VOL. 11, NO. 9, MAY 2016 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

AUTOMATION OF THE DRYING AND MILLING UNIT FOR THE MINERAL POWDERS PLANT

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ABSTRACT

The article gives a brief description of the block diagram of drying and milling units (DMU) for the mineral powder plant. The influence of structural and technological parameters of aggregates DMU on the character of the technological process of mineral powder. Software implementation ACS DMU is a complex of technical means, technical, informational, mathematical and software for management of technological objects. ACS DMU provides the optimal level of automation of collection and processing of information for generating control signals and transmit them without loss and distortion to the actuators in order to achieve the most efficient operation of engineering systems as a whole.

Keywords: mineral powder, mnemonic scheme, automated control system (ACS), process, drum dryer, centrifugal impact mill, programmable logic controller (PLC).

1. INTRODUCTION

Mineral powder particle size is not only additive, but also structures the bitumen and forms a asphalt binder, which largely determines the strength, density, heat resistance and durability of asphalt concrete.

Road construction practice shows that asphalt concrete with a mineral powder lasts longer. It is characterized in particular by higher long-term water resistance and a number of other indicators predetermining the durability of the coating.

As is known, mineral powder is a product of fine grinding of carbonate rocks (limestones, dolomites, dolomite limestone, metallurgical slags, etc.). The traditional apparatus for producing mineral powder is a ball mill, which is characterized by high energy consumption and considerable operating costs. Furthermore, the key index of mineral powder in addition to its particle size distribution is obtained form grains. Mineral powder grain shape affect the workability and compactibility of mixtures as well as the mechanical properties of asphalt concrete.

Processes control the raw material drying and further grinding covers a range of issues related to the development of new principles and methods of automation [1 ... 21]. It is necessary to use a new approach to the synthesis of production of mineral powder for the integration of technology, facilities and management. Only in this way it is possible to significantly improve technical and economic indices of industrial production of mineral powder, to avoid the impact of significant fluctuations in quantity and quality of raw mode rejection operation of individual units on its qualitative characteristics.

2. DESCRIPTION OF THE AUTOMATION

Drying and Milling Unit (DMU) (Figure-1) for drying and grinding of mineral raw materials up to 40 mm particle size and moisture content of not more than 15%.

DMU has an autonomous operating principle, but the overall system of management and are arranged modular devices optimally integrated, providing high performance, simplicity and ease of operation, small footprint and low power consumption.

DMU provides up to 15 t/h of several narrow fractions of the final product in a desired size range (0.04 - 0.4 mm).

Specially selected universal scheme can significantly improve the economic performance of grinding and qualitative indicators of the resulting material. A fineness of the finished product can be adjusted during operation without stopping the equipment.

For a continuous supply of material from drying complex to shredding as well as intermediate storage and cooling of the material requires the elevator and silos.

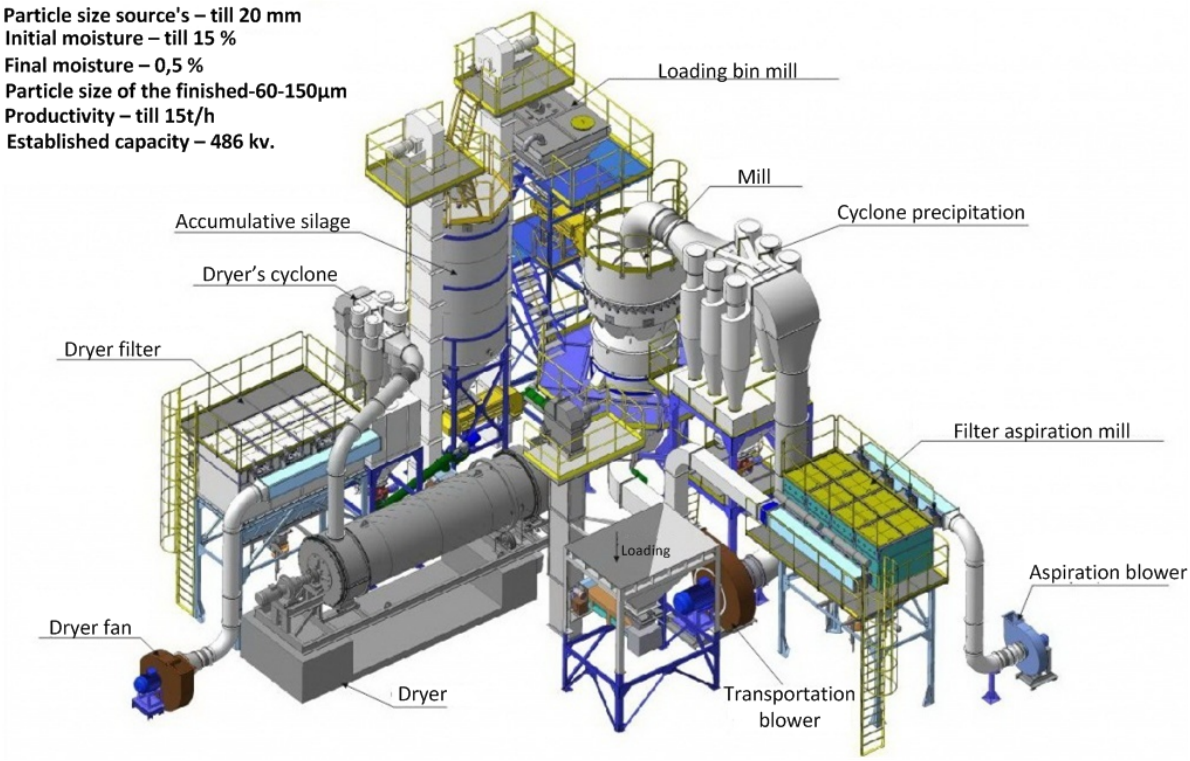

Figure-1. Drying and milling unit.

The starting material is fed into the rotary accelerator. After receiving the necessary to grind the peripheral speed, takes off from the accelerator hits the impingement surface of the crushing chamber and destroyed.

Then picked up by the air stream and carried into the classifier, a part of the mill, where it is split.

Unmilled material returns to remilling, the material is taken out in a desired size cyclone which is deposited in the hopper and enters the final product.

This scheme allows to significantly improving the economic performance of the grinding process, to reduce the specific power consumption, prevent over grinding by continuous removal of the finished product and increase the quality indicators of the resulting material. The desired particle size can be adjusted during operation without stopping the equipment.

The entire chain of grinding complex operates in vacuum and does not cause dusting. Air consumption is minimized due to recurrent, cyclical usage pattern of air flow. The volume flow and venting to the atmosphere does not exceed 30% of the total consumption necessary for the implementation of traffic flows and of the units of the complex.

For the development of a specific scheme, the definition of size, performance and equipment is most suitable for the needs of a particular production.

3. AUTOMATIC MODE CONTROL CENTRIFUGAL-IMPACT MILL

Centrifugal impact mills (Figure-2) [13] are designed for dry grinding of metallic and nonmetallic materials of any strength and hardness.

Fan of high pressure the air pressure is created for the formation of a "gas bearing" (air gap) between the rotor and the stator. The motor via the drive line drives the rotor and the accelerator mill. Starting material through the crushing hopper is fed to the separation cone and is distributed through the channels of the accelerator. After receiving the necessary peripheral speed, material is fed into the crushing chamber, where it is crushed by hitting the surface of the lining and collision particles.

The crushing chamber airflow produced primary classification of materials: separation unmilled particles to return to the mill. The milled product is taken out by air flow into the integrated air classifier mill, where the process of fine division of the resulting material separate unmilled regrinding particles are returned to the crushing chamber. Particles that satisfy the specified range of size, in the form of a dusty mixture formed in the milling process, are fed to the process scheme for the separation of complex grinding fractions and precipitation of the final product.

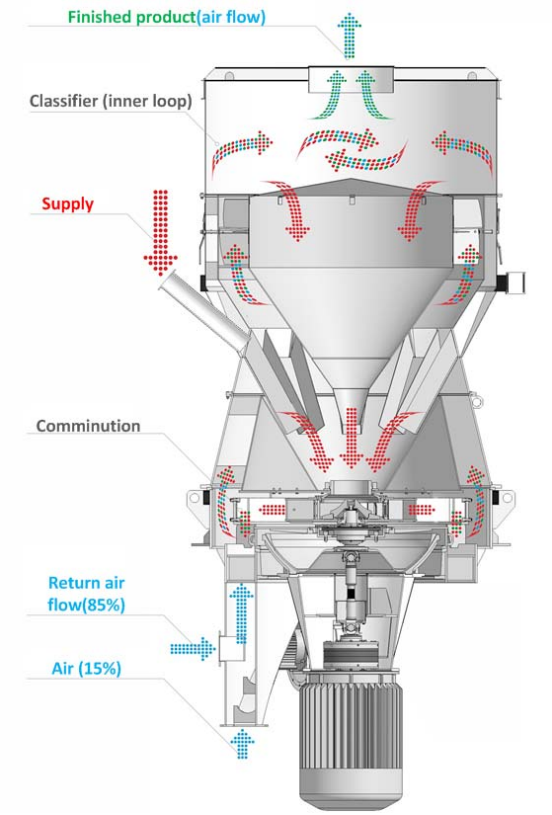

Figure-2. Centrifugal impact mills.

To solve the problem of controlling the rotational speed of the mill, the time constant of which varies depending on the load, it is advisable to apply a self-tuning system with the reference model. Self-tuning systems with a reference model implement the desired dynamic characteristics of the main system, providing high quality management processes in a wide range of changes of properties of the object.

Changing the equivalent transfer function $\Delta W_1(\delta)$ applied to the input of the main component, which can be formed by using additional connections, containing a filter with a transfer function $\Phi_0(p)$ (Figure-3).

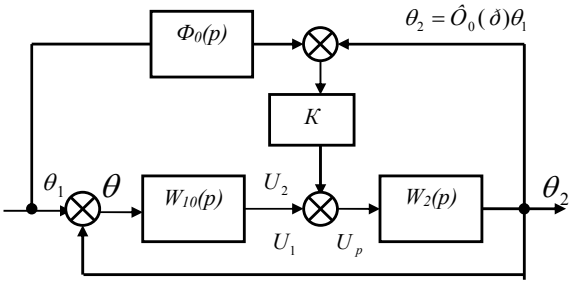

Figure-3. Scheme of automatic control system (servo-system).

The manipulated variable θ_1 is fed to the device with an optimum constant transfer function $W_{10}(p)$ and the input of the filter. The filter has an optimal transfer function of the closed system $\Phi_0(p)$.

Filter output signal is subtracted from the entire closed system $\theta_2 = \Phi_0(p)\theta_1$. The difference of these signals through the unit with the gain K is input to the main link of the system transfer function $W_2(p)$.

In consideration of the structural scheme of the system keeps constant transfer functions of the closed system to the extent $W_2(p)$.

The main parameter control in an aspiration path of the aspiration is the load path, which must be maintained at the highest possible level with the changing external conditions.

System flow control fuel mixture in the working space of the mill allows for stability and high-performance aspiration processes and material removal maximum predetermined particle size distribution.

4. DESCRIPTION ACS MILLING UNIT

Milling Unit for the production of mineral powder equipped with modern automatic control system based on SCADA [1, 15], and interactive control panel, with system performance analysis, logging and statistics collection, taking into account the options and the required parameters of the final product.

The operation of the Milling Unit with the use of modern SCADA-system is made from a specially equipped control room (Figure-4) [12].

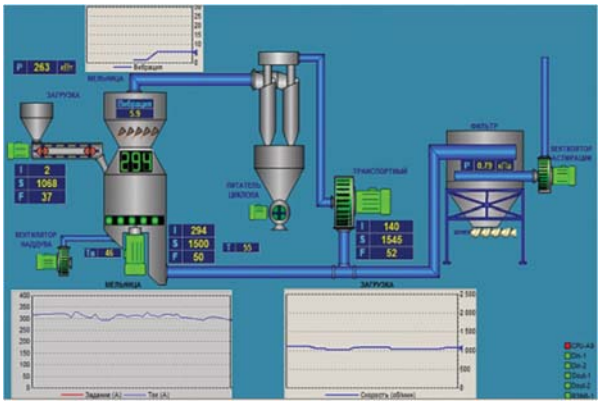

Figure-4. SCADA-system.

The touch panel displays the mnemonic operation of the plant in real time. The operator touch of the "Start" icon starts the job complex in idle mode, then there is a serial automatic startup of individual units of the complex.

Further, making the normal operation of vehicles in the workshop, the operator returns to the control system and starts the download operation of the complex. In this work the operator to manage the complex ends. PCS system on the previously developed and introduced the program controls the process automatically.

The role of the operator in the production process is the operational control of the information and subsequent analysis of the parameters of the complex.

ACS shredding installation can improve the culture of production due to the stabilization process, to increase productivity and product quality, raise the efficiency of the process equipment, to significantly reduce the number of mistakes made by the staff, to reduce the number of employees at the complex while improving their skills.

5. CONCLUSIONS

It is necessary to further improve the automated production technology of new materials based on mineral supplements.

Automation of technological processes of production of mineral powder, allows to obtain a building material with high technical and economic indicators. One of the effective ways to improve the efficiency of grinding is the grinding of raw materials in a centrifugal impact mills that allows a better product compared to other types of mills.

The maximum possible effect of grinding related to obtaining the maximum amount of mineral powder, subject to its defined quality characteristics, developed by the operation of the stabilization and optimization of a number of parameters centrifugal impact mills local automatic control systems, as well as the introduction of automation Milling Unit on the basis of SCADA- system.

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