**[Modernization](http://slovari.yandex.ru/modernization/en-ru) of existing manufactures of nitrogen containing mineral fertilizers and porous ammonium nitrate for production of** [**energy-efficient**](http://slovari.yandex.ru/energy-efficient/en-ru)**, environmentally-friendly products of improved quality**

 **Taran Yliya**, candidate of technical sciences, assistant of the department “Processes and devices of chemical technology named. N.I. Gelperin”, MITHT. The M. V. Lomonosov Moscow state university of fine chemical technologies,

Moscow.

**Taran Alla**, candidate of technical sciences, senior staff scientist of the department “Processes and devices of chemical technology named. N.I. Gelperin”, MITHT.

e-mail: capsula2@mail.ru

**Keywords**: granulation, energy-saving, large-capacity manufactures, nitrogen containing mineral fertilizers, porous ammonium nitrate.

**Abstract.** The suggestions for re-equipment of existing preel production capacities of ammonium nitrate, carbamide, NPK, porous ammonium nitrate etc. are given for possibility of flexible (one shift reset maximum) production of up-graded ammonium nitrate with various additives, microelements, with reduced velocity of solution, NPK of flexible formula and composition. This technology also allows to improve strength and granulometric composition of the obtained product. As a result we get a flexible manufacture that easily and quickly adapts to customers’ needs and produces granules of excellent quality and various compositions at the same period of time.

Part of this suggestions passed experimental - industrial and industrial tests.

The article by Taran Y.A., Taran A.V. contains results, which were obtained within State assignment of Minobrnauki of Russian Federation.

**References**

1. Taran A.L., Konokhova N.V., Kuchinskiy V.E., Taran Y.A., Yakovlev D.S., Kuzina D.A. The principles of reconstruction of the units of ammonium nitrate production for the production of ammonium nitrate with fillers and porous ammonium nitrate. Chim. prom. segodnya [Chem. prom. Today], 2011, no. 8, pp. 17-22. (In Russ.)

2. Taran Y.A. Development and analysis of melt granulation processes with environmentally safe energy saving schemes: dis. cand. tech. sciences. М., 2011.

3. Taran A.L., Theory and practice of melt and powders granulation processes. dis. doc. tech. sciences. М., 2001.

4. Taran A.L., Dolgalev E.V., Taran Y.A. The algorithm of jet pelletizer calculation for production of lime - ammonium nitrate in the towers. Vestnik MITHT [MITHT herald], 2006, v.1, no. 3, pp.42-46.

5. Patent РF 2277011. Granulator. Rystambekov M.K., Taran A.L., Troshkin O.A., Dolgalev E.V., and oth. bull. No. 15, 2006.

6. Certificate of authorship USSR 1613159. Installation for melt granulation. Veylert V.V., Shalin P.V., Taran A.L., Vinogradov A.S. bull. no.46, 1990.

7. Chernishov A.K., Levin B.V., Tygolykov A.V. and oth. Ammonium nitrate: properties, production, application. // М.: 2009. 544 p.

8. Taran A.L., Dolgalev E.V., Taran Y.A. Ecological - cost-efficient technology for the production of nitrogen fertilizers, developed at MITHT. // Vestnik MITHT [MITHT herald], 2008, no. 2, pp. 33-36.

9. Macarov B.N. Gaseous nitrogen losses of soil and fertilizers and methods of their reduction Agrohimiya [Agrochemistry]. 1994, no. 1. pp. 101-114.

10. Usmonov A.K. Modification of ammonium nitrate with inorganic silicon compounds: Dis. cand. tech. sciences М., 2013.

11.Guchenko E.I. Industrial explosives, Part 1. The granulated explosive mixtures and their application // М.: MGTU. 2003.

12. Olevskiy V.M. Technology of ammonium nitrate. // M., Chemistry, 1978.

13. Taran Y.A., Pynkova T.I., Taran A.L. Theory and practice of determining the velocity of nucleation and growth of micro-drops in the three-liquid mixtures with limited solubility of the components. Vestnik MITHT [MITHT herald], 2012, v. VII, no. 2. pp. 38-42.

14. Taran Y.A., Pynkova T.I., Taran A.L. Ecologically safe and energy saving technology of granules capsulation with water resistant thin polymer shells Himicheskya tehnologiya [Chemical technology], no. 8, 2012, pp. 496-504.

15. Olevskiy V.M. The production of ammonium nitrate in units of large capacity. // M., Chemistry, 1990.

**Еfficiency of sorption of Mg(II) and Са(II) cations by glauconite from chloride solutions**

**Vigdorovich Vladimir I.** - Doctor of Chemistry,professor, chief research worker of All-Russian Scientific Institute of Equipment and Oil-products Application, Tambov

**Tsygankova Liudmila E**. - Doctor of Chemistry, professor of Analytical and inorganic chemistry department, Tambov State University named after G.R. Derzhavin,

**Shel Natalia V**. - Doctor of Chemistry, professor of Department «Chemistry and chemical technology», Tambov State Technical University,

**Morshinina Irina V.** - Postgraduate student, Analytical and inorganic chemistry department, Tambov State University named after G.R. Derzhavin

**Esina Marina N.** – Ph. Doctor, lecturer of Analytical and inorganic chemistry Department, Tambov State University named after G.R. Derzhavin.

**Uryadnikov Alexender A.** - Ph. Doctor, lecturer of Analytical and inorganic chemistry Department, Tambov State University named after G.R. Derzhavin.

**Keywords:** magnesium, calcium, chloride, glauconites, sorption, concentration, competition, indifferent electrolyte, extraction level.

**Abstract**. Kinetics and level of sorption extraction of Mg(II) and Са(II) cations from solutions of MgCl2 and CaCl2 by glauconite concentrate has been studied. Effect of initial concentration of the salts, their correlation, twofold sorption, process duration, indifferent electrolyte on the extraction level of the model media is considered. Sorption of Mg(II) and Са(II) corresponds to Langmuir isotherm. The values of constants of the adsorption equilibrium, adsorption rates and maximum specific adsorption were calculated for both cations. Two stages sorption permits to bring the Mg(II) content up to 0.01mol-equiv/L and lesser. At the joint presence, the Са(II) sorption proceeds more effectively and the Г∞,Са(II) : Г∞,Mg(II) ratio is , as a rule, essentially higher than initial ratio of the cation concentrations in the solution and depends on the nature of the present extraneous anions. A presence of the extraneous salts (NaNO3 and Na2SO4) decreases the depth of Mg(II) and Са(II) sorption by the glauconite.

**References**

1. GOST 2874-82 «Drinking water. Hygienic requirements and control of quality» (in Russ.).

2. GOST R 51232-98 “Drinking water. General requirements for organization and methods of control of quality” (in Russ.).

3. Grigorieva Е.А. Sorption properties of Karinsk deposit glauconite. Avtoreferat diss. Kand. Chim. nauk [Author's abstract of PhD dissertation]. Chelyabinsk. 2004. 140 p. (in Russ.).

4. Vigdorovich V.I., Tsygankova L.E., Akulov A.I. PH influence on phenol extraction by glauconite and its fractions from running solution. Sorbtsionnye i khromatographicheskie protsessy [Sorption and chromatographic processes], 2011, v. 11, no. 2, pp. 256 – 263 (in Russ.).

5. Vigdorovich V.I., Bogdanova E.P., Tsygankova L.E. Influence of medium acidity on Fe (II) sorption by glauconite from running chloride solutions. Sorbtsionnye i chromatographicheskie protsessy [Sorption and chromatographic processes], 2011, v.12, no. 2, pp. 274 – 282 (in Russ.).

6. Srivasava P, Singh B., Andrews J.E. Competitive adsorption behavior of heavy metals on kaolinite. Colloid interface sci., 2005, v. 291, pp. 588 - 592.

7. Eqirani D.E., Baker A.R., Andrews J.E. Copper and zinc removal from aqueous solution by mixed mineral systems: 1. Reactivity and removal kinetics. Colloid interface sci., 2005, v. 291, pp. 313 - 325.

8. Zhao J., Zhu Y., Wu J., Zheng J., Zhao X., Lu B., Chen F. Chitosan-coated mesoporous microspheres of calcium silicate hydrate: Environmentally friendly synthesis and application as a highly efficient adsorbent for heavy metal ions. Colloid interface sci., 2014, v. 418, pp. 208 - 215.

9. Schwarzenbakh G., Flaschka G. Complexometric titration. M.: Chemistry. 1970, 360 p. (in Russ.).

10. Gellebrand V.F., Lendel G.E., Brayt G.A., German D.I. Applied direction for inorganic analysis. M.: Chemistry. 1966, 1112 p. (in Russ.).

11. GOST R 52407-2005. National standard of Russian Federation. Drinking water. Methods of hardness testing. (in Russ.).

12. Emely J. Elements. М.: Мir. 1993, 256 p.

13. Tarasevich Y.I, Ovcharenko F.D. Adsorption on clay minerals. Kiev. Naukova Dumka. 1975, 352 p.

14. Goldovskaya- Peristaya L.F., Volovicheva N.A., Vezentsev A.I., Peristyi V.A. Sorption isotherm of strontium ions by montmorillonite-hydromica clays. Sorbtsionnye i chromatographicheskie protsessy [Sorption and chromatographic processes], 2011, v.11, no. 2, pp. 165 – 171 (in Russ.).

15. Voyutskyi C.C. Course of colloidal chemistry. M.: Chemistry. 1964, 574 p. (in Russ.).

16. Fridrikhsberg D.A. Course of colloidal chemistry. M.: Chemistry. 1995, 400 p. (in Russ.).

**The technology of low-tonnage production**

**of fluorides metals of high purity for optical glass**

**Sokol Vladimir Alexandrovich**

Doctor of Technical Sciences, Head of Laboratory Technology superfine inorganic substances FSUE «IREA» Federal State Unitary Enterprise «State Scientific Research Institute of Chemical Reagents and High Purity Chemical Substances» (FSUE «IREA»)

Address: 107076, Moscow, Bogorodskiy val, 3

Tel.: (495) 963-74-05, e-mail: sokol@izmaylovo.ru

**Keywords:** low-tonnage, manufacturing, fluorides, especially high purity, optical glass.

**Abstract.** The paper includes an analysis of the existing technical literature on synthesis and technological processing of fluorides Li,Na,Mg,Ca,Sr,Ba,Y,La and Al. It is shows the possibility of essentually simplification and unification of manufacturing this reagents. A low-tonnage production of metal fluorides for optical glass ,based on neutralization of strong hydrofluoric acid by hydroxides or carbonates of metals, is developed. As a result of neutralization, depending on the bases ,the mother liquor contains a small amount of carbon dioxide and hydrofluoric acid ( for the synthesis aplied excess of about 5% from stoichiometric amount ).

At subsequent annealing in a glassy carbon crucibles at 450-500 oC this excess is removed together with the steam and is captured in the filter-absorber.

**References**

1.Naumova T.N.,Yefimov V.M. About getting of metal fluoride high purity.
 Visokochistiye veschestva [ Jornal of high-pure substances ] , 1987,no.6,pp.16-23 ( in Russ.).

2.Volinez F.K.,Chernevskaya E.G High-pure fluorides.Jurn.prikl.himii [ J.of applide chemistry ],1979,no.2, p.458 (in Russ ).

3.Patent RF no.2278073.Synthesis of inorganic fluorine compounds. Melnichenko E.I.Byull. no.3,2006.

4.Patent RF no.2038310. Method of receiving fluorid rare earth elements and ittrium.Ivanov A.V. i dr.Byull.no. 2, 1995.

5.Patent RF no.2107029.About obtaning unhydrous polycristalline fluoride cerium high purity.Shatalov V.V. i dr.Byull. no.1, 1998.

6.Angelov I.I.,Hainson S.I. To the question of obtaining a crystal of barium

 and calcium fluoride high purity.Trudi IREA [ Procedings of IREA],1959,no.23,pp.19-24(in Russ)

7.Angelov I.I., Nechayeva V.S. About obtaining lithium fluoride high purity.

Trudi IREA [ Procedings of IREA ] ,1959,no.23,pp.14-18 (in Russ) .

8.Ardashnikova i dr. Pyrohydrolysis kontrol of metals fluorides.

 V11 Vsesoyuzniy simp. po himii neorg.ftoridov.Tez.doklladov [V11 all-Union symp. on cemistry of unorganik fluorides ], 1984,p.287.

9.Sharov A.A.,Molev V.I. Lenses-apochromats for amateur and professional astronomy.Opticheskiy jurnal [J.of optical technology ],

2013,no. 4,pp.43-46.

10.Sokol V.A.Low-tonnage production of high purity metal metaphosphates for optical glass.Himicheskaya promishlennost segodnya [ J.of chemical industry today ],2010,no.9,pp.18-21

**Explore the use of coal by Kuznetsk basin for activated carbons**

**Farberov Elena** Abramovna

Perm research and development

Polytechnic University, associate Professor

the Department of chemistry and biotechnology.

Address: 614990, Perm region, Perm GSP,

Komsomolsky Prospekt, 29 D.

Tel. (342)2198150

e-mail: elenafarb@gmail.com

**Tingaev Elena** Aleksandrovna

Perm research and development

Polytechnic University, associate Professor

the Department of chemistry and biotechnology.

Address: 614990, Perm region, Perm GSP,

Komsomolsky Prospekt, 29 D.

Tel. (342)2198150

e-mail: teengaeva@mail.ru

**Potapov Igor** Sergeevich

Perm research and development

Polytechnic University, Junior research fellow

the Department of chemical technologies.

Address: 614990, Perm region, Perm GSP,

Komsomolsky Prospekt, 29 D.

**Limonov Nikolay** Viktorovich

JSC "Sorbent", Perm,

Deputy technical Director.

Address: 614113, Perm region,

Perm, street Halperin, 6.

e-mail: nvlimonov@sorbent.su

**Velikiy Evgeny** Mikhailovich

JSC "Sorbent", Perm,

production Director.

Address: 614113, Perm region,

Perm, street Halperin, 6.

e-mail: velikiy@sorbent.su

**Keywords:** the activated carbon, fossil coals, metamorphism of coals, fragrance level, ash-content, output of volatiles.

**Abstract.** Researches of physical and chemical properties of fossil coals (from brown to lean and anthracite) of different stages of a metamorphism are provided. In operation analysis results of element composition of fossil coals, their ash-contents, the maintenance of basic elements in a mineral component, a level of fragrance and an output of volatiles are given. With use of a scanning electron microscope the structure of their surface is studied. Optimum conditions and kinetic characteristics of process of thermal modifying of fossil coals are defined when receiving shredded activated carbons. The assessment of their qualitative characteristics and suitability for receiving shredded activated carbons with high getter and physical and chemical characteristics is carried out.

**References**

1. Muhin V.M., Tarasov A.V., Klushin V.N.

Activated carbons in Russia [ Aktivnyie ugli Rossii ]

 //M.: Metallurgiya, 2000. ( in Russ )

2. GOST 25543-88. Brown coals black coals

And antracites. Classificaton process and genetics

parameters.[ Klassifikatsiya po geneticheskim

i tehnologicheskim parametram.] M.: Izdatelstvo standartov, 2002.

3. Gagarin S.G., Lesnikova Ye.B., Shulyakovskaya

L.V. i dr. Estimation of degree of aromatizations

of brown coals.[ Otsenka stepeni aromatichnosti

 struktury burykh ugley], [ Chemistru of solid fuel.]

–1993.–№1. P.3–11. ( in Russ )

**Denitration of spent sulphuric acid production of high-energy substances and concentration of nitric acid with the help of sulfuric**

**Kim Pavel Pavlovich**

doctor of technical Sciences, Professor DPI NSTU n.a. R.E. Alexeev

e-mail: lab202@ dfngtu.nnov.ru

t. (8313) 32-27-61

**Komarov Wafa Abdulmalikovich**

candidate of technical Sciences, Professor DPI NSTU n.a. R.E. Alexeev

e-mail: lab202@ dfngtu.nnov.ru

**Pastukhova Galina Viktorovna**
candidate of technical Sciences, Professor DPI NSTU n.a. R.E. Alexeev

e-mail: lab202@ dfngtu.nnov.ru

**Peretrutov Anatoly Anatolyevich**

candidate of technical Sciences, Professor DPI NSTU n.a. R.E. Alexeev

e-mail: lab202@ dfngtu.nnov.ru

**Chubenko Maria Nikolaevna**

candidate of technical Sciences, Professor DPI NSTU n.a. R.E. Alexeev

e-mail: lab202@ dfngtu.nnov.ru

**Keywords:** denitration, spent sulphuric acid, thermodynamic analysis, cetan, isooctane.

**Abstract**. Thermodynamic analysis of the interaction of nitrogen oxides (III) and nitric acid with isooctane and cetane recovery of nitrogen compounds to nitrogen oxides (II) and (I) and elemental nitrogen, and carbon compounds to carbon oxide (II) and (IV) has been performed. The Gibbs energy of formation of these oxides and elemental nitrogen is negative and sufficiently large in absolute value. To validate the results of thermodynamic calculation was carried out experimental study on denitration of sulfuric acid containing 0,13 % of N2O3 and 0,061 % HNO3, unleaded gasoline A-72 in the amount of 0,18 to 0,27 g per 1 g of nitrogen oxide (III) and 0,18 - 0.27 g per 1 g of nitric acid in terms of isooctane, and diesel fuel with a cetane number of 45 in the amount of 0,18 to 0,27 g per 1 g of nitrogen oxide (III) and 0,37 – 0,56 g per 1 g of nitric acid in terms of cetane at a temperature of 130 to 170 °C, which showed the possibility of reduktion nitrogen compounds contents in acid after denitration to 1·10-4%. Analysis of the gas environment after denitration showed that products of denitration contains elemental nitrogen and nitrogen dioxide.

**References**

1. Kim P.P., Timin K.I., Kazantsev B.P., Peretrutov A.A. Denitration of waste sulfuric acid vapor mixture. Zhurnal Himicheskaya promyishlennost' [Journal of chemical industry], 1999, no. 5, pp. 307 – 308 (in Russ.).

2. Kim P.P., Peretrutov A.A., Katraev A.N. i dr. The method of purification of waste sulfuric acid. A.S. № 1834228 SSSR MKI C O1 B 17/90 [A.S. № 1834228 USSR MKI C 01 In 17/90] Appl. 11.12.89., Theregister. 13.10.92. (in Russ.).

3. Kim P.P., Katraev A.N., Pastuhova G.V. The chemistry of the process denitration of sulfuric acid reducers. Zhurnal Prikladnaja himija[Journal of applied chemistry], 1987, no. 4, pp. 927 – 929 (in Russ.).

4. Kim P.P., Pastuhova G.V., Peretrutov A.A. The study of the gas phase at denitration of sulfuric acid reducers. Zhurnal Himicheskaya promyishlennost' [Journal of chemical industry], 1998, no. 11, pp. 28 – 30 (in Russ.).

5. Ioshpa I.E., Peretrutov A.A., Kim P.P., Krivonogov V.P., Rybakova L.I. The equilibrium pressure of oxides over microsemi containing free nitric acid. Zhurnal Prikladnaja himija[Journal of applied chemistry], 1973, no. 5, pp. 967 – 972 (in Russ.).

6. Kim V.P., Petrovsky A.M., Morozov L.N., Shevchuk S.A. Denitration of waste sulfuric acid adducts dewaxing of petroleum fractions.  Izvestiya VUZov. Himiya i him. tekhnologiya. [Izvestiya VUZov. Chemistry and chem. technology], 2005, so 48, vol. 4, pp. 152 – 154 (in Russ.).

7. Kim P.P., Peretrutov A.A., Pastuhova G.V. Denitration of spent sulphuric acid waste processing raw spirit and some physico-chemical properties. Zhurnal Himicheskaya promyishlennost' [Journal of chemical industry], 1998, no. 12, pp. 34 – 36 (in Russ.).

8. Kim P.P., Peretrutov A.A., Kim V.P., Komarov V.A. Denitration of spent sulphuric acid. Zhurnal Himicheskaya promyishlennost' segodnja. [Journal of chemical industry today], 2013, no. 8, pp. 9 – 10 (in Russ.).

9. Kim P.P., Komarov V.A., Pastuhova G.V., Peretrutov A.A., Chubenko M.N. Denitration of waste sulfuric acid dicarboxylic acids. Zhurnal Himicheskaya promyishlennost' segodnja. [Journal of chemical industry today], 2014, no. 7, pp. 39 – 43 (in Russ.).

**Study of the filtration process of fermentation suspensions based on acid hydrolysates brewing spent grains**

**Vasilyev Aleksandr Vyacheslavovich**

D.Mendeleev University of Chemical Technology of Russia, department of biotechnology, research worker

Phone: 8(499)978-74-66

Fax: 8 499 978-74-92

e-mail: vasilye@yandex.ru

**Shakir Irina Vasilevna**

D.Mendeleev University of Chemical Technology of Russia, lecturer

125047, Moscow, Miusskaya sq., 9

Phone: 8(499)978-74-66

e-mail: krylov@muctr.edu.ru

**Panfilov Viktor Ivanovich**

D.Mendeleev University of Chemical Technology of Russia, Doctor of Science and innovation, Professor

125047, Moscow, Miusskaya sq., 9

Phone: 8 499 978-87-22

e-mail: vip@muctr.edu.ru

**Guseva Tatyana Valerianovna**

D.Mendeleev University of Chemical Technology of Russia, Scientific Secretary of the University

125047, Moscow, Miusskaya sq., 9

Phone: 8(499)978-86-44

e-mail: tguseva@muctr.ru

**Keywords:** deep heterophase cultivation, acid hydrolysis, filtration, filtrating materials, brewing spent grains, yeast, Endomycopsis fibuligera, Yarrowia lipolytica.

**Abstract.** The article describes the results of yeast *Yarrowia lipolytica and* yeast-like fungus *Endomycopsis fibuligera* cultivating and concentrating suspensions of microorganisms. Deep heterophase cultivation process using hydrolisates of brewing spent grains has been applied. To obtain microorganism biomass, a perspective energy efficient filtration process run in the presence of non-utilisable solid phase has been used. The optimum process conditions to ensure the best filterability have been identified. It has been found that *Endomycopsis fibuligera* suspensions are characterised by better filterability than *Yarrowia lipolytica* suspensions. Comparing modern filtrating materials, it has been demonstrated that PX 562-04 (manufactured by UK) has optimal characteristics for the studied process.

**References**

1. Kasatkin A.G. Osnovnye protsessy i apparaty khimicheskoy tekhnologii [Basic processes and devices of chemical technology], M.: Alliance, 2005, 750 pp (in Russ.).

2. Yelshin A.I. Sgushchenie suspenziy mikrobiologicheskikh proizvodstv i sposoby intensifikatsii protsessa [Thickening of microbiological production suspensions and methods of process intensification], M.: Agropromizdat, 1987, 225 pp (in Russ.).

3. Kamennyy V.I. Vydelenie, kontsentrirovanie i poluchenie tovarnykh form bioproduktov: uchebnoe posobie dlya studentov vysshikh uchebnykh zavedeniy, obuchayushchikhsya po spetsialnosti "Biotekhnologiya" [Extraction, concentration and obtaining commodity forms of bioproducts: a textbook for students in higher education, students majoring in "Biotechnology"], Arkhangelsk: Publishing house AGTU, 2009, 212 pp (in Russ.).

4. Tikhanov I.V., Voronin Ye.S., Gryazneva T.N., Dervinov D.A., Vasilev A.V., Chekmarev A.D., Maslov S.A. Osnovy biotekhnologicheskikh protsessov: uchebno-metodicheskoe posobie po biotekhnologii. Ch. III. Vydelenie, kontsentrirovanie i ochistka biopreparatov [Fundamentals of biotechnological processes: teaching manual on biotechnology. Part III. Extraction, concentration and purification of biological products], M.: K.I. Skryabin Moscow State Academy of Veterinary Medicine and Biotechnology, 2002, 136 pp (in Russ.).

5. Protsessy i apparaty mikrobiologicheskikh proizvodstv. Obzornaya informatsiya [Processes and devices of microbiological productions. Overview], M., vol. 3, 1987, 240 pp (in Russ.).

6. Grichenko A.A., Yelshin A.I., Putintsev S.A. On the possibility of applying the filtering process with thickening biosuspensions in the production of fodder yeast. Kontsentrirovanie, vydelenie i ochistka produktov mikrobiologicheskogo sinteza: tez. dokl. vsesoyuz. soveshch. [Concentration, separation and purification products of microbiological synthesis: Theses of reports of All-Union Meeting], 16 - 19 April 1985, pp. 8 – 10 (in Russ.).

7. Filtry dlya zhidkostey mikrobiologicheskoy promyshlennosti. Obzornaya informatsiya [Filters for microbiological industry liquids. Overview], M.: VNIIsenti, 1985, 55 pp (in Russ.).

8. Gradova N.B., Babusenko Ye.S., Gornova I.B., Gusarova N.A. Laboratornyy praktikum po obshchey mikrobiologii [Laboratory workshop on general microbiology], M.: DeLi print, 2001, 132 pp (in Russ.).

9. Shakir I.V., Krasnoshtanova A.A., Babusenko Ye.S., Parfenova Ye.V., Suyasov N.A., Smirnova V.D. Obshchaya biotekhnologiya. Laboratornyy praktikum. – uchebnoe posobie RKhTU [Total biotechnology. Laboratory workshop. - Tutorial of MUCTR], 2007, 120 pp (in Russ.).