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# The gas bubble size parameters monitoring and control method

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Abstract
A method for the effective control of the pulp gas phase composition in the flotation process using dynamic effects of high energy ultrasound and nature experiments on laboratory installation using high-speed video recording with data feedback via function programmed in Matlab for gas bubble size parameters monitoring and control are described.
Key words: ULTRASOUND, PULP, CONTROL, CONTROL FEEDBACK, FLOTATION, GAS BUBBLES

Understanding the physical processes defining the flotation requires accurate data about the parameters of the gas phase, where gas bubble size and distribution by size are the most important. The process efficiency is directly related to the number of collisions between particles and bubbles, which depend on their size relation. In flotation processes there is a strong connection between bubbles and particles. It is known that for the particle size distribution, optimal distribution of the bubbles can exist. Then the task is to obtain the distribution of the bubbles and the particle size, which would correspond to each other.

Single gas bubble size and the gas bubble size distribution in the chamber are strongly dependent on various operational, technical and chemical factors, which influence should be considered in designing and modeling of the flotation process. To develop scientific principles of calculation and construction of process control systems in automatic control mode the kinetic model of the flotation process is required [1].

$$\varepsilon = 1 - \exp(-kt) \quad (1)$$

where $\varepsilon$ - is the dependence on the floating mineral extraction from time $t$.

The dependencies on the concentrate output from the flotation time according to the classical model of the flotation, obtained in the simulation software package Matlab are shown in the Fig. 1 [2].

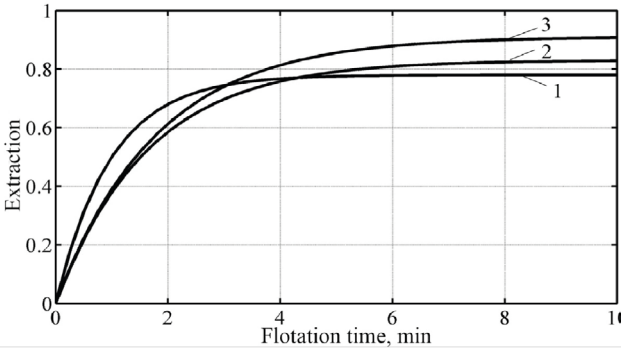


**Figure 1.** The dependence of concentrate output from the flotation time:1 – $\varepsilon = 0{,}78$; $k = 1{,}025$ min$^{-1}$; 2 – $\varepsilon = 0{,}83$; $k = 0{,}61$ min$^{-1}$; 3 – $\varepsilon = 0{,}91$,$k = 0{,}56$ min$^{-1}$

To solve this problem, it is necessary to investigate the possibility to control the pulp gas phase parameters, namely the concentration and bubble size distribution. The gas bubble size distribution depends on factors such as rotor speed, air flow rate, and the surface tension of the flotation solution. To reduce the energy consumption caused by the rotor spinning, it's advisable the energy from the rotation, which is directed to the bubbles, to replace by the other external influence, such as dynamic effects of high-energy ultrasound. In [3-7], the results of modeling of impact of the dynamic effects of high-energy ultrasound on the pulp gas phase, which allowed to obtain the dependencies of the gas bubble size distribution function parameters from the frequency and amplitude of the applied ultrasonic influence are described. Currently, the problem-oriented and general purpose computer modeling packages for solving various problems in the mineral processing area are widely used [8, 9].

To estimate the parameters of gas bubbles in the liquid during their free floating and under the influence of external forces, as well as the impact of high-energy ultrasound the experimental installation and a series of experiments using a video camera was developed [3, 6]. The pulp parameters measurement and generated ultrasonic influence was carried out by connection of analog measurement devices (sensors) to the computer, which allowed to register different parameters such as pH, temperature, pulp and air flow rate. The position of the bubble is extracted from video using image processing procedures in the Matlab package. The gas bubble size distribution function was obtained using the function programmed in Matlab, which is based on data from the camcorder by Bezier curves approximation, which builds the gas bubble size resulting density function, which allowed analyzing the influence of the gas bubbles parameters on the shape of this curve (Fig. 2). Fig. 3 shows the resulting density function of bubble size distribution calculated as a linear combination of the density distribution of $f_1(x)$ and $f_2(x)$ and using the method of density distribution estimates on the basis of the (40,000) points entire set of data.

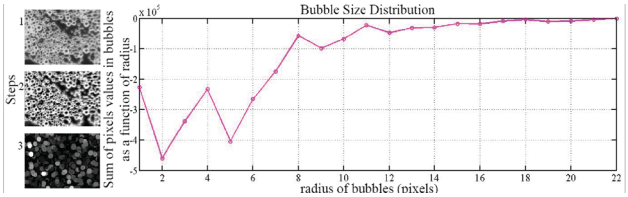


**Figure 2.** Bubble size distribution obtained from camcorder using Matlab

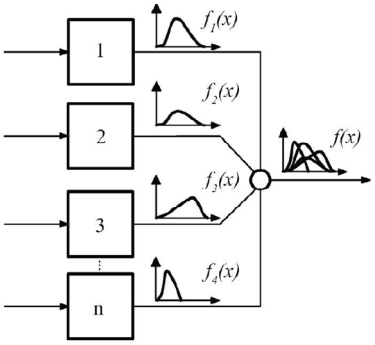


**Figure 3.** The parallel distribution method

**Conclusion**

The proposed control approach for the pulp gas phase parameters on the basis of high-energy ultrasound allows to implement the effective management of pulp gas phase composition, enhance the concentrate quality and efficiency of the mineral processing technological process.

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# Design of an Intelligent Vehicle Control System Based on LabVIEW


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Abstract

Compared with the traditional intelligent vehicle control system has the following deficiencies: complex image processing algorithm and not flexible cable communication mode, and not real-time traffic monitoring and control, the design by use of LabVIEW which has a wealth of signal processing functions and graphical