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Research of the Physical and Chemical Indicators of Zinc Absorber

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Abstract: The influence of different amounts of binding additives on the physicochemical parameters of the absorber of sulfur compounds (bulk density, mechanical strength, specific surface area and sulfur capacity) was studied. With an increase in the amount of binding additives CuO from 5% to 10% and MgO to 7%, bulk density increases from 0.95 g/cm3 to 1.02 g/cm3, mechanical strength: splitting strength index from 0.37 kg/mm to 0.41 kg/mm, and the specific surface from 93.1 m2/g to 97.8 m2/g.

Keywords: zinc adsorber, binding additives, zinc oxide, bulk density, mechanical strength, specific surface area.

In the world, meeting the needs of the planet's population in food products is impossible without the use of nitrogen fertilizers, such as ammonium nitrate, urea, ammonium sulfate. Their production is associated with the purification of natural gas from sulfur compounds by absorption on zinc absorbers. Every year, in the process of cleaning natural gas from sulfur compounds, a huge amount of spent zinc absorbers is formed. Due to the lack of zinc production in the country and its high cost, much attention has been paid in recent years to the use of spent industrial waste as secondary raw materials. Scientific research is being carried out on a global scale to develop a technology for processing spent zinc-containing raw materials . In this regard, special attention is paid to the study of the processes of acid methods for processing spent zinc raw materials, including the stages of preliminary leaching of raw materials, processing acid solutions of zinc into zinc oxide, processing or disposal of mother liquors, the development of effective technologies for the preparation of an absorber of sulfur compounds with the use of *binders* [1, p. 23].

The results of studies on the influence of the amount *of binding* additives on the physicochemical and mechanical properties (bulk density, mechanical strength, specific surface area) of zinc oxide-based sulfur compound absorbers are presented in Tables 1 and 2 [2; pp . 18324-18327] .

Table 1. Effect of *binder content* additives Cu O and Mg O on the physicochemical and mechanical properties of sulfur compound absorbers

No.	Name of indicators	Sample of absorber						
		№1	№2	№3	№4	№5	№6	№7
1	Mass fraction of ZnO , %	95	93	90	85	88	86	83
2	Mass fraction of CuO , %	-	-	7	10	5	7	10
3	Mass fraction of MgO , %	5	7	3	5	7	7	7
4	Dimensions of the outer diameter of granules, mm	6.2	6.2	6.2	6.3	6.2	6.1	6.2
5	Bulk density, g/ ^{cm3}	1.01	1.04	1.17	1.25	0.95	0.99	1.02
6	Mechanical strength: splitting strength index, kg/mm, granule diameter: average-0.7 min.-0.35	0.34	0.37	0.35	0.38	0.37	0.39	0.41
7	Specific surface area, m2 / g	75.2	78.7	80.3	85.7	93.1	95.3	97.8

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From Table 1 it is evident that with an increase in the content of *binding* additives (CuO from 5% to 10% and MgO from 3% to 7%) the bulk density changes from 0.95 g/cm^3 to 1.04 g/ cm^3 , the mechanical strength - the splitting strength index increases from 0.34 kg/mm to 0.41 kg/mm , the specific surface from 75.2 m^2/g to 97.8 m^2/g.

Table 2. Effect of *binder content* additives of CuO , MgO , Al_2O_3 and talum on the physicochemical properties of sulfur compound absorbers

No.	Name of indicators	Sample of absorber						
		№8	№9	№10	№11	№12	№1 3	No. 14
1	Mass fraction of ZnO, %	90	85	84	83	90	86	83
2	Mass fraction of CuO, %	-	5	5	7	-	7	7
3	Mass fraction of MgO, %	-	-	4	5	-	-	5
4	Mass fraction of Al_2O_3 , %	10	10	7	5	-	-	-
5	Mass fraction of *talum*, %	-	-	-	-	10	7	5
6	Dimensions of the outer diameter of granules, mm	6.2	6.3	6.1	6.1	6.2	6,1	6,1
7	Bulk density, g/cm^3	1.29	1.16	1,12	1.03	1.35	1,14	1,07
8	Mechanical strength: splitting strength index, kg/mm, granule diameter average - 0.7 min.-0.35	0.32	0.37	0.48	0.52	0.35	0.33	0.37
9	Specific surface area, m2 / g	77.9	78.3	76.7	74,2	75,9	76,3	77,1

From Table 2 it is evident that the study on the influence of the content of additives Al2O3 or talum *in the molding mass* of the absorber of sulfur compounds based on zinc oxide showed that the physicochemical and mechanical properties of the absorber in the absence of MgO do not improve.

Next, the influence of the content of *the binding* additive CuO on the physicochemical and mechanical properties (mechanical strength, specific surface area) of sulfur compound absorbers based on zinc oxide was investigated with the addition of CuO 5%-10% and MgO 7%. The results obtained are shown in Figures 1 and 2 .

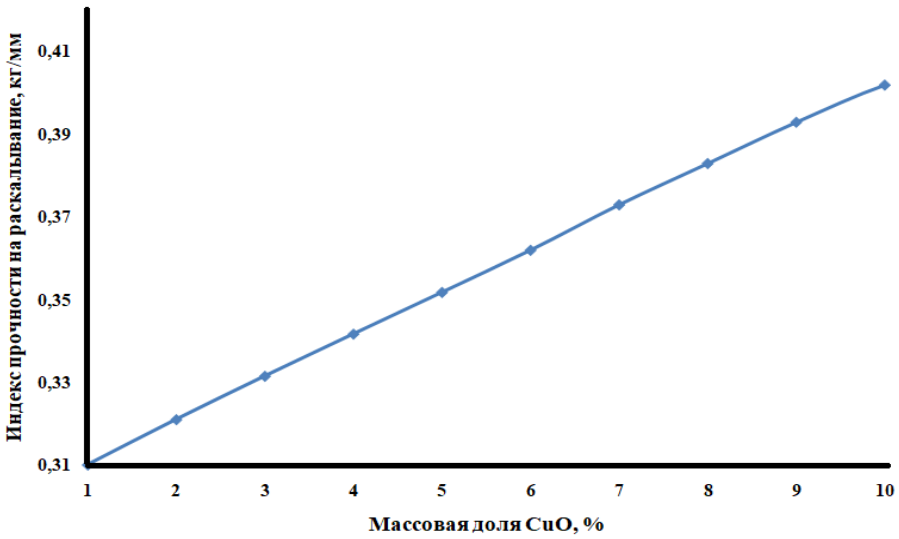

Fig. 1. Effect of copper oxide content on splitting strength index.

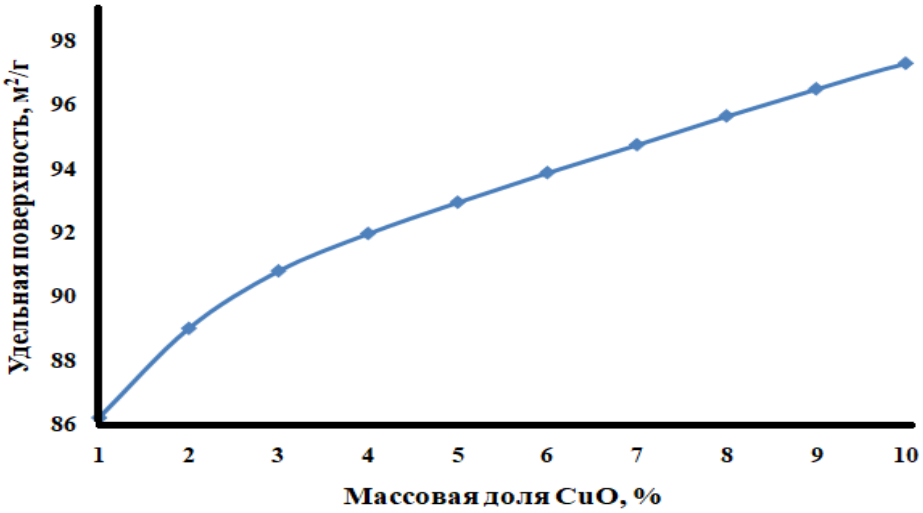

Fig. 2. The influence of copper oxide content on the specific surface area of the absorber.

It is evident from Fig. 1 that with an increase in the amount of Cu O from 5% to 10%, the mechanical strength - the index of the cleavage strength of the zinc oxide-based sulfur compound absorber increases from 0.37 kg/mm to 0.41 kg/mm. It is evident that with an increase in the Cu O content from 5% to 10%, the specific surface area of the zinc oxide-based sulfur compound absorber increases from 93.1 m^2/g to 97.8 m^2/g (Fig. 2).

Fig. 3 shows an X-ray diffraction pattern of an absorber obtained on the basis of zinc oxide using *the binding* additives CuO and MgO.

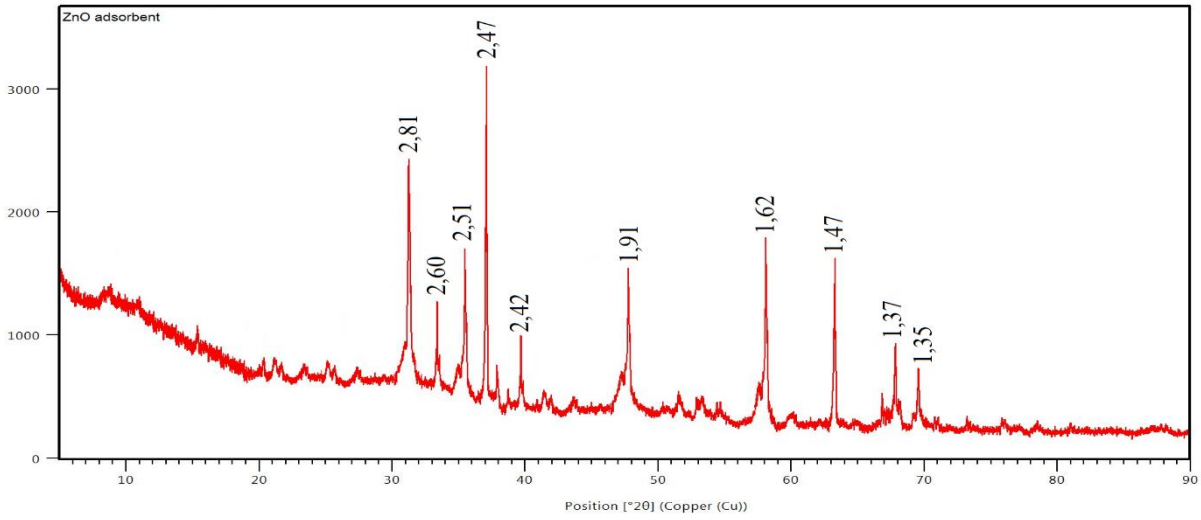

Fig. 3. X-ray diffraction pattern of zinc oxide absorber and *binding* additives CuO and MgO

The X-ray diffraction pattern of the absorber based on zinc oxide using *binding* additives at a mass fraction of Cu O of 10% and MgO of 7% is characterized by intense peaks at 2.81; 2.60; 2.47; 1.91; 1.62; 1.47; 1.35Å corresponding to ZnO; 2.51; 1.37Å – CuO; 2.42Å – MgO.

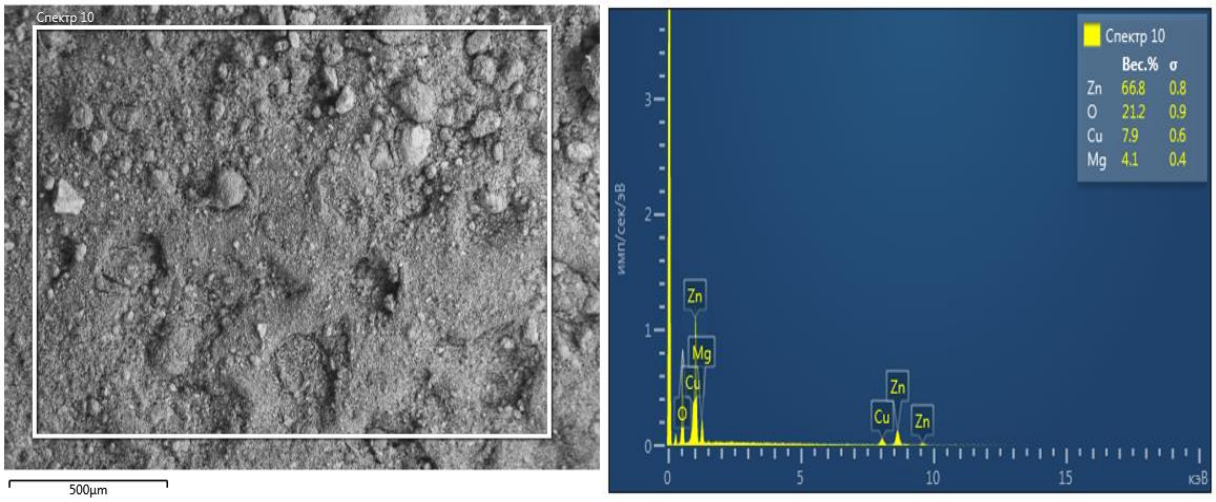

Fig. 4 . Scanning electron micrograph of zinc oxide absorber *and binding* additives CuO and MgO

Fig. 4 shows a scanning electron micrograph of an absorber based on zinc oxide with the removal of bar-radiographs and the establishment of quantitative characteristics of the chemical elements present. The data obtained indicate that the main elements are zinc, oxygen, copper and magnesium. According to the results obtained, the contents of zinc, oxygen, copper and magnesium are: 66.8%, 21.2%, 7.9% and 4.1%, respectively.

When preparing the zinc oxide-based absorber in laboratory conditions, it was molded in a manual injection press in the form of granules (cylindrical) using *the binding* additives CuO - 10% and MgO - 7%. This increases the splitting strength index to 0.41 kg/mm and the specific surface area to 97.8 m^2/g.

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