

# Study of the Process of Evaporation of Mother Liquors during the Production of Potassium Nitrate By Means of Conversi

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**Normamatov Farhod Haydarali o'g'li**<sup>1</sup>

<sup>1</sup> Karshi engineering and economic institute, Uzbekistan

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## **Abstract:**

This article analyzes the state of global production of potassium nitrate with substantiation of the relevance of the problem being solved and a study of the influence of technological parameters on the process of evaporation of mother liquors of potassium nitrate by the conversion method. The influence of those formed during technological processes on the degree of yield of K<sub>2</sub>O and at least in products has been studied. The optimal technological parameters for the production of potassium nitrate by the conversion method from potassium chloride and ammonium nitrate have been established.

**Keywords:** potassium chloride, ammonium nitrate, conversion, potassium nitrate, evaporation, ammonium chloride.

The production of chlorine-free water-soluble complex fertilizers is a promising and intensively developing segment of the production of mineral fertilizers, as evidenced by the following figures; the production capacity of potassium nitrate in the world amounted to over 474 thousand tons/year. The global growth rate of the chlorine-free water-soluble fertilizer market is estimated at 4% per year.

We have improved the process of producing potassium nitrate using conversion methods.

First, an analysis was carried out of multicomponent systems  $K^+$ ,  $NH_4^+ // Cl^-, NO_3^- -H_2O$ , which are the theoretical basis for choosing the range of variation of technological parameters and the sequence of technological processes.

In this work, based on the analysis of the solubility diagram of  $K^+$ ,  $NH_4^+$  //  $Cl^-$ ,  $NO_3^-$  - $H_2O$ , the following range of variation of the main technological parameters was selected; KCl:NH<sub>4</sub>NO<sub>3</sub> -1,0-1,2:1; conversion duration - 1-40 minutes, crystallization temperature - 5-20 °C, crystallization duration - 15-30 minutes.

The influence of the KCl:NH<sub>4</sub>NO<sub>3</sub> ratio, temperature and duration of conversion, as well as the kinetics of crystallization at temperatures of 5, 10 and 20 °C were studied.

As the data obtained show, in the studied intervals after the conversion process, regardless of the conversion conditions at 90 °C, no solid phase is formed in the system. After a given duration of the conversion process, the system was cooled to a certain crystallization temperature with stirring at a stirrer speed of 50-100 rpm and cooling - 2-14 °C\*/min.

The resulting solid product and liquid phase were analyzed for the content of  $K^+$ ,  $Cl^-$  and nitrogen in the form of nitrate and ammonium according to generally known methods in the field of mineral fertilizers.

The following optimal technological parameters of the process have been established: ratio KCl:NH<sub>4</sub>NO<sub>3</sub>=1:1÷1.1:1, conversion duration 2-3 minutes, conversion process temperature 95-100 °C, temperature and duration of crystallization 5-10 °C and 30-40 min respectively.

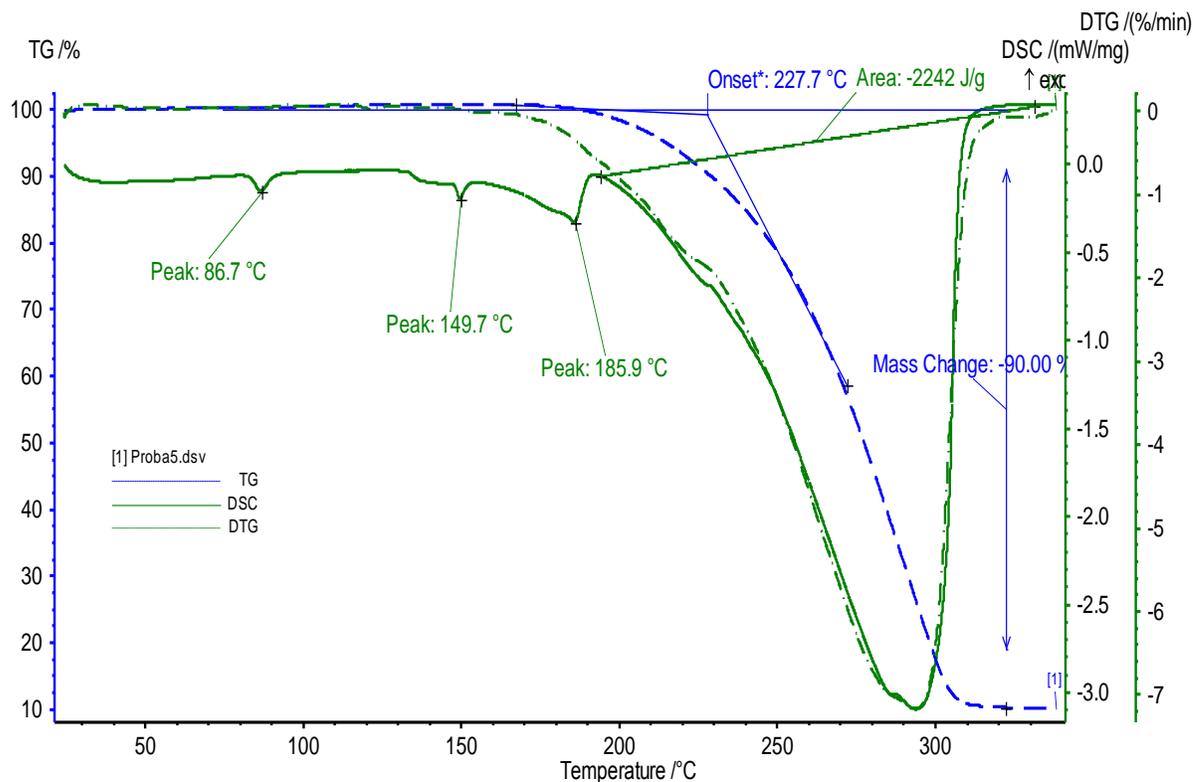
It was determined that with a change in the above parameters, the yield of potassium nitrate ranges from 46,44 to 54,53%, and L:S - in the range of 3,75-4,70 the filtration rate is 106,24-2213,85 kg/m<sup>2</sup> hour .

The process of evaporation of the mother liquor formed during conversion depending on the input technological parameters was studied and it was found that with 30-40% evaporation, the yield of ammonium chloride is 3,15-16% of the total mass of the mother liquor.

Below is a thermogram of the obtained ammonium chloride under optimal conditions. Thermoanalytical studies of the presented samples were carried out on a Netzsch Simultaneous Analyzer STA 409 PG device (Germany), with a K-type thermocouple (Low RG Silver) and aluminum crucibles.

All measurements were carried out in an inert nitrogen atmosphere with a nitrogen flow rate of 50 ml/min.

The temperature range of measurements was 25-370 °C, the heating rate was 5 K/min. The amount of sample per measurement is 5-10 mg. The measuring system was calibrated with a standard set of substances KNO<sub>3</sub>, In, Bi, Sn, Zn.



**Fig. TG-DSC curve of ammonium chloride formed during evaporation of the mother liquor.**

In the temperature range 20-170°C, three endothermic peaks are observed without changing the mass of the sample. The first two (86,7 and 149,7 °C) most likely characterize phase transitions - the first peak  $T_{max} = 86,7^{\circ}\text{C}$  and  $\Delta Q = -5,23\text{J/g}$  and  $T_{max} = 149,7^{\circ}\text{C}$  and  $\Delta Q = -2,57\text{J/g}$  (phase transitions of the first order - transition from a metastable crystalline state to a stable one) and the third peak  $T_{max} = 185,9^{\circ}\text{C}$  and  $\Delta Q = -27,24\text{J/g}$  may be due to melting of the sample. The process of destruction (decomposition) begins after 227,7 °C destruction occurs at a rate of 7% per minute. The sample decomposes with a mass loss of 90% up to 310 °C.

Thus, the obtained data is shown by the conversion method with a short conversion time, it is possible to obtain sufficiently pure ammonium chloride with good technological indicators of the evaporation conversion processes.

## LITERATURE

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