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INITIAL PRODUCT INFLUENCE ON SEPARATION CHARACTERISTICS WHILE PLACER ORE GRAVITY DRESSING

Results of separation characteristics research of zircon-titanium sands gravity dressing according laboratory studies and industrial results allowed to establish it change depending on initial product influence.

Ore-dressing plant "VGMK" concentrates titanium-zirconium sand extracted at Eastern site of Malishevskiy deposit. Concentration of titanium-zirconium sand from Matronovskiy site is in its plans too. However, the geological data of this site show steady reduction of heavy fraction and mineral grains coarseness that need change in concentration process. Experimental dressing of these ore sands showed reduction of qualitative and quantitative data. This fact says about the initial product influence on separation characteristics of gravity cone separators used to produce a collective concentrate.

Separation characteristic is the dependence of the extracting particles probability in any separation product on the separation feature [2], which is the minerals density.

It is claimed, that the separation characteristics remain unchanged with consist and properties change of the separated material. However, “VGMK” experience shows that the same separator in the same mode for the different ore separation gives a different extraction of heavy fraction. It says about the probable change of the separation characteristics [1].

The laboratory researches of tapered chute were carried out for research the initial ore sands influence on separation characteristics of cone separators. Tapered chute modeled cone separator work. Results of these experiments were compared with the industrial results. The model mixture of quartz, ilmenite, rutile, zircon, kyanite and staurolite was used in the laboratory experiments. These minerals are included in Malishevskiy deposit.

Industrial experience [3, 4] of cone separators using allowed to take following technological and design parameters of the tapered chute: the ratio of the solid and liquid phases (by weight) – 1,5, water flow rate – 0,03 l/s, slurry flow rate – 0,1 kg/s, the slope of tapered chute bottom – 15º, the height of the unloader mechanism – 1,4 sm.

Results of researches are presented in tab. 1 and in fig. 1 – 4.

Fig. 1, 2 shows minerals extractions in concentrate: 1 – at α =5 %; 2 – at α =10 %; 3 – at α =15 %; 4 – at α =20 %; 5 – at α =25 %; 6 – at α =35 %; 7 – at α =40 %.

Fig. 3, 4 shows minerals extractions in concentrate: 1 – at α =5,02 %; 2 – at α =6,07 %; 3 – at α =11,17 %; 4 – at α =36,65 %; 5 – at α =38,48 %.

Where: α – heavy fraction content in the initial product, %.

Table 1

Minerals	Minerals density kg/m^3	Minerals extractions in concentrate, %											
		According to laboratory experiments							According to industrial results				
		Heavy fraction content											
		5	10	15	20	25	35	40	5,02	6,07	11,17	36,65	38,48
Kyanite	3350	51,26	62,94	77,06	58,18	58,03	58,23	67,57	36,92	35,95	32,49	18,11	14,02
Staurolite	3680	65,80	74,71	47,88	61,56	64,77	59,04	77,01	42,91	41,96	38,49	22,12	19,52
Ilmenite	4150	64,15	77,65	70,12	55,49	61,82	62,76	78,81	56,91	54,96	48,50	33,12	30,53
Rutile	4230	76,53	94,36	84,90	70,80	81,36	78,34	88,58	57,92	56,95	53,50	40,13	40,52
Zircon	4580	62,21	68,42	74,99	73,20	89,96	64,98	82,26	75,02	75,95	62,48	53,06	55,52
Quartz	2670	34,37	13,76	28,07	15,83	19,91	21,97	33,95	6,94	6,35	9,83	1,92	2,31

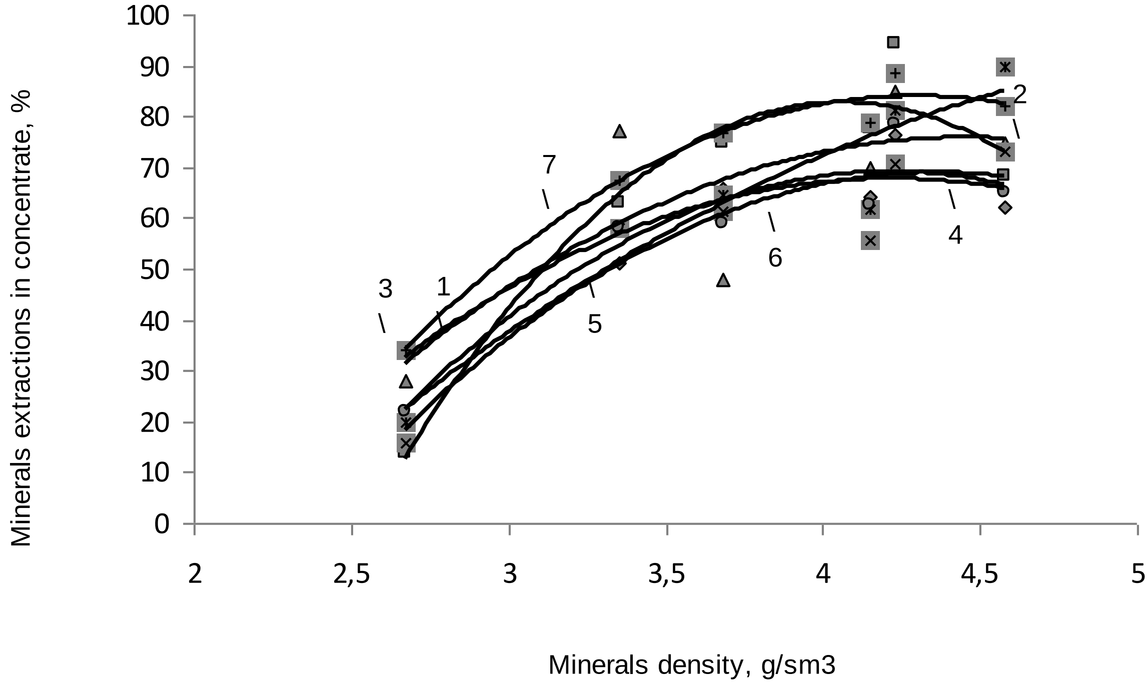

Fig. 1. Dependence of minerals extractions in concentrate on their densities according to laboratory experiments

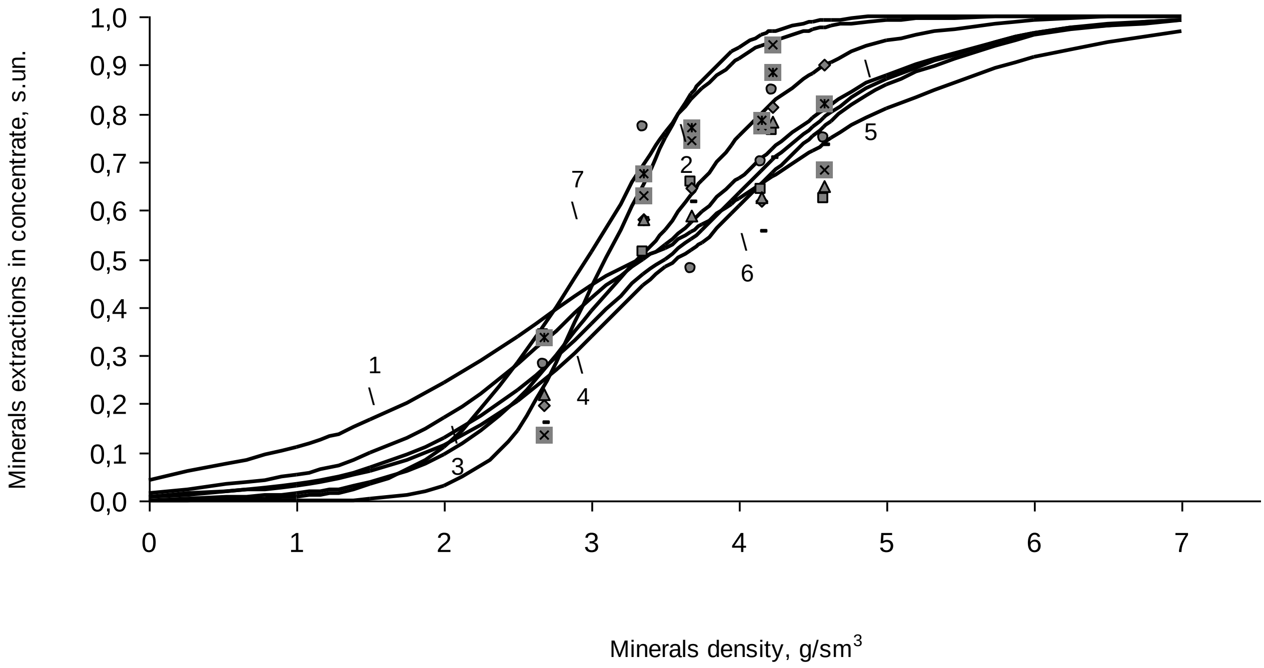

Fig. 2. Comparison of concentrate separation characteristics while ore sands dressing with different initial product content (according to laboratory experiments)

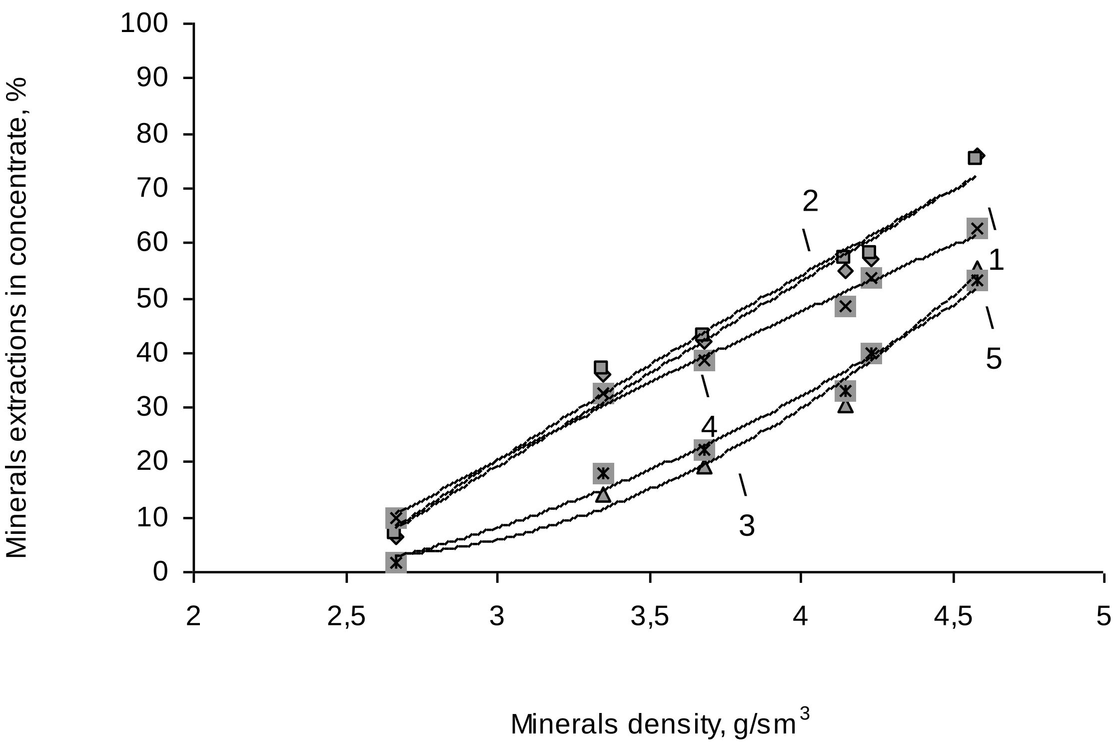

Fig. 3. Dependence of minerals extractions in concentrate on their density according industrial data

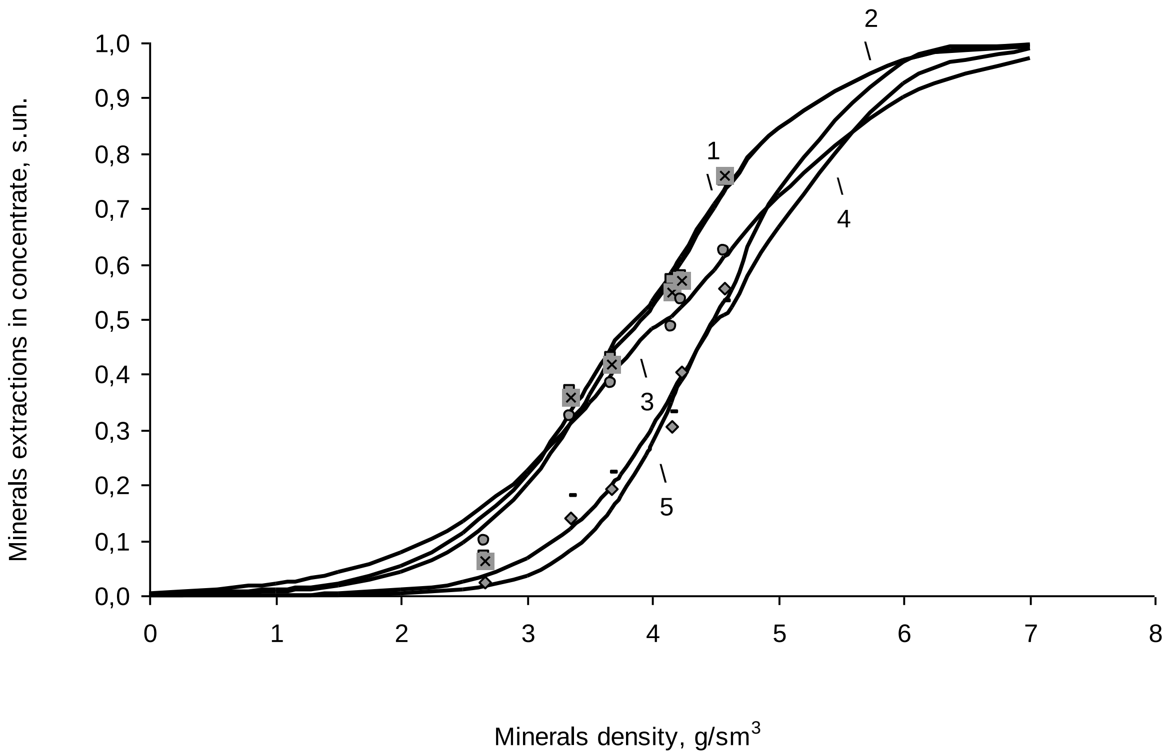

Fig. 4. Comparison of concentrate separation characteristics while ore sands dressing with different initial product content (according to industrial data)

The data, presented in fig. 1 and 3, show dependences of heavy fraction minerals extractions in concentrate on their density. Increasing of mineral density rises its extractions in separation product, but lower density minerals (kyanite, staurolite) are lost with tails of dressing processing. Fig. 2 and 4 shows the separation characteristics described Gaussian probability integral. Analysis of fig. 1 – 4 shows the proximity of ore sands gravity separation results obtained in industrial and laboratory conditions.

Analysis of data in tab. 1 and fig. 2 shows increasing of heavy fraction content from 5 % to 40 % in initial product and rising of separation efficiency at the same time (E_{pm} reduces from 1,33 to 0,54). However, initial product influence on separation characteristics and separation density is insignificant (R_2 = 0,1485 and R_2 = 0,0093). This statement is proved by curves, showed in fig. 5 and 6.

Tab. 2 and fig. 5 and 6 illustrate the dependence of separation density and medium probable deviation E_{pm} on minerals content in the initial product.

Table 2

Heavy fraction contentsin initial product, %		Separation density, kg/m^3		Medium probable deviation, kg/m^3	
According to industrial data	According to laboratory experiments	According to industrial data	According to laboratory experiments	According to industrial data	According to laboratory experiments
5,02	5	3870	3340	0,78	1,33
6,07	10	3910	3110	0,75	0,40
11,17	15	4110	3350	1,02	0,99
36,65	20	4540	3500	0,7	0,93
38,48	25	4490	3310	0,56	0,70
-	35	-	3590	-	0,92
-	40	-	2950	-	0,54

Fig. 5 and 6 present: 1 – industrial data, 2 – laboratory results.

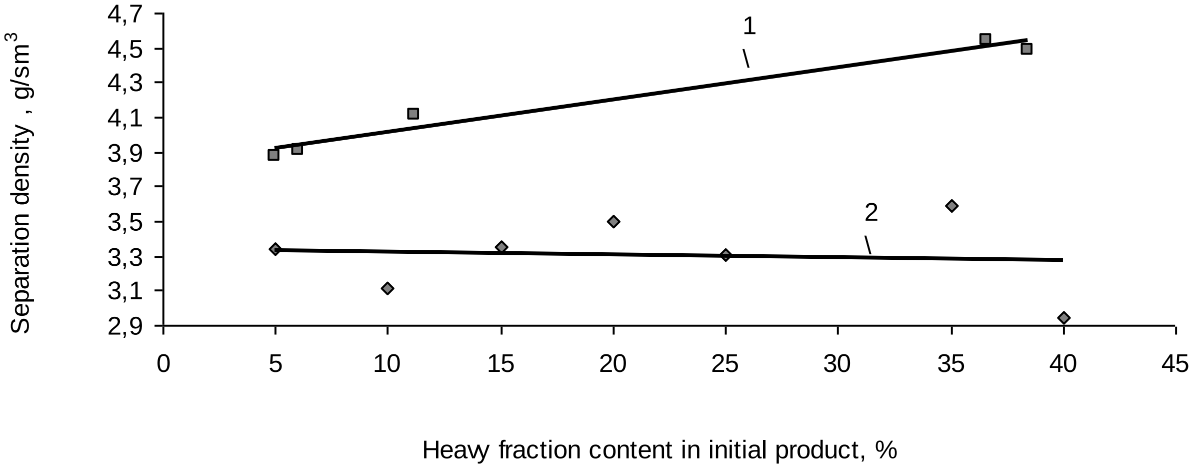

Fig. 5. The dependences of separation density on heavy fraction content in initial product, according to industrial and laboratory results

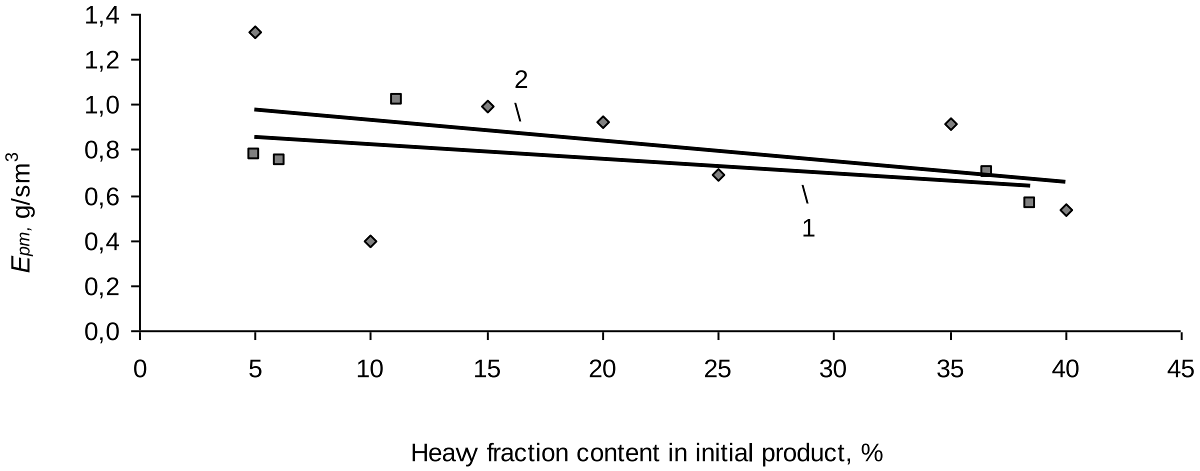

Fig. 6. The dependences of medium probable deviation on heavy fraction content in initial product according to industrial and laboratory results

Tab. 2 and fig. 5 and 6 show increasing of heavy fraction content according to industrial results and laboratory experiments and rising of separation density and decreasing of medium probable deviation at the same time. It should be noted that at the maximum of heavy fraction content, separation density tends to decrease. However, the initial product influence on separation density according industrial results is more accurate than the laboratory results (R_2 = 0,9682 and R_2 = 0,0093). Initial product influence on separation characteristics in industrial conditions is also more accurate than the results of laboratory tests (R_2 = 0,4105 and R_2 = 0,1485).

The fact of medium probable deviation change while ore sands of different content dressing suggests about connection between separation characteristics and initial product content while gravity dressing on cone separators. This phenomenon requires a detailed research, because the definition of the laws of possible changes in separation characteristics will allow to improve the placer ore dressing technology and to adapt it to conditions of consist and properties changing of titanium-zirconium sands.

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