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DETERMINATION OF THE CRITICAL TEMPERATURE DIFFERENCE THAT CAUSES LOSS OF BALANCE FLAT SHAPE OF THE DISK CUTTERS

One of the factors of working condition of disc cutters is a stable form of balance of the disc (resistance).

The main factors of the sharp loss of mill stability are cutting force and uneven heating of the radius of the disc. The identification of the critical value of these factors is necessary for assessing the stability of the mills. The issues of the loss of dynamic stability of the action of cutting forces were considered in [1]. This work is aimed at determining the critical temperature difference at which the disk cutter is losing stability.

The peripheral zone of cutter disc heats up more than the inner ring zone during processing. As a result, thermal stress appears. Its value depends on the temperature difference ΔT and the law of temperature distribution on the disc cutters.

The research [2] shows the dependence for calculating the critical temperature difference at which the drive loses stability:

$$\Delta T^{кр} = \frac{1}{\alpha_1}\left[\frac{\left(\frac{h}{R}\right)^2}{12\,(1-\mu^2)} f_0^{/}(c,\lambda) + \frac{\rho v^2}{E} f_o^{//}(c,\lambda)\right], \quad (1)$$

where $E=2\cdot10^{11}$ is Young's modulus, Pa;

h is the thickness of the disc, m;

μ=0,3 is Poisson's ratio;

R is the outer radius of the disk, m;

$\frac{f_0}{\square}(c,\lambda) = 98{,}185$, $f_o^{\frac{\square}{\square}\square}(c,\lambda) = 2{,}61$ is dimensionless function [2];

$\rho=7850$ kg/m^3 is material density disk;

ν=0,667 m/sec is the rotational speed of the disc.

The first item in equation (1) describes the critical temperature difference of the rotating disk, and the second $\Delta T^{кр}$ takes into account the increase of centrifugal forces of inertia.

Groove cutting and processing operations are performed at low cutting speeds (40 m / min), so the effect of inertia forces on the size of the critical temperature difference is minimal, and thus the second item in the calculation can be neglected.

The maximum allowable temperature difference along the radius of the disk cutter is given by:

$$\Delta T^{max}_{доп} = 0{,}85 \cdot \Delta T^{кр}. \quad (2)$$

Table. 1 shows the calculated value of the critical and the maximum temperature difference for different sizes and cutting trench cutters.

Table 1

Estimated value of the critical temperature difference for different sizes and trench cutting mills

№	Dimensions cutters, mm			Cutting speed, m,min	кр , º C	,ºC
	D	d	h			
1	63	32	0,3	40	110,7	94,095
2			0,5		307,04	260,98
3			1,0		1227,56	1043,43
4			2,0		4910	4173,5
5	80	34	0,5		127,7	108,55
6			1,0		510,56	433,98
7			2,0		2042,25	1735,91
8	100	34	0,5		60,93	51,79
9			1,0		243,61	207,07
10			2,0		974,44	828,27
11	125	34	0,8		81,04	68,88
12			1,0		126,62	107,63
13			2,0		506,5	430,53

Analyzing the data, we can conclude that the cutters of 1 mm thick in the test range of diameters are sensitive to temperature changes within the range and may lose stability consequently. These results require further research in the area, i.e. improving the design of mills, definition of the cutting mode etc.

REFERENCES

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