

**INFLUENCE OF PRE-TREATMENT OF FLAX FIBERS ON CELLULOSE PROPERTIES (p. 4-8)**

Valerii Barbash, Julia Nagorna

The influence of the main process parameters (temperature, duration, irrigation modulus, catalyst content) alkaline and acid treatment of flax fibers on the quality parameters of the obtained pulp was investigated. The effect of various chemical agents on removing non-cellulose components of flax fibers, in particular minerals, was studied. It was found that during alkaline treatment of the flax fibers sodium hydroxide better removed lignin and minerals than potassium hydroxide and hydrous ammonia.

For the production of microcrystalline cellulose of flax fibers, it is recommended to carry out alkaline treatment at the concentration of sodium hydroxide in 20–25 % solution at the temperature of 160 °C for 180 minutes.

The preliminary stage of acid hydrolysis of flax fibers is recommended to be carried out with a sulfuric acid concentration of 1 % at 100 °C for 180 minutes.

**Keywords:** alkaline treatment, acid treatment, flax fiber, delignification, sulfate ash.

**References**

- Habibi, Y., Lucia, L. A., Rojas, O. J. (2010). Cellulose Nanocrystals: Chemistry, Self-Assembly, and Applications. *Chemical Reviews*, 110 (6), 3479–3500. doi:10.1021/cr900339w
- Kai, Y., Hamada, J., Morioka, M., Todaka, T., Hasegawa, S., Ushio, Y. (2000). The utility of the microcrystalline cellulose sphere as a particulate embolic agent: an experimental study. *American Journal of Neuroradiology*, 21 (6), 1160–1163.
- Kim, J., Yun, S., Ounaies, Z. (2006). Discovery of Cellulose as a Smart Material. *Macromolecules*, 39 (12), 4202–4206. doi:10.1021/ma060261e
- Sarymsakov, A. A., Baltaeva, M. N., Nabyev, D. S., Rashidova, S. S., Yugay, G. M. (2004). Dysperhyrovannaya microcrystalline cellulose and Hydrogel Bases. *Chemistry rastytelnogo raw materials*, 2, 11–16.
- State Statistics Committee of Ukraine. Available at : [http://uga-report.org.ua/sites/default/files/bl\\_posiv\\_2013.pdf](http://uga-report.org.ua/sites/default/files/bl_posiv_2013.pdf).
- Nepeny, U. N. (1990). *Tehnologiya cellulosi: in 3 volumes. V.2. Production sulfatnoy cellulosi*. Textbook for high schools. Lesnaya promishlennost, 600.
- Hu, F., Ragauskas, A. (2012). Pretreatment and Lignocellulosic Chemistry. *BioEnergy Research*, 5 (4), 1043–1066. doi:10.1007/s12155-012-9208-0
- Denisova, M. N., Mitrofanov, R., Budaeva, V. V., Arkhipova, D. C. (2010). Cellulose and lignin, which are obtained by the hydrotropic method from miscanthus. *Polzunovskii Journal*, 4, 198–206.
- Barbash, V. A. (2014). Microcrystalline cellulose from bast fibers plants. *Scientific news "KPI"*, 1, 117–122.
- Barbash, V. A., Danylenko, A. A., Nagorna, Y. M. (2013). Investigation of the effect of different stages of the process of obtaining microcrystalline cellulose fibers from hemp for its quality. *Scientific news "KPI"*, 2, 147–151.
- Rylskyy, A. U., Lebedev, V. A., Marchenko, A. N., Pynytsa, A. P. (2007). Linen cellulose – cotton alternative papermaking. *Cardboard and Corrugated cardboard*, 38–39.
- Artemyev, A. V., Ruzhytskyi, A. A. (2004). Organic substances of Bast Crops. *Journal Hosudarstvennoho himicheskogo society im. D. I. Mendeleev*, XXVIII (3), 55–62.
- Perepelkin, K. E. (1985). *Structure and properties of fibers*. Moscow: Chemistry, 280.
- Barbash, V. A., Trembus, I. V., Shevchenko, V. M. (2014). Ammonia-sulfite-ethanol pulp from wheat straw. *Cellulose chemistry and technology*, 48, 345–353.
- Yin, H. C., Soo, H. N., Cheu, P. L. (2013). Improved oxygen delignification selectivity of oil palm (*elaeis guineensis*) efb soda-aq pulp: effect of photo-pretreatment and aq-aided h<sub>2</sub>o<sub>2</sub> reinforcement. *Cellulose Chemistry and Technology*, 47, 277–283.

- Huhnyn, M. Y., Malkov, Y. A., Nepeny, Y. N. (1983). On the mechanism of action of anthraquinone in alkaline cooking. *Chemistry of wood*, 3, 43–46.
- Kryukov, V. M. (1980). Investigation of the possibility of intensifying the process of alkaline pulping of hardwood pulp. Moscow: Lesnaya industry, 150.

**OBTAINING SURFACTANTS BY TRANSESTERIFICATION OF GLYCERYL ESTERS OF LACTIC ACID WITH TRIACYLGLYCEROL (p. 9-13)**

Daria Nevmyvaka, Igor Demidov

Despite the widespread use of food surfactants, the existing technologies for their production are complex, multistep and energy intensive. Moreover, today in Ukraine there are no enterprises that could produce mono- and diacylglycerols independently, so the domestic food industry enterprises have to buy food surfactants abroad.

The possibility of obtaining food surfactants, namely lactic acid esters, mono- and diacylglycerols, during the two-step process: the esterification of lactic acid with glycerol, followed by the transesterification of the obtained esters with triacylglycerols, is considered in the paper. The kinetics of the reaction behavior of the glycerol esterification with lactic acid by acid and ester numbers is presented, as well as a comparative characteristic of the emulsifying ability of the obtained product with industrial monoacylglycerols is given. The described method allows obtaining a food emulsifier with high surface-active properties.

**Keywords:** emulsifiers, monoacylglycerol, lactic acid, fat, esterification, transesterification, emulsion stability.

**References**

- Nechaev, A. P., Kochetkova, A. I. (2002). *Pishchevye dobavki. Uchebnoe posobie*, 256.
- Friberg, S. E., Larssons, K. (1997). *Food emulsions: third edition, revised and expanded*, 55–56.
- Roller, S., Jones, S. (1996). *Handbook of Fat Replacers*. doi:10.1201/9781420048971
- Whitehurst, R. J. (Ed.). (2004). *Emulsifiers in Food Technology*. doi:10.1002/9780470995747
- Young, N., Wassell, P. (2008). *Margarines and Spreads Food Emulsifiers and Their Applications*. Springer New York, 307–326.
- Krog, N. (1992). The Role of Low-Polar Emulsifiers in Protein-Stabilized Food Emulsions. *Emulsions – A Fundamental and Practical Approach*, 61–74. doi:10.1007/978-94-011-2460-7\_5
- Jovanovic, O., & Pajin, B. (2004). Influence of lactic acid ester on chocolate quality. *Trends in Food Science & Technology*, 15 (3-4), 128–136. doi:10.1016/j.tifs.2003.09.011
- Melnik, A. P., Papchenko, V. Y. (2010). Doslidzhennia oderzhannia azoto-, kysenvmisnykh pokhidnykh zhyrnykh kyslot amiduvanniam soniashnykovoii olii dietanolaminom. *Visnyk natsionalnoho tekhnichnoho universytetu "Kharkivskiyi politekhnichnyi instytut"*, 4, 3–6.
- Kramarev, S. O., Melnik, A. P., Matveeva, T. V., Malik S. H. (2013). Doslidzhennia oderzhannia diatsilglitseryniv ripa3 kovoii olii. *Visnyk natsionalnoho tekhnichnoho universytetu "Kharkivskiyi politekhnichnyi instytut"*, 37, 19–21.
- Demidov, I. N., Zlatkina, H. I. (2009). Issledovanie uslovii reaktivno-etalizatsii dlia polucheniia pishchevykh poverkhnostno-aktivnykh veshchestv. *Visnyk natsionalnoho tekhnichnoho universytetu "Kharkivskiyi politekhnichnyi instytut"*, 15, 108–111.
- Murlykina, N. V. (2012). Udoskonalennia tekhnologii miashnykh sichenykh vyrobiv shliakhom vykorystannia emulhatoriv atsilglitserynoi pryrody. *Avtoref. dys. kand. tekhn. nauk*, 23.
- Noureddini, H., Medikonduru, V. (1997). Glycerolysis of fats and methyl esters. *Journal of the American Oil Chemists' Society*, 74 (4), 419–425. doi:10.1007/s11746-997-0100-6

13. McNeill, G. P., Shimizu, S., Yamane, T. (1991). High-yield enzymatic glycerolysis of fats and oils. *Journal of the American Oil Chemists Society*, 68 (1), 1–5. doi:10.1007/bf02660298

### STUDYING THE EFFECT OF INITIATOR DOSING ON THE PROCESS OF HYDROCARBON FRACTION SUSPENSION CO-OLIGOMERIZATION (p. 14-18)

Oksana Orobchuk, Roman Subtelnyy, Bogdan Dzinyak

Improving the technology for producing co-oligomers (synthetic low molecular petroleum resins), which are obtained from cheap petrochemical raw materials - hydrocarbon fractions of liquid pyrolysis products (LPP) or cracking of oil, refining products or gas was discussed in the paper.

It was proposed to conduct a co-oligomerization of unsaturated hydrocarbons of C<sub>9</sub> fraction in two stages. At the first stage the co-oligomerization was implemented using the suspension method with a dosed supply of a benzoyl peroxide initiator. For maximizing the conversion of raw materials, at the second stage of the studies, the co-oligomerization was carried out in the solution of C<sub>9</sub> fraction unreacted residues of the suspension process, enriched with dicyclopentadiene, followed by obtaining co-oligomers with higher colour indices. The optimal technological parameters of the fraction co-oligomerization process were selected. The main regularities of the process and the physico-chemical characteristics of the obtained co-oligomers were defined.

The proposed technology allows obtaining co-oligomers of different brands with the highest possible product yield (within 39.0...41.0 % masses in terms of the fraction).

**Keywords:** suspension, co-oligomerization, C<sub>9</sub> fraction, initiator, co-oligomer, dosing.

#### References

- Kurta, S. A., Volinsky, A. A., Kurta, M. S. (2013). Environmentally-friendly organochlorine waste processing and recycling. *Journal of Cleaner Production*, 54, 150–156. doi:10.1016/j.jclepro.2013.05.010
- Akhmetov, S. A. (2002). *Technology of deep processing of oil and gas*. Ufa, Russia: Gylem, 672.
- Bratychak, M. (2013). By-products of oil fractions pyrolysis as a raw material for the production of reactive resins. *World Congress on Petrochemistry and Chemical Engineering*. TX, USA, 199.
- Ibragimov, K. D., Ismailov, E. G., Martynova, G. S., Bektashi, N. R., Ibragimova, Z. M., Rustamov, M. I. (2010). Synthesis of a component of the jet engine fuel and an accelerator of oil tar oxidation by catalytic processing of heavy pyrolysis tar. *Russ J Appl Chem*, 83 (7), 1265–1269. doi:10.1134/s1070427210070189
- Odian, G. (2004). *Principles of Polymerization*. New-York, 839.
- Subtelnyy, R. O. (2005). Receipt koolihomers from a mixture of unsaturated hydrocarbons using amino peroxides. *Lviv*, 20.
- Mitina, N., Zaichenko, O., Bratychak, M., Politikova, L. (2006). Water-dispersed film-based copolymers of unsaturated fraction C<sub>9</sub> thermolysis of oil. *Synthesis and Properties*. *Chemical Industry of Ukraine*, 3, 14–17.
- Ganyuhina, T., Orekhov, O., Kronman, A. (27.12.2007). Patent 2313540 RU. A method of producing petroleum resins. «Sibur-Petrochem», Ltd. (RU). Filing date: 24.05.2006.
- Platzer, B., Klodt, R.-D., Hamann, B., Henkel, K.-D. (2005). The influence of local flow conditions on the particle size distribution in an agitated vessel in the case of suspension polymerisation of styrene. *Chemical Engineering and Processing: Process Intensification*, 44 (11), 1228–1236. doi:10.1016/j.cep.2005.03.010
- Kurtash, Yu. (2010). Obtaining petroleum resins using Oligoperoxides.: Author. *Lviv*, 20.

### STUDYING THE ADHESIVE INTERACTION BETWEEN POLYMER COMPOSITES AND TEXTILE MATERIAL SURFACE (p. 18-22)

Mariia Pasichnyk

The experimental studies on the adhesive interaction of polymer composites are presented in the paper. The objects of the studies are four polymer composites on the basis of acrylic and urethane polymers, crosslinked by the triglycidyl ether of polyoxypropylene

trial were formed on the surface of the textile materials of different raw materials composition. When determining the strength of the adhesive bond, the contribution of the physical or chemical factors was considered, since in the adhesive interaction physical and chemical bonds were implemented between the adhesive and the substrate. Based on the mechanical theory of adhesion, the adhesive strength of polymer composites bonding was studied. Polymer coatings, which are formed on the textile material surface, must have high strength properties. Using the method of pulling small strips, it was found that a polymer coating made of a polymer composite number 4 formed on the surface of the cotton textile material (Mitkal art. 125) was characterized by the highest adhesion value. To confirm the formation of the chemical bonds between the adhesive and the substrate, the spectra of reflecting the films of polymer composites on the cotton textile surface were analyzed. It was found that high strength of fixing the film from the polymer composite number 4 on the textile material surface was due to the formation of the chemical bonds between the glycidyl groups of the triglycidyl ether of polyoxypropylene triol and the hydroxyl groups of the fiber cellulose.

**Keywords:** adhesive interaction; polymer composites; textile materials with polymer coating.

#### References

- Luo, S., Van Ooij, W. J. (2002). Surface modification of textile fibers for improvement of adhesion to polymeric matrices: a review. *Journal of Adhesion Science and Technology*, 16 (13), 1715–1735. doi:10.1163/156856102320396102
- Heisey, C. L., Wightman, J. P., Pittman, E. H., Kuhn, H. H. (1993). Surface and Adhesion Properties of Polypyrrole-Coated Textiles. *Textile Research Journal*, 63 (5), 247–256. doi:10.1177/004051759306300501
- Roberts, A. D. (1992). Acid-base interactions in the adhesion of rubber surfaces. *Langmuir*, 8 (5), 1479–1486. doi:10.1021/la00041a039
- Kravchenko, I., Zubrilina, E. M., Pankratov, E. V. (2012). Influence of geometrical parameters of the sample coated on the value of the bond strength in shear. *Scientific and technical and industrial magazine: All the materials*. *Encyclopedic Reference*, 2, 21–23.
- Pizzi, A., Mittal, K. L. (2003). *Handbook of Adhesive Technology*. Marcel Dekker, Inc. USA, 65–78.
- Bogdanova, J. G. (2010). Adhesion and its role in ensuring the strength of polymer composites. *Moscow, Moscow State University aft. Lomanosova M. V.*, 68.
- Pasichnyk, M. V. (2013). Coated textiles: the development of composite structures and application technology. *Kherson, Ailanthus*, 240–241.
- Packham, D. E. (2005). *Hanbook of adhesion - 2nd ed.* UK. John Wiley & Sons Ltd, 677.
- Pasichnyk, M., Kulish, I., Saribekov, G. (2010). Composition development for fabric with polymer coating. *Eastern-European Journal of Enterprise Technologies*, 5(6(47)), 8–12.
- Pasichnyk, M., Slepchuk, I., Michielsen, S. (2012). Network characterization and swelling behavior of polymer composition for surface modification of textile materials. *Science, Technology and Higher Education*, 2, 479–485.
- Pocius, A. V., Dillard, D. A. (2002). *The Mechanics of adhesion*. Amsterdam, Elsevier, 303–350.
- Textiles. *Fabrics and piece goods. Methods for determination of tensile rupture characteristics* (1992). GOST 3812-72. *Izd. Standards*, 20.
- Tolstoy, V. P., Chernyshova, I. V., Skryshevsky, V. A. (2003). *Handbook of Infrared Spectroscopy of Ultrathin Films*. Wiley, 739.

### METHOD OF ORGANIC CARCINOGENIC SUBSTANCES CONTROL IN DIFFERENT PHYSICAL NATURE OBJECTS (p. 23-30)

Olga Sushko, Mykola Rozhitskii

Chemical carcinogenesis caused by intake of exogenous carcinogenic organic compounds is the most widespread reason for initiation and progress of cancer. So the analytical methods for such compounds detection should have low detection limits and high selectivity. Known analytical methods for the carcinogenic sub-

stances detection have a number of disadvantages and limitations. Therefore, we have proposed a new optical nanophotonic method for carcinogenic substances detection such as polynuclear aromatic hydrocarbons (PAH) in objects of different physical nature liquids in the first place. This method is based on main physical peculiarities of a new optical science called nanophotonics which, in short, describes size dependent optical transitions in quantum confined space. The article considers main principals of using nanophotonics for the purpose of chemical organic carcinogens detection with the help of so called nanophotonic analytical instruments – sensors. The latter main detection element constitutes nanophotonic material such as semiconductor quantum dots. The specific interactions of the organic carcinogens with the detection elements bringing to the emission of optical analytical signal represent the essence of nanophotonic analytical method revealing its advantages over known approaches. Proposed method and its instrumental realization for certain PAH detection was experimentally tested. As the detection elements semiconductor CdSe/ZnS/TOPO quantum dots were used. On the basis of the obtained results nanophotonic method of analytical control of exogenous carcinogenic substance was developed and its main characteristics were defined showing good perspective for its utilization in ecology, biomedicine and other fields.

**Keywords:** analytical control, chemical carcinogenesis, exogenous carcinogen, quantum dots, nanophotonics, polynuclear aromatic hydrocarbons

#### References

- Oliveira, P. A., Colaço, A., Chaves, R. et al. (2007). Chemical carcinogenesis. *Anais da Academia Brasileira de Ciências*, 79 (4), 593–616. doi: 10.1590/S0001-37652007000400004
- Tannheimer, S. L., Barton, S. L., Ethier, P. (1997). Carcinogenic polycyclic aromatic hydrocarbons increase intracellular  $Ca^{2+}$  and cell proliferation in primary human mammary epithelial cells. *Carcinogenesis*, 18 (6), 1177–1182. doi: 10.1093/carcin/18.6.1177
- Stewart, B. W., Wild, C. P. (2014). *World Cancer Report 2014 – Lyon: WHO, IARC*, 630.
- Masolova, N. V., Rozhitskii, N. N. (2003). Electronic processes in film structure of optochemotronic sensor electrodes. *Functional Materials*, 10 (4), 711–714.
- Kukoba, E. A. (2012). Polyaromatic determination in water with use Langmuir-Blodgett electrochemiluminescent technology. *Eastern-European Journal of Enterprise Technologies*, 1/5 (55), 40–46.
- Khrustalev, K. L., Snizhko, D. V., Rozhitskii, M. M. (2001). Optochemotronic sensors – new elements of biomedical diagnostic systems. System histamine-anthracene. *Problems of bionics: Ukrainian interagency scientific and engineering compilation*, 54, 60–67.
- Zholudov, Yu. T., Bilash, O. M., Rozhitskii, M. M. (2012). Electrochemiluminescent properties of organic films with embedded carbon nanotubes. *J. of nano- and electronic physics*. 4 (1), 02030(4pp).
- Zholudov, Yu. T. (2011). Modeling of transient processes in electrochemiluminescent sensor with a modified electrode. *Information processing systems*, 8 (98), 75–78.
- Jorge, P., Martins, M. A., Trindade, T. (2007). Optical Fiber Sensing Using Quantum Dots. *Sensors*, 7 (12), 3489–3534. doi: 10.3390/s7123489
- Nizomov, N., Holov, A. U., Ishchenko, A. A. (2007). Electronic structure and spectral-fluorescent properties of umbelliferone and herniarin. *J. of Appl. Spectroscopy*. Minsk, 74 (5), 573–580.
- Feynman, R. P. (1960) There's Plenty of Room at the Bottom. *Caltech Engineering and Science*. 23, 22. doi: 10.1109/84.128057
- Sushko, O. A., Mukanovska, I. V. (2014). Quantum-mechanical approach to the determination of the nanophotonic sensor parameters when 3,4-benzopyrene detection. *Radiotechnics*, 176, 191–199.
- Sushko, O. A., Bilash, O. M., Rozhitskii, M. M. (2012). New nanophotonic detection method of carcinogenic polycyclic aromatic hydrocarbons by the example of benzo[a]pyrene. *Luminescence*. 27 (1), 101.
- Karpov, S. V., Mikushev, S. V. (2010). Electron-hole excitations in CdSe quantum dots under conditions of strong and intermediate confinement. *Solid State Physics*. 52 (8), 1627–1633.
- Shtykov, S. N., Rusanov, T. Yu. (2008). Nanomaterials and nanotechnologies in chemical and biochemical sensors: capabilities and applications. *J. of Rus. chem. society of Mendeleev*, LII (2), 92–100.
- Sushko, O. A., Rozhitskii, M. M. (2014). Investigation of a Nanophotonic Sensor with Electrode Modified by Semiconductor Quantum Dots. *J. of nano- and electronic physics*, 6 (1), 01009(7pp).
- Sushko, O. A. (2014). Analytical system for 3,4-benzopyrene detection based on nanophotonic sensor. *Eastern-European Journal of Enterprise Technologies*, 2 (5), 8–15.
- Peng, X., Yu, W., Qu, L. (2003). Experimental Determination of the Extinction Coefficient of CdTe, CdSe, and CdS Nanocrystals. *Chem. Mater.* 15, 2854–2860. doi: 10.1021/cm033007z
- Amelia, M., Avellini, T., Monaco, S. (2011). Redox properties of CdSe and CdSe/ZnS quantum dots in solution. *Pure Appl. Chem.* 83 (1), 1–8. doi: 10.1351/PAC-CON-10-08-10
- Kim, S. M., Kyhm, K., Yang, H.-S. (2006). Optical Properties and Surface Conditions of CdSe Quantum Dots. *J. of the Korean Phys. Society*. 49, 688–S691.
- Sushko, O. A., Rozhitskii, M. M. (2012). Nanophotonic method for organic carcinogens in water media. *Eastern-European Journal of Enterprise Technologies*, 1/5 (55), 40–46.
- Sushko, O. A., Rozhitskii, M. M. (2013). Optical sensor based on semiconductor quantum-sized structures for condensed aromatics detection in water environment objects. *Information Processing Systems*, 2 (109), 259–264.

#### SOME REGULARITIES OF CALCIUM OXIDE HYDRATION ACTIVITY (p. 30-35)

Yaroslav Yakymchko

Physicochemical factors that affect chemical and hydration activity of alkaline earth metal oxides are considered in the paper. It is shown that an important factor of monoxide binders, particularly based on calcium oxide is its rate of interaction with water. Unlike the hydration mechanism of clinker minerals, CaO hydration process flows very fast with the change in the crystal lattice structure and emission of the large amount of energy, which causes an increase in the volume of system and self-dispersion of hydration products. The main process that leads to high heat emission is the protonation of  $O^{2-}$  ions by water molecules and the appearance of  $OH^-$  ions. The studies of hydration parameters of CaO, SrO and BaO oxides have revealed that high activity is caused by crystal-chemical features of their structure, in particular the coordination instability of cations. Due to electron-microscopic studies using the thin-film technique, it is found that CaO hydration kinetics is affected by the rate of water diffusion in the inner layers of grains and their subsequent destruction, and hydration rate deceleration is achieved by limiting the expansion of hardening system, removal of hydration heat and use of substances. CaO hydration kinetics in solutions, containing additives  $H_3BO_3$ ,  $Na_2CO_3$  and  $CaSO_4 \times 2H_2O$  is investigated. It is shown that, under these conditions, the reaction between CaO and water takes place in the diffusion region. These data allow to regulate hydration activity of CaO and obtain special binding compositions on its basis. The practical value of the work is confirmed by the results of industrial tests and mastering the production of efficient building materials.

**Keywords:** lime, hydration activity, lime stone, hydration, crystallization, self-dispersion, expansion, shrinkage, heat emission.

#### References

- Shpynova, L., Belov, N., Sanitsky, M., Chyh, V. (1977). The mechanism of hydration of alite. *DAN USSR*, 236 (1), 168–171.
- Belov, N., Belova, E. (1976). Chemistry and crystallochemistry of cement minerals. In book: *International congress of chemistry of cement*, I, 19–24.
- Polak, A., Andreeva, E. (1984). About the mechanism of hydration of binder. *Magazine of the applied chemistry*, 57 (9), 1991–1996.
- Vyrodov, I. (1983). Physical and chemical bases of processes of forming of durability of cement stone and concrete. *Dep. VNIIESM*, 1071, 294.

5. Kapranov, V. (1976). Interaction of liquid and hard phases in the process of hydration of cement. In book: Sixth international congress on chemistry of cement, 2, 19–24.
6. Sychov, M. (1978). Chemistry of hardening and forming of strength properties of cement stone. Cement, 2, 6.
7. Ramkumar, S., Fan, L.-S. (2010). Thermodynamic and Experimental Analyses of the Three-Stage Calcium Looping Process. Ind. Eng. Chem. Res., 49 (16), 7563–7573. doi:10.1021/ie100846u
8. Luginina, I., Cherkasov, A., Cherkasov, R. (2013). The Oxide Composition with a Controlled Expansion of Cement. World Applied Sciences Journal, 25 (12), 1735–1739.
9. Manzano, H., Pellenq, R. J. M., Ulm, F.-J., Buehler, M. J., van Duin, A. C. T. (2012). Hydration of Calcium Oxide Surface Predicted by Reactive Force Field Molecular Dynamics. Langmuir, 28 (9), 4187–4197. doi:10.1021/la204338m
10. Speziale, S., Reichmann, H. J., Schilling, F. R., Wenk, H. R., Monteiro, P. J. M. (2008). Determination of the elastic constants of portlandite by Brillouin spectroscopy. Cement and Concrete Research, 38 (10), 1148–1153. doi:10.1016/j.cemconres.2008.05.006
11. Stark, J., Moser, B., Eckart, A. (2001). New approaches cement hydration, Part 2. ZKG, 2, 114–119.
12. Sheeba, K. Inamdar, N., Akash, D. (2011). Calcium Hydroxide – A Great Calcific Wall. Journal of Orfacial Research, 1 (1), 128–133.
13. Potgieter, J., Potgieter, S., Moja, S., Mulaba-Bafubandi, A. (2002). An empirical study of factors influencing lime slaking. Part I: production and storage conditions. Minerals Engineering, 15 (3), 201–203. doi:10.1016/s0892-6875(02)00008-0
5. Cahn, J. W., Balluffi, R. W. (1979). Diffusion induced grain boundary migration. Scr. Met., 13, 503–509.
6. Balluffi, R. W., Cahn, J. W. (1981). Mechanism for diffusion induced grain boundary migration, 29, 493–500. doi:10.2172/5013063
7. Vitek, V., Minonishi, Y., Wang, G.-J. (1985). Multiplicity of grain boundary structures: vacancies in boundaries and transformations of the boundary structure. J. Phys. Colloques, 46 (C4), 171–183. doi:10.1051/jphyscol:1985420
8. Musasi, F., Kuntomi, M. (1962). Synthesis of fibred alkaline titanates through the hydrothermal reactions. Kogyo Kagaku, 65 (11), 1775–1779.
9. Kuznetsov, V. A., Panteleyev, V. V. (1965). Hydrothermal synthesis of rutile. Crystallography, 10 (3), 663–667.
10. Ikornikova, N. Yu. (1962). Role of chlorides at the hydrothermal transfer at formation of ore. Geology of ore deposits, 5, 610–612.
11. Shaporev, V. P. (1992). Physical and chemical properties of threadlike crystals  $K_2Ti_6O_{13}$ , synthesized by different methods, AS USSR, 28 (8), 1045–1052.
12. Shaporev, V. P. (1992). Use of basic reinforcing agents for plastics and ceramics. Ecology of chemical technology and biotechnology, 1, 27–32.
13. Ryzhov, B. N. (1981). Thermodynamics of equilibrium in hydrothermal solutions. Moscow, USSR, Chemistry, 356.
14. Malinin, S. D. (1984). Hydrothermal process by the eyes of a physicist-chemist. Nature, 10, 21–25.
15. Kalashnikov, L. A. (1987). Physical chemistry of matters at high pressures. Moscow, USSR, High school, 238.
16. Fialkov, Yu. Ya. (1990). Solvent as the mean of chemical process control. Leningrad, USSR, Chemistry, 232.
17. Nikolayev, L. A. (1984). Theoretical chemistry. Moscow, USSR, High school, 400.
18. Shtenberg, A. A. (1962). About the processes of crystallization in autoclaves. Crystallography, 7, 114.
19. Landau, L. D., Lifshits, Ye. M. (1979). Theoretical physics. Moscow, USSR, Science, Part. 2, 700.
20. Lobachev, A. N. (1968). Hydrothermal synthesis of crystals. Moscow, USSR, Science, 216.
21. Tonkov, Ye. Yu. (1983). Phases diagrams of connections at high pressure. Moscow, USSR, Science, 250.
22. Zhulin, V. M. (1984). Influence of high pressure on the reactions in a liquid phase. Moscow, USSR, Chemistry, 200.
23. Semenchko, V. K. (1952). About the structure of phases in a critical region. Journal of physical chemistry, 26 (4), 1337.
24. Ammer, S. A., Postnikov, V. S. (1974). Threadlike crystals. Voronezh, USSR, Voronezh polytechnic institute, 284.
25. Brenner, S. (1968). Theory and practice of growing of crystals. Moscow, USSR: Metallurgy, 294.
26. Shaporev, V. P. (1995). Technology of inorganic reinforcing fillings: dis. PhD, (Engineering) 05.17.08. Kharkiv, Kharkiv polytechnic institute, Ukraine, 365.
27. Shaporev, V. P., Sebko, V. V. (2012). About possibilities of application of methods of nano-chemistries for the analysis and intensification of chemical technological processes. Visnyk NTU «KhPI», 61 (967), 164–176.
28. Shaporev, V. P., Khitrova, I. V. (1992). Cooperation in the system  $Y_2O_3 - BaO_2 - CuO$  in the process of firmly-phases reaction. VIII All-union conference on the physical and chemical analysis (17-19 sept. 1991): theses, Saratov, Russia, Part. 1, 58.
29. Ovechkin, Ye. K. (1970). Hydrothermal synthesis of fibred gek-satitanates of potassium. Labours of 1<sup>st</sup> science conf. «Thread-like crystals and unferromagnetic tapes». Voronezh, Russia, Voronezh polytechnic institute, 91 – 97.

## SYNTHESIS OF ALKALI METAL TITANATES THROUGH HYDROTHERMAL REACTIONS (p. 35-43)

Valery Shaporev, Inna Pitak, Oleksii Shestopalov

Applying the hydrothermal reactions for synthesizing whiskers of alkali metal titanates is considered in the paper. Some results of our research in this field are presented. The main purpose of this research is to study the mechanisms of the hydrothermal synthesis process and to obtain kinetic models of whisker growth. The idea of the mechanisms of crystal synthesis is considered and the influence of pressure, temperature, degree of the autoclave filling and other process parameters is estimated. As a result of experimental studies, the possibility of synthesizing potassium titanate whiskers under hydrothermal conditions in obtaining high-quality fibrous crystal structure, corresponding to potassium hexatitanite, the maximum yield of which can be achieved by the degree of filling the reactor by 60 % and a pressure of 50 MPa. Based on the studies of the process mechanisms the kinetic models are constructed. They can be used for analyzing the process and selecting the rational parameters of synthesizing potassium hexatitanite crystals. The results of theoretical and experimental studies allow estimating the measurements of the various process properties on the hydrothermal treatment and identifying the factors of controlling either the processes of batch mixture dissolution in the autoclave or the crystal growth processes, which can be applied in the development and design of reactors for performing hydrothermal reactions in obtaining whiskers.

**Keywords:** hydrothermal reaction, autoclave, whiskers, potassium hexatitanite, kinetic models.

### References

1. Ostroushko, V. I., Zaytsev, I. D., Tkach, G. A., Shaporev, V. P., Makogon, A. T., Lev, M. B., Teyshv, Ye. A., Lyutsareva, L. A. (1983). Method of receipt of fibred titanium of potassium. Patent USSR, №. 3593657/23-26.
2. Cooksey, D. J. S., Munson, D., Wilkinson, M. P., Hellawell, A. (1964). The freezing of some continuous binary eutectic mixtures. Philosophical Magazine, 10 (107), 745–769. doi:10.1080/14786436408225381
3. Toshev, S., Gutzow, I. (1972). Nichtstation re Keimbildung: Theorie und Experiment. Krist. Techn., 7 (1-3), 43–73. doi:10.1002/crat.19720070108
4. Reeve, K. D., Perera, D. S., Buykx, W. S., Vance, E. R. (1990). New materials development at ANSTO. Mater. Austral, 22 (8), 16–17.

## SOLID-PHASE SPECTROPHOTOMETRIC DETERMINATION OF Hg (II) USING XYLENOL ORANGE (p. 44-48)

Elizaveta Kostenko, Elena Butenko

The following optimal interaction conditions of mercury with xylene orange in the phase of the polymeric anion exchanger AB-17 8-C1 were determined: maximum extraction (87 %) of Hg (II) is achieved at pH 5–7 for 20 minutes of phase contact from the volume of 50 cm<sup>3</sup>. Quantitative sorption is also possible from 500 cm<sup>3</sup> of the solution. Herewith, the concentration coefficient is 1667 cm<sup>3</sup>/g. The detection limit is 0.2 mcg/cm<sup>3</sup>. Mercury is not virtually adsorbed

by the basis (AB-17/8). The Baer's law is fulfilled in the mercury concentration range  $(0,1-8,0) \times 10^{-5}$  M ( $V = 50\text{cm}^3$ ).  $\lambda_{\text{opt}}=640$  nm.

Complexing of Hg (II) with SP XO is affected by: 1:1 – Cu (II), Zn (II), Cd (II), Zr (IV), Fe (III); 1:50 – Pb (II), Sn (IV); 1:100 – Co (II), a. e. m., Br<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, F<sup>-</sup>, Al (III); 1:1000 – NO<sub>3</sub><sup>-</sup>.

Chemistry of complexing in the studied system was considered. Ratio of components in the complex – Hg:CO-A=1:1 was determined. Conditional stability constant of the complex  $\lg b_1=16,9 \pm 0,5$  was calculated.

The data obtained were used to develop a new technique for the SPS determination of mercury (II) in chemicals, which is highly competitive with the best standard techniques by sensitivity, selectivity and promptness, and superior to them by the simplicity of the experiment.

The technique was tested on a model mixture. Data validation was carried out using the "made-found" method. Convergence of results, obtained using the new technique and standard (AAS method), verifies them.

**Keywords:** spectrophotometry, analysis, mercury, concentration, sorption, dyes, immobilization, anion exchanger.

### References

- Zajcev, V. N. (1997). Kompleksoobrazujushhie kremnezemy: sine tez, stroenie privitogo sloja i himija poverhnosti. Harkiv: Folio, 240.
- Gladyshev, V. P., Levickaja, S. A., Filippova, L. M. (1974). Analiticheskaja himija rtuti. Moscow: Nauka, 224.
- Alekseev, V. G. (2010). Ionnye ravnovesija v rastvorah penicilinov, cefalosporinov i ih metallokompleksov. Tverskoj gos. un-t. Tver, 48.
- Vladimirova, E. V. (2011). Primenenie vol'tamperometrii na granice razdela dvuh nesmeshivajushhhsja rastvorov jelektrolitov dlja opredelenija antibiotikov makrolidnogo i aminoglikozidnogo rjadov. Moscow university, 28.
- Gusev, S. N., Gusev, R. S., Gramma, A. I.; zajaviteli i patentoobladateli Gusev, S. N., Gusev, R. S., Gramma, A. I. (2012). Helatnye komplekxy rtuti s cisteinom i metioninom, sposob ihpoluchenija i lekarstvennyj preparat «Merkurid» - moduljator apoptoza, obladajushhij protivoopuholevyj, protivovirusnyj, protivoparazitarnyj i immunomodulirujushhim dejstviem. Patent 2456001 Russia: MPK Ros. Federacija: A61K 33/28, A61K 31/198, C01G 13/00, A61P 35/00, A61P 31/12, A61P 37/02, A61P 33/00 (2006.01). № 2010107176/15; zajavl. 26.02.10; opubl. 20.07.12, Bjul. № 25, 3.
- Mondal, B. C., K. Das, A. (2003). Determination of mercury species with a resin functionalized with a 1,2-bis(o-aminophenylthio)ethane moiety. *Analytica Chimica Acta*, 477 (1), 73–80. doi:10.1016/S0003-2670(02)01372-7
- Dedkova, V. P., Shvoeva, O. P., Savvin, S. B. (2004). Test-metod opredelenija rtuti (II) ditizonom na tverdoj faze voloknistogo anionoobmennika. *Zhurn. analit. himii*, 59 (4), 429–433.
- Kotodyńska, D. (2009). Polyacrylate anion exchangers in sorption of heavy metal ions with the biodegradable complexing agent. *Chemical Engineering Journal*, 150 (2-3), 280–288. doi:10.1016/j.cej.2008.12.027
- Kostenko, E. E., Shtokalo, M. J. (2006). Doslidzhennja vzaemodii Cu(II), Pb(II), Zn(II), Hg(II), Cd(II) z tverdogafaznim eriohromom chornim T. *Eastern-European Journal of Enterprise Technologies*, 6 (24), 45–48.
- Kostenko, E. E., Butenko, O. M. (2014). Tverdogafazne spektrofotometrichne viznachennja Hg (II) za dopomogoj hromazurola S. *Eastern-European Journal of Enterprise Technologies*, 3/5 (69), 20–24.
- Vengris, T., Binkien, R., Sveikauskait, A. (2001). Nickel, copper and zinc removal from waste water by a modified clay sorbent. *Applied Clay Science*, 18 (3–4), 183–190. doi:10.1016/S0169-1317(00)00036-3
- Pradas, E. G., Sánchez, M. V., Cruz, F. C., Vician, M. S., Pérez, M. F. (1994). Adsorption of cadmium and zinc from aqueous solution on natural and activated bentonite. *J. Chem. Technol. Biotechnol.*, 59 (3), 289–295. doi:10.1002/jctb.280590312
- Viraraghavan, T., Kapoor, A. (1994). Adsorption of mercury from wastewater by bentonite. *Applied Clay Science*, 9(1), 31–49. doi:10.1016/0169-1317(94)90013-2
- Tonle, I. K., Ngameni, E., Walcarius, A. (2005). Preconcentration and voltammetric analysis of mercury(II) at a carbon paste electrode modified with natural smectite-type clays grafted with organic chelating groups. *Sensors and Actuators B: Chemical*, 110 (2), 195–203. doi:10.1016/j.snb.2005.01.027
- Goswami, A., Singh, A. K. (2002). Silica gel functionalized with resacetophenone: synthesis of a new chelating matrix and its application as metal ion collector for their flame atomic absorption spectrometric determination. *Analytica Chimica Acta*, 454 (2), 229–240. doi:10.1016/S0003-2670(01)01552-5
- Etienne, M. (2003). Analytical investigation of the chemical reactivity and stability of aminopropyl-grafted silica in aqueous medium. *Talanta*, 59 (6), 1173–1188. doi:10.1016/S0039-9140(03)00024-9
- Pérez-Quintanilla, D., del Hierro, I., Fajardo, M., Sierra, I. (2006). Preparation of 2-mercaptobenzothiazole-derivatized mesoporous silica and removal of Hg(II) from aqueous solution. *Journal of Environmental Monitoring*, 8 (1), 214. doi:10.1039/B507983g
- Arendarjuk, E. N., Trofimchuk, A. K., Janovskaja, Je. S., Batkovskaja, L. A. (2001). Sorbcionno-spektroskopicheskoe opredelenie rtuti na  $\gamma$ -aminopropilsilikagele. *Ukr. him. zhurn*, 67 (9), 33–36.
- Simonova, L. N., Bruskina I. M., Trofimchuk A. K., Trjashin, A. S. (1989). Sorbcionno-fotometricheskoe opredelenie razlichnyh form rtuti s pomoshh'ju silikagelja s privitoj N-benzoil-N'-propiltiomochevinoj. *Zhurn. analit. himii*, 44, 661–665.
- Ajvazov, B. V. (1968). Prakticheskoe rukovodstvo po hromatografii. Moscow: Vyssh. shk., 81–88.
- Kostenko, E. E., Shtokalo, M. I. (2004). Tverdogafaznaja spektrofotometrija – jeffektivnyj metod opredelenija tzhzhelyh metallov v pishhevyyh ob'ektah. *Zhurn. analit. himii*, 59 (12), 1276–1282.
- Kostenko, E. E. (2011). Himiko-analitichni vlastivosti sul'foftaleinovih barvnikiv, immobilizovanih na anioniti AV-17-8 ta ih vikoristannja v analizi harchovih ob'ektiv. *Metodi ta ob'ekti him. analizu*, 6 (1-2), 56–70.
- Kostenko, E. E. (2002). Patent № 49538 A. Ukraina. MPK 7 S01G13/00. Sposib viznachennja mikrokil'kostej merkuriyu (II). Zajavnik i vlasnik patentu Nacional'nij universitet hari chovih tehnologij. № 2001128967; zajavleno 25.12.01; Nadruk. 16.09.2002, Bjul. № 9, 4.
- Nikolaeva, T. M., Lazarev, A. I. (1992). Opredelenie zheleza metodom tverdogafaznoj spektrofotometrii. *Zavodskaja laboratorija*, 58 (10), 10–13.
- Brykina, G. D., Marchenko, D. Ju., Shpigun, O. A. (1995). Tverdogafaznaja spektrofotometrija. *Zhurn. analit. himii*, 50 (5), 484–491.
- Brykina, G. D., Krysin, L. S., Ivanov, V. M. (1988). Tverdogafaznaja spektrofotometrija. *Zhurn. analit. himii*, 43 (9), 1547–1560.

## ELECTROCHEMICAL DESALINATION OF SOLUTIONS, CONTAINING HARDNESS IONS (p. 48-53)

Iryna Makarenko

Processes of the electrochemical desalination of solutions with high content of hardness ions in three-chamber electrolyzer with two anionic membranes MA-41 were studied. On the example of model solutions of magnesium sulfate, it was shown that, in this electrolyzer there is desalination of the solution, placed in the working chamber between the anionic membranes due to diffusion of sulfate anions to the anodic region and hydrolysis of magnesium ions in the working area due to diffusion of hydroxide anions from the cathode chamber to the working.

The peculiarity of the electrolyzer is using anionic membrane from the cathode side. This prevents the migration of cations, including hardness ions, to the cathode region and protects the cathode from the formation of hardness ions hydrolysis products on its surface, especially from deposits on the magnesium hydroxide cathode surface, which significantly increases the electrical resistance of the system. Electrical conductivity in the electrolyzer is maintained by the migration of hydroxide anions, generated at the cathode, from the cathode chamber to the working chamber, thus compensating for the migration of chlorides and sulfates from the working chamber to the anode region. It was shown that hydroxide anions virtually do not pass to the anode chamber since they are bound in the working chamber during the hydrolysis of magnesium ions, and with the presence of hydrocarbons during their conversion into carbonates.

This promotes the mitigation of the solution in the working chamber and its purification from chlorides and sulfates. In the anode chamber during the separation of oxygen and protons on the anode there is the formation of sulfuric acid. Chlorine after oxidation at the anode is separated from the acidic medium in the form of gas and is absorbed by an alkali solution with the formation of sodium hypochlorite.

Similar processes are implemented during mine water desalination in this electrolyzer when adding magnesite to the working chamber near mine water.

**Keywords:** electro dialysis, desalination, anionic membranes, mine water, catholyte, anolyte.

#### References

- Honcharuk, V. V., Chebotarova, R. D., Bagryi, V. A., Basha-tan, S. Y., Remez, S. V. (2005). Softening water electrolyzer with ceramic membrane. *Chemistry and technology of water*, 27 (5), 460–470.
- Xu, F., Innocent, C., Pourcelly, G. (2005). Electrodialysis with ion exchange membranes in organic media. *Separation and Purification Technology*, 43 (1), 17–24. doi:10.1016/j.seppur.2004.09.009
- Duganova, R. Y., Shushkevich, E. O., Barieva, E. R. (2003). Studing of the dynamics of the process water softener unit ECHO. *Proceedings of the universities. Energy problems*, 1–2, 128–135.
- Wiśniewski, J., Rózańska, A. (2007). Donnan dialysis for hardness removal from water before electro dialytic desalination. *Desalination*, 212 (1-3), 251–260. doi:10.1016/j.desal.2006.11.008
- Pisarska, B., Dilevski, R. (2005). Analysis of the conditions for obtaining H<sub>2</sub>SO<sub>4</sub> and NaOH solutions of sodium sulphate by electro dialysis. *Journal of Applied Chemistry*, 78 (8), 33–38.
- Shablii, T. O., Ivanuk, V. V., Gomelia, M. D. (2011). Electro dialysis sodium chloride to produce hydrochloric acid and alkali. *Journal of NTUU "KPI". Chemical engineering, ecology and resource*, 1 (11), 67–71.
- Goltvianitska, O. V., Shablii, T. O., Gomelia, M. D., Stavska, S. S. (2012). Removal and separation of chlorides and sulfates in ion-exchange water desalination. *Eastern-European Journal of Enterprise Technologies*, 1/6 (55), 40–44.
- Ayala-Bribiesca, E., Pourcelly, G., Bazinet, L. (2007). Nature identification and morphology characterization of anion-exchange membrane fouling during conventional electro dialysis. *Journal of Colloid and Interface Science*, 308 (1), 182–190. doi:10.1016/j.jcis.2006.11.012
- Chkhenadze, N. V., Kurtshalia, T. S. (2004). By definition, the permissible value of calcium hardness in electro dialysis mineralized water with simultaneous concentration. *GEN: Georg. Eng. News*, 4, 118–122.
- Kucheryk, G. V., Omelchuk, Y. A., Gomelia, M. D. (2011). Electrochemical chloride extraction of natural water and alkali regeneration solutions. *Collected Works of Sevastopol National University of Nuclear Energy and Industry*, 2 (38), 189–196.
- Shablii, T. O., Gomelia, M. D., Panov, E. M. (2010). The electrochemical recycling of waste solutions generated during regeneration of cation. *Ecology and industry*, 2, 33–38.
- Shablii, T. O. Design of the new reagents and technologies for prevention of aquatic contamination by industrial drain waste. *Environmental Safety*, 39.

### CHANGE OF MONTMORILLONITE SURFACE STRUCTURE WITH CATIONIC SURFACTANTS ADSORPTION (p. 53-57)

Anton Golembiovskiy, Anna Brezicka, Larysa Spasonova

This paper shows the influence of cationic surface-active agents (SAA) with a different structure of the hydrophobic chain on the modification of the surface structure of silicate mineral montmorillonite and adsorptive properties of the resultant sorbent for extracting ions of chromium (VI) and cobalt (II) from aqueous media. Macroelectrophoresis and sorption methods for designating the selected samples were used in the research. It was proved that increasing the amount of surfactants added to a dispersed system, long-chain surfactants tend to form more stable hemicellar structure on the clay surface and more fully recharge it. It was found that the increasing the number of the hydrocarbon chain links from 1 to 16

the physicochemical characteristics of the obtained materials are changed dramatically: the adsorption of chromium increases to about 45 mg/g, while the adsorption of cobalt falls to zero in the full range of the surface-active agents concentrations. The research results will be useful and important in obtaining sorbents for extracting chromium (VI) ions from aqueous media.

**Keywords:** surface adsorption, montmorillonite, quaternary alkylammonium salts, sedimentation, macroelectrophoresis, chromium, cobalt.

#### References

- Kornilovych, B. Yu., Andrievska, O. R., Plemiannikov, M. M., Spasonova L. M. (2013). *Physical chemistry of silica and nano-disperse silicates*. Kyiv, Ukraine: Osvita Ukrainy, 178.
- Bergaya, F., Theng, B. K. G., Lagaly, G. (2006). *Developments in clay science. Handbook of clay science*. Amsterdam, Kingdom of the Netherlands: Elsevier, 1224.
- Yariv, S. (2002). *Organo-clay complexes and interactions*. New York, USA: Marcel Dekker, 688.
- De Paiva, L. B., Morales, A. R., Valenzuela D az, F. R. (2008). *Organoclays: Properties, preparation and applications*. *Applied Clay Science*, 42 (1-2), 8–24. doi:10.1016/j.clay.2008.02.006
- Lagaly, G. (1981). Characterization of Clays by Organic Compounds. *Clay Minerals*, 16 (1), 1–21. doi:10.1180/claymin.1981.016.1.01
- Mittal, V., Herle, V. (2008). Physical adsorption of organic molecules on the surface of layered silicate clay platelets: A thermogravimetric study. *Journal of Colloid and Interface Science*, 327 (2), 295–301. doi:10.1016/j.jcis.2008.08.036
- Hu, Z., He, G., Liu, Y. et al. (2013). Effects of surfactant concentration on alkyl chain arrangements in dry and swollen organic montmorillonite. *Applied Clay Science*, 75-76, 134–140. doi: 10.1016/j.clay.2013.03.004
- Kajino, M., Saito, T., Okamoto M. (2010). Nonisothermal order-disorder phase transition of alkylammonium ions in nanoconfined space. *Applied Clay Science*, 48 (1-2), 73–80. doi: 10.1016/j.clay.2009.11.025
- Tarasevich, Yu. I. (1981). *Natural sorbents in water treatment processes*. Kyiv, Ukraine: Naukova Dumka, 208.
- Golembiovskiy, A. O. (2014). Physical and chemical organoclay synthesis features for adsorption of chromium. *Eastern-European Journal of Enterprise Technologies*, 6 (67), 4–7.
- Jiang, N., Li, P., Wang, Y. (2005). Aggregation behavior of hexadecyltrimethylammonium surfactants with various counterions in aqueous solution. *Journal of Colloid and Interface Science*, 286 (2), 755–760, doi: 10.1016/j.jcis.2005.01.064
- Mukerjee, P., Mysels, K. J. (1971). *Critical Micelle Concentrations of Aqueous Surfactant Systems*. Washington D.C., U.S.: NBS, 222.
- Rubingh, D. N., Holland, P. M. (1991). *Cationic Surfactants: Physical Chemistry*. Boca Raton, U.S. (Florida): CRC Press, 544.
- Penner, D., Lagaly, G. (2000). Influence of organic and inorganic salts on the coagulation of montmorillonite dispersions. *Clays and Clay Minerals*, 48 (2), 246–255. doi: 10.1346/ccmn.2000.0480211
- Tarasevich, Yu. I., Ovcharenko, F. D. (1975). *Adsorption on clay minerals*. Kyiv, Ukraine: Naukova Dumka, 351.
- Kovunua, H., Yildiz, N., Salgin, U. (2011). Adsorption of o-, m- and p-nitrophenols onto organically modified bentonites. *Journal of Hazardous Materials*, 185 (2-3), 1332–1339, doi: 10.1016/j.jhazmat.2010.10.050
- Hu, B., Luo, H. (2010). Adsorption of hexavalent chromium onto montmorillonite modified with hydroxyaluminum and cetyltrimethylammonium bromide. *Applied Surface Science*, 257 (3), 769–775, doi: 10.1016/j.apsusc.2010.07.062

### SORPTION OF COBALT, CHROMIUM AND URANIUM IONS ON Fe/Ti-PILLARED MONTMORILLONITE (p. 57-61)

Igor Pylypenko, Larysa Spasonova, Iryna Kovalchuk, Vasyl Veremeienko

The structural and adsorption properties of montmorillonite pillared with titanium and iron polyhydroxocomplexes are given in the paper. It was found that the composition of the polyhydroxocom-

plexes significantly affects the properties of the resultant materials. For studying the basic properties of the resultant materials, the X-ray phase analysis, the low-temperature nitrogen adsorption, and adsorption of the metal ions from aqueous solutions were used.

The results of the X-ray phase analysis, with changes in the respective basal reflections, confirm the presence of iron and titanium polyhydroxocomplexes in the interlayer space of the mineral. Synthesized pillared minerals have a well-developed specific surface, micro- and mesoporosity, as confirmed by the low-temperature nitrogen adsorption.

It was found that the pillared montmorillonite shows relatively high adsorption characteristics relatively to chromium and uranium ions. Adsorption on the pillared montmorillonite samples significantly depends on the pH solutions, adsorptive properties and the composition of the polyhydroxocomplexes, which were used for synthesizing adsorbents.

The research results can be useful for developing and synthesizing new types of inorganic ion-exchange materials for extracting cations and anions of various inorganic toxicants from aqueous solutions.

**Keywords:** pillared montmorillonite, adsorption, polyhydroxocomplex, porous structure, modification, cobalt, chromium, uranium.

## References

1. Bergaya, F., Theng, B. K. G., Lagaly, G. (2006). Handbook of clay science. London : Elsevier, 1224. doi: 10.1016/S1572-4352(05)01012-3
2. Pylypenko, I. V. (2014). Granular composite for removal of cobalt and methylene blue ions. Eastern European Journal of Enterprise Technologies, 11, 16–20.
3. Romero, A., Dorado, F., Asencio, I., Garcia, P. B., Valverde, J. L. (2006). Ti-pillared clays: synthesis and general characterization. Clays Clay Miner., 6, 737–747. doi: 10.1346/CCMN.2006.0540608
4. Lei, G., Ma, J., Guan, X., Song, A., Cui, Y. (2009). Effect of basicity on coagulation performance of polyferric chloride applied in eutrophicated raw water Guoyuan. Desalination, 247, 518–529. doi: 10.1016/j.desal.2008.06.026
5. Mei, J. G., Yu, S. M., Cheng, J. (2004). Heterogeneous catalytic wet peroxide oxidation of phenol over delaminated Fe–Ti–PILC employing microwave irradiation. Catal. Commun., 5, 437–440. doi: 10.1016/j.catcom.2004.05.009
6. Jagtap, N., Ramaswamy, V. (2006). Oxidation of aniline over titania pillared montmorillonite clays. Appl. Clay Sci., 33, 89–98. doi: 10.1016/j.clay.2006.04.001
7. Na, P., Jia, X., Yuan, B., Li, Y., Na, J., Chen, Y., Wang, L. (2010). Arsenic adsorption on Ti-pillared montmorillonite. J. Chem. Technol. Biotechnol., 85, 708–714. doi: 10.1002/jctb.2360
8. Masih, D., Izumi, Y., Aika, K., Seida, Y. (2007). Optimization of an iron intercalated montmorillonite preparation for the removal of arsenic at low concentrations. Eng. Life Sci., 1, 52–60. doi: 10.1002/elsc.200620171
9. Gupta, K., Ghosh, U. C. (2009). Arsenic removal using hydrous nanostructure iron (III)–titanium (IV) binary mixed oxide from aqueous solution. Journal of hazardous materials, 161(2), 884–892. doi: 10.1016/j.jhazmat.2008.04.034
10. Dou, B., Dupont V., Pan W., Chen B. (2011). Removal of aqueous toxic Hg(II) by synthesized TiO<sub>2</sub> nanoparticles and TiO<sub>2</sub>/montmorillonite. Chem. Eng. J., 166, 631–638. doi: 10.1016/j.cej.2010.11.035
11. Cardoso, V. D. A., Souza, A. G. D., Sartoratto, P. P., Nunes, L. M. (2004). The ionic exchange process of cobalt, nickel and copper (II) in alkaline and acid-layered titanates. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 248(1), 145–149. doi: 10.1016/j.colsurfa.2004.09.012
12. Abou-Mesalam, M. M. (2004). Applications of inorganic ion exchangers: II—adsorption of some heavy metal ions from their aqueous waste solution using synthetic iron (III) titanate. Adsorption, 10(1), 87–92. doi:10.1023/B:ADSO.0000024038.32712.18
13. Ahmed, M. A., El-Katori, E. E., Gharni, Z. H. (2013). Photocatalytic degradation of methylene blue dye using Fe<sub>2</sub>O<sub>3</sub>/TiO<sub>2</sub> nanoparticles prepared by sol–gel method. Journal of Alloys and Compounds, 553, 19–29. doi: 10.1016/j.jallcom.2012.10.038
14. Li, X., Li, G., Qu, Z., Zhang, D., Liu, S. (2011). The role of titania pillar in copper-ion exchanged titania pillared clays for the selective catalytic reduction of NO by propylene. Appl. Catal., A: General, 2, 82–87. doi: 10.1016/j.apcata.2011.03.020
15. Ramesh, A., Hasegawa, H., Maki, T., Ueda, K. (2007). Adsorption of inorganic and organic arsenic from aqueous solutions by polymeric Al/Fe modified montmorillonite. Sep. Purif. Technol., 1, 90–100. doi: 10.1016/j.seppur.2007.01.025
16. Rouquerol, F. (2014). Adsorption by powders and porous solids principles, methodology and applications. London: Elsevier, 626. doi: 10.1016/B978-0-08-097035-6.00012-7
17. Valverde, J. L., Romero, A., Romero, R., Garcia, P. B., Sanchez, M. L., Asencio, I. (2005). Preparation and characterization of Fe-pilcs. Influence of the synthesis parameters. Clays Clay Miner., 6, 613–621. doi: 10.1346/CCMN.2005.0530607
18. Yuan, P., Yin, X., He, H., Yang, D., Wang, L., Zhu, J. (2006). Investigation on the delaminated-pillared structure of TiO<sub>2</sub>-PILC synthesized by TiCl<sub>4</sub> hydrolysis method. Microporous Mesoporous Mater., 93, 240–247. doi: 10.1016/j.micromeso.2006.03.002
19. Amphlett, C. B., McDonald, L. A., Redman, M. J. (1958). Synthetic inorganic ion-exchange materials. II Hydrous zirconium oxide and other oxides. J. Inorg. Nucl. Chem., 6, 236–245. doi: 10.1016/0022-1902(58)80153-0
20. Li, D., Scala, A. A., Ma, Y. H. (1996). Adsorption and characteristics of base-treated pillared clays. Adsorption., 2, 227–235. doi: 10.1007/BF00128304
21. Kornilovych, B. Yu., Sorokin, O. G., Pavlenko, V. M., Koshyk, Y. J. (2011). Environmental technology in uranium mining and processing industry. Kiev: Norma, 156.
22. Chen, L., He, B. Y., He, S., Wang, T. J., Su, C. L., Jin, Y. (2012). Fe–Ti oxide nano-adsorbent synthesized by co-precipitation for fluoride removal from drinking water and its adsorption mechanism. Powder Technol., 227, 3–8. doi: 10.1016/j.powtec.2011.11.030

## IMPROVING WATER RESISTANCE OF CHROME-TANNED LEATHER BY ALKENE-MALEIC COMPOSITION (p. 62-66)

Anatoliy Danylkovich, Natalia Omelchenko, Natalia Lysenko

To solve the problem of improving the performance properties of hydrophobic leather materials and products, a wide range of chemical materials and methods of their application in manufacturing technologies of leather for various purposes are used.

The influence of processing semi-finished leather by alkene-maleic composition of the chemical composition and physicochemical properties hydrophobized material was determined in the paper. Hydrophobization of semi-finished product was performed after its neutralization by formate and sodium bicarbonate, washing, dyeing, retanning by mixture of organic-mineral tannins. Greasing-hydrophobization was performed after increasing the temperature of the solution, containing alkene-maleic polymer, formic acid and fish oil or sunflower oil, further fixation was performed by potassium alums in the presence of masking solution - sodium formate.

Using AMC compared to traditional greasing leads to an increase in the amount of bound fatty substances in the semi-finished product by 1.7–2.0 times and a corresponding reduction of substances, extracted by organic solvents.

Semi-finished product, obtained using this technology is characterized by high deformation capacity and stiffness less by 18–20 % compared to the materials, produced using the control option 6, and water permeability in dynamic conditions is higher by 45–48 times.

The obtained research results confirm that using alkene-maleic composition in manufacturing technology of leather materials allows to produce them with high hydrophobic effect and complex of necessary physicochemical properties and suggest that alkene-maleic composition, developed and implemented in the production is a promising water-repellent reagent that can be effectively used in manufacturing technologies of leather for everyday and special shoes, suitable for extreme conditions.

**Keywords:** chrome-tanned leather, water resistance, grease composition, alkene-maleic polymer, processing, hydrophobization.

## References

1. Danylkovich, A. H. (2011). Problema polipshenia hadrofobnykh vlastyovostei vrsorovoho shkiranoho i khutrovoho materialiv

- [The problem of improving the hydrophobic properties of the piled leather and fur materials]. *Lehka promyslovist – Light industry*, 3, 27–29 [in Ukrainian].
2. Artamonov, A. E. (2013). Primenenie hidrofobiziruiushchih sostavov dlia vodo- i griazeotalkivaiushchei propitki tekstilnyh izdelii na predpriatiiah himicheskoi chistki [Application of hydrophobic compounds for water and dirt-repellent treatments for the textile goods in the enterprises chemical cleaning]. Available at: [http://www.travers.su/pages/files/1267304816foborit\\_ya.doc](http://www.travers.su/pages/files/1267304816foborit_ya.doc) [in Russian].
  3. Meyndt, Renate, Germann Heinz-Peter (2007). The hydrophobing of chrome-free leather. – *World Leather*, 8, 49-50, 52-54 [in Deutshland].
  4. Studenikin, S., Yakovlev, K., Bogomolov, V. (2010). Sposob vyrabotki hydrofobnyh kozh [Method of making hydrophobic leathers]. Patent 2404260 C 14 C 13/00 [in Russian].
  5. Reiners, Juergen, Kleban, Martin, Bley, Matthias (2006). Verfahren zur Hydrophobierung von Leder mittels Alkylalkoxysilanen sowie hydrophobiertes Leder. Patent DE 102005012329 A1, C 14 C 9/02 [in Deutshland].
  6. Ramazonov, B. G. (2008). Issledovanie obrabotki kozh i kozhevennyh izdelii nekotorymi polimernymi sviazuiushhimi [Investigation of processing of leathers and leather products by some polymeric binders]. Proceedings from MIIM '12: – International Scientific Conference «Theoretical knowledge into practice». Omsk, 260–261. [in Russian].
  7. Drik, vfon Ber (2008). Optymyzaciia protsessa gidrofobizacii kozh s pomoshiu Synthol EW-321 [Optimization of the process of hydrophobic treatment of leathers using Synthol EW-321]. *Skins. footwear. Industry*, 2, 17-18 [in Russian].
  8. Muzafarov, A. M., Serenko, O. A., Myshkovskiy, A. M. (2010). Sposob gidrofobyzatsiy kozhevenno-mehovogo polufabrykata [Method hydrophobic leather and fur semifinished]. Patent 2390567 RF, S 14 S 11 [in Russian].
  9. Eysiukova, N. V., Voroieva, Y. V., Poluhina, L. M. (2009). Gydrofobizaciia kozhevenno-mehovogo polufabrykata ftorsoderzhashhimi funktsyonalnymi silanami i siloksanami [Hydrophobic treatment of leather and fur semi-finished product by fluorinated silanes and siloxanes]. *Dizain i tehnologii – Design and technology*, 11, 68–72 [in Russian].
  10. Ahmedov, V. N., Dzhuraev, A. M., Toshev, A. Ju. (2007). Polietilgidroksiloksanoakrilatnye polimery dlja povysheniya jefekta gidrofobizacii [Polyethylhydrooxylanoacrylat polymers for enhancing the effect of hydrophobic treatment]. *Chemical technology*, 5, 145–146 [in Russian].
  11. Maurer, T., Htrwerth, S., Konig, E., Stadtmuller, S. (2008). Neue polycarboxyfunktionelle Organosiloxanylderivate und deren Wervendung zur Behandlung von Leder. Patent. C 08 G 77/38. DE102006042869 A1, MPK C 08 G 77/38 [in Deutshland].
  12. Lishhuk, V., Danylkovich, A., Omelchenko, N., Lysenko, N. (2012). Sposib emulsiinogo zhyruvannia-hidrofobizacii shkiry [The method of emulsion fattening and hydrophobic treatment of leather]. Patent 70418 C 14 C 3/00 [in Ukrainian].
  13. Danylkovich, A. G. (2009). Tehnologiia i materialy vyrobnytstva shkiry: navch. posibnik [Technology and materials leather production: studies. manual]. Kyiv: Feniks, 578. [in Ukrainian].
  14. Danylkovich, A. G. (2006). Praktykum z himii i tehnologii shkiry ta hutra : 2 vid., pererob. i dop.: navch. posibnyk [Practicum in chemistry and technology of leather and fur] Kyiv: Feniks [in Ukrainian].
  15. Mokrousova, O. R., Oliinyk, M. M., Danylkovich, A. G. (2008). Sposib zhyruvannia-hidrofobizacii shkirianogo napivfabrykatu [The method of fattening-hydrophobic treatment of semi-finished leather]. Patent 33010 MPK S14 S 9/00 [in Ukrainian].