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PERFORMANCE REVIEW AND PRINCIPAL DIRECTIONS FOR DEVELOPMENT OF A GRINDING EQUIPMENT IN CEMENT FACTORY

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ABSTRACT

The importance of energy-savings in grinding of materials in a cement factory using press-rolling crusher and grinding mill was considered. An analysis of the development of grinding equipment on the basis of grinding mill in the past half century has been presented. Comparative characteristics of existing grinding units are also presented. Established that the vast reserves of energy saving during grinding contain materials having anisotropic texture and is widely used in the manufacture of building materials, including cement, which have different ultimate resistance in directions perpendicular and parallel to the layering of the mineral.

The recommended of development and retrofit of the grinding equipment to grind anisotropic materials, which include:

- to the uniform and ingress direction of mill feed across the width of the working surfaces of the rolls;
- force strength action in the direction of the strength of minimal pieces of anisotropic material;
- effective conditions deagglomeration and grinding mill the compacted pressure press-rolling crusher of materials;
- realization of effective constructively- technological solutions structural and technological solutions that enhance the wear resistance of working surfaces and other aggregates.

Suggested areas of development and improvement of engineering and technology development grinding materials may be of interest to Russian and foreign organizations operating in the design and manufacture of the grinding equipment.

Keywords: energy intensity, technological grinding complex, press-rolling grinding mill, the press-roll coal, anisotropic materials.

INTRODUCTION

In cement production process among the most energy-intensive process is the heavy grinding of cement materials (clinker and additives), implemented mainly in the grinding mills (GM), spent about 35-40 kWh / t. This is due to the fact that a significant portion of the energy in the implementation process in the grinding mills for heating of ball charges for sound effect, etc. [1-8]

Attempted to create a new design of high-performance grinding units (roll, ink, etc.), allowing escape from the grinding mills, since their specific deficiencies are not wide spreading.

As before, thanks to its high unit size tumbling mill remains the main unit in the grinding of the cement industry.

RESULTS AND DISCUSSION

Improving the efficiency of these units in the last half-century occurred in two main ways:

a) Increase in unit size of aggregate, by increasing its size;
b) Intensification of the grinding process in the machine, through the use of:

- Physic - chemical methods of intensifying the process of grinding;
- Rational scheme of devices installed inside the mill and the optimal quantity of the parameters of the ball load;

Adoption by the industry of high-performance systems to reduce the capital cost of equipment and construction, to reduce the area of industrial buildings, reduce the cost of automation and instrumentation, and others. However, increasing the size and capacity of individual grinding plant (Table-1.) Did not result in a significant improvement of quality performance.

Table-1. Comparative characteristics of grinding aggregates.

№ п/п	Typical size of aggregate	Generating capacity of drive, kW.	Productiveness, t/h.	Specific energy consumption, kW/h.	Weight a grinding media, t.
1	2,6 x 13 м	1000	25-28	40-35	80
2	3,0 x 14м	1600	40-45	40-35	110
3	3,2 x 15 м	2000	50-60	40-33	130
4	4,0 x 13,5м	3200	80-85	40-37	200

As before, by its grinding aggregates remain high specific energy consumption and specific quantity of metal.

In addition, increased unit capacity grinding mill has led to an increase in their dimensional specifications and weight, which in turn led to problems associated with the transport, installation and repair service of aggregate.

The second way to improve the efficiency of clinker and additives was carried out by the intensification of the grinding process in the aggregate.

One of the solutions which are the use of physical and chemical methods for intensification based on the creation of small synthetic surface active substances (SSAS) adsorption-active medium and maintaining rational conditions of a wet thermal process in a grinding aggregate.

With the introduction of SSAS penetrate in microcrack that exerts a force on it wedging out action, thereby reducing the strength of the material. Efficiency of the use of grinding aids (GA) increased by grinding materials with high defect structure and back off when grinding crushable materials. [8-10].

Grinding aids, giving the effect of the grinding material one cannot produce an effect when grinding else that requires an individual approach and a wide variety of GA. However, not only is the concentration and composition of the GA, but a method of feeding are significant when grinding materials such as the effective length of the surfactant in the dispersion mill is in the range of from 0.5 to 1.5 in its diameter, which is quite difficult realizable with the presence of aspiration and high temperatures grinding aggregates (t = 100-200 ° C), it reduces the effects of GA.

More significant indicators of the aggregate to increase the efficiency of the process of grinding materials in drum mills allows for the development of highly energy-exchange devices inside the mill. It is include: inclining intermediate diaphragm, annular aperture, blade segments ellipse, spiral energy-exchange and other devices. The use of these devices to ensure the destruction of energy exchange stagnant zones grinding download and inclusion of additional work (40%) of milling tools, it can improve the performance of the grinding unit and reduce the specific energy consumption by 15-25%.

Analysis performed to establish energy-exchange developments devices shows their diversity and relatively high efficiency. However, without changing the physics of the grinding process can hardly be expected cardinal improvement of technical and economic parameters of grinding process. In this regard, the implementation is very promising partitioned grinding batches to the imposition of a rough grinding step beyond in a special grinding aggregate, which provides a more efficient mode of fracture of materials compared with grinding ball aggregate [3].

The main characteristics of the use of comparative sectional grinding process materials in comparison with customary milling are presented in Table-2.

Table-2. Comparative characteristics of grinding machines.

	Grinding systems				
Indicator name	**GM**	**PGM-GM**		**CIC-GM**	
		PVI	**GM**	**CIC**	**GM**
Characteristics of grinding machines:					
Size, м	3,2x15	1,0x0,8	3,8x14	1,75	3,8x14
Mass, t	700	60	590	90	590
Generating capacity of					
electric motor, kW.	2000	500	3250	500	3250
Energy input of drive, kW.	1940	460	2320	470	2380
Specific energy consumption by disintegration of clinker, kW. h/t.	38,8	4,6	23,2	4,7	23,8

The represented data demonstrate the feasibility of using a partitioned grinding process with the removal stage coarse grinding ball mill grinding aggregates to another (press-rolling grinding mill (PGM) or cone-type inertia crusher (CIC)).

In fact, that the implementation of the partitioned grinding process using radiation with a press-rolling grinding mill shredder reduces specific energy consumption by 25-40% and improve performance of the ball mill by 30-40%. This is achieved through the use of step raw grinding more efficient way of destruction of materials (crushing shift implemented in PGM than CIC - shock at the first stage). For example: the specific energy consumption spent on pre-grinding materials in PGM is 3-4 kWh/t, corresponding to the cost in equal CIC 7-10 kWh / t.

In our opinion, may significantly improve the grinding process by using the internal energy of shredded materials.

It is known that rock formation used as raw materials in the production of various construction materials, including cement - are natural compounds formed as a result of geological and cosmochemical and other processes. These breeds have certain energy reserves, which account in their processing technologies will significantly reduce energy consumption. The huge reserves of energy saving during grinding in our opinion contain materials having anisotropic texture and is widely used in the manufacture of building materials, including cement. Materials with anisotropic texture have different tensile strength in directions perpendicular and parallel to the layering of mineral [5-7].

Representatives of this group are anisotropic materials organogenous carbonate of lime, marbles, carbonate of lime dense banded, marl and other different density value of fine-grained rocks and having different strength and anisotropy (Table-3).

Submission in the interroll space and precompacting uniformly distributed layer of material across the width of the rolls have a positive impact not only on the performance of the press roller chopper and the destruction efficiency of anisotropic materials, but also the nature of wear of the working surfaces of the rolls. However, today as we have in the country and abroad and projected manufactured crushing and milling equipment ignores texture and crushed materials.

Table-3. Characterization of anisotropic materials used as raw material in cement factories.

Material short text	Compressive resistance, MPa		Anisotropy coefficient
	Perpendicularl in fissility	Perpendicularl in fissility	
Organogenous carbonate of lime	95	65	1,46
Banded marble	226	162	1,4
Banded carbonate of lime compact grained полосчатый	101,3	72	1,41
Chalky clay	42	35	1,2

Based on the analysis, we conclude that one of the ways to significantly reduce energy costs for the implementation processes of crushing is to develop new and improve existing equipment implements the deformation of materials of a force in the direction of least resistance for each reduction stage.

CONCLUSIONS

At this rate, the analysis shows that in the present and near future development and improvement of the partitioned grinding process, implemented in the grinding complex PGM - GM is considered a promising direction, despite having a specific design and technological shortcomings PGM, expressed in irregular wear on the rolling face.

Resume

Conducted analysis of the organization of the process of grinding materials, implemented in the grinding complex PGM - GM revealed that for increasing the efficiency of grinding materials in cement production and reliability of the design units must be created:

- to the uniform and ingress direction of mill feed across the width of the working surfaces of the rolls;
- force strength action in the direction of the strength of minimal pieces of anisotropic material;
- Effective conditions deagglomeration and grinding mill the compacted pressure press-rolling crusher of materials;
- Realization of effective constructively- technological solutions structural and technological solutions that enhance the wear resistance of working surfaces and other aggregates.

All of this is in our view determines the direction of the next few years the development of scientific bases of calculation and design to improve the techniques and technology of the stepwise process of crushing materials implemented in the PGM - GM and its introduction into production.

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