

Lecture Notes in Mechanical Engineering

Vitalii Ivanov
Justyna Trojanowska
Jose Machado
Oleksandr Liaposhchenko
Jozef Zajac
Ivan Pavlenko
Milan Edl
Dragan Perakovic *Editors*

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




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Cutting Stone Building Materials and Ceramic Tiles with Diamond Disc

Ala Bezpalo¹ , Vladimir Lebedev² ,
Vladimir Tonkonogyi² , Yuri Morozov² ,
and Olga Frolenkova² 

¹ Odessa State Academy of Civil Engineering and Architecture, 4 Didriksona St., Odessa 65029, Ukraine

² Odessa National Polytechnic University, 1 Shevchenko Ave., Odessa 65044, Ukraine

wlebedev29@rambler.ru, vmt47@ukr.net

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 strengthen structures that have great destruction. At the same time, auxiliary structures are introduced into the walls, foundations and floors, in which they have to cut anchors and sockets where reinforcing elements are inserted.

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

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

Almost all elements of the cutting modes affect the temperature of the disk, although in the varying degrees. The greatest impact is the value of the vertical feed.

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

The change in the grain of the cutting disk significantly affects its heating. The dependence here is quite complicated, since an increase in the grain size increases the unit of the cutting force and the thermal power from each single grain. However, this reduces the number of grains simultaneously involved in the work. In our case, smaller amount of more powerful heat sources take part in the heat generation. However, an increase in the power of each single source cannot compensate the decrease in their number. This phenomenon should be checked on other disks, for 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 the actual process of cutting stone materials and ceramics with a diamond cutting disk.
2. The conditions for the solvability of this model developed and determined with the help of creation of the discontinuous solution of the Eq.
3. Based on the data obtained, we can determine the heating temperature of the disk in contact with the product, the temperature along the radius of the disk, the cooling of the heated disk with an air flow, the increase in the temperature of the disk for each revolution and the time of continuous operation of the disk until the critical temperature.
4. According to the simulation results, we can say that to ensure the maximum stability of the disk, one should choose grains of the disk of at least B2-01 100% (Nz25) and work at a vertical feed rate of not more than 0.05 mm/rev.

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