SYSTEMATIC ANALYSIS OF THE DRYING PROCESS OF DISPERSED MATERIALS

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Abstract

The article analyzes the superphosphate mineral fertilizer manufacturing process, problems, and equipment designs used. Based on the analysis, an improved construction scheme of a two-part nozzle for a drum dryer is recommended. Systematic analysis of the proposed nozzle with similar structures was carried out and its effect on the heat exchange process in the drum dryer was studied. The MATLAB program was used in the multi-stage analysis and parameters calculation in the working zone of the drum dryer.

Keywords: nozzle, ridge analysis, drum dryer, superphosphate, heat exchange surface.

Introduction

Currently, the need for high-quality drying of products produced in chemical, food, agricultural and other industries is growing day by day. As one of the main reasons for this, it can be said that the quality indicator of the produced product depends on the moisture content of the product [1-9]. Therefore, it is of urgent importance to study the possibilities of cost-effectively combining convective, infrared and microwave energy in the drying process, to choose the optimal options and constructions, to put them into practice and to ensure product quality, exportability and energy efficiency in the drying process [10-17].

In particular, drying is one of the main processes in the production of mineral fertilizers, and the granularity, quality and exportability of the fertilizer depend on this process [18-31].On the basis of the above, the superphosphate mineral fertilizer production process and existing problems were analyzed in the AS-72M workshop of "Fargonazot" JSC, which is one of the largest chemical enterprises in the Republic of Uzbekistan. Figure 1 shows the technological scheme of superphosphate mineral fertilizer production.

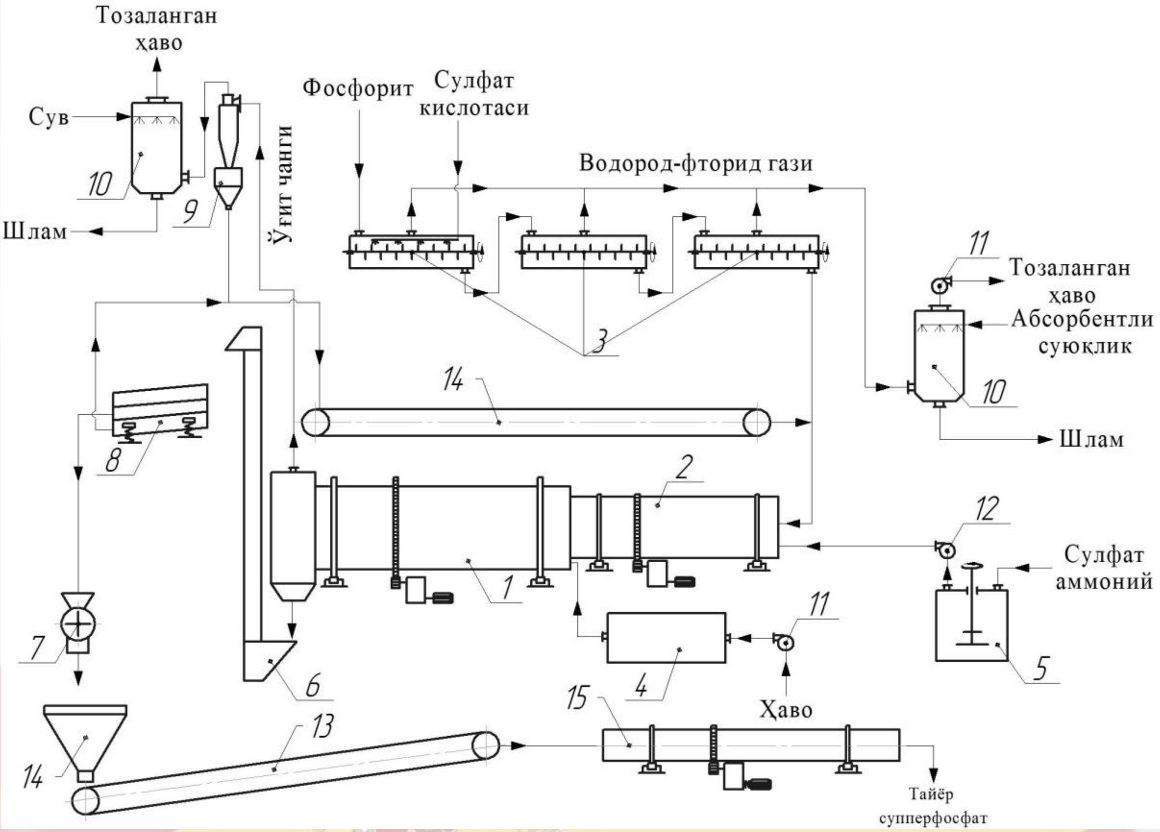

Figure 1. Technological scheme of superphosphate mineral fertilizer production

Analytical research methodology

1-drum dryer; 2-drum granulator; 3-horizontal reactor with mixer; 4-calorifer; 5-vertical reactor with mixer; 6-bay elevator; 7-hammer grinder; 8--trade; 9th cyclone NIOGAZ; 10th hollow scrubber; 11th fan; 12-centrifugal type pump; 13-belt conveyor; 14- supply bunker; 15-drum cooler.The superphosphate production process at Fergonazot JSC consists of mixing phosphorite flour and sulfuric acid in a reaction medium, granulating in a drum granulator by sprinkling ammonium sulfate liquid into the mixture, drying the granulated fertilizer, separating it into granulometric compositions according to the regulations, and coating the finished product. There is a designed technological line. it is energy efficient compared to classical methods. However, the quality index and exportability of the produced product is not very high. In order to identify existing problems, studies were conducted using the method of systematic analysis.

Analytical research results

The results of the analysis showed that the fertilizer temperature at the entrance to the drum granulator was 100 ℃ and its moisture content was 26.4%. The temperature at the exit from the drum dryer was 70 ℃ and its humidity was 14.39%. The obtained results show that the manufactured fertilizer complies with the regulation prescribed for the technological line (the granulometric composition of the fertilizer according to the technological regulation3÷5 mm, humidity not exceeding 10% and finished product temperatureto be in the range of 35÷40 ℃

must) does not satisfy the requirements. The origin of this situation is related to the heat exchange processes in the dryer, and the current situation is caused by the fact that the granulated fertilizer in the granulator goes to the dryer and does not come into contact with a sufficient heating agent there [32-47]. An optimal solution to eliminate the studied problem is to choose a nozzle suitable for the process and to improve its construction. Currently, a lot of scientific research is being conducted in this direction, and two-piece nozzle designs are shown as a promising option. Based on the above, an improved structural scheme of the two-part nozzle was developed. Figure 2 shows the installation scheme of the nozzle on the drum [48-55]. The advantage of nozzle over existing structures is that first of all, the fact that its material discharge part has a certain slope ensures a sharp reduction of non-heat exchange zones in the dryer. Secondly, the installation of the parts in a semi-circular structure prevents the material from getting stuck in the nozzle. In order to test the proposed nozzle in real production conditions, to evaluate its effect on non-heat exchanging zones, the design of the nozzle was developed andAS-72M plant of "Fergonazot" JSC installed a drum dryer in the production process of superphosphate mineral fertilizer.Photographs were taken and analyzed to assess the effect of the nozzle on the non-heat-exchange zones in the dryer. According to the results of the analysis, the area of the material curtain spread along the surface section of the drum was 5.9 m2 and the non-heat exchange zone was 0.5 m2. The results were compared with existing constructions. In order to fully compare the parameters and reduce the error of the results, the method of multifactorial systematic analysis was used [9]. Systematic analysis was carried out in the following sequence.

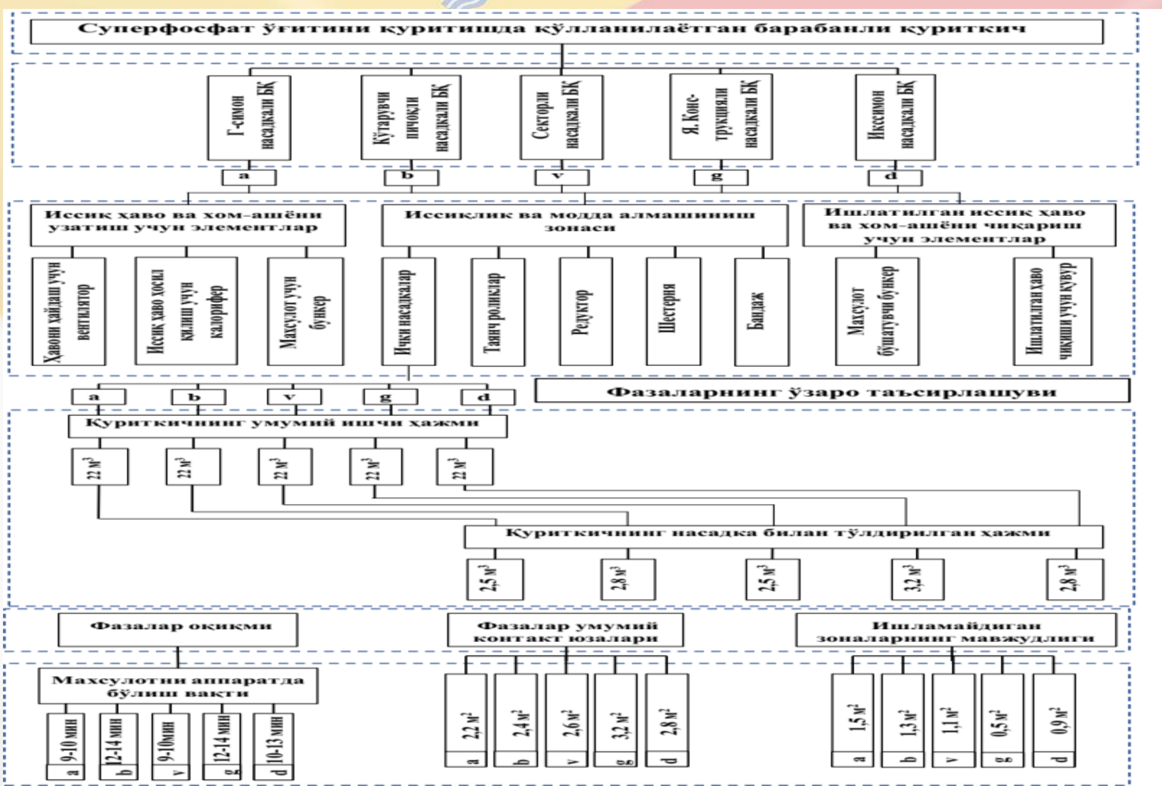

Figure 2. A systematic analysis view with four hierarchical levels

At the first initial hierarchical level, the drum dryer used for drying superphosphate mineral fertilizer and nozzles of various constructions installed on it can be seen. System input and output parameters are defined. On the second hierarchical level, elements for the transfer of hot air and raw materials, heat and mass exchange zone and elements for the release of used hot air and raw materials were seen. Input and output parameters of each auxiliary system1 are defined. At the third hierarchical level, the interaction of the phases, the total working volume of the dryer, and the nozzle-filled volume of the dryer were considered. Input and output parameters are defined. At the fourth hierarchical level, the flow of phases, the common contact surfaces of the phases, the presence of non-working zones and the time of product distribution in the apparatus were seen. Input and output parameters are defined. The MATLAB program was used for the multi-stage analysis and parameter calculation in the working zone of the drum dryer. Figure 2 shows the results of the analysis. The information given in Figure 4 allows you to find the types of nozzles that can be used in the process, their operating parameters, optimal modes. In this case, each column of the four-level hierarchical levels is important.

Conclusion

The drum dryer used in the researched fertilizer production process, its working parameters, different designs of nozzles were systemically analyzed and an improved design of two-part nozzle was recommended. The proposed nozzle design was used in real production conditions and it was found in experiments that it fully satisfies the technological regulation.

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