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STUDY OF THE PROCESS OF PRODUCING POTASSIUM NITRATE

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Abstract:

Potassium nitrate KNO_3, also known as potassium nitrate, is an anhydrous white crystalline salt, highly soluble in water. It has orthorhombic crystal symmetry; contains 46.58% K_2O, which in terms of nitrogen is 13.85%.

Potassium nitrate is a strong oxidizing agent. At temperatures above 340° C, it first intensively decomposes in its own melt with the formation of atomic oxygen.

Potassium nitrate can be obtained by several methods [1, 2].

The most common conversion method involves exchange decomposition between various nitrates and potassium chloride, carbonates or sulfate. Typically, exchange decomposition is carried out between potassium chloride and sodium nitrate.

NH_4NO_3 can also be used, but in this case NH_4Cl is obtained as a by-product, the demand for which is limited.

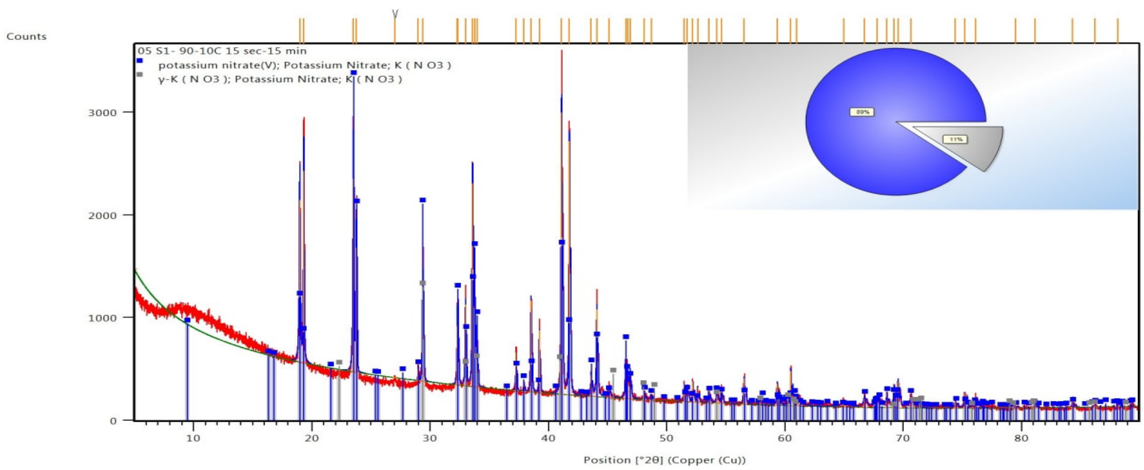
Potassium nitrate can be obtained relatively simply by neutralizing nitric acid with potassium hydroxide or carbonate, or by capturing solutions of these substances from exhaust nitrous gases. In the latter case, solutions of potassium nitrate and nitrite are obtained, which are inverted with nitric acid.

In this regard, for the physicochemical substantiation of the process of producing chlorine-free complex nitrogen-potassium fertilizer with a high content of nutritional components, we studied the conversion of potassium chloride with calcium nitrate.

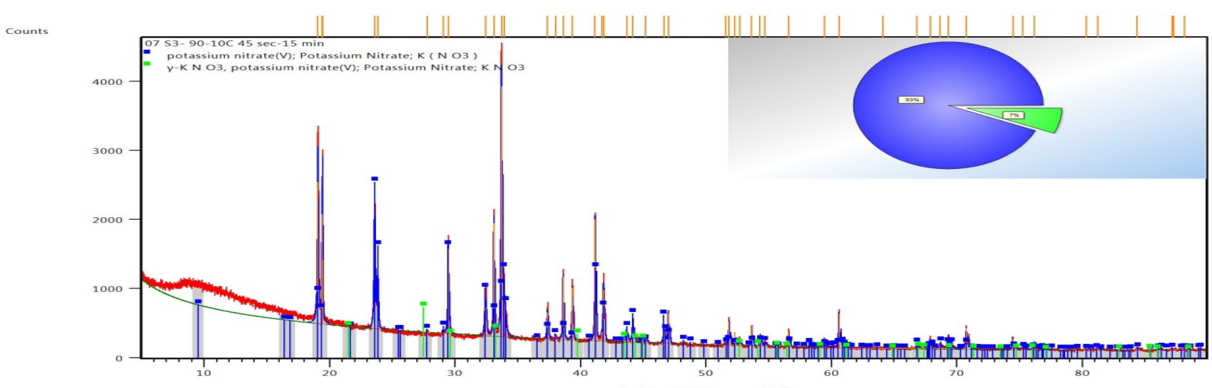
Experiments on the conversion of potassium nitrate from potassium chloride and calcium nitrate were carried out in a laboratory setup consisting of a glass quartz reactor with a stirrer and electrical heating. The conversion temperature in the reactor was maintained using a TK-300 contact thermometer, with an accuracy of ±1°C. The rotation speed and temperature were continuously adjusted.

Crystalline potassium chloride and calcium nitrate were used for the study. The experiments were carried out in a round-bottomed flask on a heated stirrer, into which the calculated amount of KCI, $Ca(NO_3)_2$ and H_2O was loaded. The flask with potassium chloride and water was dissolved in a magnetic stirrer at 90^0C, then calcium nitrate was added. The conversion was carried out for 15 and 30 minutes. After conversion, the solution was cooled to a temperature of 10^0C in order to extract potassium nitrate from the solution. The obtained potassium nitrate was used to analyze the chemical composition of the liquid and solid phases.

X-ray image of the resulting potassium nitrate has individual sets of diffraction reflections, diffraction line intensities and reflection angles that are not characteristic of the original components (figure).



A)



b)

Drawing. X-ray patterns of potassium nitrate obtained at the time of exchange decomposition, (min): a-15; b-30.

The time of the exchange decomposition reaction has a significant influence on the crystal structure of the resulting potassium nitrate, an x-ray study (figure) of which showed that with an increase in the conversion time from 15 to 30 minutes, the content of the γ-form of potassium nitrate crystals decreases from 12 to 0%.

Consequently, at the beginning of the process, the γ-form of potassium nitrate crystallizes, which gradually turns into the α-form.

Thus, analyzing these data, we can conclude that the production of potassium nitrate on an industrial scale is quite acceptable and potassium nitrate is in great demand in both domestic and foreign markets.

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