

About the development of an intelligent flotation process control system in metallurgical production

Zhanar Lukmanova*, Shamil Koshimbayev

Kazakh National Research Technical University named after K. I. Satpayev, Institute of Information and Telecommunication Technologies, Kazakhstan, Almaty

*Corresponding author's e-mail: zhanar.lukmanova@gmail.com



Abstract

In this article there were obtained the results of consideration of the possibility of intelligent control systems applying to the flotation processes of the metallurgical industry. The analysis of the processes occurring in flotation machines is presented. The main input, output parameters, as well as disturbing influences that constitute the expert base for the formation of a control action using a neural network are considered. It is shown how to control and visualize, diagnose and monitor the flotation process based on intelligent methods using the platform Experion PKS.

Keywords: Intellectual control system, foam flotation, flotation technology, experion PKS software package.

1 Introduction

Nowadays, the tasks of control systems development for flotation processes — mineral processing based on selective adherence of mineral particles in an aqueous environment to air bubbles are urgent tasks. The processes of foam flotation include the process in which hydrophobic (not wetted by water) mineral particles adhere to air bubbles entered the pulp and rise with them to the top, forming an enriched foam layer on the pulp surface, and hydrophilic (water-wetted) rock particles remain suspended in pulp and move to the chamber product. The foam layer is separated from the pulp and, thus, the separation of minerals is occurred. The basis of the flotation process is the property of selectively fixing of the mineral particles treated with flotation reagents on air bubbles. The action of the reagents is aimed at increasing the flotation activity in some particles and lowering it in others. As a result, mineralized foam is formed on the pulp surface, which is moved for recycling. The main technological equipment is flotation machines [1].

2 Overview

The flotation receives the pulp, characterized by an amount of properties that determine its behavior in the flotation chamber. These properties are determined by both the mineralogical composition and the previous treatment in the processes of crushing, grinding, as well as in contact tank. At least several dozens of factors affecting the flotation process can be distinguished [2].

3 Decision

Analysis of the processes occurring in flotation machines, allows to select the main input, output parameters, as well as disturbing influences.

Input parameters are pulp density, copper ion concentration in the pulp, xanthate consumption, copper sulfate consumption, compressed air consumption, pulp level, pulp aeration rate.

Disturbing influences are: α - the metal content in the ore, the floatability of the raw material, the particle size distribution of the crushed enrichment product.

Output parameters are: β - metal content in the concentrate, γ - metal content in the tails, plant capacity, concentrate output, tails output. As an output indicators there can be taken, which are more complex functions calculated by simple indicators. This function is called extraction:

$$\xi = \frac{\alpha - \gamma}{\beta - \gamma} \cdot \frac{\beta}{\alpha} \quad (1)$$

During the process these parameters change and are stationary random functions. Input parameters can vary significantly. In this regard, the output parameters during manual control also change.

In order to obtain the statistical characteristics of the flotation process is very difficult and is possible due to the use of statistical methods. This leads to an interest to the use of the methods of intelligent systems. In particular, to the use of neural networks (Figure 1).

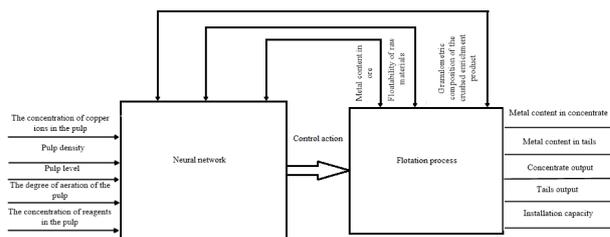


FIGURE 1 Intelligent flotation control system

An expert database of statistical characteristics of the flotation process was developed for this intelligent flotation control system.

In order to maintain the input and output parameters at a given level, it is necessary to automate an intelligent flotation process control system. A block diagram of the Experion PKS system is shown on Figure 2.

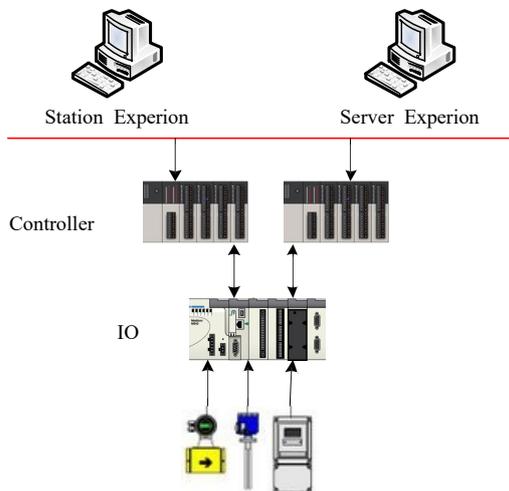


FIGURE 2 Experion PKS system block diagram

In order to control and visualize, diagnose and monitor the process at the centralized control center, which provides quick access to all data and allows global settings, there is

used the Experion PKS platform, which is a multi-layered architecture for solving complex tasks from information collection and processing to optimization of operating modes of technological processes [3].

The program complex includes the ACS development mode and the execution mode (real time). Distributed creation control system on the OPC – OLE for Process Control standard (mechanism of linking and embedding objects for data collection and control in industrial automation systems), which is the most common way of organization of interaction between various sources and receivers of data, such as: devices, databases and systems for information visualization about a controlled automation object. The use of a fault-tolerant industrial network (FTE) provides the ability to connect all control nodes, but at the same time has a number of characteristics that allow a high level of reliability and security, as well as connection of equipment from third-party manufacturers. During the connection of the field devices via digital interfaces, not only the measurement channel error decreases, but also provides extended information [4].

4 Conclusion

The considered flotation process control system solves the problem of ensuring the maximum efficiency of useful components extraction, reduction of wastes and losses. These measures lead to an improvement of the products quality and of the working conditions of the staff.

References

- [1] Podolyak M 2012 *Automation of the flotation process of gold sulfide ores* E-source: <http://conf.sfukras.ru/sites/mn2012/section03.html>
- [2] Trop A E, Kozin V Z, Prokofiev E V 1986 *Automatic control of technological processes of processing plants*
- [3] Pariev G V 2015 *Centralized control system of technological facilities based on a single operator LLC "Lukoil-Volgogradneftepererabotka"*
- [4] Koshimbayev Sh, Lukmanova Z 2018 *Analysis of the current state of control problems of the flotation enrichment process using artificial intelligence approaches*