ABSTRACT AND REFERENCES

ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

DESIGN OF MATHEMATICAL MODEL OF ELECTRIC CAR WITH COMBINED ENERGY SUPPLY MODES (p. 4–8)

Sergiy Popov, Mykhailo Gurtovyi

Modeling of operation modes of the electric car (EC) allows to evaluate important parameters such as driving range, acceleration, battery capacity and type. The task of analysis and modeling of parameters and characteristics of EC with combined energy supply modes is important and of practical interest to developers and carmakers.

Currently, the issue of developing EC with combined energy supply modes is not fully disclosed. Also, there are many management strategies of energy storage units (batteries, supercapacitors, fuel cells and their possible combinations).

The authors have proposed a mathematical model, which is based on a new algorithm for the power division between the traction battery and the supercapacitor unit in the EC energy supply system. Based on the driving range simulation algorithm, a computing experiment was conducted, followed by analysis of experimental data. Analysis and modeling of the main parameters of EC with combined energy supply modes yielded concrete results of changing the battery life and driving range of EC. The results may be useful for engineering calculations (for example, to search for the optimal values of the energy capacity of the battery and the SC) and improving energy supply systems of electric cars.

Keywords: mathematical model, management strategy, computing experiment, electric car with combined energy supply modes, supercapacitor, power division algorithm, peak power.

References

1. Implementing regenerative mode in the electric vehicle with supercapacitors. Available at: http://www.uk.xlibx.com/4mehanika/23929-48-kremen chuckiy-nacionalniy-universitet-imeni-mihayla-ostrogradskog o -mizhnarodna-naukovo-tehnichna-konferenciya-mo.php (Last accessed: 11.09.2015).
2. Development of electric drive. Available at: http://nbuv.gov.ua/j-pdf/etks_2011_3_41.pdf/ (Last accessed: 24.08.2015).
3. Control of Ultracapacitor-Battery Hybrid Power Source for Vehicular Applications. Available at: https://thayer.dartmouth.edu/inductor/papers/gsei2008a.pdf/ (Last accessed 24.08.2015).
4. Thounthong, P., Rael, S., Davat, B. (2006). Control strategy of fuel cell/supercap a citors hybrid power sources for electric vehicle. Journal of Power Sources, 158 (1), 806–814. doi: 10.1016/j.jpowsour.2005.09.014
5. Gao, L., Dougal, R. A., Liu, S. (2005). Power Enhancement of an Actively Controlled Battery/Ultracapacitor Hybrid. IEEE Transactions on Power Electronics, 20 (1), 236–243. doi: 10.1109/tpel.2004.839784
6. Payman, A., Pierfederici, S., Meibody-Tabar, F. (2009). Energy Management in a Fuel Cell/Supercapacitor Multisource/Multiload Electrical Hybrid System. IEEE Transactions on Power Electronics, 24 (12), 2681–2691. doi: 10.1109/tpel.2009.2028426
7. Xiong, R., He, H., Wang, Y., Zhang, X. (2010). Study on ultracapacitor-battery hybrid power system for PHEV applications. High Technology Lett., 16, 23–28.
8. Ortuzar, M., Moreno, J., Dixon, J. (2007). Ultracapacitor-based auxiliary energy system for an electric vehicle: Implementation and evaluation. IEEE Transactions on Industrial Electronics, 54 (4), 2147–2156. doi: 10.1109/tie.2007.894713
9. Anosov, V. N. (2007). Using the power of filters to increase the run time mezhzaryadnogo autonomous vehicles. Electricity, 8, 2–7.
10. Busy guin, B. P. (1979). Electric motorcars (Calculation methods). Evaluation of electric vehicles and the analysis of their profiles. Moscow, CT : MADI, 52–67.
11. Design and Analysis of Fuel-Cell Hybrid Systems Oriented to Automotive Applications. Available at: https://upcommons.upc.edu/bitstream/handle/2117/7505/design_analysis.pdf/ (Last accessed: 24.08.2015)
12. Ultracpacitor Assisted Powertrains: Modeling, Control, Sizing, and The Impact on Fuel Economy. Available at: http://www.nt.ntnu.no/users/skoge/prost/proceedings/acc08/data/papers/0916.pdf/ (Last accessed: 24.08.2015)
13. Samosir, A. S. (2009). Development of a current control ultracapacitor charger based on digital signal processing. Telkomnika, 7 (3), 145–150. doi: 10.12928/telkomnika.v7i3.587
14. Slipchenko, N. I., Gurtovyi, M. Yu. (2014). Development of the stand for research electric vehicle's traction system with supercapacitors. Eastern- European Journal of Enterprise Technologies, 1/8 (67), 36–40. doi: 10.15587/1729-4061.2014.19898
15. Sauer, D. U., Wenzl, H. (2008). Comparison of different approaches for lifetime prediction of electrochemical systems – Using lead-acid batteries as example. Journal of Power Sources, 176 (2), 534–546. doi: 10.1016/j.jpowsour.2007.08.057
16. Downing, S. D., Socie, D. F. (1982). Simple rainflow counting algorithms. International Journal of Fatigue, 4 (1), 31–40. doi: 10.1016/0142-1123(82)90018-4
17. Trojan Battery Company. Available at: http://www.trojanbattery.com/pdf/GEL_SS_web.pdf/ (Last accessed: 25.08.2015)
18. Larminie, J., Lowry, J. (2003). Electric Vehicle Techology Explained. Electric Vehicle Modelling. Chichester, John Wiley & Sons Ltd, 296.

INFLUENCE RESEARCH OF PROFILE CHORDS RATIO ON AERODYNAMIC CHARACTERISTICS OF TANDEM COMPRESSOR CASCADE (p. 9–13)

Yuriy Tereschenko, Ekaterina Doroshenko, Jalal Abolhassan zade

Efficiency improvement of gas turbine compressors is ensured by the extensive use of tandem blade rows in straightener blades of the last stages of multistage axial compressors. Their installation provides large flow deflection angles in the unstalled flow of blade rows and, consequently, a low level of losses in the design mode of the compressor. The problem of influence research of the first- and second-row blade chords ratio in tandem blade rows in a wide range of angles of attack is relevant and is of practical interest in developing recommendations for ensuring the gas-dynamic stability of gas turbine compressors. To solve the problem, the method of the computational experiment was used and characteristics of tandem compressor cascade with different first- and second-row blade chords ratios were calculated in the paper. The calculation results of the characteristics of tandem cascade were compared with the characteristics of an equivalent single compressor cascade. For the computational domain of the studied tandem and equivalent single cascades, small adaptive unstructured grid and the second-order design scheme with the local use of the first-order design scheme (High resolution) was applied. The Menter's SST model was used to solve the problems. The results showed that the aerodynamic characteristics of the tandem compressor cascades essentially depend on the first- and second-row blade chords ratio. With positive angles of attack, the quality parameter of tandem cascades is higher than that of single, with the first- and second-row blade chords ratio, corresponding to the position of the slot $x_{ш}=(0,3...0,4)b_{\Sigma}$. With negative angles of attack, the quality parameter of tandem cascades is higher than that of single, with the first- and second-row blade chords ratio, corresponding to the position of the slot $x_{ш}=(0,5...0,7)b_{\Sigma}$.

Keywords: simulation, angle of attack, tandem cascade, stall, compressor, flow, aerodynamic characteristics, viscosity.

References

1. Teres c henko, Yu. M. (1987). Ajerodinamicheskoe sovershenstvovanie l opatochnyh apparatov kompressorov. Moscow, USSR: Mashinostroenie, 168.
2. Gostelou, Dzh. (1987). Ajerodinamika reshetok turbomashin. Moscow, USSR: Mir, 392.
3. Chen, N. (2010) Aerothermodynamics of turbomachinery: analysis and design. Singapure: John Wiley & Sons Pte Ltd, 461. doi: 10.1002/9780470825020
4. Fikkert, K. (1953) Issledovanie difuzornyh reshetok s bol'shim otkloneniem potoka. Voprosi raketnoj tehniki, 1, 57–67.
5. McGlu m phy, J., Wing-Fai, Ng, Steven, R., Kempf, W., Kempf, S. (2010). 3 D Numerical Investigation of Tandem Airfoils for a Core

Compressor Rotor. Journal of Turbomachinery, 132 (3), 1–9. doi: 10.1115/1.3149283
6. Zhao, S., Luo, J., Lu, X., Zhu, J. (2010). Exploring the intention of using aspirated cascade to replace tandem cascades. Journal of Thermal Science, 19 (5), 390-396. doi: 10.1007/s11630-010-0399-4
7. Lee, T. (2011). Flow past two in-tandem airfoils undergoing sinusoidal oscillations. Experiments in Fluids, 51 (6), 1605–1621. doi: 10.1007/s00348-011-1173-4
8. Shen, C., Qiang, X., Teng, J. (2012). Numerical and experimental investigation of an axial compressor flow with tandem cascade. Journal of Thermal Science, 21 (6), 500–508. doi: 10.1007/s11630-012-0574-x
9. Qiushi, L., Hong W., Sheng Zh. (2010). Application of tandem cascade to design of fan stator with supersonic inflow. Chinese Journal of Aeronautics, 23 (1), 9–14. doi: 10.1016/s1000-9361(09)60181-3
10. Menter, F. R. (1994). Two-equation eddy viscosity turbulence models for engineering applications. AIAA Journal, 32 (8), 1598–1605. doi: 10.2514/3.12149
11. Tereshchenko, Ju. M., Doroshenko, E. V., Abolhassan zade, Dzh. (2015). Modelirovanie techenija v dvuhrjadnyh lopatochnyh vencah. Visnik Nacional'nogo tehnichnogo universitetu "HPI". Serija: Mehaniko-tehnologichni sistemi ta kompleksi, 22, 75–77.

STUDY OF CORROSION RATE AND ACCUMULATION OF DEPOSITS UNDER CIRCULATING WATER CONCENTRATION IN BENCH EXPERIMENTS (p. 14–20)

Vadim Chichenin, Victor Kishnevskiy, Anastasiia Hrytsaienko, Vitaliy Ahrameev, Iryna Shuliak

The results of the study of corrosion rate and accumulation of deposits on the equipment of circulating cooling systems (CCS) fed with biologically treated municipal and industrial wastewater in the circulating water inhibition by phosphonate-based reagents were presented.

Methods of testing the corrosion intensity, the formation of sparingly soluble deposits from carbonates and corrosion products on heated and unheated samples of various metals in the circulating water inhibition were given.

Stands for investigating low-temperature scale formation and corrosion of structural materials of power equipment, simulating thermal-hydraulic operating conditions of circulating cooling systems of large power facilities to conduct a series of experiments on samples of different metals were developed.

Comparisons of the results of physicochemical composition of deposits based on X-ray phase analysis, gravimetric, chemical control on test samples, and the corrosion intensity of the St.20 samples show the comparability of the results obtained after 100...150 hours of testing. However, at longer tests, the total amount of deposits on samples, obtained by gravimetric control is lower than the mass loss due to corrosion, which is explained by metal dissolution in the circulating water and low adhesion of the corrosion products with the sample surface.

The data are needed to predict the management efficiency of water chemistry of the cooling systems of large power facilities fed with make-up high-salinity water by controlling the deposition intensity of sparingly soluble salts and corrosion on the heat transfer surfaces of power equipment.

Keywords: corrosion, circulating cooling system, recycling, wastewater, inhibition.

References

1. Gallegos, A. A., Martinez, S. S., Reyes Ramirez, L. J. (2005). Evaluation of Water Corrosivity Using a Corrosion Rate Model for a Cooling Water System. Journal of New Materials for Electrochemical Systems, 8, 133–142.
2. Cervová, J., Hagarová, M., Lacková, P. (2014). Corrosive protection of metal materials in cooling water. American Journal of Materials Science and Application, 2 (1), 6–10. Available at: http://www.openscienceonline.com/journal/ajmsa
3. Safari, I., Walker, M. E., Hsieh, M.-K., Dzombak, D. A., Liu, W., Vidic, R. D. et. al. (2013). Utilization of municipal wastewater for cooling in thermoelectric power plants. Fuel, 111, 103–113. doi: 10.1016/j.fuel.2013.03.062
4. Li, Y.-D., Xu, N., Wu, X.-F., Guo, W.-M., Shi, J.-B., Zang, Q.-S. (2013). Failure analysis of the condenser brass tube in 150MW thermal power units. Engineering Failure Analysis, 33, 75–82. doi: 10.1016/j.engfailanal.2013.04.026
5. Karabelas, A. J. (2002). Scale formation in tubular heat exchangers-research priorities. International Journal of Thermal Sciences, 41 (7), 682–692. doi: 10.1016/s1290-0729(02)01363-7
6. Hui, Q., Peiyue, L. (2011). Mixing Corrosion of CaCO 3 in Natural Waters. E-Journal of Chemistry, 8 (3), 1124–1131. doi: 10.1155/2011/891053
7. Marín-Cruz, J., Cabrera-Sierra, R., Pech-Canul, M. A., González, I. (2007). EIS characterization of the evolution of calcium carbonate scaling in cooling systems in presence of inhibitors. Journal of Solid State Electrochemistry, 11 (9), 1245–1252. doi: 10.1007/s10008-007-0279-3
8. Little, B., Wagner, P., Mansfeld, F. (1992). An overview of microbiologically influenced corrosion. Electrochimica Acta, 37 (12), 2185–2194. doi: 10.1016/0013-4686(92)85110-7
9. Shen, C., Cirone, C., Jacobi, A. M., Wang, X. (2015). Fouling of enhanced tubes for condensers used in cooling tower systems: A literature review. Applied Thermal Engineering, 79, 74–87. doi: 10.1016/j.applthermaleng.2015.01.014
10. Technical Reference for water treatment (2007). SPb.: New Journal.
11. Akol'zin, P. A. (1982). Heat power equipment metal corrosion and protection. Moscow: Energoizdat, 303.
12. Kishnevskiy, V. A., Chichenin, V. V. (2014). Study of carbonate deposits on heat exchange surfaces of condensers. Eastern-European Journal of Enterprise Technologies, 3/8 (69), 52–58. doi: 10.15587/1729-4061.2014.25191
13. Kishnevskiy, V. A., Chichenin, V. V., Shuliak, I. D. (2013). Water chemistry calcucation method of the circulating cooling system with recirculation. Eastern-European Journal of Enterprise Technologies, 6/8 (66), 10–14. Available at: http://journals.uran.ua/eejet/article/view/19428/17072
14. Chichenin, V. V. (2010). Improving the efficiency of coolants conditioning in the clarifier at complex cooling systems of power plants. Odessa, 19.
15. Peev, T., Taseva, V., Mitov, I., Kunev, B., Paneva, D., Bonev, B. (2001). Some Data on the Dynamics of Corrosion Processes in Water Circulation Cooling Systems. Monatshefte Fuer Chemie/Chemical Monthly, 132 (10), 1181–1188. doi: 10.1007/s007060170033

EXPERIMENTAL STUDY ON ANTIWEAR PROPERTIES FOR BLENDS OF JET FUEL WITH BIO-COMPONENTS DERIVED FROM RAPESEED OIL (p. 20–28)

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Antiwear properties of jet fuel, two kinds of biocomponents derived from rapeseed oil and their mixtures were investigated experimentally. Antiwear properties were estimated by the value of the scuffing load and the limiting load of scuffing applied to the friction pair working in a fuel medium. Biocomponents, mainly rapeseed oil FAME and rapeseed oil FAME modified via vacuum distillation were used during the study. It is found that lubricity of biocomponents is significantly higher comparing to conventional jet fuel. It is explained by the chemical composition of FAME: highly polarity of molecules stipulate their good adsorption at the surface of friction pair. High viscosity of biocomponents due to chemical structure positively influence on their lubricity. Adding biocomponents into jet fuel results in strengthening of boundary film and thus improves antiwear properties of fuel blends. It is determined that FAME modified via vacuum distillation possesses better lubricating ability comparing to standard FAME derived from rapeseed oil. Correlation between viscosity and lubricity of fuel is shown.

Keywords: jet fuel, alternative fuel, biocomponent, lubricity, wearing, viscosity, scuffing load.

References

1. Kandaramath Hari, T., Yaakob, Z., Binitha, N. N. (2015). Aviation biofuel from renewable resources: Routes, opportunities and challenges. Renewable and Sustainable Energy Reviews, 42, 1234–1244. doi: 10.1016/j.rser.2014.10.095

2. Maurice, L. Q., Lander, H., Edwards, T., Harrison, W. (2001). Advanced aviation fuels: a look ahead via a historical perspective. Fuel, 80 (5), 747–756. doi: 10.1016/s0016-2361(00)00142-3
3. Liu, G., Yan, B., Chen, G. (2013). Technical review on jet fuel production. Renewable and Sustainable Energy Reviews, 25, 59–70. doi: 10.1016/j.rser.2013.03.025
4. Hileman, J. I., Stratton, R. W. (2014). Alternative jet fuel feasibility. Transport Policy, 34, 52–62. doi: 10.1016/j.tranpol.2014.02.018
5. Jenkins, R. W., Munro, M., Nash, S., Chuck, C. J. (2013). Potential renewable oxygenated biofuels for the aviation and road transport sectors. Fuel, 103, 593–599. doi: 10.1016/j.fuel.2012.08.019
6. Hong, T. D., Soerawidjaja, T. H., Reksowardojo, I. K., Fujita, O., Duniani, Z., Pham, M. X. (2013). A study on developing aviation biofuel for the Tropics: Production process – Experimental and theoretical evaluation of their blends with fossil kerosene. Chemical Engineering and Processing: Process Intensification, 74, 124–130. doi: 10.1016/j.cep.2013.09.013
7. Chuck, C. J., Donnelly, J. (2014). The compatibility of potential bioderived fuels with Jet A-1 aviation kerosene. Applied Energy, 118, 83–91. doi: 10.1016/j.apenergy.2013.12.019
8. Lapuerta, M., Rodríguez-Fernández, J., Estevez, C., Bayarri, N. (2015). Properties of fatty acid glycerol formal ester (FAGE) for use as a component in blends for diesel engines. Biomass and Bioenergy, 76, 130–140. doi: 10.1016/j.biombioe.2015.03.008
9. Alves, S. M., Barros, B. S., Trajano, M. F., Ribeiro, K. S. B., Moura, E. (2013). Tribological behavior of vegetable oil-based lubricants with nanoparticles of oxides in boundary lubrication conditions. Tribology International, 65, 28–36. doi: 10.1016/j.triboint.2013.03.027
10. Iakovlieva, A. V., Boichenko, S. V., Vovk, O. O. (2015). Patent of Ukraine No. 95751. Method of jet fuels component production from plant feedstock. Registered on 12.01.2015.
11. Kallio, P., Pásztor, A., Akhtar, M. K., Jones, P. R. (2014). Renewable jet fuel. Current Opinion in Biotechnology, 26, 50–55. doi: 10.1016/j.copbio.2013.09.006
12. Hu J., Du Z., Li C., Min E. (2005). Study on the lubrication properties of biodiesel as fuel lubricity enhancers. Fuel, 84, 1601–1606. doi: 10.1016/j.fuel.2005.02.009
13. Maru, M. M., Trommer, R. M., Cavalcanti, K. F., Figueiredo, E. S., Silva, R. F., Achete, C. A. (2014). The Stribeck curve as a suitable characterization method of the lubricity of biodiesel and diesel blends. Energy, 69, 673–681. doi: 10.1016/j.energy.2014.03.063
14. Xu, Y., Wang, Q., Hu, X., Li, C., Zhu, X. (2010). Characterization of the lubricity of bio-oil/diesel fuel blends by high frequency reciprocating test rig. Energy, 35 (1), 283–287. doi: 10.1016/j.energy.2009.09.020
15. Devyanin, S. N., Markov, V. A., Semenov, V. G. (2007). Rastitelyie masla i topliva dlya dizelnikh dvigatelei. Kharkiv: Novoe Slovo.
16. Agarwal, S., Chhibber, V. K., Bhatnagar, A. K. (2013). Tribological behavior of diesel fuels and the effect of anti-wear additives. Fuel, 106, 21–29. doi: 10.1016/j.fuel.2012.10.060
17. Geller, D. P., Goodrum, J. W. (2004). Effects of specific fatty acid methyl esters on diesel fuel lubricity. Fuel, 83 (17-18), 2351–2356. doi: 10.1016/j.fuel.2004.06.00
18. Aviation Turbine Fuel Lubricity – A Review (2014). CRC Report AV-14-11. Coordinating Research Council, Inc.
19. Yanovskii, L., Dubovkin, N., Galimov, F. et. al. (2005). Inzhenernyie osnovy aviatsionnoi khimmotologii. Kazan: Izdatelstvo Kazanskogo Universiteta.
20. Dubovkin, I., Yanovskyi, L. Shigabaev, T., Galimov, F., Ivanov, V. (2000). Inzhenernyie metody analiza fiziko-khimicheskikh i ekspluatatsionnykh svoistv topliv. Kazan: Master-line.
21. T-02U (2011). Universal Four-Ball Testing Machine – user manual. Radom: Institute for Sustainable Technologies – National Research Institute.
22. Szczerek, M., Tuszycski, W. (2000). Tribological researches – scuffing. Radom: Institute for Sustainable Technologies – National Research Institute.
23. Piliavskyi, V., Polunkin, E., Gaidai, O. (2013). Improvement of lubricating properties of ethanol motor fuels. Proceedings of the 2-d All-Ukrainian ecological conference, 46–50.
24. Anastopoulos, G., Lois, E., Zannikos, F., Kalligeros, S., Teas, C. (2002). HFRR lubricity response of an additized aviation kerosene for use in CI engines. Tribology International, 35 (9), 599–604. doi: 10.1016/s0301-679x(02)00050-6
25. Yanovskii, L., Dmitrenko, V., Dubovkin, N. et. al. (2005). Osnovy aviatsionnoi khimmotologii. Moscow: MATI, 678.
26. Nagornov, S. A., Dvoreckyi, D. S., Romancova, S. V., Tarov, V. P. (2010). Tekhnika i tekhnologii proizvodstva i pererabotki rastitelnyh masel. Tambov: Izdatelstvo TGTU, 96.
27. Sarin, R., Kumar, R., Srivastav, B., Puri, S. K., Tuli, D. K., Malhotra, R. K., Kumar, A. (2009). Biodiesel surrogates: Achieving performance demands. Bioresource Technology, 100 (12), 3022–3028. doi: 10.1016/j.biortech.2009.01.032

ANALYZING THE OVERALL PERFORMANCE OF AIR COOLERS OF THE EQUIPMENT FOR PRIMARY OIL REFINING (p. 29–34)

Viktoria Kryvda

The paper presents findings on the efficiency of air coolers of the equipment for primary oil refining. The research has revealed that in the process of condensation of light fractions of oil products, air coolers emit into the environment a high-temperature exhaust gas, which should be used for regenerative heating in heat exchangers. Gases with a complex hydrocarbon composition are supplied with their thermal parameters at the operating temperatures. The heat capacity that can be used to transfer heat energy from hot to cold flows reaches 20 MW. This allows using the heat of the exhaust gases and saving primary energy expended in the production process in the facility for primary processing of oil. Temperature pressure in the air coolers can be reduced by regenerative use of their thermal potential energy for district heating.

Keywords: air cooler, heat flow, thermal potential energy, heat capacity/thermal capacity.

References

1. Maksimov, M. V., Kryvda, V. I. (2014). Ustanovka atmosfernoi vakuumnoi trubchatki dlya pidgotovky ta pervynnoi pererobky nafty [Installation of atmospheric vacuum trubchatka for preparation and primary oil refining]. Patent of Ukraine № 107027, MPK C10 G7/00. Appl. № a201303011. Filed 11.03.2013. Bull. № 21/2014, 5
2. Saghafifar, M., Gadalla, M. (2015). Innovative inlet air cooling technology for gas turbine power plants using integrated solid desiccant and Maisotsenko cooler. Energy, 87, 663–677. doi: 10.1016/j.energy.2015.05.035
3. Haijie Q., Weizhong L., Bo D., Zhihai Zh., Weiying Zh. (2014). Experimental study of the characteristic of frosting on low-temperature air cooler. Experimental Thermal and Fluid Science, 55, 106–114. doi: 10.1016/j.expthermflusci.2014.02.021
4. Bolotin, S., Vager, B., Vasilijev, V. (2015). Comparative analysis of the cross-flow indirect evaporative air coolers. International Journal of Heat and Mass Transfer, 88, 224–235. doi: 10.1016/j.ijheatmasstransfer.2015.04.072
5. Anisimov, S., Pandelidis, D., Jedlikowski, A. (2015). Performance study of the indirect evaporative air cooler and heat recovery exchanger in air conditioning system during the summer and winter operation. Energy, 89, 205–225. doi: 10.1016/j.energy.2015.07.070
6. Liu, H., Nagano, K., Morita, A., Togawa, J., Nakamura, M. (2015). Experimental testing of a small sorption air cooler using composite material made from natural siliceous shale and chloride. Applied Thermal Engineering, 82, 68–81. doi: 10.1016/j.applthermaleng.2015.02.060
7. Ou, G., Wang, K., Zhan, J., Tang. M., Liu. H., Jin. H. (2013). Failure analysis of a reactor effluent air cooler. Engineering Failure Analysis, 31, 387–393. doi: 10.1016/j.engfailanal.2013.02.025
8. Zhelezny. V. P., Markvart. A. S.; Grigor'ev, B. A. (Ed.) (2011). Novie strukturno-additivnie metody prognozirovania teplofizicheskih svoяjstv uglevodorodov [The Methods of Prediction of the Properties for Substances on the Coexistence Curve Including Vicinity of the Critical Point] Aktual'nye voprosy issledovsnij plastovyh sistem mestorogdenij uglevodorodov: sb. nauch. Statej v 2 ch. Part 1. Gazprom VNIIGAZ, 207–218.
9. Wrenick, S., Sutor, P., Pangilinan, H., Schwarz, E. E. (2005). Heat transfer properties of engine oils. World Tribology Congress III, 595–596. doi: 10.1115/wtc2005-64316
10. Maksimov, M. V., Kryvda, V. I. (2011). Opredelenie minimal'nogo temperaturnogo napora mezhdu kholodnymi i goryachimi potokami dlya rekuperativnykh teploobmennikov ELOU-AVT [Determination of Minimal Temperature Pressure between Cold and Hot Flows for Recuperative Heat Exchangers REDA-VDU]. Kholodyl. tekhnika i tekhnolohiia, 3 (131), 56–62.
11. Salehi, M. M., Safarzadeh, M. A., Sahraei, E., Nejad, S. A. T. (2014). Comparison of oil removal in surfactant alternating gas with water alternating gas, water flooding and gas flooding in secondary oil re-

covery process. Journal of Petroleum Science and Engineering, 120, 86–93. doi: 10.1016/j.petrol.2014.05.017
12. Li, X., Chan, C. W., Nguyen, H. H. (2013). Application of the Neural Decision Tree approach for prediction of petroleum production. Journal of Petroleum Science and Engineering, 104, 11–16. doi: 10.1016/j.petrol.2013.03.018
13. Sun, K., Ouyang, H., Tian J., Wu, Y., Du, Zh. (2015). Experimental and numerical investigations on the eccentric vortex of the cross flow fan. International Journal of Refrigeration, 50, 146–155. doi: 10.1016/j.ijrefrig.2014.10.005

THE INFLUENCE OF SYNTHESIS OF THE INITIAL MIXTURE AND BLOWING AGENTS ON THE FORMATION OF A POROUS STRUCTURE (p. 35–38)

Andrey Cheylitko

It is shown that a porous structure affects the thermophysical characteristics of the material. The analysis of experimental studies on the influence of synthesis of the initial mixture on the formation of a porous structure was performed.

Blowing agents in swelling or foaming of the mixture are gases released in the chemical reaction (oxygen, water vapor, hydrogen, carbon dioxide, etc.). The paper presents the reactions with the greatest decline in the Gibbs free energy, i.e. most likely to occur.

Based on the analysis, the principal blowing agents were identified, and also the dependencies of material properties on the synthesis of the initial components were found. The absence (at the present stage of scientific discovery) of the possibility of quality control of porous structure by synthesis of the initial mixture was shown. Integrated indicators of the porous structure (porosity, number of pores, position of pores in space, the shape of the pores, pore formation energy), which will allow to develop a new control methodology of the porous structure were proposed.

Keywords: porous structure, blowing agents, swelling, thermodynamic analysis.

References

1. Cheylitko, A. A. (2013). Study of vesiculation in intumescent material. Technology audit and production reserves, 5/4 (13), 38–40. Available at: http://journals.uran.ua/tarp/article/view/18251/16063
2. Chudnovskij, A. F. (1962). Teplofizicheskie harakteristiki dispersnyh materialov. Moscow: Gosudarstvennoe izdatel'stvo fiziko–matematicheskoj literatury, 456.
3. Cheylyitko, A. A, Pavlenko, A. M. (2013). Vspuchivanie poristogo kremnezemistogo materiala. Saarbrucken, Deutschland: LAP LAMBERT Academic Publishing, 130.
4. Pavlenko, A. M, Cheylitko, A. A. (2013). Skorost' formirovanija pory v materiale, kotoryj nabuhaet. University of Technology and Humanities in Radom. Poltava National Technical Yuri Kondratyuk University, 31–37.
5. Demidovich, B. K. (1972). Proizvodstvo i primenenie penostekla. Minsk: Nauka i tehnika, 304.
6. Temkin, M. I, Shvarcman, L. A. (1948). Vspomogatel'naja tablica dlja raschetov po himicheskoj termodinamiki. Uspehi himii, 2, 259–262.
7. Keshishjan, T. N, Bokunjaeva, V. I. (1950). Sb. nauchnyh rabot po steklu. Moscow, 128–134.
8. Chubakov, N. G, Chubakova, V. A. (1996). Teplomassoperenos v deformirujushhihsja v processe strukturoobrazovanija gazobetonah. Teplomassoperenos v deformirujushhihsja v processe strukturoobrazovanija gazobetonah, 188–191.
9. Freire–Gormaly, M. (2013). The Pore Structure of Indiana Limestone and Pink Dolomite for the Modeling of Carbon Dioxide in Geologic Carbonate Rock Formations. Department of Mechanical and Industrial Engineering. – University of Toronto, 85.
10. Dincov, D. D., Parrott, K. A., Pericleous, K. A. (2004). Heat and mass transfer in two-phase porous materials under intensive microwave heating. Journal of Food Engineering, 65 (3), 403–412. doi: 10.1016/j.jfoodeng.2004.02.011 Available at: http://www.researchgate.net/publication/222658046
11. Eom, J.-H., Kim, Y.-W., Raju, S. (2013). Processing and properties of macroporous silicon carbide ceramics: A review. Journal of Asian Ceramic Societies, 1 (3), 220–242. doi: 10.1016/j.jascer.2013.07.003
12. Ashkroft, N. Mermin, N. (1979). Fizika tverdogo tela. Moscow: Mir, 392.

ENERGY EFFICIENT AND ENVIRONMENTALLY FRIENDLY TECHNOLOGY OF STABILIZING AIRLINE ENTERPRISES' WASTEWATER SLUDGES (p. 39–45)

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Various utilization methods of wastewater sludges were considered. It is shown that their use as organic fertilizer can be considered as the most promising. However, their preliminary stabilization is necessary to prevent further decay and to get rid of pathogens. Many traditional methods of anaerobic fermentation and conventional designs of the digests were analyzed. It is shown that all of them have a significant number of shortcomings, making them not always cost effective and environmentally friendly.

A variety of intensification methods of anaerobic fermentation processes was examined. It is shown that the methods of separation of different fermentation stages, such as hydrolysis, acidogenesis, acetogenesis, and methanogenesis in space (when these stages proceed in different tanks) and in time (when done consistently) may be the most promising. Different strains of bacteria that are responsible for different fermentation stages grow in many cases far more rapidly when separated one from the other. Anaerobic processes occurring at different fermentation stages were investigated. The most important parameters and their optimal values for each stage were also identified. Based on this, a new fermentation technology, which allows to intensify the process, significantly reduce the fermentation duration, produce commodity carbon dioxide, environmentally clean organic fertilizer, as well as biogas with significantly higher methane content than with traditional technologies, was proposed.

Keywords: airline enterprise, biogas, intensification, digester, wastewater sludge, anaerobic fermentation technology.

References

1. Jakovlev, S. V., Karelin, J. A., Zhukov, A. I., Kolobanov, S. K. (1975). Sewerage. Moscow: Strojizdat, 632. [In Russian]
2. Udalov, R. V., Andreeva, L. V. (2006). Environmental aspect of treatment and utilization of sewage sludge. Proceedings of Institute SHPR Novgorod State University, 14, 45–59. [In Russian]
3. Alrawi, R. A., Ahmad, A., I., N., A. K., M. O. (2010). Methane Production during Start-Up Phase of Mesophilic Semi-Continues Suspended Growth Anaerobic Digester. International Journal of Chemical Reactor Engineering, 8 (1), 89. doi: 10.2202/1542-6580.2034
4. Babaev, V. N., Goroch, N. P., Korinko, I. V. (2011). Power budget of methane formation during mesophilous anaerobic decomposition of organic parts of wastes. Eastern-Europian journal of advanced technology, 4/6 (52), 59–65. Available at: http://journals.uran.ua/eejet/article/view/1427/1325
5. Fesjuk, V. O. Prospects assessment of biogas production out of sewage sludge of Lutsk city's sewage water treatment plant. Nature of Western Polesye and adjoining areas, 7, 84–90. [In Russian]
6. Altas, L. (2009). Inhibitory effect of heavy metals on methane-producing anaerobic granular sludge. Journal of Hazardous Materials, 162 (2-3), 1551–1556. doi: 10.1016/j.jhazmat.2008.06.048
7. Volova, T. G. (1999). Biotechnology. Novosibirsk: publishing house of Siberian branch of Russian Academy of Science, 252. [In Russian]
8. Lisitsyn, E. F., Shamanskiy, S. I., Pochtovenko, V. V. (2008). Desinfection of sewage water sludges with biogas producing in multisectional methanetanks. Proceedings of the Khmelnitsk National University, 4, 107–110. [In Ukrainian]
9. Trakhunova, I. A. (2014). Increasing efficiency of anaerobic preatment of organic wastes in a methanetank with hydraulic agitation on the basis of numerical experiment: aref. of PhD thesis. Kazan', 19. [In Russian]
10. Karaeva, U. V., Trakhunova, I. A. (2010). Review of biogas technologies and methods of intensification of anaerobic fermentation processes. Proceedings of Academenerg, 3, 109–127. [In Russian]
11. Kovalev, V. V., Ungurjanu, D. V., Kovaleva, O. V. (2012). Theoretical and practical aspects of improving processes of biogas technology. Problems of Regional Energetics, 1, 102–114. [In Russian]
12. Barskiy, E. L., Shandieva, I. O., Savanina, J. V. et. al. (2011). Effect of melafen on development of cyanobacteria cultures and green mikroalgae under stress conditions. Proceedings of the Moskow State University, 1, 15–20. [In Russian]

13. Liao, B. Q., Kraemer, J. T., Bagley, D. M. (2006). Anaerobic membrane bioreactors. Application and research directions. Sci. Technol, 36, 489–530. [In English]
14. Ungureanu, D. (2005). Biological wastewater treatment using fixed film. "Inovations in the field of water supply, sanitation and water". Psper of Conference of the young scientists and researches, Bucharest, 97–102. [In English]
15. Korznikova, M. V. (2006). Strategic aspects of sustainable management of livestock and poultry farming wastes for minimization of the negative affect on the environment: aref. of PhD thesis. Moscow, 38. [In Russian]
16. Gjunter, L. I., Goldfarb, L. L. (1991). Methanetanks. Moscow: Strojizdat, 280. [In Russian]
17. Ziemiński, K., Frac, M. (2012). Methane fermentation process as anaerobic digestion of biomass: Transformations, stages and microorganisms. African Journal of Biotechnology, 11(18), 4127–4139. doi: 10.5897/ajbx11.054
18. Chae, K. J., Jang, A., Yim, S. K., Kim, I. S. (2008). The effects of digestion temperature and temperature shock on the biogas yields from the mesophilic anaerobic digestion of swine manure. Bioresource Technology, 99 (1), 1–6. doi: 10.1016/j.biortech.2006.11.063
19. Möller, U. (1988). Entseuchung von Klarschlam. Eine Standartbestimmung 1987. Korrespondenz Fbwasser, 1, 24–30. [In German]
20. Danilovich, D. A., Kozlov, M. N., Kevbrina, M. V., Gusjev, D. V. Influence of sewage water sludges pretreatment on completeness of methane fermentation processes. Water: technologies, materials, equipment, ecology, 2, 24–26. [In Russian]
21. Predzimirska, L. M. (2015). Cavitational purification of natural and sewage waters from organic and biological contaminations. Ivao-Frankivsk, 21. [In Ukrainian]
22. Pereira, M. A., Sousa, D. Z., Mota, M., Alves, M. M. (2004). Mineralization of LCFA associated with anaerobic sludge: Kinetics, enhancement of methanogenic activity, and effect of VFA. Biotechnology and Bioengineering, 88 (4), 502–511. doi: 10.1002/bit.20278
23. Welsh, F. (1986). Untresuchungen zur Optimisierung der zweistufigen anaeroben Klarschlamm. GFW-Wasser-Abwasser, 3, 109–117. [In German]
24. Pereira, M. A., Cavaleiro, A. J., Mota, M., Alves, M. M. (2003). Accumulation of long chain fatty acids onto anaerobic sludge under steady state and shock loading conditions: effect on acetogenic and methanogenic activity. Water Sci. Technol., 48, 33–40. [In English]
25. Patent USA 4722741 (1988). MKI CO2 F11/04, HKI 48/197A. [In English]