

Control of Powdery Superphosphate Granulation Process

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Abstract— The given work falls into the domain of granulation process automatic control in drum granulators and can be rather useful in terms of granulated superphosphate production.

Keywords— control; granulator; powdery superphosphate; sensor; standard fraction

I. INTRODUCTION

For the increase of the standard fraction output, the flow rate and equivalent humectants drops diameter are adjusted for the drum granulator length. The adjustment is made in view of granulator angle of inclination and rotation speed [1-3].

II. STATEMENT OF PROBLEM AND SOLVING THE PROBLEM

The process control is executed in the following way (see fig.1).

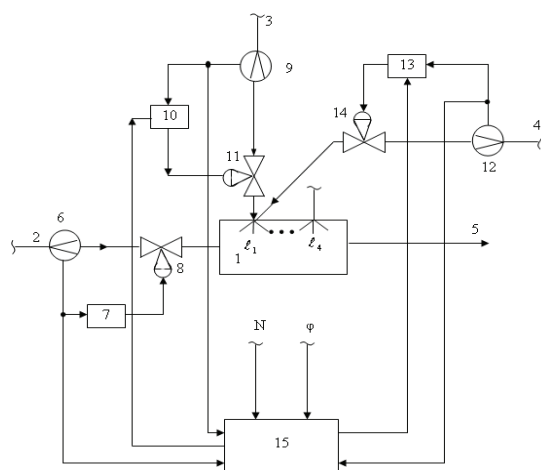


Figure. 1. Control of powdery superphosphate granulation process

The powdery superphosphate comes on the pipeline 2 into the granulator 1. The air-atomized humectants comes along the pipeline 3, while the atomizing air – along the pipeline 4. The granulated superphosphate is removed from granulator using the pipeline 5.

The powdery superphosphate flow rate is measured by the sensor 6 and is adjusted with the controller 7 by the effect upon the damper 8. The humectants flow rate is measured by the sensor 9 and is adjusted with the controller 10 by the effect upon the operating mechanism 11. The flow rate of the agent, which atomizes the humectants, is measured by the sensor 12 and is adjusted with the controller 13 by the effect upon the operating mechanism 14.

Information about the flow rates of powdery superphosphate, humectants and atomizing agent from sensors 6, 9 and 12, correspondingly, enters the computational system 15. The signals proportional to the angle of inclination φ and the drum granulator rotation speed N , are also discretely fed into the computer from the keyboard.

For the specified G_d values of the powdery superphosphate flow rate, angle of inclination and rotation speed, the computer calculates values of flow rate, as well as the ones humectants drops equivalent diameter alongside with the drum granulator length.

The computations are based upon the following algorithms:

$$G_{hj} = G_d e^{-(\alpha + \beta \ell_j)} \quad (1)$$

$$d_e = a + b \left(\frac{G_{hj}}{G_a} \right)^{1,5} \quad (2)$$

where:

G_{hj} is humectants flow rate at j -th point,

G_d is the dry substance flow rate,

ℓ is the drum length,

α and β are the variable coefficients, which depend upon the angle of inclination and the drum rotation speed,

a and b are the coefficients, which are defined by experiment.

The obtained values of the humectants flow rates are conveyed into the chambers of corresponding controllers 10 setting, and G_a the ones of the agent, atomizing the humectants (for each jet), are conveyed into the chambers of corresponding controller 13 setting.

Although only one fixed point is shown at the chart, is should be noted, that the agent was fed into 4 fixed points, being at the distances $\ell_1 = 1,5$ m, $\ell_2 = 3,0$ m, $\ell_3 = 4,5$ m and $\ell_4 = 6,0$ m from the start point of drum granulator (the length of the drum is $\ell = 12$ m, its diameter is $d = 2,8$ m).

III. CONCLUSION

The proposed technique of process control will enable increase of the specific output of granulated superphosphate standard fraction.

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