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INVESTIGATION OF THE PROCESS OF EVAPORATION OF MASTERBATCH SOLUTIONS IN THE PRODUCTION OF POTASSIUM BICARBONATE BY AMINE METHODS

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Abstract:

Currently, much attention is paid in the world to the production of potassium carbonate (potash) by amine methods. At the same time, there are sufficient proven reserves of potassium-containing raw materials in the world, which, according to technological, economic and, most importantly, rational levels of use, provide an opportunity to obtain potash to ensure domestic and foreign consumption markets with affordable energy and technological indicators.

In this regard, the development of a method for producing potash based on specific local raw materials is relevant.

Keywords: potassium chloride, diethylamine, evaporation, filtration, parameter, degree, dilution, time, process, norm.

Prospects for the use of potassium carbonates, especially as a chlorine-free potassium mineral fertilizer, create certain conditions for the organization of their production in Uzbekistan. Currently, there is no production of potassium carbonates in Uzbekistan, although there are deposits of local potassium-containing raw materials in Uzbekistan, which will make it possible to obtain its own potassium carbonate [1].

All existing industrial methods of potassium carbonate production can be divided into two groups. The first group-the production of potassium carbonate by electrolysis of potassium chloride solutions with subsequent processing of potassium hydroxide into potassium carbonate is characterized by the complexity of the process due to multistage, high energy consumption [2-3] and the high cost of the resulting bicarbonate and potassium carbonate.

The second group of schemes is based on the production of potassium bicarbonate (K_2CO_3), similar to the ammonia method for producing soda by carbonization of potassium chloride (KCl) in the presence of various aliphatic amines and their salts [4-5].

It is known that in the production of potassium carbonate by the amine method [6] at the first stage in the carbonization process in the presence of potassium chloride and DEA, potassium bicarbonate is formed in the solid phase, and in the liquid phase an unreacted part of potassium chloride and DEA remains, and diethylamine hydrochloride is also formed. As it was noted, during the evaporation and distillation of DEA from mother liquor during the process, the system gradually concentrates and at the end, depending on the degree of evaporation, a thick suspension is formed.

To determine the state of the system, the sequence of processes, the selection of equipment and technology control, it is necessary to study the influence of:T, and temperatures for viscosity, density, refractive indices and electrical conductivity of the reaction system, as well as the settling and filtration rates of the suspension.

Data (Table 1) show that with a decrease in the residual pressure in the evaporator from 740 to 284 mm Hg, the boiling point of the solution decreases from 83.0, 85.0°C to 63.5 and 67.0°C, respectively, at a concentration of 10.0-45.0%. The refractive indices and electrical conductivity of the samples, depending on the degree of evaporation, fluctuate in the intervals of 1.409-1.433 and 61.59-27.12 μS/cm, respectively. With an increase in the degree of evaporation from 10 to 45%, the refractive index increases by 0.020, and the electrical conductivity, on the contrary, decreases by 34.47 μS/cm.

With increasing concentration and decreasing temperature, the viscosity of the system increases. The influence of temperature on the process increases when it decreases to 18°C and the DEA concentration increases by more than 40%. Drawing the viscosity line (Fig. 1) for 26.5 sPz (d21-d11), with obtaining an orthogonal projection (d2-d1) shows that in order to maintain the viscosity value of 26.5 sPz with an increase in the degree of evaporation to 10,20,30%, the system temperature must be at least 12,15,16°C, respectively.

The filtration rate is strongly influenced by W:T and temperature of the filtration process (Table 2). With an increase in W:T at a temperature of 60°C, the filtration rate decreases by 2.40; 5.20 times at W:T 4:1 and 8:1, respectively, than at W:T = 2:1. This trend increases with a decrease in the process temperature to 20°C, at which the filtration rate decreases by 2.70, 7.15 times, respectively. When evaporating , sludge is formed with W:T is more

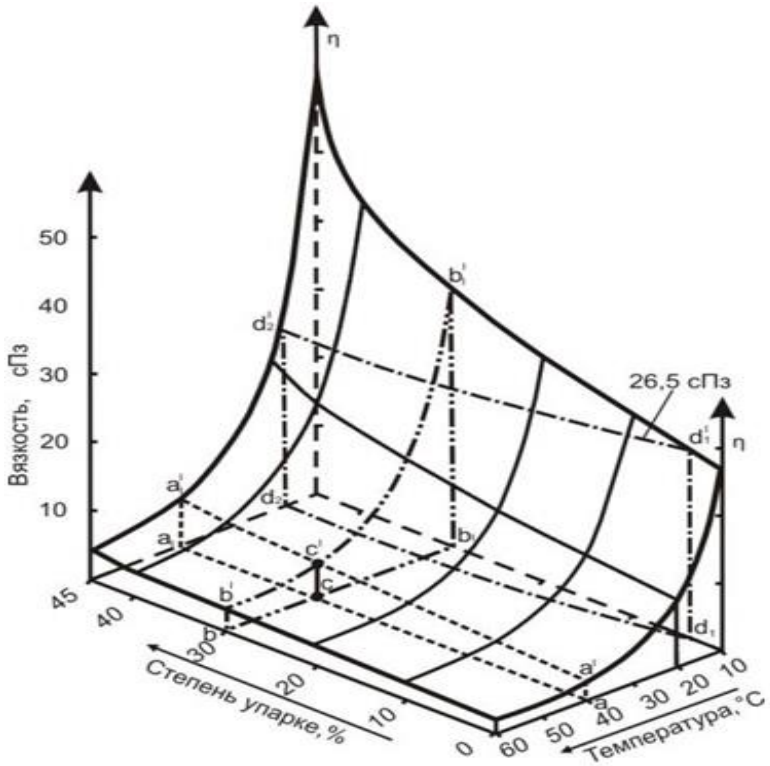
than 20:1 and with a temperature of 80-90 ° C. Based on the above, W:T must be reduced to no more than 8:1, in connection with which we have studied the kinetics of the decantation process (Fig.2).

Table 1
Physico-chemical properties of evaporated masterbatch solutions

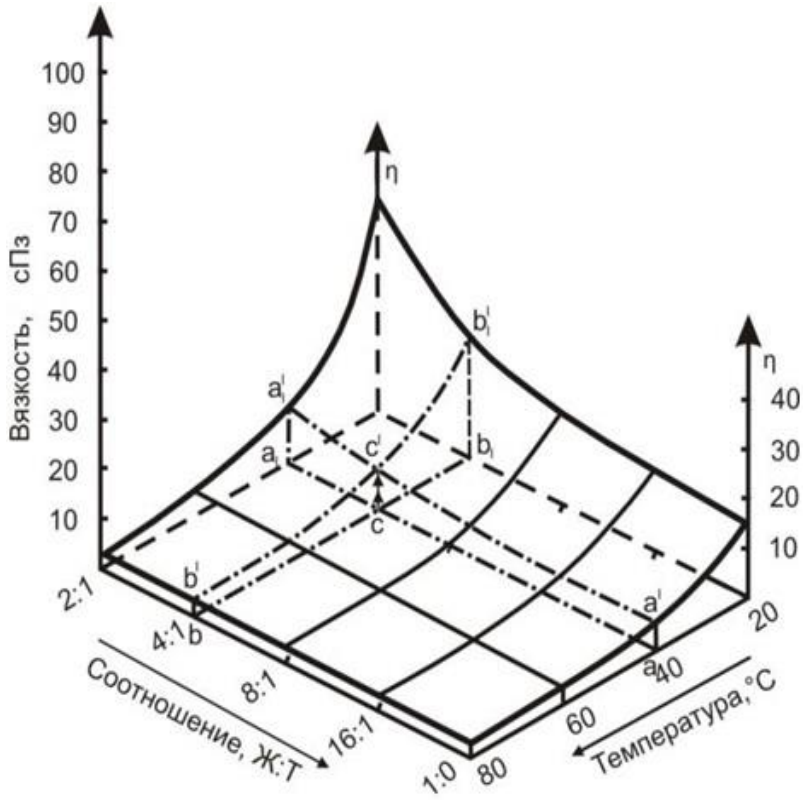
№	Degree of evaporation %	Elasticity, mm.Hg				n^{20},	Electrical conductivity at 20°C, **μS/cm**
		740	588	436	284		
1	0	82,0	78,0	72,0	63,0	1,409	61,59
2	10	83,0	78,5	73,0	63,5	1,413	58,45
3	20	83,5	79,0	73,5	64,0	1,416	54,84
4	30	84,0	80,0	74,0	65,0	1,422	47,63
5	40	84,5	81,0	74,5	66,0	1,427	36,66
6	45	85,0	82,0	75,0	67,0	1,433	27,12

Table 2
The influence of W:T and temperature on filterability of evaporated mother liquor

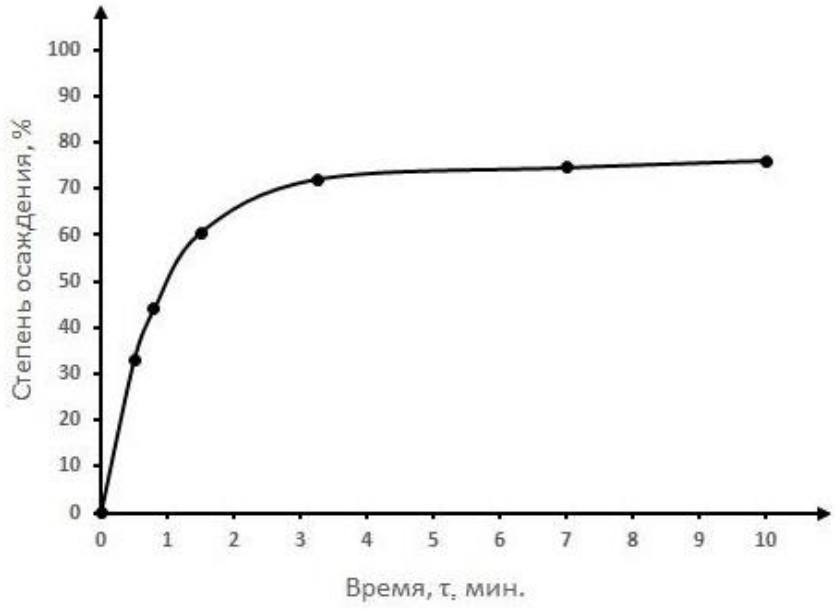
№	Ж:Т	Скорость фильтрации при 20°C, кг/м^{2}с		Скорость фильтрации при 60°C, кг/м^{2}с	
		Жид, фаза	Твер, фаза	Жид, фаза	Твер, фаза
1	1:0	-	-	-	-
2	16:1	856,59	63,29	3234	202
3	8:1	1047,54	156,18	3483	435
4	4:1	1263,31	414,28	3773	944
5	2:1	2134,22	1116,97	4578	2264



Pict.1. Change in the viscosity of mother liquor depending on the degreeof evaporation and temperature



Pict. 2. Change in the viscosity of a 30% evaporated mother liquor depending on temperature and the ratio of W:T.



Pict.3. Kinetics of precipitation of sediments formed during the evaporation of masterbatch solutions.

Within 3 minutes, the degree of clarification of the suspension reaches more than 70% and 75% with a decrease in W:T from 9:1 to 13:1, respectively (Fig.3).

Thus, the mother liquor after the evaporation process is maintained for 10-15 minutes before being fed to filtration and the resulting thick mass with W:T no more than 8:1 is fed to the filtration stage with a filtration rate of at least 435 kg/m2 * h.

By rheological properties, suspensions and solutions are formed in the system, which can be easily pumped by existing devices.

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