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H. B. Krykh, PhD, Associate Professor, Lviv Polytechnic National University,
H. F. Matiko, PhD, Associate Professor, Lviv Polytechnic National University,
I. D. Stasiuk, PhD, Associate Professor, Lviv Polytechnic National University.

IMPROVEMENT OF CONTROL SYSTEM FOR pH OF AMMONIUM NITRATE SOLUTION

Abstract. The features of pH control in the process of neutralization of ammonium nitrate are considered. The control system is proposed that ensures the technological requirements for providing a desired pH value.

Keywords: neutralization, ammonium nitrate, automatic control system.

The neutralization process is a considerable stage of the ammonium nitrate production. The quality of mineral fertilizers and the environmental aspects of its application depend on it [1]. One of the control tasks at this stage is to prove the hydrogen index of ammonium nitrate in pre-neutralizer to the values close to neutral media. pH control is carried out by the supply of gaseous ammonia to the pre-neutralizer. A common feature of the pH control plants is the nonlinearity of their static characteristic (see Fig.). The area of the static characteristic corresponding to neutral environments has a very large gain and the area corresponding to the acid media has a variable gain which increases with acidity decreasing. Various systems [2] are used for control of such plants, particularly control systems with the principle of „rough-fine", control systems with variable structure with controller parameters tuned to the plant models which are linearized within each area.

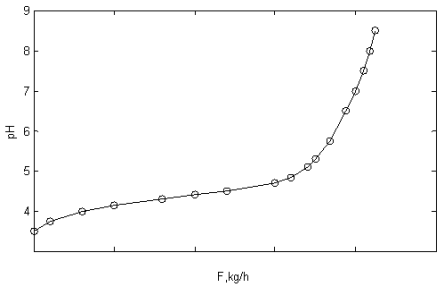

Fig. Static characteristic of pre-neutralizer

The purpose of this study is to increase the efficiency of pH control in conditions of various and significant disturbances by improving the structure of the automatic control system. On the basis of the static characteristic of control plant an inverse characteristic was obtained in the range from 3 to 8.5 pH. The authors propose to tune the PI controller parameters according to the inverse static characteristic. Thus, the controller parameters automatically change depending on the value of the deviation of pH from the set point in order to compensate the nonlinearity of the control system. The model of automatic control system with variable parameters of PI controller was investigated using computing software Matlab (Simulink). The obtained transient responses for positive and negative deviations of the gaseous ammonia flow from the nominal value have shown that the efficiency of the control processes for all values of the flow deviations was improved compared to the system with the controller that was tuned by the transfer coefficient of the plant model, which corresponds to the desired pH value. For example, the maximum dynamic deviation for all processes is reduced by 20% and the system response speed is doubled. The next task consists in implementing of the proposed control system and carrying out the experimental research.

References

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