COMPUTER IMAGES ANALYSIS OF GOLD-CONTAINING PYRITE AND ARSENOPYRITE IN SEPARATION MECHANISMS AND MINERALS BREAKING-UP INVESTIGATION

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At processing of the gold-containing ores the authentic information about the character of the gold particles precipitation and about the gold particles association with the mineral matrix is necessary. Also it's necessary to have the data about the structural-morphological parameters of the gold particles and the minerals defects structure.

Earlier the computer images analysis was used to predict the technological properties of the South-Sakhalin gold-quartz ores [1] and to estimate the production possibility of the gold-contaning copper concentrate from the deposit Shinchao (China) pyrites tails [2]. Also this method was used for the mineralogical-technological estimation of the rest gold-containing ores and concentrates [3-5]. In the latter case this method was used for the ores and the minerals properties prediction, and for the theoretical investigations of the behaviour mechanisms of the gold-contaning sulphide minerals in the flotation and geotechnological processes.

In IPKON RAS to solve the problems (i) of the gold-contaning pyrites and arsenopyrites separation and (ii) of the breaking-up of the gold-contaning ores the technique of the complex estimation of the minerals softening is developed. The method of the computer images analysis of the minerals surface structures and the fine-grained minerals particles structures is put in a basis of this technique.

For the explanation of the features peculiar to the electrophysical and technological properties of the sulphide minerals (pyrite and arsenopyrite) and for the description of the computer images of the minerals surface defects structures the method of the fractal parametrisation of structures is used. This approach to the quantitative analysis of the natural disorder allows to assign to the each surface defects structure the concrete fractal dimension (D_f). In addition to the traditional statistical methods this method enables to describe the disorderly structures of the minerals in the strict quantitative terms of the fractal geometry.

The fractal dimension of the defects structures of the minerals surface local regions, and also their physical properties are given in the Table. For arsenopyrite the negative linear correlation between the normalized values of the specific resistance $\rho^{Ar}/\rho^{Ar}{}_{max}$ and D_f–values is established, and the positive linear correlation between the thermoEMF ($\alpha^{Ar}/\alpha^{Ar}{}_{max}$) и D_f is established. Also the linear correlation between ρ^{Ar} и α^{Ar} (for $D_f \geq 1.65$) is obtained: $\rho^{Ar}/\rho^{Ar}{}_{max} = 1 - 0{,}8(\alpha^{Ar}/\alpha^{Ar}{}_{max})$.

The comparison of the separation force of the air bubble from the local sites of the mineral surface with the fractal dimension of the surface defects structure has allowed to determine the regions of the surface geometry action on the local hydrophobe properties of the pyrite and the arsenopyrite. The influence of the surface heterogeneity factor is most actively shown in the range pH 9-11. In this range the fractal dimension D_f determines the distinctions between the force of the air bubble from the surface of the pyrite and the arsenopyrite.

Alongside with the investigations of the gold-containing sulphide minerals separation process the computer images analysis was used to the study of the gold-containing pyrite and arsenopyrite breaking-up mechanisms under the electrochemical action. In this case both the plain macro-specimens of monominerals units and the particles of the crushed materials were investigated for the quantitative description of the minerals surface structures and for the estimation of the particles geometrical characteristics change.

Table

Fractal dimension of the defects structures (D_f) and electrophysical characteristics of the minerals surface local areas

Mineral	D_f	$\rho \cdot 10^{-3}$, Om·m	$\alpha_{thermoEMF}$, μkV/°C
Pyrite	1.770	12.5	400
	1.695	4.5	450
	1.691	11.0	240
	–	7.5	340
	1.473	6.25	320
Arsenopyrite	1.652	1.86	70
	1.536	3.43	120
	1.861	0.63	160
	1.711	1.64	110
	1.485	1.65	20

The computer images analysis of the gold-containing pyrite and arsenopyrite plane grinded-and-polished specimens before and after the electrochemical treatment has allowed to study the evolution of the minerals surface defects structure under the electrochemical action. The microdamages growth process and the minerals intergrown pieces borders disclosing process were described. The process of the minerals surface softening in time (t) was estimated quantitatively on the change of the fractal

dimension (D_f (t)) of the minerals surface defects structures before and after treatment.

The analysis of the computer images of the Nezhdaninsky gravitation concentrate fine-grained particles before and after electrochemical treatment has shown the class –0.1mm content change (see.Figure). The evolution of the particles form (the rounding and the form-factor) under the electrochemical treatment was investigated.

Thus, the application of the computer images analysis for the decision of the minerals processing tasks and the technological mineralogy problems allows to predict the behaviour of the gold-containing sulphide minerals in the hydrometallurgical processes and also to reveal the separation mechanisms of minerals.

1. Chanturija V.A., Bashlykova T.V., Chanturija E.L. // Mining Journal (Rus.), 1995, № 11. P.46-50.
2. Chanturija V.A., Bashlykova T.V. // Mining Herald (Rus.), 1998, № 1, P. 37-52.
3. Chanturija V.A., Fedorov A.A., Chekushina T.V. et al. // Mining Journal (Rus.), 1997, № 10,C.51-56.
4. Chanturija V.A.,Fedorov A.A.,Bunin I.J. // Doklady Chemical Technol. 1998, V.362, № 4, C.513-517.
5. Chanturija V.A., Fedorov A.A., Bunin I.J. et al. // Mining Journal (Rus.), 2000, № 2, P.24-27.

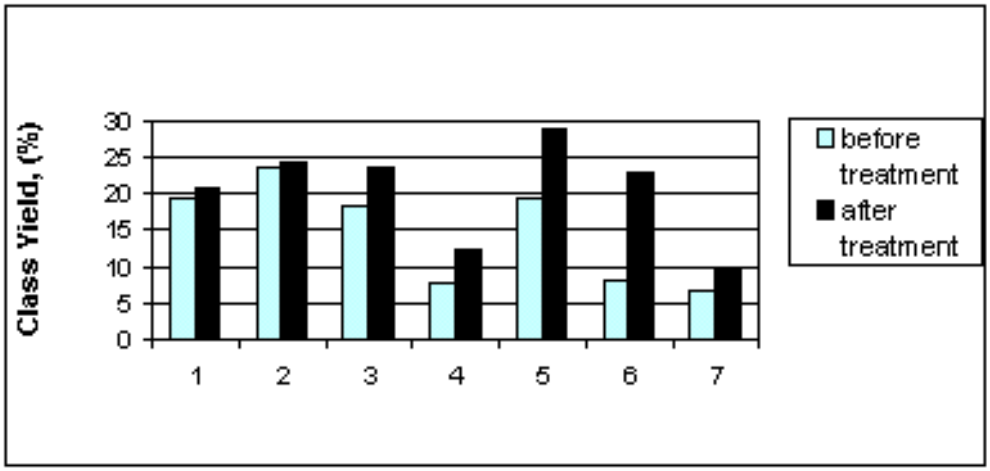

Fig. The histogram of the class -0,1mm content (1-5 – pyrites, 6-7 – arsenopyrites)