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X-RAY PHASE ANALYSIS OF COMPLEX MINERAL FERTILIZERS BASED ON GLAUCONITE SAND AND WITH SOME MINERAL FERTILIZERS

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Abstract

The work studied the physicochemical characteristics of the raw materials used – glauconite sand and jelvak phosphorites of Karakalpakstan. The process of preparing complex glauconite-containing fertilizers based on glauconite, Karakalpakstan and fertilizing salts was investigated. The possibility of obtaining complex glauconite-containing fertilizers based on glauconite, nitrogen and potassium fertilizers is shown. Diffractograms of binary mixtures of glauconite sands with ammonium nitrate, ammonium sulfate, potassium chloride, carbamide, ammophos and phosphorite flour are also given.

Keywords: *Karakalpakstan, Krantau, glauconite, glauconite sands, X-ray phase analysis, mineral fertilizers*

Introduction

The main task of modern agriculture is to obtain high-quality yields while increasing soil fertility, which is impossible without the use of fertilizers. Mineral fertilizers are one of the sources of additional nutrition of plants (Artyushin, A.M., Derzhavin L.M., 1984).

However, in modern conditions, the salinity and degradation of the soils of the sown areas of the republic are manifested on an increasing scale. This applies to the northern regions of the republic, especially the Republic of Karakalpakstan, where approximately 80% of irrigated arable land is subject to various degrees of salinity and degradation (Environmental problems of Uzbekistan, 2011).

Based on the above, along with the need to develop effective soil brining measures, a promising direction is the creation of trace elements containing fertilizers with complex-forming, ion-exchange and sorption properties that would help plants grow on saline soils. Complex fertilizers produced on the basis of glauconite of the Republic of Karakalpakstan in the presence of fertilizing salts possess such properties

(Allaniyazov, D.O., 2019; Allaniyazov, D.O., Erkaev, A.U. 2021; Allaniyazov, D.O., Erkayev, A.U., Tajibayev, T.A., Ochilov, S.U., 2023).

Objects and methods of research:

The object of research in this work are glauconite sands Krantau, Phosphorite flour of the Khudjakul deposit of Karakalpakstan and standard mineral fertilizers produced in Uzbekistan, ammonium nitrate, ammonium sulfate, potassium chloride, urea, ammophos and phosphate flour.

Research material and methodology:

Based on the above, in the laboratory conditions we decided to test the possibility of obtaining complex glauconite fertilizers using mineral salts based on their granulation. First, granular mineral fertilizers were ground in a porcelain mortar to a powdery state. Obtained powders are mixed till homogeneous mass with enriched glauconite sands at various mass ratios of glauconite: potassium chloride, ammonium nitrate, ammonium sulfate, carbamide and moistened to 7–16.6% of total mass and supplied to granulator. At the same time, microelement-containing granules were formed, in appearance similar to granules of standard fertilizers produced at factories.

Identification of the samples was carried out on the basis of diffractograms taken on a computer-controlled XRD-6100 apparatus (Shimadzu, Japan). Radiation-CuKa (β filter, Ni, 1.54178 tube current and voltage mode 30 mA, kV) and constant detector rotation speed 4 deg/min, in 0.02 deg increments, (ω/20 coupling) were used, and the scanning angle varied from 4 to 80 °, the scanning angle during diffractometric studies varied from 2 to 80 °. Qualitative and quantitative identification of the phases of the presented samples was carried out using the MATCH! ® Phase identification from Powder Diffraction program (Crystal Impact, GbR, Bonn, Germany, 2015) (MATCH!® Phase identification from Powder Diffraction 2015; Döbelin, N., Kleeberg, R. 2015).

Research results:

The production of complex mineral fertilizers based on glauconite and widely used mineral fertilizers was continued. Figure 1–10 shows diffractograms of binary mixtures of glauconite sands with ammonium nitrate, ammonium sulfate, potassium chloride, carbamide, ammophos and phosphorite flour. When taking diffraction patterns, the same conditions were observed, and the sample weights were approximately equal. Glauconite sands produced on an industrial scale need to be enriched because they need to have a percentage of glauconite of at least 50% in order to be used as mineral fertilizers. In the samples studied, this percentage is no more than 30% (Drits, V.A., Zviagina, B.B., McCarty, D.K., Salyn, A.L., 2019).

Figure 1. *Diffractograms of glauconite: saltpeter mixtures in different ratios: 1) saltpeter; 2) 5:45; 3) 15:35; 4) 45:5*

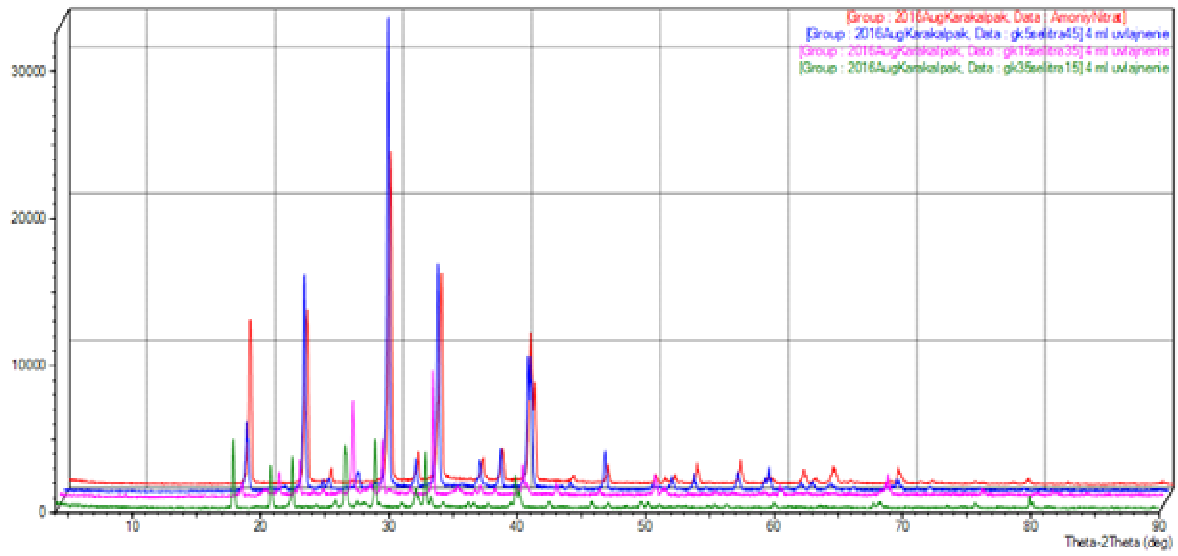


Figure 2. *Diffractograms of mixtures of glauconite: ammonium sulfate in different ratios: 1) ammonium sulfate; 2) 5:45; 3) 15:35; 4) 45:5*

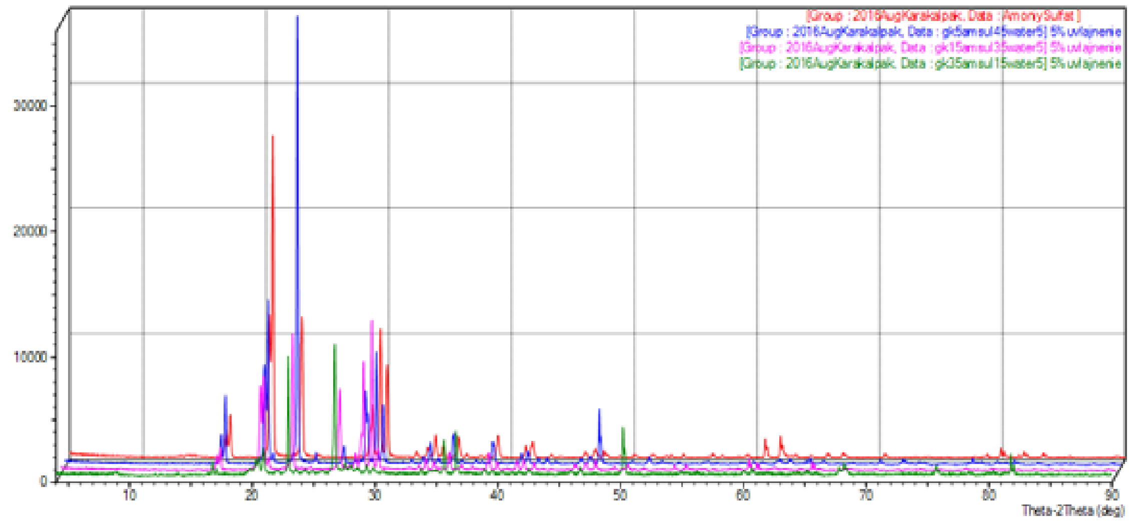


Figure 3. *Diffractograms of glauconite mixtures: potassium chloride in different ratios: 1) potassium chloride; 2) 5:45; 3) 15:35; 4) 45:5*

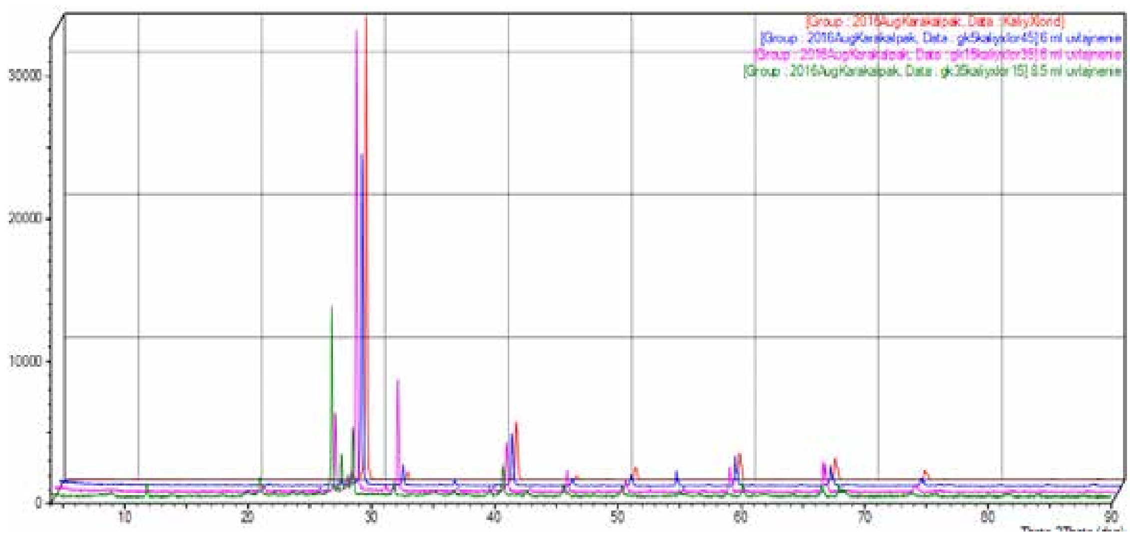


Figure 4. *Diffractograms of glauconite: carbamide mixtures in different ratios of: 1) carbamide; 2) 5:45; 3) 15:35; 4) 45:5*

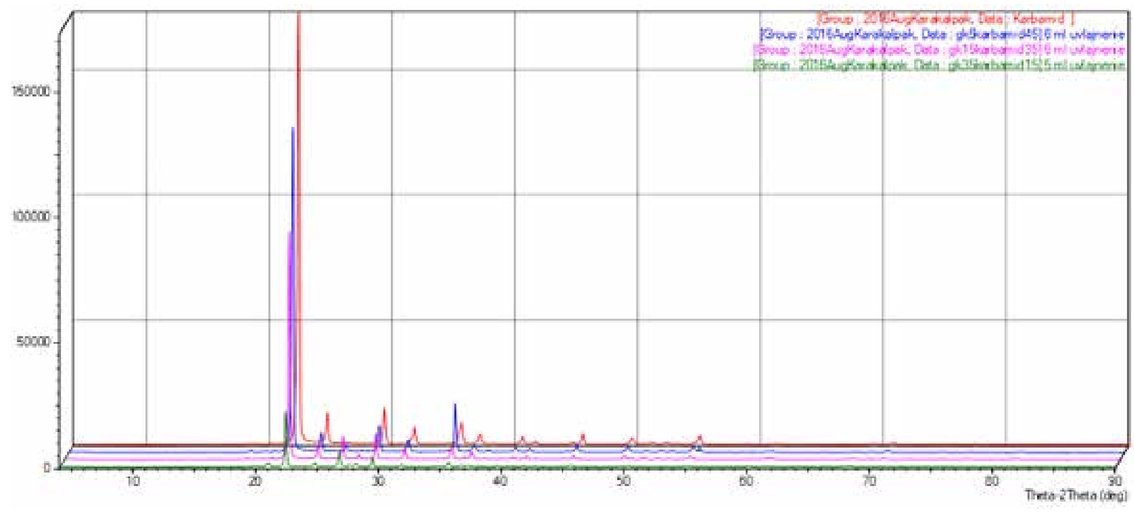


Figure 5. *Diffractograms of glauconite mixtures: ammophos in different ratios: 1) ammophos; 2) 5:45; 3) 15:35; 4) 45:5*

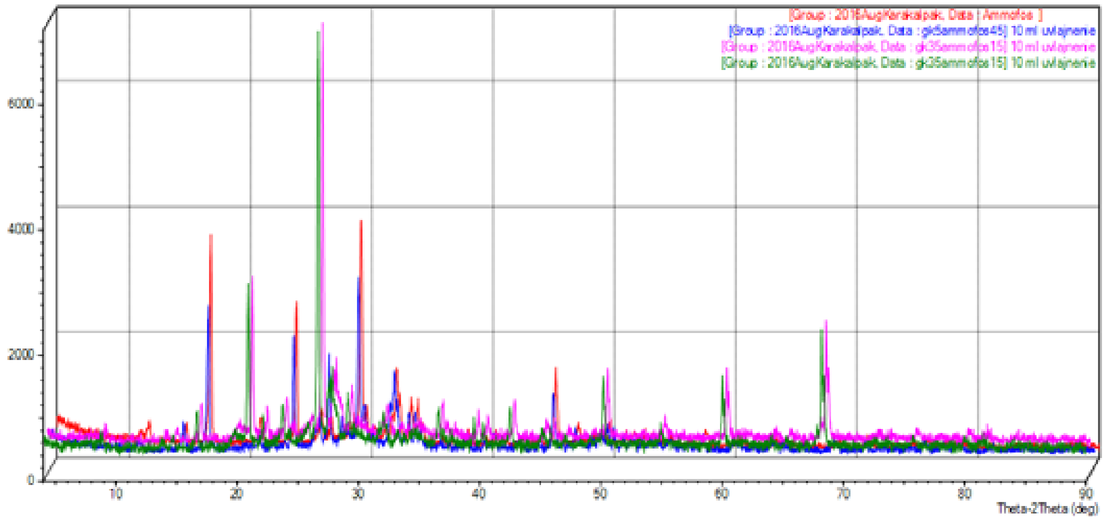


Figure 6. *Diffractograms of glauconite mixtures: phosphorite flour in different ratios: 1) phosphorite flour; 2) 5:45; 3) 15:35; 4) 45:5*

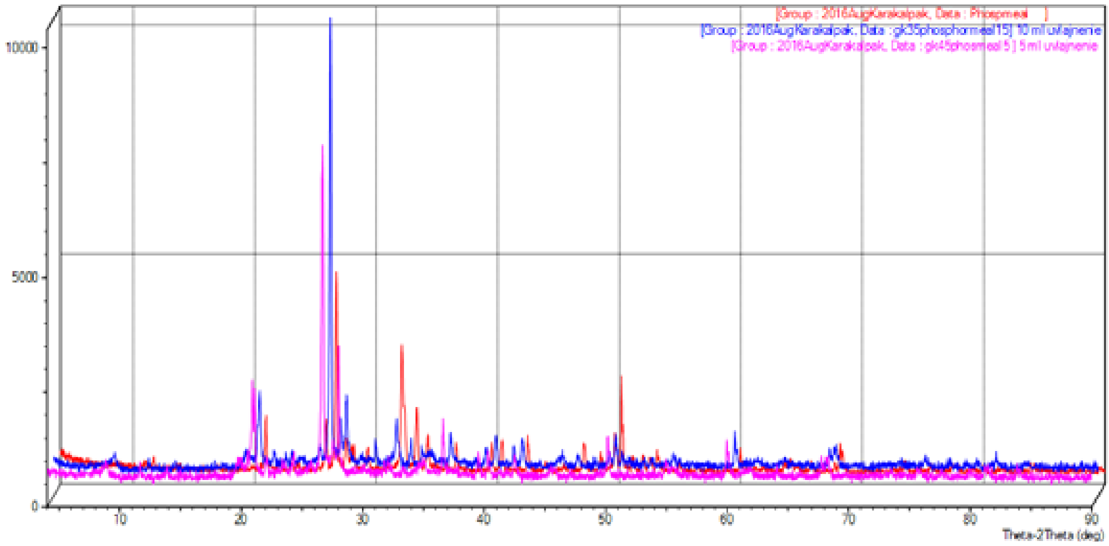


Figure 7. *Diffractograms of triple mixtures of glauconite: carbamide: phosphorite flour in different ratios: 1) phosphorite flour; 2) 15:35:50,31; 3) 15:35:21,50*

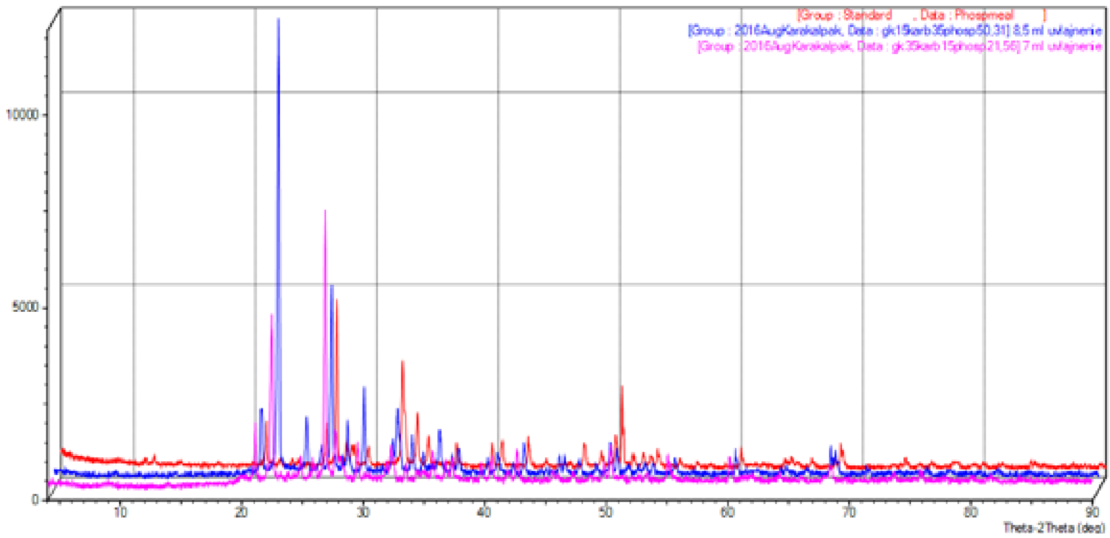


Figure 8. *Diffractograms of triple mixtures of glauconite: potassium chloride: phosphorite flour in different ratios: 1) 15:35:65; 2) 15:35:32*

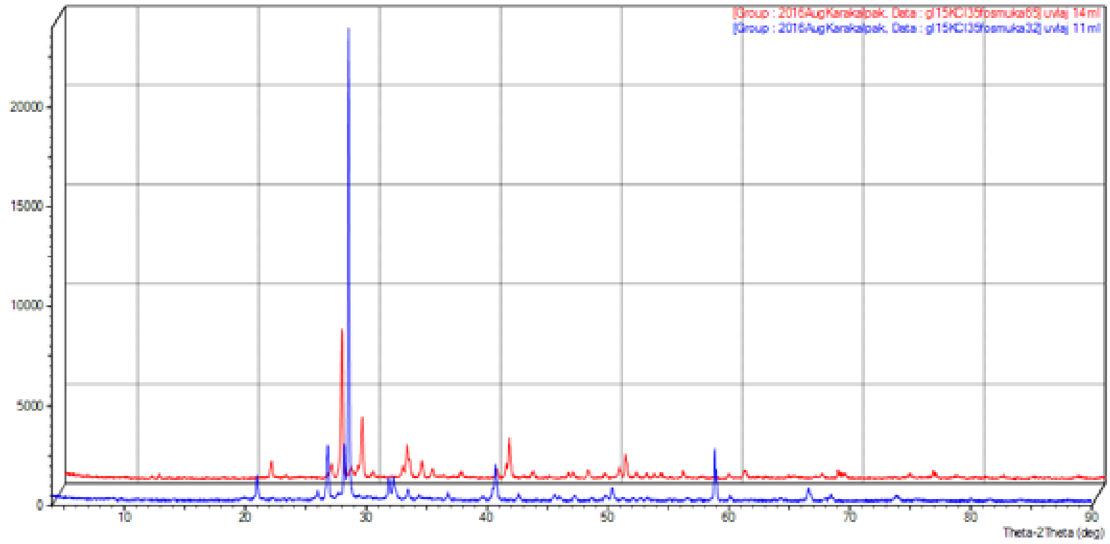


Figure 9. *Diffractograms of triple mixtures of glauconite: ammonium sulfate: phosphorite flour in different ratios: 1) 15:35: 11.5; 2) 15:35:23.*

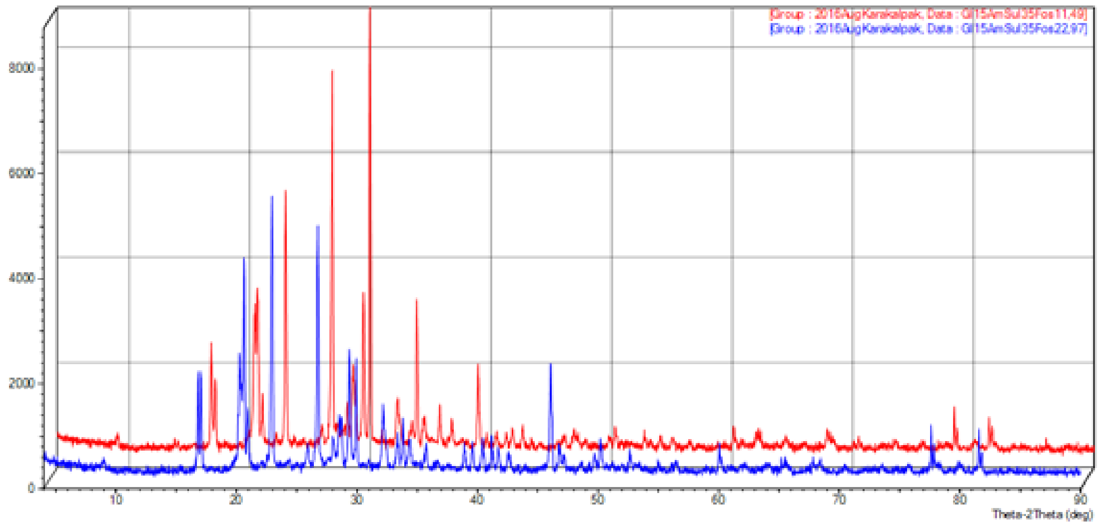
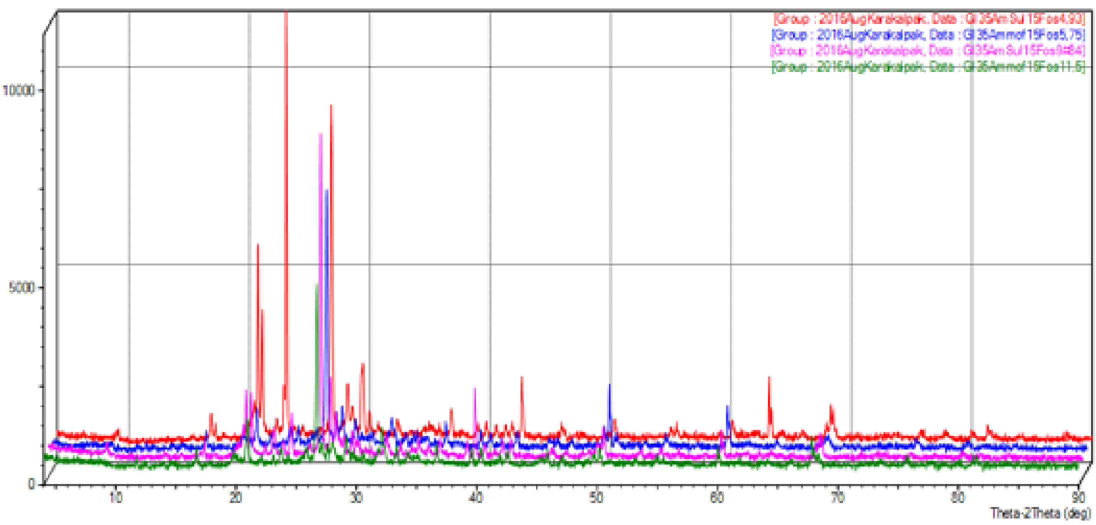


Figure 10. *Diffractograms of triple mixtures of glauconite: ammonium sulfate: phosphorite flour in different ratios: 1) 35:15:5; 2) 35:15:6;.3) 35:15:10; 2) 35:15:12.*



The difficulty of determining the quantitative content of glauconite in glauconite sands by the X-ray phase method, as the most operational, is that the glauconite contained in them has poor crystallinity and a large content of organic residues. It can be seen in (fig. 1) that with small amounts of glauconite sand, its peaks are weak, where the ratio of glauconite sand: ammonium nitrate, the contribution of glauconite sand peaks grows.

In glauconite sand samples: ammonium sulfate (Fig. 2), there is no direct dependence of ammonium sulfate content on the heights of the corresponding peaks in diffractograms. This trend is also observed in other samples of binary mixtures with glauconite (Fig. 3–6). Apparently, when the contribution of saltpeter, ammonium sulfate, potassium chloride, carbamide, ammophos and phosphorite flour decreases, they interact with moisture or with glauconite, and as a result, there is no direct dependence of the composition on the values of diffraction peaks. A similar pattern is observed with mixtures in which three components are present: glauconite, phosphorite flour and carbamide or potassium chloride (Fig. 7–10).

Conclusions:

Thus, during the work, it was revealed: It was found that in the prepared complex fertilizers, potassium chloride reacts with ammonium salts (ammophos, ammonium nitrate, ammonium sulfate) to form ammonium chloride and potassium salt. In turn, ammonium salts can mutually form double and triple salts. Urea remains neutral in the composition of these fertilizers. When making complex fertilizers, these interactions should be taken into account.

It has been determined that in complex fertilizers the introduced components may be crystalline or amorphous due to interaction with water, glauconite and other sand components.

References

Artyushin, A. M., Derzhavin L. M. A brief guide to fertilizers.– 2 ed.– Moscow: Kolos, 1984.–208 p.
Environmental problems of Uzbekistan. Collection of articles,– Tashkent, 2011.
Allaniyazov, D. O. Development of scientific foundations of processes for production and technology of complex fertilizers from glauconites and phosphorites of Karakalpakstan Diss. Ph D.– Tashkent. IONH AN RUz, 2019.– 123 p.
Allaniyazov, D. O., Erkaev, A. U. Enrichment of Karakalpakstan glauconite by dry method. International Scientific Journal “National Association of Scientists” (NAU). ISSN 2413–5291, 2021.– Vol. 2.– No. (36_63).– P. 4–8.
Allaniyazov, D. O., Erkayev, A. U., Tajibayev, T. A., Ochilov, S. U. Processing of local agro ores of Karakalpakstan for high-efficiency fertilizer. Journal of Survey in Fisheries Sciences – 10(3S). 2023.– P. 1225–1232.
MATCH!® Phase identification from Powder Diffraction (Crystal Impact, GbR, Bonn, Germany, 2015).
Döbelin, N., Kleeberg, R. “Profex; a graphical user interface for the Rietveld refinement program BGMN”. Journal of Applied Crystallography. 2015.– № 48.– P. 1573–1580.
Drits, V. A., Zviagina, B. B., Mc Carty, D. K., Salyn, A. L. American Mineralogist, 2010.– 95,–348 p.

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