3. Менеджментна автомобильном транспорте в условиях рынка / Под ред. Л. Б. Миротина. - М„ 1995. - 152 с.
4. Body of Knowledge. Association of Project Menagers, INTERNEN UK, Buckmghamshize, 1992. - 184 p.

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LABORATORY INVESTIGATIONS OF EFFICIENCY OF THE MILLING TECHNOLOGY WITH INSIDE-MILL CHARGE'S VARIABLE MOVEMENT TRAJECTORY

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Түйін

Мақалада лабораториялық дөңгелек үккіш диірменнің құрылысы, оның түрлері айтылады. Арнайы электрлік желі кестесіне тоқталады.Үккіш құрылғының түрлі деңгейдегі айналу мерзімінің өзгеру кестесі қаралады.

Резюме

В статье рассматриваются структура лабораторных шаровых мельниц. Специлизированнык схемы электропривода были созданы. Схема позволяет изменить период темпа вращения с любым уровнем.

Key words: laboratory ball mill, charge, scheme, speed mode, rate of rotation

Theplantconsistsofa40 МЛ laboratory ball mill with pivot shaft. This mill is designed for periodical fine milling of both wet and dry material with the size of particles less than 4-6 mm.

Ball load in laboratory mills is accepted in the same proportions as in a coarse grinding chamber of a "Polisius-like" two-chambered separator mill where the weight scale coefficient is 1:1000

Specialized motor drive circuitries were created in order to regulate the angular rate of rotation. The scheme allows changing the rate of rotation with a period of $t_ц = 0 - 100$ by any rate. The following rates correspond with realization of alternative speed mode: 84, 80, 74, 68, 60, 55, 50, 45 rev/min. The first one conforms with purely "tumbling" mode (95% of the critical speed), the last one - with purely "cascade" mode (50% of the critical speed), the others - with intermediate speed modes. The operating times for each of the eight steps were fixed by hand stopwatch. In all comparative tests the following terms were assumed: 84 rev/min - 2 min; 80 rev/min - 2 min; 74 rev/min - 2 min; 68

rev/min - 2 min; 60 rev/min - 3 min; 55 rev/min - 3 min; 45 rev/min - 6 min. The total operational time equals 24 minutes.

The method used by Fahrenwald is a basis for this testing practice [1].

Initial granulometric texture of samples of series "A", "B", "C" is illustrated in the Table 1.

Table 1- Size characteristics of base ores

Sample	Size	Class content				
«A» Series	mm	-2+0,4	-0,4+0,14	-0,14+0,1	-0,1+0,074	-0,074
	%	50,0%	17,3%	6,6%	0,7%	25,4%
«B» Series	mm	-3+0,4	-0,4+0,14	-0,14+0,1	-0,1+0,071	-0,074
	%	67,8%	9,2%	2,8%	3,6%	17,6%
«C» Series	mm	-5+0,4	-0,4+0,14	-0,14+0,1	-0,1+0,071	-0,074
	%	81%	6,2%	2,2%	1,4%	9,4%

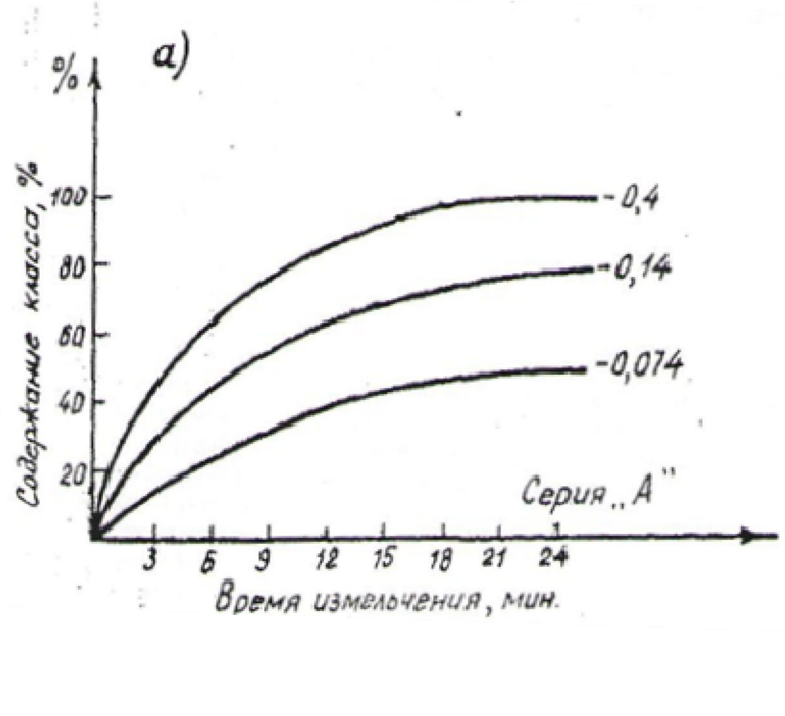
To get samples with smaller size the initial material was griddled out through two sieves which have the size widths corresponding with the largest and the smallest sizes. In such a manner the samples by classes were made up: [-5+3 mm], [-3+2 mm], and [-2+1 mm]. Considering the linear law of allotment of materials in one fraction [-8; 10], in accordance with obtained sizes, the:

- fourth ("M" series) - with 1,5 mm average grain size;
- fifth ("L" series) - with 2,5 mm average grain size;
- sixth ("D" series) - with 1,5 mm average grain size;
- seventh ("N" series) - with 2,5 mm average grain size;
- eighth ("K" series) - with 4 mm average grain size;

Test charge was considered equal to the volume of spaces between balls which was determined by filling with liquid and turned out to be as much as 12% of the mill's struck volume. Further, a number of identical test charges are prepared with the help of gauge the volume of which is 850 cm^3, i.e. also approximately 12% of the mill's struck volume (according to the methodology of "Mechanobor" institute, during the standard testing of grind ability test charge is taken as 12% of the mill's struck volume, too [2]). Test charges of identical samples are arranged in numbers necessary for the test work. In all tests the particles analyses were carried out by wet-dry technique, i.e. before determining the size characteristics, the fine class is rinsed out (-0,074 mm). The upper class is dried out and dispersed into fractions. In defining the class origins the washed-out products are added to the lower fraction which was derived from the same sieve dry. Screen sizing of the ground product was classified as +0,4; +0,14; +0,1; +0,074; -0,074; -0,054 mm. The weight of the sample for screen sizing was taken as 100 g [3].

In ball milling of a material the time selection of staying duration of the material in the mill, i.e. milling time is highly important. Usually the first period of milling is characterized by uneven supply of all minerals in the original ore, and significant productivity of a finished product in a time unit. This is explained by that minerals which are part of coal's composition and which show the strongest resistance to the destructive force is concentrated in the mill, while less strong minerals are quickly destroyed, thus provide larger finished products yield in a time unit. An increase in milling time means that mineral composition of a product from the mill will correspond with the mineral composition of the original ore, since strong minerals which were earlier not destroyed start to disintegrate. Herewith, finished product yield in a time unit will be decreasing as easily-granulated components delay the breakdown rate of the stronger minerals [4]. For this same reason, to obtain objective results from the experiment it is crucial to correctly define the milling time. Milling tests were carried out for that with different time intervals: 4, 6, 8, 12, and 24 minutes, to plot a curve of class content "by minus" depending on milling time. The tests were conducted on samples of series "A", "B", and "C" under constant angular velocity $\omega_0 = 64$ rev/min. The curves we get are illustrated in Figure 1, a.

The analysis of the curves demonstrates that the milling takes place very intensively until 12 minutes, then after 20 minutes milling intensity decreases. That means stabilization of the milling process and that further milling will not bring significant increase in productivity. On the basis of the foregoing, the productivity of the comparison tests is accepted as equal to $T_{m.} = 24\,\text{min}$.



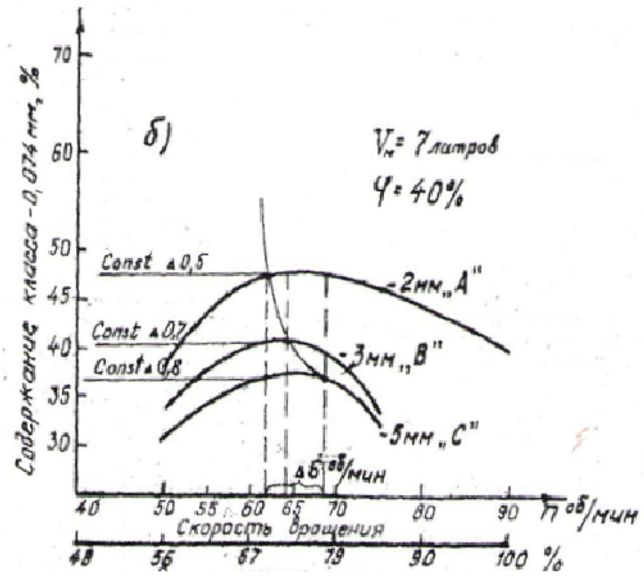


Figure 1 - Dependences of the class content "by minus" on the milling time (a) and of the from 0,074 mm class content "by minus" on the rate of rotation of the mill barrel

Since the mode with alternating movement trajectory of the inside-mill charge is based on the change of the mill barrel's rate of revolutions, then to compare the results obtained from supposed milling method, determination of some optimal rate of rotation which shows best figures of milling under permanent movement trajectory of inside-mill charge mode, namely the largest -0,074 mm class content of the milled product, is necessary. This determination of an optimal rate was carried out on samples with wide size range of samples of series "A", "B", and "C". According to the tests results curves of -0,074 mm class contents dependant on rates of rotation on different samples were drawn (Figure 1, b) (the curves were drawn relying on arithmetic mean value of the four tests). The milling time was taken as $T_{m.} = 24\min$. It emerged that for samples of series "A" the optimal rate is 60 rev/min, $\beta_{74} = 47.5\%$; for samples of series "B" - 64 rev/min, $\beta_{74} = 41\%$, and of series "C" - 67,5 rev/min, $\beta_{74} = 37\%$. As all tests should be carried out with the same rate, the principal rate is accepted as equal to $\omega_0 = 64 rev/\min$, the arithmetic value of the three. In this respect error caused by the establishment of the principal rate is not more than ±1.5%.

From the Figure 1, b, it follows that dependence of -0,074 mm class content of milled product on the rate of rotation is at its maximum.

REFERENCES

1 Fahrenwald A.W. Grinding and Classification. Report of Investigation, Bureau of Mines, USA, 28-29.

2 АндреевС.Е. Закономерностиизмельчения. - М.: Металлург-издат., 1957.-p.348.