**The application of the qualitative methods for analysis of differential equations describing physical and chemical processes**

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**Keywords:** mathematical models, chemical processes, reactors, co and countercurrent columns, stability, stationary and periodical regimes, Hopf bifurcation.

**Abstract.**  The article analyzes the results of the qualitative theory of differential equations, which not only have been used in the modelling of physical and chemical processes, but also were stimulated by them.

Author analyzed the issues of number and stability of stationary solutions. In addition, conditions were obtained for the Hopf’s bifurcation of the periodic solutions of them. Despite the concurrent flow chemical reaction mechanism, it is shown that in countercurrent flow it is possible to bifurcate the time periodic solutions near the steady state. By using the numerical calculations of the model of countercurrent reactor (with the Lotka-Volter’s kinetic as an example) was established that periodic regimes can give higher yield of useful product compared with a stationary regime in a concurrent flow chemical reactor or in the continuous flow stirred-tank reactor with the same kinetics.

**References.**

[1] Aris R.The Mathematical Theory of Diffusion and Reaction in Permeable Catalysts. Oxford:Clarendon Press.1975.V.1,2.

[2] Wei J. Axiomatic treatment of chemically reacting systems // J. Chem. Phys. 1962. V. 36, №6. P. 1578-1584.

[3] Krambek F.J.The mathematical structure of chemical kinetics in homogeneous single-phase systems // Arch. Rational Mech. Anal. 1970. V. 38, №5. P. 317-347.

[4] Feinberg M.On chemical kinetics of a certain class // Arch. Rational Mech. Anal. 1972. V. 36, №1. P. 1-41.

[5] Belonosov V.S., Vishnevskii M.P. On the stability of the stationary solutions for parabolic systems. Matematicheskij Sbornik [The Mathematical Collection], 1977, no. 12, pp. 535-558 (in Russ.)

[6] Belonosov V.S. Estimations of parabolic systems in Holder weighted classes .

Dokl. AN USSR [Reports of AS of USSR], 1978, V. 241, no.2, pp . 265-268 (in Russ.).

[7] Belonosov V.S . Estimations of the solutions of nonlinear parabolic systems in

a weighted Holder classes and some their applications. Matematicheskij Sbornik [The Mathematical Collection], 1979, no. 2, pp. 163-188 (in Russ.).

[8] Eltysheva N.A. To a question on stability of the solutions of some hyperbolic

systems. Matematicheskij Sbornik [The Mathematical Collection], 1986, no.1, pp. 30-32 (in Russ.).

[9] Eltysheva N.A. About qualitative properties of the solutions of some

hyperbolic systems on a plane . Matematicheskij Sbornik [The Mathematical Collection], 1988, no.2, pp. 1 Dokl. AN USSR [Reports of AS of USSR]86-209 (in Russ.)

[10] Lavrent’ev M.M. (-Jr.) , Ljulko N.A. Increase of smoothness for the solutions of some hyperbolic tasks. Sibirskii Mat. Zurnal [Sib.Math.J.] 1997, no.1, pp. 109-124 (in Russ.).

[11] Zelenyak T.I. The qualitative theory of boundary problems for the quasilinear

second order parabolic type equations. Novosibirsk: NSU, 1972 (in Russ.).

[12] Zelenyak T.I. On the qualitative properties of the solutions for the quasilinear mixed problems of the parabolic type equations. Matematicheskij Sbornik [The Mathematical Collection], 1977, no.3, pp. 486-510 (in Russ.).

[13] Zelenyak T.I. On the stability of the stationary solutions of the mixed problem. Dokl. AN USSR [Reports of AS of USSR], 1966, no.2, pp. 266-268 (in Russ.).

[14] Zelenyak T.I. About the stationary solutions of the mixed problems arising by the studying some chemical processes. Dif. Uravnenija [Differential Equations], 1966, no. 2, pp. 205-213(in Russ.).

[15] Zelenyak T.I. To the problem of the stability of solutions for the some class of quasilinear equations. Dif. Uravnenija [Differential Equations], 1967, no.1, pp. 19-29 (in Russ.).

[16] Akramov T.A. The differential equations and their application in modeling

physical and chemical processes. Ufa: BSU, 2000 (in Russ.).

[17] Perlmutter D. Stability of the Chemical Reactors. Leningrad: Chemistry, Lenigr. Dept., 1976 (in Russ.).

[18] Musienko E.I. The solution’s control for the some parabolic problems in the neighborhood of the instable steady state. Dinamika sploshnoj sredy [Dynamic of the Continuous Medium]. AS USSSR, Sib. Branch, Institute of the Hydrodynamics. Novosibirsk,1983, v. 60, pp. 163-169 (in Russ.).

[19] Musienko E.I. The solution’s control for the some parabolic problems in the neighborhood of the unstable steady state. Dif. Uravnenija [Diff. Equat.], 1984, no.12, pp. 2120-2130 (in Russ.).

[20] Akramov T.A. About some mixed problem for the quasilinear parabolic

system. Dokl. AN USSR [Reports of AS of USSR], 1979, no.3, pp. 554-558 (in Russ.).

[21] Akramov T.A , Vishnevskii M.P. Solvability in the whole Diffusion-Reaction

System. Matematicheskoe Modelirovanie [Mathematical modeling],1992, no. 1, p. 110-120 (in Russ.).

[22] Akramov T.A , Vishnevskii M.P Some qualitative properties of the diffusion-

reaction system. Sibirskii Mat. Zurnal [Sib. Math. J.],1995, no. 1, pp. 3-19 (in Russ.).

[23] Glensdorff P., Prigogine I. Thermodynamic theory of structure, stability, and fluctuations. Moscow: Mir, 1973, (in Russ.).

[24] Slinko M.G., Bykov V.I., Yablonskij G.S., Akramov T.A. Multiplicity of steady states in the heterogeneous catalytic reactions. Dokl. AN USSR [Reports of AS of USSR], 1976, no. 4, pp. 876-879 (in Russ.).

[25] Akramov T.A. The qualitative analysis of the differential equations

describing chemical reactions taking account of diffusion. Mathematical modelling of the catalytic reactors. Novosibirsk: Nauka, Sib. Brunch, 1984, pp. 102-115 (in Russ.).

[26] Akramov T.A. Mathematical models of detailed and complex balanced chemical systems. Proceedings of the conference on mathematical methods in chemical engineering. Balaton, Hungary, 5-8 May, 1986, v. 1, pp. 51-59.

[27] Zelenyak T.I. The qualitative theory of boundary problems for the quasilinear

second order of a parabolic type equations. Novosibirsk: NSU, 1972 (in Russ.).

[28] Belonosov V.S., Zelenyak T.I. Non local problems in the theory of the

quasilinear parabolic equations. Novosibirsk: NSU, 1975 (in Russ.).

[29] Zelenyak T. I., Lavrentiev Jr. M. M. and Vishnevskii M. P.Qualitative Theory of Parabolic Equations. Part 1. VSP, The Netherlands, 1997.

[30] Belonosov V.S.The Lyapunov Function Method for Unbounded Operators. Siberian Journal of Differential Equations. Nova Science Publishers, Inc., New York, 1995, no. 2, pp. 121-156.

[31] Belonosov V.S. On the indexes of the instability for the unbounded operators. Dokl. AN USSR [Reports of AS of USSR], 1983, no. 1, pp. 11-14 (in Russ.).

[32] Belonosov V.S. The indexes of the instability for the differential operators. Matematicheskij Sbornik [The Mathematical Collection], 1986, no. 4, pp. 494-513 (in Russ.).

[33] Skazka V.V. On the calculation of the eigenvalues situated in the right half-plane of the spectral problems connected with the hyperbolic systems.1. Sibirskii Mat. Zurnal [Sib.Math.J.], 1996, no. 3, pp. 656-676 (in Russ.).

[34] Akramov T.A. About some hyperbolic problem describing chemical reactor. Dinamika sploshnoj sredy [Dynamic of the Continuous Medium]. AS USSSR, Sib. Branch, Institute of the Hydrodynamics. Novosibirsk,1988, v. 83, pp.3-23 (in Russ.).

[35] Akramov T.A*.* Qualitative and numerical analysis of the model for the reactor with the counter current components. Matematicheskoe modelirovanie kataliticheskix reaktorov [Mathematical modelling of the catalytic reactors]. Novosibirsk: Nauka, Sib. Brunch, 1989, pp. 195-214 (in Russ.).

[36] Akramov T.A. On the behavior of the solutions for the some hyperbolic

problem. Sibirskii Mat. Zurnal [Sib. Math. J.], 1998, no. 3, pp. 3-19 (in Russ.).

[37] Moravec P., Akramov T. A., Stanek V. A.Mathematical model as a tool the rating of gas-solid reactions with special reference to iron ore reduction. Proc. of 9th International congress CHISA-87, Praha, August 31-September 4, 1987, A4.1.

[38] Akramov T.A.Analytical and numerical analysis of counter-current chemical reactor // Proc. of 10th International congress CHISA-90. Praha, September 1990, P. 8.

[39] Akramov T.A., Nazmutdinova L.R., Stanek V. The qualitative and numerical

analysis of periodical regimes in the counter-current chemical reactors.

Proc. Of 16th International Congress of Chemical and Process Engineering CHISA- 2004, C3.5.

[40] Akramov T.A., Svoboda P., Jiricny V., Stanek V. Analysis of the conditions

for the Appearance of the “Overshoot” Phenomenon in Counter-Current Packed Columns. Ind. Eng. Chem. Res., 2004, no. 43, p. 5899-5903.

(in Russ.). [41] Akramov T.A., Stavarek P., Jiricny V., Stanek V. The Hydrodynamics of

Counter Current Packed Bed Exposed to Periodic Variations of Inlet Velocity Analysis . Ind.Eng.Chem.Res., 2008, no. 47, pp. 7424-7432.

[42] Akramov T.A., Stavarek P., Jiricny V., Stanek V. Minimum Energy

Dissipation under Cocurrent Flow in Packed Beds. Ind.Eng.Chem.Res., 2011, no. 50, pp.10824-10832.

[43] Akramov T.A. Analysis of the model for the concurrent packed bed with

the periodical boundary conditions in the inlet. Sibirskii Zurnal Industrial’noy Matematiki [Sib. J. Ind. Math.] , 2013, no. 3(55), pp.16-27 (in Russ.).

**Structural and parametric identification of kinetic models of chemical reactions involving organometallic compounds based on information and computing analytical system**

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**Keywords**: information and computer analysis system, organometallic compounds, the induction period, a database of kinetic researches, the automated system.

**Abstract**. A methodology for the design, development and implementation of information and computing systems for analysis of kinetic models (ICAS KM). Description of the components ICAS KM such as database kinetic studies, complexes of programs for solving direct and inverse kinetic problem using parallel computing technology are presented in the study of reaction mechanisms examples hydroalumination of (GA) olefins with organoaluminum compounds in the presence of the Cp2ZrCl2. Defined numerical characteristics of the induction period the reaction under consideration, the dependence of the reactivity of a series of acetylenes to olefins reaction GA.

**References**

1. Koledina K.F., Gubaydullin I.M. Software package for the solution of inverse problems of chemical kinetics and its implementation as a virtual test bed. Nauka i obrazovanie. Electronnoe nauchno-tehnicheskoe izdanie [ Science and education. Electronic scientific and technical publication], July 2013, no 07, 12 p. (in Russ.)

2. Parfenova L.V., Pechatkina S.V., Khalilov L.M. Study of mechanism hydroaluminination alkilalan olefins catalyzed Cp2ZrCl2. Izvestiya RAN, seriya khimicheskaya [Russian Chemical Bulletin], 2005, no 2, pp. 311-322 (in Russ.)   
3. Gubaydullin I.M., Lind Y.B., Koledina K.F. Parallelization methodology for solving multiparameter inverse problems of chemical kinetics. Vychislitelnye metody i programmirovanie: novye vychislitelnye tehnologii [Computational methods and programming: new computing technologies], 2012, vol. 13, no 2 (26), pp. 28-36 (in Russ.)   
4. Pankratyev E. Yu., Khursan S.L., Dzhemilev U.M. DFT and Ab Initio study on mechanism of olefin hydroalumination by XAlBui2 in the presence of Cp2ZrCl2 Catalyst. III. Efficiency of Transmetallation in Cp2ZrRCl - XAlBui2 system. Journal of Organometallic Chemistry, 2012, vol. 718, pp. 117-123, (DOI: 10.1016/j.jorganchem.2012.07.027)   
5. Parfenova L.V., Balaev A.V., Gubaydullin I.M., Abzalilova L.R., Pechatkina S.V., Khalilov L.M., Spivak S.I., Dzhemilev U.M. Kinetic Model of Olefins Hydrometallation by HAlBui2 and AlBui3 in the Presence Cp2ZrCl2 Catalyst. Int. J. Chem. Kinet, 2007, vol. 39, no 6. pp. 333-339.

6. Gubaydullin I.M., Koledina K.F., Lind Y.B. Modern HPC technologies in modeling the detailed mechanism of the reaction of catalytic olefin hydroalumination. Nauka i obrazovanie. Electronnoe nauchno-tehnicheskoe izdanie [ Science and education. Electronic scientific and technical publication], June 2011, no 6, 25 p. [in Russ.]

7. Maskov D.F., Gubaydullin I.M. Database design kinetic studies. Vestnik Omskogo universiteta [Herald of Omsk University], 2012, no 2 (64), pp. 182-184. (in Russ.)   
8. Parfenova L.V., Vildanova R.F., Pechatkina S.V., Khalilov L.M., Dzhemilev U.M. Zr, Al-complexes as New Reagents for Olefin Hydrometallation. J. Organomet. Chem., 2007, vol. 692, pp. 3424-3429.

9. Novichkova A.V., Bobreneva Y.O. Information-analytical system of interval analysis of the kinetic parameters of the reaction of olefins hydroalumination. Trudy megdunarodnoi konferencii "Informacionnye tehnologii intellectualnoi poddergki prinatia reshenii" [Proceedings of the International Conference "Information Technologies intelligent decision support"], 2013, vol. 1, pp.138-143. (in Russ.)

**Conditions of safe monitoring of the process of ethylene oxidation into ethylene oxide**

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**Keywords**: ethylene oxide, industrial catalytic reactors, emergency shut downs, thermal runaway, reserve resistance parameters to ranaway

**Abstract**. The article is dedicated to the memory of my Teacher and well-known scientist Slinko Mihail Gavrilovich. Our joint activity in the fild of the process of Ethylene oxidation into Ethylene Oxide was continued more than 50 years. A mechanism of origination and development of termal runaways in the industrial catalytic reactors on the basis ofa theory of self-organizing criticality is considered. Thermal runaways and emergency shutdowns of industrial tubular reactors in the production of ethylene oxide and the conditions of their origination are analyzed. Special experiments were conducted in a pilot tube, an element of the industrial reactor, under the real conditions related to the study of origination and development of thermal runaway. Potentially dangerous ranges of reactor operation as well as slow variables permitting in most cases to fix appearance of local thermal runaways in separate tubes of the industrial reactor and to prevent their distribution over the whole reactor.

**References**  
1. Boreskov G.K., Slinko M.G., Chesnokov B.B. et al . The oxidation of ethylene in the fluidized bed catalyst. Kinetika I kataliz [ Kinetics and Catalysis] ,1962.v 3. № 2. pp.214-220. (in Russ.).

2. Slinko M.G., Vasilevich L.A., Chesnokov B.B., Talaeva I.G. et al. A catalyst for the oxidation of ethylene in a fluidized bed. A.S. № 1051761 USSR , 1983

(in Russ.).

3. Chesnokov B.B., Gelbshtein A.I., Boreskov G.K., Vasilevich L.A. et al. The method for producing ethylene oxide, A.S. № 367695 USSR, 1973 (in Russ.).

4. Chesnokov B.B., Davidov V.A. et al. A method for preparing porous corundum carriers for catalysts. A.S.№ 385910 USSR, 1973 (in Russ.).

5. Vasilevich L.A, Slinko M.G, Chesnokov B.B., Avetisov A.K. et al. The catalyst for the oxidation of ethylene. A.S.№1051762 USSR, 1983 (in Russ.).

6. Chesnokov B.B., Davidov V.A., Slinko M.G. et al. Basic characteristics of organized fluidized bed. Trudi 5 Konferentsii po himicheskim reaktoram “Himreaktor-5” [Proceedings of the 5 Conference on Chemical Reactors “CHEMREACTOR-5”], Ufa, 1974, vol.2, p.26. (in Russ.).

7. Chesnokov B.B., Slinko M.G., Bukhairov R.X.. Effect of reactor diameter on the behavior of organized fluidized bed. Trudi 6 Konferentsii po himicheskim reaktoram “Himreaktor-6” [Proceedings of the 6 Conference on Chemical Reactors “CHEMREACTOR-6”], v 1, 1977, pp 74-83. (in Russ.).

8. Boreskov G.K., Slinko M.G., Chesnokov B.B., Davidov V.A. et al. The method for producing ethylene oxide. Patent USA 4130570, 1979.

9. Volin U.M., Ostrovsky G.M., Sadovsky G.S., Chesnokov B.B. Collected articles ”Modelling and optimization of catalytic processes” М., Nauka, 1965, pp.88-96. (in Russ.).

10. Slinko M.G., Khimicheskaya prоmishlennost [Chemical Industry], 1990, № 2, p.67. (in Russ.).

11. Slinko M.G., Kinetika I kataliz [ Kinetics and Catalysis], 2000, № 6, p.933.

(in Russ.).

12. Slinko M.G., Khimicheskaya promishlennost [Chemical Industry], 1980, № 11, p.662. (in Russ.).

13.Kolobashkin V.S., Avetisov A.K., Shub F.S., Slinko M.G.,  
Khimicheskaya prоmishlennost [Chemical Industry], 1989, no 12, p.888. (in Russ.).

14.Sokolov V.S., Otborkina E.P., Davidov V.A., Chesnokov B.B. Kinetika  
i kataliz , [ Kinetics and Catalysis] 1987, v.28, no 2, p.398. (in Russ.).

15. Chesnokov B.B., Kolobashkin V.S., Stul B.Y., Parphenov A.N.,  
Emelyanov V.I., Slinko M.G. Khimicheskaya promishlennost [Chemical Industry], 1990, no 8, p.457. . (in Russ.).

16. Talaeva I.G., Vasilevich L.A., Avetisov A.K., Chesnokov B.B. et al. Materiali 3 Konferenstii po kinetike khimicheskih reakcii “Kinetics-3” [Proceedings of the 3 Conference on Kinetics of chemical reactions “KINETIKA-3”],), Kalinin, 1980,

v.2, p 441-447. (in Russ.).

17.Chesnokov B.B., Kolobashkin V.S., Gabutdinov M.S., Ionov U.V., Slinko M.G. et al. Khimicheskaya promishlennost [Chemical Industry], 1991, № 8, p. 491. (in Russ.).

18. Chesnokov B.B., Кataliz v promishlennost [Catalysis in industry], 2001. no 1. p. 56 (in Russ.).

19. Chesnokov B.B., С Stul B.Y., Derugin A.V., Slinko M.G. Investigation of thermal shutdown in industrial reactors of the process of producing ethylene oxide. Materiali Mezdunarodnoi Konferenstii po Himicheskim Reaktoram “Himreaktor-14” [Proceedings of the 14 International Conference on Chemical Reactors “CHEMREACTOR-14”], Tomsk, June 23-26, 1998, Publ. Novosibirsk, 1998,

p 49 (in Russ.).  
20. Chesnokov B.B., Kolobashkin V.S., Stobetsky V.N., Smirnov V.P.,  
Glotov V.V., Slinko M.G. // Khimicheskaya promishlennost [Chemical Industry], 1991, № 12, p 707. (in Russ.).

21. Chesnokov B.B., Sokolov V.S., Davidov V.A., Ionov U.V.,Virin L.I.,  
Emelyanov V.I., Khimicheskaya promishlennost [Chemical Industry], 1988, № 5, p. 270. (in Russ.).  
22. Chesnokov B.B., С Stul B.Y., Derugin A.V., Slinko M.G. Кataliz  
v promishlennosti [Catalysis in Industry], 2002, no 3. p. 29. (in Russ.).

23. Chesnokov B.B., С Stul B.Y., Derugin A.V., Slinko M.G. Trudi Konferentsii po himicheskim reaktoram “Himreaktor-15” [Proceedings of the 15 International Conference on Chemical Reactors “CHEMREACTOR-15”], Helsinki June 5-8, 2001, Publ. Novosibirsk, 2001, p 111.

**Sodium Hydroxide Influence on Salts Crystallization**

**in the HCOONa – NaCl – H2O System**

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**Keywords:** water-salt system, sodium formiate, chloride, hydroxide

**Abstract.** Sodium hydroxide influence on salts crystallization in the HCOONa – NaCl – H2O system was investigated with the purpose of temperature-concentration parameters definition of the sodium formiate production process with the minimal sodium chloride impurity. Solubility in the HCOONa - NaOH - H2O ternary system and four sections of HCOONa - NaCl - NaOH - H2O system was studied at 25 and 50°C. It was found that the increasing of sodium hydroxide concentration resulted in sodium chloride salting out and more pure sodium formiate production. The experimental results obtained for the model systems were tested on the real technological mixtures. The specific features of the salts crystallization process were established during laboratory tests.

**References**

1. Patent RU № 2076854. Continuous production process of chloroform and ant acid salt. V.V. Andreychatenko, L.M. Borovnev, A.N. Golubev i dr. Bull. №10, 1997 (in Russ.).
2. Patent RU № 2160250. Method of industrial sodium formate separation. A.S. Dedov, V.U. Zakharov, A.I. Maslyakov i dr. Bull. №34, 2000 (in Russ.).
3. Patent RU № 2222524. Method of industrial sodium formate separation. O.B. Abramov, V.V. Andreychatenko, N.I. Borovneva i dr. Bull. №3, 2004 (in Russ.).
4. Patent RU № 2222521. Continuous production process of chloroform and sodium formate. O.B. Abramov, V.V. Andreychatenko, N.I. Borovneva i dr. Bull. №3, 2002 (in Russ.).
5. Kudryashova O.S., Matveeva K.R. Solubility in the HCOONa – NaCl – HOCH2COONa – H2O system. Khimicheskaya tekhnologiya [Chemical Engineering], 2013, v. 14, no. 8, pp. 449-452 (in Russ.).
6. Nikurashina N.I., Mertslin R.V. Method of sections. Its application to multiphase condition of multicomponent systems studying. Saratov: Saratovsk. un-t, 1969 (in Russ.).
7. Zhuravlev E.F., Sheveleva A.D. Solubility study in water-salt systems by graphoanalytical method of sections. Zhurn. neorgan. khimii [Russian Journal of Inorganic Chemistry], 1960, v. 5, no. 11, pp. 2630-2637 (in Russ.).
8. Ioffe B.V. Refractometric chemical methods. L.: Khimiya, 1983 (in Russ.).
9. Patent RU № 2416790. Determination method of nonvariant equilibrium phases composition of multicomponent water-salt systems. Mazunin S.A., Frolova S.I., Kistanova N.S. Bull. №11, 2010 (in Russ.).

**The technological basis of the synthesis process N-aniline oxopropylidene**

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**Keywords**: N-hydroxypropyl aniline synthesis technology hydroxypropyl amine synthesis optimization technology oxypropylated aniline.

**Abstract**: Aromatic aminoalcohols are widely used in many areas of the economy, including the production of stabilizers. Industrial implementation of the processes of stabilizers and modifiers of rubbers will solve the problem of import substitution on the important areas of fine organic synthesis. The paper discusses the technology of obtaining N-oxopropylidene aniline, application and properties. Technological scheme was developed and the optimal process parameters to achieve maximum yield of the target product at the minimum specific energy consumption and material costs were determined. The proposed scheme of heat recovery of exothermic reaction, is characterized by 3-5 % less power consumtion compared to the original scheme.

**References**

1. Dorofeeva, J.N. Features of synthesis and the efficiency of stabilizing systems. Vestnik KGTY [Bulletin of the Kazan Technological University], 2009, no.3, pp. 52 – 56 (in Russ).
2. Dorofeeva, J.N. The influence of the composition of the oligomeric amine stabilizers on thermal-oxidative aging of vulcanizates. Kauchuk i rezina [International Polymer Science and technology], 2009, no.6, pp. 12 – 13 (in Russ).
3. Ionova, N.I. The influence of the structural features of hydroxypropyl aromatic amines on the physico-mechanical properties of rubber compounds. message 2. Kauchuk i rezina [International Polymer Science and technology], 2011, no.1, pp. 9-12 (in Russ).
4. Malinovski, М. S. Olefin oxides, and their derivatives. // М.: State scientific - technical publishing chemical literature, 1961.
5. Lebedev, N. N. Chemistry and technology of basic organic and petrochemical synthesis. // М.: Chemistry, 1988.
6. Yarulina, G.R. Kinetic regularities of hydroxypropyl. Vestnik KGTY [Bulletin of the Kazan Technological University], 2011, no.7, pp. 37 – 41 (in Russ).
7. Pavlov, K. F Examples and problems at the rate of processes and devices of chemical technology: Textbook. manual for schools. // М.: Alians, 2005.

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**Abstract.** Recently, composite materials are widely used in various industrial fields. Usual thermosetting binders have several disadvantages: low heat resistance and low impact resistance. The modification of thermosets (primarily, epoxy resins) with thermoplastics is considered an alternative to the modification with rubbers; the addition of rubber is known to enhance the crack resistance of materials in many cases and, at the same time, to decrease the elastic modulus, thermal stability, heat resistance, and oxidative stability.The aim of this work was to study the relaxation properties of the composition based on epoxy oligomer ED-20 and DADFS modified with PEI. For systems cured at different temperatures the dependence of the elastic modulus, mechanical loss tangent and a glass transition temperature (Tg) using DMA were determined. The prospects for the introduction of PEI modified epoxy binder are discussed.

**References**

1. Shanjin Li, Bin-Lin Hsu, Fuminng Li et al.   
   A study of polyimide thermoplastics used as tougheners in epoxy resins-structure, property and solubility relationships.   
   [Thermochimica].   
   Acta 340, 1999. р. 221-229.
2. Kalaev D.V., Branceva T.V., Gorbatkina Y.A., Kerber M.L., Kravchenko T.P., Salazkin S.N., Shaposhnikova V.V.   
   Adhesion of the epoxy resins – polyarilenesteroketone mixtures to the fibers

[High molecular compaunds].  
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