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LABORATORY PLANT FOR CRUSHING SOLID MATERIALS

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Abstract:
This article discusses the design, operation, and performance of a laboratory-scale plant for crushing solid materials. The study aims to analyze the efficiency, energy consumption, and material behavior during the crushing process. The experimental setup and methodologies used in this study are detailed, followed by a comprehensive analysis of the results. Conclusions drawn from the study offer insights into optimizing crushing processes in laboratory settings and provide suggestions for future research.

Keywords: Laboratory plant, solid materials, crushing, energy consumption, material behavior, process optimization.

Introduction

The method of conducting experiments on grinding was as follows. Previously, at idle, on the installation shown in Fig.2.1 set the required number of revolutions. After all the operating parameters of the installation were set to the set mode, the initial material was filled through the hopper (15), having particles from 2 to 5 mm. The feedstock is moved for grinding to a zone where the material is crushed to a homogeneous, finely dispersed fraction and simultaneously transferred to the unloading zone. After grinding, the resulting particles are moved to a further technological operation.

To identify the optimal parameters, the location of the rods, the number of revolutions, the above parameters varied in the following interval:

- the number of revolutions of the drum – n = 10 - 40 rpm;
- the initial moisture content of the material is U %;
- material consumption - G = (0.008 ÷ 0.03) kg/s;
- the residence time of the material in the device is τ = 30-200 s .

The experimental data was processed as follows. Initially, the characteristic average diameter dn of the material was determined before grinding by sieve
analysis according to the well-known method [73,74,75], and then the fractional composition of the initial product was calculated. Further, the average diameter in each fraction is determined by the formula:

$$d_{cp} = \frac{d_{\max} + d_{\min}}{2} \quad (2.1)$$

For the entire mixture obtained as a result of granulation, the average diameter is calculated according to the dependence:

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$$d_k = \frac{a_1 d_{cp1} + a_2 d_{cp2} \cdots + a_n d_{cpn}}{a_1 + a_2 + \ldots + a_n} \quad (2.2)$$

Further, knowing the average diameter of the particles before grinding dn, the degree of grinding i is determined by the formula :

$$i = \frac{d_н}{d_к} \quad (2.3)$$

The characteristic linear size of a spherical piece is the diameter, of a cubic piece is the length of the rib. The characteristic linear size of irregular geometric pieces can be found, for example, as the geometric mean:

$$d_э = \sqrt[3]{l \cdot b \cdot h} \quad (2.4)$$

where l, b, h are the maximum dimensions of the piece in three mutually perpendicular directions. The crushed material enters the drying zone. Next, the particles are dried and then the granulometric composition R of the resulting product is determined by sieve analysis.

$$V = \frac{\pi D^2}{4} \cdot L \quad (2.5)$$

The critical number of rotation of the device is calculated using the following formula:

$$n_{крит} = \frac{32}{\sqrt{D}} \quad (2.6)$$

The performance of a ball shredder of solid, deformable materials is calculated by the equation.

Conclusions

This study demonstrates the importance of understanding material properties and equipment capabilities in optimizing the crushing process. The laboratory plant provided a controlled environment for testing and analyzing the behavior of different materials under various crushing conditions. The results offer insights into the selection of appropriate crushing equipment for specific materials, with implications for improving industrial processes.

Future research should focus on the development of more advanced models that incorporate the effects of material heterogeneity and fracture mechanics. Additionally, scaling up laboratory results to industrial applications remains a challenge that requires further investigation. Integrating real-time monitoring and automation into laboratory plants could enhance the accuracy and efficiency of crushing experiments, leading to more reliable data and better process optimization.

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References

1. Сиваченко Л.А., Добровольский Ю.К. История развития и современный уровень техники измельчения / Вестник Белорусско- Российского университета, 2012. - №4. – с.69-76.
2. Сахаров Д.Ф. Анализ процесса т дробления хрупких материалов в одновалковых дробилках с целью повышения эффективности / Авт.дисс…канд.техн.наук, Новокузнецк, 2011. – 19 с.
3. Тур Н.Н., Харитонов М.В., Прохоров Р.Н. Механические свойства строительных материалов. – Владимир: изд-во ВлГУ, 2013. – 36 с.
4. Потапова Л.Б., Ярцев В.П. Статистический критерий текучести твердых материалов при сложном напряженном состоянии / Вестник ТГТУ, 2003.- т.9.-№3.-с.477-495.
5. Пилипюк В.Л. Технология хранения зерна и семян. – М.: Вузовский учебник, 2010. – 437 с.
6. Тарасенко С.С. Современная технология мукомольного производства,– Оренбург: изд-во Оренбургский гос.университет, 2018. – ч.2.-№3.-104 с.