrees. The greatest impact is the value of the [illegible]

The frequency of the disk rotation and the change in its diameter affect [illegible] same, since the cutting speed depends on both the frequency of rotation [illegible] diameter of the circle.

The change in the grain of the cutting disk significantly affects its [illegible] dependence here is quite complicated, since an increase in the grain size [illegible] unit of the cutting force and the thermal power from each single grain. [illegible] reduces the number of grains simultaneously involved in the work. [illegible] smaller amount of more powerful heat sources take part in the heat [illegible] However, an increase in the power of each single source cannot [illegible] decrease in their number. This phenomenon should be checked on other [illegible] example, on a ceramic bundle.

5 Conclusions

As a result of the work done, the following issues were solved:

1. A mathematical model has been developed that adequately reflects [illegible] cess of cutting stone materials and ceramics with a diamond cutting [illegible]
2. The conditions for the solvability of this model developed and [illegible] help of creation of the discontinuous solution of the Eq.
3. Based on the data obtained, we can determine the heating temperature [illegible] of the disk in contact with the product, the temperature along the [illegible] the cooling of the heated disk with an air flow, the increase in the [illegible] disk for each revolution and the time of continuous operation of the [illegible] critical temperature.
4. According to the simulation results, we can say that to ensure the [illegible] stability of the disk, one should choose grains of the disk of at least [illegible] B2-01 100% (Nz25) and work at a vertical feed rate of not more [illegible]

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