



*Thematic section:* Research into New Technologies.

*Subsection:* Technology of the Organic Substances.

**Full Paper**

*The Reference Object Identifier* – ROI-jbc-A/21-2-4-9

*The Digital Object Identifier* – DOI: 10.37952/ROI-jbc-A/21-2-4-9

Received 18 August 2021; Accepted 21 August 2021

## Utilization of spent acid mixtures of cellulose nitrate production for long-acting fertilizers

Rinat H. Fazullin,\* Rifcat A. Khalitov,+

Rifcat H. Khuziakhmetov, and Alsu A. Fazulina

*Department of Equipment of Chemical Plants. Engineering Chemical and Technological Institute. Kazan National Research Technological University. K. Marx St., 68. Kazan, 420015. Republic of Tatarstan. Russia. Phone: +7 (843) 231-40-90. E-mail: [kstuoxz@gmail.com](mailto:kstuoxz@gmail.com)*

\*Supervising author; +Corresponding author

**Keywords:** spent acid mixtures, utilization, ammonium sulfonitrate, nitrogen-potassium fertilizer, urea-formaldehyde fertilizer, long-acting fertilizer.

### Abstract

Regeneration of waste acids of nitrocellulose production is associated with high material and energy costs and is an environmentally hazardous production. The regeneration process is accompanied by gas emissions of toxic gases into the atmosphere in the form of a mist of nitric and sulfuric acids, sulfur dioxide and nitrogen oxides. In this regard, the article considers a method for recycling spent acid mixtures of cellulose nitrate production with the production of mineral fertilizers of prolonged action. A method for obtaining ammonium sulfonitrate and nitrogen-potassium fertilizer from spent acid mixtures of nitrocellulose production by neutralization with ammonia and/or potassium hydroxide has been developed. The results of experimental studies of the production of prolonged fertilizers using a urea-formaldehyde mixture of KFK-85 (60% urea, 25% formaldehyde and 15% water) are presented. The optimal temperature of polycondensation of urea-formaldehyde fertilizer in a mixture with ammonium sulfonitrate and nitrogen-potassium fertilizer is determined. A sufficient condition for the end of the polycondensation reaction was determined to be a set of static strength equal to 1 MPa.

The physicochemical properties of the obtained prolonged fertilizers were determined. Samples of ammonium sulfonitrate with the addition of urea-formaldehyde fertilizer show less hygroscopicity. With an increase in the content of urea-formaldehyde fertilizer, the static strength increases up to 5 times, and the dissolution time increases up to 75 times.

Based on the results of studying the literature and conducting experiments on the polycondensation of KFK-85 and urea having ammonium sulfonitrate or nitrogen-potassium fertilizer as a filler, which are both catalysts for the polycondensation

reaction, the technological parameters for obtaining a prolonged-acting fertilizer are justified and a technological scheme for obtaining a prolonged-acting fertilizer from spent acid mixtures of nitrocellulose production is constructed.

**For citation:** Rinat H. Fazullin, Rifcat A. Khalitov, Rifcat H. Khuziakhmetov, Alsu A. Fazulina. Utilization of spent acid mixtures of cellulose nitrate production for long-acting fertilizers. *Butlerov Communications A*. **2021**. Vol.2. No.4. Id.9. DOI: 10.37952/ROI-jbc-A/21-2-4-9

## References

- [1] S.V. Afanasyev, Yu.N. Shevchenko, M.V. Kravtsova. Nitrogen fertilizers of prolonged action. *Chemical Engineering*. **2017**. No.9. P.33-35. (Russian)
- [2] V.I. Gindich. Technology of pyroxylin powders: Vol.2. Production of gunpowders. *Kazan: Tat. Gaz. Journal Publishing House*. **1995**. 400p. (Russian)
- [3] *Patent 2602097 of the Russian Federation*, IPC7 C 01 C 1/18, C 05 C 3/00. Method for obtaining ammonium sulfatonitrate. R.A. Khalitov, A.F. Makhotkin, R.R. Magyarov, R.R. Khairullin, I.I. Valeev. The applicant and the patent holder is Kazan National Research Technological University. No. 2015120763/05; application 01.06.2015; publ. 10.11.**2016**. (Russian)
- [4] *Patent 2747779 of the Russian Federation*, IPC7 C 05 G 1/00, C 05 G 5/12, C 05 D 1/02, C 05 C 3/00, C 05 C 5/02. Granular sulfur-containing nitrogen-potassium fertilizer and a method for its production. R.H. Khuziakhmetov, R.H. Fazullin, R.A. Khalitov, E.V. Tolstoguzova. The applicant and the patent holder is the Federal State Budgetary Educational Institution of Higher Education "Kazan National Research Technological University" (KNITU). No. 2020132516; application 30.09.2020; publ. 14.05.**2021**. (Russian)
- [5] A.A. Meshcheryakova. The mechanism of obtaining urea-formaldehyde resins. *Forestry Journal*. **2012**. No.3(7). P.130-134. (Russian)
- [6] Rinat H. Fazullin, Rifcat A. Khalitov, Rifcat H. Khuziakhmetov, Alsu A. Fazulina. Utilization of spent acid mixtures of cellulose nitrate production for long-acting fertilizers. *Butlerov Communications*. **2021**. Vol.67. No.9. P.98-102. DOI: 10.37952/ROI-jbc-01/21-67-9-98 (Russian)