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Investigation of the Solubility of the Ternary Systemkcl – K_2SO_4- H_2O

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The possibility of practical use of a substance is entirely determined by its properties. When addressing this issue, the economic feasibility of its application is also considered. Therefore, before finding a use for a substance, its physical and chemical properties are first studied in detail. After that, the boundaries of the use of the substance become clear.

Potassium sulphate is a chlorine-free potassium fertilizer that simultaneously contains an element such as sulfur, which is also partially used for plant nutrition. Sulfur is a constituent of amino acids and is of great importance in redox processes. Sulfur has a positive effect on the formation of chlorophyll, promotes the formation of nodules on the roots of legumes and nodule bacteria that absorb atmospheric nitrogen. Lack of sulfur in plants disrupts the metabolic process and protein synthesis, leads to chlorosis, which reduces the yield and quality of plants [1].

There are numerous ways to produce potassium sulfate using natural sulfate-type potash ores as raw materials, as well as technical potassium chloride and various sulfate-containing chemical products - sodium, magnesium, iron and calcium sulfates, sulfuric acid and others.

The technological basis for the production of potassium sulfate by the conversion of potassium chloride with sodium sulfate is based on the physicochemical properties of the quaternary reciprocal aqueous system of chlorides and sulfates of sodium, potassium and its constituent ternary systems [2-3].

The studied quaternary system $2Na^+$, $2K^+//2Cl^-$, SO_4^{2-} - H_2O consists of four ternary aqueous systems. The ternary systems Na_2SO_4 – NaCl – H_2O, Na_2SO_4 – K_2SO_4 – H_2OиNaCl – KCl – H_2O are sufficiently illuminated at temperature intervals of 0–100 degrees Celsius.

From the results of the study of these systems, it follows that it is expedient to carry out the conversion of potassium chloride with sodium sulfate under elevated temperature conditions, under which the yield of potassium sulfate increases. In this regard, in order to substantiate the process of conversion of potassium chloride with sodium sulfate under elevated temperature conditions and to clarify the disagreements in the literature, the solubility diagram of the KCl – K_2SO_4- H_2O system at a temperature of 100 degrees Celsius was studied.

Equilibrium was established by mixing the phases after 3-4 days. Liquid and solid phases were analyzed according to known methods for the content of sulfate, potassium and chlorine ions.

Data on the solubility of the system KCl – K_2SO_4- H_2O100^{0}C

Table 1

Liquidphasecomposition, %		Solidphase
KCl	K_2SO_4	
26,4	0	KCl
25,6	1,10	KCl – K_2SO_4
20	2,1	K_2SO_4
15	3,3	«»

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10	4,9	«»
5	7,1	«»
0	10,7	«»

The obtained data show that the system belongs to the simple euphonic type.

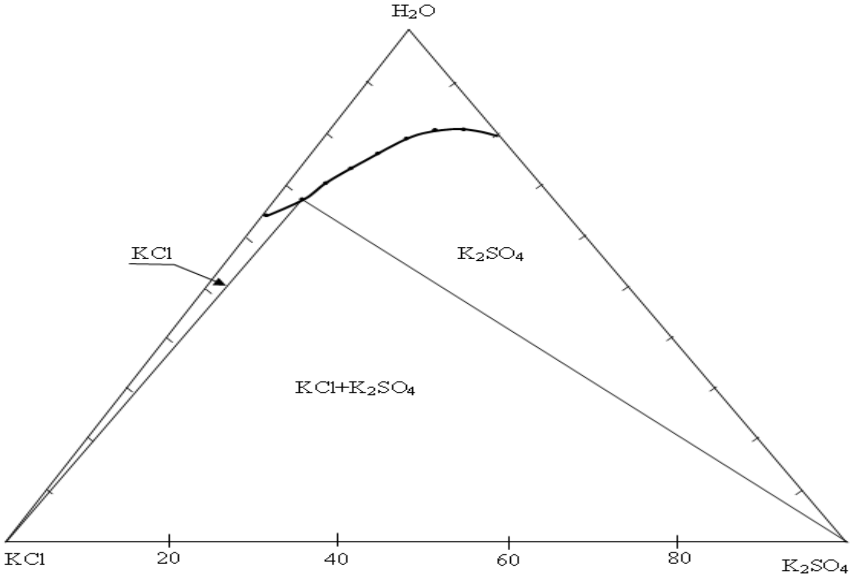

Figure 1. Isothermal diagram of the solubility of the system potassium sulfate - potassium chloride - water at 100 degrees Celsius.

Data analysis shows that the initial components, i.e. potassium chloride and potassium sulfate, crystallize in the system [4].

From the results of the analysis of the studied system at a temperature of 100 degrees Celsius, it follows that the components of the system have a mutual salting out effect on each other. Sodium chloride has a greater salting out effect than potassium sulfate, therefore, the field of crystallization of sodium chloride is expanding.

Thus, according to a review of the literature in our country, the most promising methods for obtaining potassium sulfate from natural potassium sulfate ores or from potassium chloride by conversion with magnesium sulfate or sulfuric acid.

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