DEVICES MANUFACTURED
IN LABORATORIES

DEVICE-ANALYZER FOR MONITORING THE CONTENT OF MAGNETICALLY ACTIVE PARTICLES (IMPURITIES) OF BULK MEDIA

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In order to extract the magnetoactive fraction of particles from a dispersed medium (food or technological) using the separators described in [1–3], it is necessary to have information on the quantitative content of such a fraction [4, 5]. Such information can be most reliably obtained according to a new, specially developed, experimental and calculation method of operational extrapolated extraction of impurities [6, 7]. The concept of this method provides for the implementation of operational weighing of the magnetoactive particles extracted from the sample (instead of their additive accumulation) to obtain the dependence of the mass of the extracted impurities m on the ordinal number n of the operation, and with the subsequent use of the appropriate mathematical apparatus - the determination of any of the operational masses of magnetoactive particles m (including outside the actual experiment) and, as a consequence, their total mass Σm in the sample.

Based on the method from works [6, 7], a device-analyzer (Fig. 1) for operational-digital control of particles (impurities) was created, providing the possibility of automatic calculation of operational*Accepted for publication 11.09.2024* and the total Σ*m*masses of magnetoactive particles [8]. The device consists of tanks for feeding and receiving the analyzed sample of the medium, between which there are four magnetoactive blocks (it is important that these blocks must be identical to each other). When the sample passes from the feeding to the receiving tank, each block provides the possibility of progressive (from block to block) sedimentation of magnetoactive impurities. The

body of the device is transparent, which allows visually monitoring the intensity of accumulation of the released particles in the device in real time, controlling the process. The dimensions of the device are as follows: length - 500 mm, width - 300 mm, height - 974 mm; magnetic field induction at the block surface and gradient - 180 mT and 55 mT/mm, respectively.

Fig. 1. Photo of the analyzer device with four magnetically active blocks for monitoring the content of magnetically active particles in bulk media.

After the entire sample of the medium has undergone such magnetic treatment, the precipitated impurities (on each block) are removed from the magnetic blocks with subsequent discharge of particles onto four scale trays, i.e., under each of the blocks. The readings of the mass content of impurities on each block (operations n) are automatically transmitted to the PC, and using a specially developed computer program [9], which is based on the previously mentioned method of multi-operational magnetic control, the operational and total masses of magnetically active impurities are calculated using formulas $m = a \cdot e^{-kn}, \sum m = a/(e^k - 1)$, where a and k are empirical parameters (they are constants for one sample of the medium, automatically set by the computer program).

The developed device has undergone trial testing: various media of the glass and ceramic industry were investigated. The significance of controlling construction media is evidenced by the fact that the standardized indicators of the content of specifically metal-magnetic fraction of impurities (ferruginous) appear in the very marking of a particular medium. For example, for the manufacture of high light-transparent products, first-grade sand of the VS-040-1 brand is used, where "040" means the standardized content of ferruginous impurities (not more than 0.04%), and dolomite with a standardized content of ferruginous impurities not more than 0.1% is marked as DK-19-0.10.

The result of the trial testing of the created device showed the correspondence of the obtained data to the developed methodology (Fig. 2) - these data are well described by a functional dependence of the exponential type, as they are quasi-linearized in semi-logarithmic coordinates (according to the program the reliability of approximation is 0.98 and 0.99 for dependencies *1* and *2* respectively). According to the calculation formula for determining the total masses of impurities contained in the studied samples, the following values of this indicator were established: 0.14 g/kg (0.014%) in sand and 0.062 g/kg (0.0062%) in dolomite, which corresponds to the standardized values of these indicators.

Fig. 2. Dependence of the mass of magnetically active particle-impurities extracted from samples of quartz sand *1* and dolomite *2* on the number of magnetic control operations (on the sequential number of the block), presented in semi-logarithmic coordinates.

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FIGURE CAPTIONS

Fig. 1. Photo of an analyzer device with four magnetically active blocks for monitoring the content of magnetically active particles in a bulk medium.

Fig. 2. Dependence of the mass of magnetically active particle-impurities extracted from samples of quartz sand *1* and dolomite *2* on the number of magnetic control operations (on the sequential number of the block), presented in semi-logarithmic coordinates.

Fig. 1

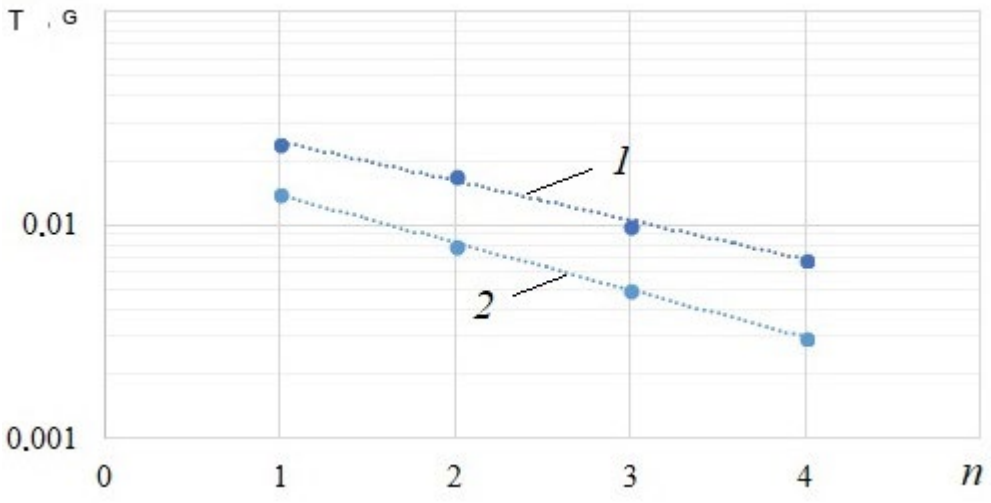

Fig. 2