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RESEARCH ON THE PROCESS OF PROCESSING SLUDGE WASTE FROM A SODA PLANT WITH NITRIC ACID

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Abstract: The research work on the decomposition of the sludge waste of the Kungrad soda plant with nitric acid and the production of liquid and granular fertilizers based on them is relevant. In particular, it was not known until now how the concentration of nitric acid during the decomposition process affects the decomposition process. This research work is devoted to the solution of this unknown process.

Keywords: Acid concentration, temperature, time, transition rate, liquid phase, solid phase.

According to the results of the ongoing research, the effects of acid rate, temperature and time on the nitric acid treatment of soda ash sludge waste were studied and optimal parameters were determined (nitric acid rate – 105%, mixing duration – 30 min, temperature – 40 °C) [1]. It is also important to study the effect of nitric acid concentration on the decomposition process of these wastes. Because various technological problems arise due to the incorrect organization of the solid-liquid phase ratio in the production process. In addition, it is possible to dilute high-concentration acid through washing water or acidic wastewater in technological processes.

The results of the experiment are presented in the table and figure below.

Table

Effect of nitric acid concentration on phase composition.

HNO ₃ , concent ration. %	Chemical composition, wt. %.										S:L phase ratio
	Liquid phase					Insoluble residue					
	Mg ²⁺	Ca ²⁺	Al ³⁺	Fe ³⁺	SO ₄ ²⁻	Mg ²⁺	Ca ²⁺	Al ³⁺	Fe ³⁺	SO ₄ ²⁻	
40	1,05	8,59	0,012	0,035	0,058	1,50	20,57	0,33	1,25	8,76	89,67
45	1,15	9,47	0,009	0,029	0,060	2,36	23,92	0,68	1,85	8,48	74,94
50	1,26	10,34	0,008	0,028	0,060	2,61	26,06	0,75	2,03	8,53	65,44

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55	1,36	11,18	0,008	0,029	0,055	2,82	27,37	0,76	2,07	8,82	58,43
57,5	1,41	11,60	0,009	0,029	0,049	2,93	27,93	0,74	2,05	9,12	55,35
60	1,46	12,01	0,009	0,030	0,037	2,96	28,11	0,74	2,03	9,75	52,63

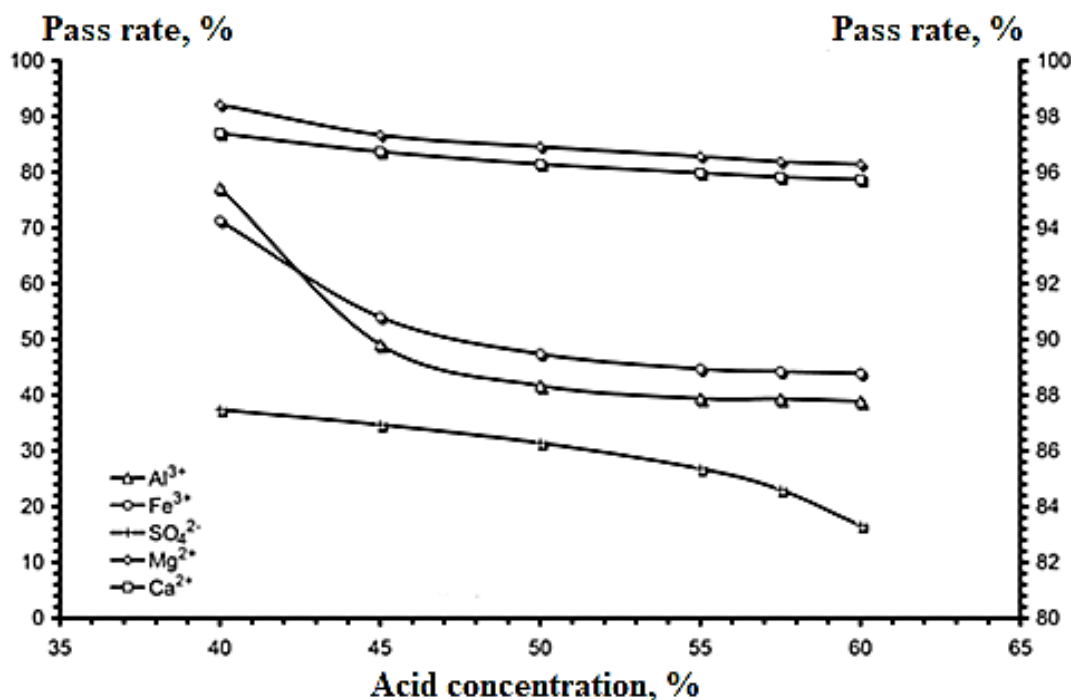


Figure - Effect of nitric acid concentration on the degree of dissolution of components

As can be seen from the table and figure above, with an increase in the nitric acid concentration in the liquid phase, the components (Mg^{2+} , Ca^{2+} , Al^{3+} , Fe^{3+} and SO_4^{2-}) in the liquid phase of the sludge waste increase accordingly. With an increase in the nitric acid concentration by 10%, that is, up to 50%, the content of Mg^{2+} and Ca^{2+} in the liquid phase increases by an average of 17.94 and 18.26%. In addition, the content of Al^{3+} , Fe^{3+} in the liquid phase decreases to 33.33 and 20.00%. This is explained by the low coefficients of dissolution of these metals at low acid concentrations. With an increase in the nitric acid concentration from 50 to 60%, the content of Mg^{2+} and Ca^{2+} in the liquid phase increases by 12.50 and 7.14%, respectively. The amount of SO_4^{2-} in the sludge increases with increasing concentration, first by 3.45%, and then decreases by 38.33%. This is explained by the fact that the concentration coefficient of the solution does not exceed the decomposition coefficient of the sludge waste. In conclusion, the effect of the concentration of nitric acid on the process of processing the sludge waste of the soda plant with nitric acid was studied, and the acid concentration in the range of 55-60% was determined as the optimal condition. Since the highest rates of Mg^{2+} and Ca^{2+} ions passing into the liquid phase were observed in this range of acid concentrations.

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