ABSTRACT AND REFERENCES

ECOLOGY

OXYGEN REGIME IN RESEARCH ON THE WORK OF PLUGFLOW AERATION TANKS WITH FIXED BIOMASSES (p. 4-11)

Aleksandr Oleynik
Institute of Hydromechanics of
the NAS of Ukraine, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0003-1095-5751

Tamara Airapetian
O. M. Beketov National University of
Urban Economy in Kharkiv, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-8834-5622

The paper presents a mathematical description of biological wastewater treatment processes, whereas the study develops more reliable methods for calculating the parameters of aerobic wastewater treatment from organic contaminants in aerotanks.

A general mathematical model has been constructed for the evaluation and analysis of the joint removal of organic pollutants (OPs) by weighed and fixed biocenoses in plugflow aerotanks. This model takes into account the provision of the oxidation process with the required amount of oxygen and the peculiarities of the joint removal of organic pollutants by a biofilm, which is formed on the surface of additional loading, and a suspended biocenosis.

Some simplifications of the model, which help obtain analytical dependencies, are suggested and proved. It is assumed that the process of OP oxidation with suspended active sludge occurs in a zero-order reaction, and in a biofilm, it occurs by a first-order reaction.

The implementation of the proposed model helps estimate the influence of various purification factors in plugflow aerotanks and substantiate the most economical and effective parameters of OP removal in these structures. The study considers the possible technological and design schemes for plugflow aerotanks when a reactor containing elements with a fixed biocenosis is located first in the direction of the flow of sewage and vice versa. It is proposed to use such technological solutions to intensify the work of biological treatment plants such as aerotanks.

Keywords: plugflow aerotank, oxygen regime, mathematical model, organic contamination, active sludge, biofilm.

References

1. Vasilenko, A., Epoyan, S., Smirnova, G. et. al. (2012). Water removal and sewage treatment of the city. Course and diploma design. Examples and calculations. Kyiv–Kharkiv: KNUBA, KhNUBA, 572.
2. Voronov, Yu. (2009). Water removal and waste waters treatment. Moscow: Izdatel'stvo Associacii stroitel'nyh vuzov, 760.
3. Zhmur, N. (2003). Technological and biochemical processes of sewage treatment in constructions with aerotanks. Moscow: AKVAROS, 512.
4. Von Sperling, M. (2007). Activated sludge and aerobic biofilm reactors. Vol. 5. Biological wastewater treatment series. London: IWA Publishing, 328.
5. Gebara, F. (1999). Activated sludge biofilm wastewater treatment system. Water Research, 33 (1), 230–238. doi: 10.1016/s0043-1354(98)00210-3
6. Oleynik, A., Airapetian, T. (2015). The modeling of the clearance of waste waters from organic pollutions in bioreactors-aerotanks with suspended (free flow) and fixed biocenoses. Reports of the National Academy of Sciences of Ukraine, 5, 55–60. doi: 10.15407/dopovidi2015.05.055
7. Henze, M., Van Loosdrecht, M. C. M., Ekama, G. A., Brdjanovic, D. (2008). Biological Wastewater Treatment. London: Iwa Publishing, 511.
8. Svyatenko, A., Dyadenko, N., Nechiporenko-Shabunina, T. (2011). Research of change of efficiency of sewage treatment in aerotanks under the influence of different factors. Ecological safety, 1/2011 (11), 64–66.
9. Liao, Q., Tian, X., Chen, R., Zhu, X. (2008). Mathematical model for gas-liquid two-phase flow and biodegradation of a low concentration volatile organic compound (VOC) in a trickling biofilter. International Journal of Heat and Mass Transfer, 51 (7-8), 1780–1792. doi: 10.1016/j.ijheatmasstransfer.2007.07.007
10. Wanner, O., Ebert, N. I., Rittman, B. E. (2006). Matematical modeling of biofilms. Scientificand Technical report, No. 18, 208.
11. Oleynik, A., Kravchuk, A., Kolpakova, O. (2012). The theoretical justification of wastewater treatment in trickling biofilters. Reports of the National Academy of Sciences of Ukraine, 3, 179–183.
12. Kolpakova, O. (2015). Theoretical studies and calculations of wastewater treatment in trickling biofilters. MOTROL. Commission of motorization and energetics in agriculture, 17 (8), 165–173.
13. Sanchez, O. (Ed.) (2016). Environmental engineering and activated sludge processes: models, methodologies, and applications. Oakville, ON; Waretown, NJ: Apple Academic Press. doi: 10.1201/b19902
14. Oleynik, A., Airapetian, T. (2016). The aerobic biological purification of the wastewaters from the organic contaminants (OC) in the aerotanks with the suspended and the fixed biocenosis. MOTROL. Commission of motorization and energetics in agriculture, 18 (10), 13–24.
15. Smirnov, N. (2013). Mathematical modelling of processes nitrification and oxidations of an organic substratum in system of biological treatment. Mathematical modelling in ecology, 245–246.
16. Oleynik, A., Airapetian, T. (2016). Modelling and computation of the oxygen regime while extracting the organic contaminants in ideal mix aeration tank with suspended and fixed biocenose. Problems of water supply, sewerage and hydraulic, 27, 269–279.
17. Oleynik, A., Kolpakova, O. (2014). Modelling and calculation of the biological sewage treatment on the trickling biofilters. Ecological safety and make use of nature, 16, 68–86.
18. Maslun, G. (2013). The practical recommendations for calculation of the oxygen regime at the cleaning of the wastewater on the pounded filters. Problems of water supply, sewerage and hydraulic, 21, 123–142.

19. DBN V.2.5-75-2013. Sewerage. Outdoor networks and structures. The main provisions of the design (2013). Kyiv: Ministry of Regional Development of Ukraine, 128.

20. Oleynik, A., Airapetian, T., Kurganska, S. (2016). Analysis and some recommendations to computation of oxygen regiment in aerotanks during clearance of the waste waters from organic pollutions with suspended and fixed biocenosis. The scientific bulletin of construction, 3 (85), 177–184.

21. Maslun, G. (2012). The calculations of the oxygen regime parameters at the biological treatment of the wastewater's by the filtration. Ecological safety and make use of nature, 10, 91–101.

22. Lee, K., Stensel, H. D. (1986). M Aeration and substrate utilization in a sparged packed bed-biofilm reactor. WPCF, 58 (11), 1065–1073.

23. Maslun, G. (2013). Research and production testing of the theoretical calculations of the oxygen regime parameters at the biological treatment of the wastewater's by the filtration. Ecological safety and make use of nature, 12, 98–113.

EFFECT OF ECOLOGICALLY SAFE GAS-AEROSOL MIXTURES ON THE VELOCITY OF EXPLOSIVE COMBUSTION OF n-HEPTANE (p. 12-19)

Volodymyr Balanyuk
Lviv State University of Life Safety, Lviv, Ukraine
ORCID: http://orcid.org/0000-0003-0853-4229

Vasily Kovalyshyn
Lviv State University of Life Safety, Lviv, Ukraine
ORCID: http://orcid.org/0000-0002-5463-0230

Nazariy Kozyar
Main Control service
emergencies Ukraine in Kyiv, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0001-9082-0771

To solve the problem of effective retardation, researchers propose to use mostly gases, powders and their mixtures, as well as, in some cases, khladons and their mixtures with gases. Given the characteristics of known agents of volumetric fire-extinguishing, they share common shortcomings: devices are rather sizeable, gas storage requires a significant number of cylinders, powders need rather big containers, in which they tend to clod. In addition, it takes too long to supply the above-mentioned substances compared with the velocity of explosion front propagation.

Determining an influence of the addition of gas-aerosol mixtures on the velocity of flame propagation throughout stoichiometric n-heptane-air mixture will make it possible to define effective concentrations and ratios of fire-extinguishing aerosol and gases CO_2 and N_2 on the velocity of flame propagation throughout a combustible homogeneous mixture, which will guide towards a more efficient use of gas-aerosol mixtures in order to prevent explosions and fires.

Present research shows high effectiveness of influence of the addition of a binary mixture of fire-extinguishing aerosol and gases CO_2 and N_2 on a decrease in velocity of flame of the homogeneous heptane-air mixture. It was experimentally found that the influence of binary mixtures on the stoichiometric n-heptane-air mixture decreases the flame propagation velocity by up to 6.5 times, compared with the original velocity of flame propagation throughout the stoichiometric mixture. Thus, even small addition of binary gas-aerosol mixtures to the homogeneous combustible systems decreases explosion power and prevents the occurrence of detonation in them. Fire-extinguishing concentrations of aerosol and gases in this case decreases considerably due to synergy between them.

Determining the effect of binary gas-air mixtures on the velocity of flame propagation throughout homogeneous combustible mixtures allows us to define conditions for effective anti-explosive and fire-retardant protection of sites with the presence of flammable, combustible and explosive media and substances.

Keywords: retarder, inhibitor of combustion, fire-extinguishing aerosol, combined extinguishing, aerosol-forming compound.

References

1. Linteris, G. T. (2009). Clean Agent Suppression of Energized Electrical Equipment Fires. Fire Technology, 47 (1), 1–68. doi: 10.1007/s10694-009-0109-5

2. Su, J. Z., Kim, A. K., Crampton, G. P., Liu, Z. (2001). Fire Suppression with Inert Gas Agents. Journal of Fire Protection Engineering, 11 (2), 72–87. doi: 10.1106/x21v-yqku-pmkp-xgtp

3. Senecal, J. A. (2005). Flame extinguishing in the cup-burner by inert gases. Fire Safety Journal, 40 (6), 579–591. doi: 10.1016/j.firesaf.2005.05.008

4. Balanyuk, V., Kozyar, N., Garasimyuk, O., Lozinskiy, A. (2016). The influence of CO_2 additives on fire extinguishing efficiency of binary aerosol-gas mixture. Pozhezhna Bezpeka, 28, 6–12.

5. Moore, T. A., Yamada, N. (1998). Nitrogen gas as a halon replacement. Halon Options Technical Working Conference, 330–338.

6. Montreal Protocol on Substances that Deplete the Ozone Layer. 1998 Assessment Report of the Technology and Economic Assessment Panel. Available at: http://apps.unep.org/redirect.php?file=/publications/pmtdocuments/-Technology%20and%20economic%20assessment%20panel-19981871.pdf

7. United Nations Environment Programme (2010). Ozone Secretariat. Scientific Assessment of Ozone Depletion.

8. Semenov, N. N. (1940). Teplovaya teoriya goreniya i zryivov. Uspekhi Fizicheskih Nauk, 23 (3), 251–292. doi: 10.3367/ufnr.0023.194003b.0251

9. Balanyuk, V., Grimalyuk, B. (2004). Doslidzhennya vplivu Inertnih gazovih rozrizhuvachiv na efektivnist vognegasnih aerozoliv. Pozhezhna Bezpeka, 5, 8–12.

10. Balanyuk, V., Zhurbinskiy, A. (2013). Phlegmatisation of flammable gas mixtures by aerosol sprays. BiTP, 32 (4), 53–58.

11. Filipczak, R. A. (1993). Relative Fxtinguishment Fffectiveness and Agent Decomposition products of Halon Alternative Agents. Halon Alternatives Technical Working Conference 1993, 149–159.

12. Ewing, C. T., Faith, F. R., Romans, J. B., Hughes, J. T., Carhart, H. W. (1992). Flame Extinguishment Properties of Dry Chemicals: Extinction Weights for Small Diffusion Pan Fires and Additional Evidence for Flame Extinguishment by Thermal Mechanisms. Journal of Fire Protection Engineering, 4 (2), 35–51. doi: 10.1177/104239159200400201

13. Dewitte, M., Vrebosch, J., van Tiggelen, A. (1964). Inhibition and extinction of premixed flames by dust particles. Combustion and Flame, 8 (4), 257–266. doi: 10.1016/0010-2180(64)90079-3

14. Mchale, E. T. (1975). Flame inhibition by potassium compounds. Combustion and Flame, 24, 277–279. doi: 10.1016/0010-2180(75)90159-5

15. Mitani, T., Nhoka, T. (1982). Comparison of experiments and theory on heterogeneous flame suppressants. Symposium (International) on Combustion, 19 (1), 869–875. doi: 10.1016/s0082-0784(82)80262-2

16. Yongfeng, Z., Xiang, J., Guangxuan, L., Ni, X. (2007). Experimental Study of the Fire-extinguishing Effectiveness of 1-Bromo-3,3,3-Trifluoropropene/Nitrogen Mixtures. Journal of Fire Sciences, 25 (2), 177–187. doi: 10.1177/0734904107067914

17. Lott, J. L., Christian, S. D., Sliepcevich, C. M., Tucker, E. E. (1996). Synergism between chemical and physical fire-suppressant agents. Fire Technology, 32 (3), 260–271. doi: 10.1007/bf01040218

18. Saito, N., Saso, Y., Ogawa, Y., Otsu, Y., Kikui, H. (1997). Fire Extinguishing Effect Of Mixed Agents Of Halon 1301 And Inert Gases. Fire Safety Science, 5, 901–910. doi: 10.3801/iafss.fss.5-901

19. Balanyuk, V. M. (2015). The effectiveness of open space fire extinguishing with flammable liquid fighting aerosols. Eastern-European Journal of Enterprise Technologies, 5 (10 (77)), 4–11. doi: 10.15587/1729-4061.2015.51399

20. Smith, F. A., Kimmel, E. C., English, J. H., Carpenter, R. L. (1995). The assessment of toxicity after exposure to a pyrotechnically generated aerosole. HOTWC, 521–532.

21. Tischenko, A. M. (1999). Kombinirovannoe pozharotushenie inertnyimi gazami s odnovremennyim ingibirovaniem ochagov goreniya poroshkovyimi smesyami. Problemy pozharnoi bezopasnosti, 6, 159–162.

22. Byikov, S. A., Otkidach, N. Ya., Tischenko, A. M. (2003). Eksperimentalnoe obosnovanie kombinirovannogo primeneniya azota s ognetushaschimi poroshkami dlya protivopozharnoy zaschityi ob'ektov. Problemy pozharnoi bezopasnosti, 14, 55–59.

23. Blanc, M. V., Guest, P. G., von Elbe, G., Lewis, B. (1947). Ignition of Explosive Gas Mixtures by Electric Sparks. I. Minimum Ignition Energies and Quenching Distances of Mixtures of Methane, Oxygen, and Inert Gases. The Journal of Chemical Physics, 15 (11), 798–802. doi: 10.1063/1.1746337

24. Chen, Z., Wei, L., Gu, X., Huang, Z., Yuan, T., Li, Y., Tian, Z. (2010). Study of Low-Pressure Premixed Dimethyl Ether/Hydrogen/Oxygen/Argon Laminar Flames with Photoionization Mass Spectrometry. Energy & Fuels, 24 (3), 1628–1635. doi: 10.1021/ef901314r

25. Qiao, L., Gan, Y., Nishiie, T., Dahm, W. J. A., Oran, E. S. (2010). Extinction of premixed methane/air flames in microgravity by diluents: Effects of radiation and Lewis number. Combustion and Flame, 157 (8), 1446–1455. doi: 10.1016/j.combustflame.2010.04.004

26. Balanyuk, V. M. (2016). Specific Nature of Phlegmatizing Air-Heptan Mixture using Aerosol and Nitrogen Binary Mixture. BiTP, 44 (4), 139–149.

27. Nikon 1 J4. Available at: http://imaging.nikon.com/lineup/acil/bodies/j4/spec.htm

28. Balanyuk, V., Kozyar, N., Garasyumyk, O. (2016). Study of fire-extinguishing efficiency of environmentally friendly binary aerosol-nitrogen mixtures. Eastern-European Journal of Enterprise Technologies, 3 (10 (81)), 4–12. doi: 10.15587/1729-4061.2016.72399

29. Agafonov, V. V., Kopylov, N. P. (1997). Aerosol Extinguishing System: Elements and Characteristics, Design, Erection and Operation. VNIIPO, 232.

30. Balanyuk, V. M., Kozyar, N. M., Garasim'yuk, O. I. (2016). The usage of gas and aerosol powder extinguishing mixtures for protection of incendiary mixtures. ScienceRise, 5 (2 (22)), 10–14. doi: 10.15587/2313-8416.2016.69333

31. Balanyuk, V. M., Garasimyuk, O. I. (2015). Kombinovane aerozolno-poroshkove pozhezhogasinnya. Pozhezhna bezpeka, 26, 7–12.

INFLUENCE OF THE SOUTH-UKRAINE ELECTRIC POWER PRODUCING COMPLEX ON THE ECOLOGICAL CONDITION OF THE SOUTHERN BUG RIVER (p. 20-28)

Yevhen Bezsonov
Petro Mohyla Black Sea
National University, Mykolaiv, Ukraine
ORCID: http://orcid.org/0000-0001-5745-3121

Olena Mitryasova
Petro Mohyla Black Sea
National University, Mykolaiv, Ukraine
ORCID: http://orcid.org/0000-0002-1052-1112

Viktor Smyrnov
Petro Mohyla Black Sea
National University, Mykolaiv, Ukraine
ORCID: http://orcid.org/0000-0001-5239-509X

Svitlana Smyrnova
V. O. Sukhomlynskyi Mykolaiv
National University, Mykolaiv, Ukraine
ORCID: http://orcid.org/0000-0001-9106-7435

Using statistical methods, an analysis of the runoff long-term distribution of the Southern Bug River in its lower reach in damming and natural conditions has been performed. It allows deepening the existing knowledge about the regularities of the water ecosystem functioning and rationalizing (balancing) the water supply system in the regional socioecological system, with the purpose of prevention of ecologically dangerous situations and minimization of ecological and economic damage. At the same time, the main emphasis is shifted to the study of the South-Ukraine electric power producing complex impact on the ecological safety in the lower reach of the Southern Bug River aquatic ecosystem (after the cascade of reservoirs). In particular, it has been proved that the river runoff decreases, and this phenomenon is particularly acute in the low water flow period when there is a problem of prioritizing the allocation of water resources between industry, population and the ecological system actually. In the statistical environment R and software MS Excel, the degree of connection of water flow in the lower reach of the Southern Bug River with the concentration of potentially dangerous substances in it is determined, and, for some of them, a functional dependence is presented. An analysis of the database of observation of daily water consumption over 80 years (from 1936 to 2016) has allowed substantiating and proving the opinion that the annual runoff of the river tends to decrease. The probability of low water flow for the months of the year for the lower reach of the Southern Bug is calculated and a probabilistic distribution of water flow is constructed. The economic risk for the South-Ukraine electric power producing complex, and to the Ukraine's energy system,

in particular, in the low water flow period, when the values of the river water flow become dangerously small for the normal functioning of the enterprise, under the terms of the set volume sanitary discharges in its lower reach is determined.

Keywords: Southern Bug River, river runoff prediction, economic risk, ecological condition, South-Ukraine electric power producing complex, statistical environment R.

References

1. The future we want. Available at: http://www.un.org/disabilities/documents/rio20_outcome_document_complete.pdf

2. Millennium Ecosystem Assessment. Ecosystems and Human Well_being: Desertification Synthesis (2005). World Resources Institute, Washington, DC. Available at: http://www.millenniumassessment.org/documents/document.355.aspx.pdf

3. Water quality for ecosystem and human health. Available at: http://www.env-edu.gr/Documents/Water%20Quality%20For%20Ecosystems%20and%20Human%20Health.pdf

4. Agenda 21. Available at: http://www.un.org/ru/documents/decl_conv/conventions/agenda21

5. Barbour, E. J., Holz, L., Kuczera, G., Pollino, C. A., Jakeman, A. J., Loucks, D. P. (2016). Optimisation as a process for understanding and managing river ecosystems. Environmental Modelling & Software, 83, 167–178. doi: 10.1016/j.envsoft.2016.04.029

6. Garcia, X., Barceló, D., Comas, J., Corominas, L., Hadjimichael, A., Page, T. J., Acuña, V. (2016). Placing ecosystem services at the heart of urban water systems management. Science of The Total Environment, 563-564, 1078–1085. doi: 10.1016/j.scitotenv.2016.05.010

7. Grizzetti, B., Lanzanova, D., Liquete, C., Reynaud, A., Cardoso, A. C. (2016). Assessing water ecosystem services for water resource management. Environmental Science & Policy, 61, 194–203. doi: 10.1016/j.envsci.2016.04.008

8. Zagonari, F. (2016). Using ecosystem services in decision-making to support sustainable development: Critiques, model development, a case study, and perspectives. Science of The Total Environment, 548-549, 25–32. doi: 10.1016/j.scitotenv.2016.01.021

9. Arhangel'skiy, V. I., Mel'nichenko, P. I. (2012). Glava 4. Gigiena vody i vodosnabzheniya naselennyh mest. Moscow: GEOTAR-Media, 392. Available at: http://vmede.org/sait/?page=5&id=Gigiena_compedenium_arxangelskii_2012&menu=Gigiena_compedenium_arxangelskii_2012

10. Ekologiya i zdorov'e cheloveka. Urboekologiya. Obshchie zakonomernosti adaptatsii cheloveka k raznym usloviyam okruzhayushchey sredy. Ekologicheski predopredelennye i ekologicheski zavisimye zabolevaniya. Available at: http://intranet.tdmu.edu.ua/data/kafedra/internal/hihiena/lectures_stud/ru/pharm/prov_pharm/ptn/основы%20экологии/1/05.%20Экология%20и%20здоровье%20человека.htm

11. The Lack of Clean Water: Root Cause of Many Problems. Available at: https://thewaterproject.org/water-scarcity/water_scarcity_2

12. Alimov, A. F. (2000). Elementy teorii funktsionirovaniya vodnyh ekosistem. SPb.: Nauka, 147.

13. Belous, E. P. (2012). Taksonomicheskaya struktura fitoplanktona verhnego uchastka reki Yuzhnyy Bug (Ukraina). Al'gologiya, 22 (4), 393–401.

14. Mudrak, O. V., Riabokon, S. V. (2011). Istoriia hospodarskoho osvoiennia poverkhnevykh vodoim Vinnychchyny. Zbirnyk naukovykh prats VNAU. Ekolohiia, 7 (47), 107–112.

15. Zholudenko, O. O. (2013). Vyvchennia bahatorichnoi dynamiky zmin pokaznykiv ridkoho ta tverdoho stoku r. Pivdennyi Buh v zoni vplyvu Tashlytskoi HAES ta Oleksandrivskoho vodoskhovyshcha. Tekhnohenno-ekolohichna bezpeka ta tsyvilnyi zakhyst, 6, 132–138.

16. Afanasieva, S. O. (Ed.) (2012). Otsinka ekolohichnoho stanu richky Pivdennyi Buh u vidpovidnosti do vymoh Vodnoi Ramkovoi Dyrektyvy YES. Kyiv, 28.

17. Shcherbukha, A. Ya. (2004). Ikhtiofauna Ukrainy u retrospektyvi ta suchasni problemy zberezhennia yii riznomanittia. Visnyk zoolohii, 38 (3), 3–18.

18. Boichenko, S. H., Havryliuk, R. B., Savchenko, S. A., Sharavara, V. V., Movchan, Ya. I., Melnychuk, V. P. (2017). Tendentsii zminy stoku Pivdennoho Buhu – vplyv klimatychnykh faktoriv ta zarehuliuvannia. Materialy V Naukovykh chytan pamiati Serhiia Tarashchuka. Seriia: «Conservation Biology in Ukraine», 3, 17–19.

19. Richnyi zvit «Pro diialnist baseinovoho upravlinnia vodnykh resursiv richky Pivdennyi Buh z pytan upravlinnia, vykorystannia ta vidtvorennia poverkhnevykh vodnykh resusiv za 2012 rik» (2013). Vinnytsia.

20. Bezsonov, Ye. M., Andrieiev, V. I. (2016). Zabezpechennia ekolohichnoi bezpeky Pivdennoho Buhu v konteksti staloho rozvytku Mykolaieva. Naukovi pratsi: naukovo-metodychnyi zhurnal. Ekolohiia, 276 (288), 19–26.

21. Bezsonov, Y., Andreev, V., Smyrnov, V. (2016). Assessment of safety index for water ecological system. Eastern-European Journal of Enterprise Technologies, 6 (10 (84)), 24–34. doi: 10.15587/1729-4061.2016.86170

22. Shipunov, A. B., Baldin, E. M., Volkova, P. A., Korobeynikov, A. I., Nazarova, S. A., Petrov, S. V., Sufiyanov, V. G. (2014). Naglyadnaya statistika. Ispol'zuem R!, 296. Available at dostupa: https://cran.r-project.org/doc/contrib/Shipunov-rbook.pdf

23. Shitikov, V. K. (2016). Ekotoksikologiya i statisticheskoe modelirovanie effekta s ispol'zovaniem R!. Tol'yatti: IEVB RAN, 149.

24. Vseob"emlyushchaya otsenka mirovyh resursov presnyh vod. Doklad General'nogo Sekretarya OON. Ekonomicheskiy i Sotsial'nyy Sovet. Komissiya po ustoychivomu razvitiyu. Pyataya sessiya. Available at: http://repository.un.org/bitstream/handle/11176/214573/E_CN.17_1997_9–RU.pdf?sequence=5&isAllowed=y

25. Zghurovskyi, M. Z. (2009). Stalyi rozvytok rehioniv Ukrainy. Kyiv: NTUU «KPI», 197.

26. Dobrovolskyi, V. V. (2010). Ekolohichnyi ryzyk: otsinka i upravlinnia. Mykolaiv: Vydavnytstvo MDHU im. P. Mohyly, 216.

27. Andreev, V. I., Bezsonov, Ye. M., Andreeva, N. Yu. (2016). Water ecosystem ecological safety assessment by the determination of energy flow sustainability. Water security: Monograph. Mykolaiv: PMBSNU – Bristol: UWE, 308.

MATHEMATICAL MODELING OF THE COLORIMETRIC PARAMETERS FOR REMOTE CONTROL OVER THE STATE OF NATURAL BIOPLATO (p. 29-36)

Yurii Balym
Kharkiv State Zooveterinary Academy, Malaya Danylivka, Dergachi district, Kharkiv region, Ukraine
ORCID: http://orcid.org/0000-0002-2494-1329

Marine Georgiyants
Kharkiv Medical Academy of
Postgraduate Education, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-1373-7840

Olena Vysotska
Kharkiv National University of
Radio Electronics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-3723-9771

Anna Pecherska
Kharkiv National University of
Radio Electronics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-7069-0674

Andrei Porvan
Kharkiv National University of
Radio Electronics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-9727-0995

An approach to the remote determination of the character of bioproduction processes in aquatic phytocenoses is proposed. The investigated plant communities can be used as natural bioplato for the elimination of biosafety threats to water consumption. The relevance of these studies is determined by the increased need for expanding the arsenal of methods for remote diagnosis of the states of natural systems that are important for biosafety provision. In particular – to ensure biosafety when using natural feed resources by waterfowls, which are a potential reservoir of bird flu.

The similarity in the dynamics of the colorimetric parameters of phytocenoses and the Margalef's succession model makes it possible to implement a new approach to the generation of productive working hypotheses for the development of remote methods for determining the state of bioproduction processes in natural bioplato. The proposed approach is based on the use of the class of mathematical models, which is called the discrete models of dynamic systems.

Based on the structure of the correlations between the colorimetric components of space photographs of the plavni in the mouth of the river Danube, a description of the structure of the intercomponent and intracomponent relations of the massifs of semi-submerged higher aquatic plants has been obtained. The resulting structure of intercomponent relations allowed us to construct idealized trajectories reflecting the dynamic changes of the system. A unique constant inverse relationship between the parameter reflecting the amount of green chlorophyll pigment affecting the level of photosynthetic production and the parameter reflecting the amount of orange-red pigments in each of the possible matrices of the ratios of colorimetric parameters has been revealed. As a result of analysis of the dynamic aspects of the RGB model, the structure of the system color parameter is shown, which is the mean square deviation of the spread in the degree of alignment of parameter values reflecting the amount of green and orange-red pigments.

As a result of analysis of the systemic colorimetric parameter of photographs of the section of the Danube plavni during various periods of the vegetative season, it is shown that it is advisable to use it as a marker of the risk of secondary water pollution, which can be used for remote determination of the state of bioproduction processes in natural bioplato.

Keywords: bioplato, bioproduction process, waterfowls, relation graph, colorimetric parameters, remote control, trajectory of the system.

References

1. Kozlova, T. V., Kozlov, A. I., Shalak, M. V., Glushakov, O. A. (2014). Ispol'zovanie muskusnoy utki v integrirovannom rybovodstve na meliorativnom vodoeme Pripyatskogo Poles'ya. Rybovodstvo i rybnoe hozyaystvo, 1, 40–45.
2. Wikramaratna, P. S., Pybus, O. G., Gupta, S. (2014). Contact between bird species of different lifespans can promote the emergence of highly pathogenic avian influenza strains. Proceedings of the National Academy of Sciences, 111 (29), 10767–10772. doi: 10.1073/pnas.1401849111
3. Titova, T. A. (2013). Effektivnost' primeneniya infil'tratsionnyh bioplato pri ochistke kommunal'nyh stochnyh vod. Vestnik Rossiyskogo gosudarstvennogo agrarnogo zaochnogo universiteta, 15 (20), 67–70.
4. Matyushenko, V. A. (2015). Otsenka vegetatsionnogo indeksa geosistem rechitskogo rayona. Tvorchestvo yunyh – shag v uspeshnoe budushchee. Tomsk, 528–530.
5. Cherepanov, A. S. (2011). Vegetatsionnye indeksy. Geomatika, 2, 98–102.
6. Antipov, T. I., Pavlova, A. I., Kalichkin, V. A. (2012). Primery avtomatizirovannyh metodov analiza geoizobrazheniy dlya agroekologicheskoy otsenki zemel'. Izvestiya vysshih uchebnyh zavedeniy. Geodeziya i aerofotos'emka, 2/1, 40–44.
7. Hohm, T., Zitzler, E., Simon, R. (2010). A Dynamic Model for Stem Cell Homeostasis and Patterning in Arabidopsis Meristems. PLoS ONE, 5 (2), e9189. doi: 10.1371/journal.pone.0009189
8. Lee, Y.-S., Tong, L.-I. (2011). Forecasting time series using a methodology based on autoregressive integrated moving average and genetic programming. Knowledge-Based Systems, 24 (1), 66–72. doi: 10.1016/j.knosys.2010.07.006
9. Anderson, T. W. (1994). The statistical analysis of time series. John Wiley & Sons, 704. doi: 10.1002/9781118186428
10. Dupont, F., Padala, C., Anning, H. et. al. (2011). A NEMO based modelling system for the Great Lakes. 15th Workshop on Physical Processes in Natural Waters. Burlington, 46–52.
11. Gal, G., Hipsey, M. R., Parparov, A., Wagner, U., Makler, V., Zohary, T. (2009). Implementation of ecological modeling as an effective management and investigation tool: Lake Kinneret as a case study. Ecological Modelling, 220 (13-14), 1697–1718. doi: 10.1016/j.ecolmodel.2009.04.010
12. Hernandez-Clemente, R., Navarro-Cerrillo, R. M., Zarco-Tejada, P. J. (2012). Carotenoid content estimation in a heterogeneous conifer forest using narrow-band indices and PROSPECT+DART simulations. Remote Sensing of Environment, 127, 298–315. doi: 10.1016/j.rse.2012.09.014
13. Feret, J.-B., François, C., Asner, G. P., Gitelson, A. A., Martin, R. E., Bidel, L. P. R. et. al. (2008). PROSPECT-4 and 5: Advances in the leaf optical properties model separating photosynthetic pigments. Remote Sensing of Environment, 112 (6), 3030–3043. doi: 10.1016/j.rse.2008.02.012
14. Chavez, R. O., Clevers, J. G. P. W., Herold, M., Ortiz, M., Acevedo, E. (2013). Modelling the spectral response of the desert tree Prosopis tamarugo to water stress. International Journal of Applied Earth Observation and Geoinformation, 21, 53–65. doi: 10.1016/j.jag.2012.08.013
15. Ruiz-Verdu, A., Simis, S. G. H., de Hoyos, C., Gons, H. J., Pena-Martinez, R. (2008). An evaluation of algorithms for the remote sensing of cyanobacterial biomass. Remote Sensing of Environment, 112 (11), 3996–4008. doi: 10.1016/j.rse.2007.11.019
16. Zholtkevych, G. N., Bespalov, G. Y., Nosov, K. V., Abhishek, M. (2013). Discrete Modeling of Dynamics of Zooplankton Com-

munity at the Different Stages of an Antropogeneous Eutrophication. Acta Biotheoretica, 61 (4), 449–465. doi: 10.1007/s10441-013-9184-6

17. Zholtkevych, G. N., Nosov, K. V., Bespalov, Y. G. et. al. (2016). Descriptive models of system dynamics. 12th International Conference on ICT in Education, Research and Industrial Applications, ICTERI 2016. Kyiv, 57–72.

18. Vysotska, O., Bespalov, Y., Rak, L. et. al. (2016). Modeling the dynamics of the cardiovascular system parameters coherence at different stages of the adaptation syndrome. Bulletin of NTU "KhPI". Series: Mechanical-technological systems and complexes, 4 (1176), 79–84.

19. Vysotskaya, E. V., Zholtkevych, G. N., Klochko, T. A. et. al. (2016). Unmasking the soil cover's disruption by modeling the dynamics of ground vegetation parameters. Visnyk Natsionalnoho Tekhnichnoho Universytetu Ukrainy «KPI». Seriya: Radiotekhnika. Radioaparatobuduvannia, 64, 101–109.

20. Landsat collections. Provding a stable environmental record. Available at: https://landsat.usgs.gov/

21. Vysotska, O. V., Bespalov, Y. G., Pecherska, A. I., Parvadov, D. A. (2016). Using of Margalef succession model in remote detection technologies for indications of human impact on vegetation cover. Radioelektronni i kompiuterni systemy, 2 (76), 15–19.

RESEARCH INTO THE BIOSORPTION PROCESS OF HEAVY METAL IONS BY THE SEDIMENTS FROM STATIONS OF BIOLOGICAL IRON REMOVAL (p. 37-43)

Alexander Kvartenko
National University of Water and
Environmental Engineering, Rivne, Ukraine
ORCID: http://orcid.org/0000-0001-5634-1128

Valery Orlov
National University of Water and
Environmental Engineering, Rivne, Ukraine

Oksana Pletuk
National University of Water and
Environmental Engineering, Rivne, Ukraine
ORCID: http://orcid.org/0000-0003-2295-4238

The article considers the possibility of using the sediments from stations of biological iron removal for the biosorption of heavy metal ions (IHMs) from both natural groundwaters and washing waters of enterprises with galvanic cycles. The processes of extracting Zn^{2+} ions (up to 50 mg/dm^3), Cu^{2+} (up to 16 mg/dm^3), Ni^{2+} (up to 1.3 mg/dm^3), Cr^{6+} (up to 2.0 mg/dm^3) on the bacterial structures of iron bacteria consortia and the optimal parameters of passing this process are determined (for washing waters pH=8.5–9.0). The influence of constant magnetic field with intensity of 20–60 mT, as well as the influence of different kinds of sediments from stations of biological iron removal on the efficiency of the process of removing IHM have been investigated. A significant percentage of the removal of IHM using calcined precipitate (98 % for Cu^{2+}, 97 % for Zn^{2+}, 85 % for Ni^{2+}) is due to the exoeffect that occurs at a wide temperature range of 200–400 ºC. In this case, there is a smooth decrease in the mass of the sediment, indicating the combustion of the organic component and the crystallization of the amorphous phase. As a result, goethite (α-FeOOH) and lepidocrocyte (γ-FeOOH) are converted into hematite (α-Fe$_2$O$_3$) and magnetite (γ-Fe$_2$O$_3$), which have magnetic properties. When using as a reagent a fresh sediment, active involvement in the process of adsorption of heavy metal ions is carried out by biominerals, cells and polymer matrices of iron bacteria that have a crystalline structure and a large specific surface. At the same time, the effectiveness of removing IHMs was, respectively: for Cu^{2+} 93 %; for Zn^{2+} 92 %; for Ni^{2+} 70 %.

The efficiency of one-, two- and three-stage water purification schemes have been investigated. It was established that using the three-stage scheme with hydromechanical mixers and water alkalinization to pH 9.0, the efficiency of IHM removal was: for Cu^{2+} up to 96 %; For Zn^{2+} up to 99 %; for Ni^{2+} up to 85 %. The X-ray spectral microanalysis of the sediment of the surface of the Gallioella bacterium case revealed the accumulation of IHM in the structure. The process of adsorption of IHM on the bacterial structures of consortia of iron bacteria due to their electrostatic bonding with both anionic surface of cell wall and with organic polymers isolated by cells of iron bacteria is substantiated.

Keywords: biominerals, biosorption of ions of heavy metals, matrices of iron bacteria, sediment of iron-removal station.

References

1. Haferburg, G., Kothe, E. (2011). Biogeosciences in Heavy Metal-Contaminated Soils. Bio-Geo Interactions in Metal-Contaminated Soils, 17–34. doi: 10.1007/978-3-642-23327-2_2

2. Fylypchuk, V. L. (2004). Ochyshchennia bahatokomponentnykh metalovmishchuiuchykh stichnykh vod promyslovykh pidpryiemstv. Rivne: UDUVHP, 232.

3. Dolina, L. F. (2008). Sovremennaya tekhnika i tekhnologiya dlya ochistki stochnyh vod ot soley tyazhelyh metallov. Dnepropetrovsk: Kontinent, 254.

4. Zapotoczny, S., Jurkiewicz, A., Tylko, G., Anielska, T., Turnau, K. (2007). Accumulation of copper by Acremonium pinkertoniae, a fungus isolated from industrial wastes. Microbiological Research, 162 (3), 219–228. doi: 10.1016/j.micres.2006.03.008

5. Kochergin, A. S., Andreev, S. Yu., Grishin, B. M., Bakunov, M. V. (2010). Novaya tekhnologiya i princip raboty lokal'nyh ochistnyh sooruzheniy cekhov gal'vanopokrytiy. Izvestiya vyssh. ucheb. zavedeniy. Stroitel'stvo, 1, 68–74.

6. Comte, S., Guibaud, G., Baudu, M. (2008). Biosorption properties of extracellular polymeric substances (EPS) towards Cd, Cu and Pb for different pH values. Journal of Hazardous Materials, 151 (1), 185–193. doi: 10.1016/j.jhazmat.2007.05.070

7. Ahluwalia, S. S., Goyal, D. (2007). Microbial and plant derived biomass for removal of heavy metals from wastewater. Bioresource Technology, 98 (12), 2243–2257. doi: 10.1016/j.biortech.2005.12.006

8. Hennebel, T., De Gusseme, B., Boon, N., Verstraete, W. (2009). Biogenic metals in advanced water treatment. Trends in Biotechnology, 27 (2), 90–98. doi: 10.1016/j.tibtech.2008.11.002

9. Sahabi, D. M., Takeda, M., Suzuki, I., Koizumi, J. (2010). Comparison of Arsenate, Lead, and Cadmium Adsorption onto Aged Biofilter Media. Journal of Environmental Engineering, 136 (5), 493–500. doi: 10.1061/(asce)ee.1943-7870.0000184

10. Fujikawa, Y., Sugahara, M., Hamasaki, T., Yoneda, D., Minami, A., Sugimoto, Y., Iwasaki, H. (2010). Biological filtration using iron bacteria for simultaneous removal of arsenic, iron, manganese and ammonia: Application to waterworks facilities in Japan and developing countries. Journal of Human Environmental Studies, 9, 261–276.

11. Bukreeva, V. Yu., Grabovich, M. Yu., Eprincev, A. T., Dubinina, G. A. (2009). Sorbciya kolloidnyh soedineniy oksidov zheleza i marganca s pomoshch'yu zhelezobakteriy na peschanyh zagruzkah ochistnyh sooruzheniy vodopod'emnyh stanciy. Sorbcionnye i hromatograficheskie processy, 9 (4), 506–514.

12. Orlov, V. O. (2008). Znezaliznennia pidzemnykh vod sproshchenoiu aeratsieiu ta filtruvanniam. Rivne: NUVHP, 158.

13. Kvartenko, O. M. (2016). Vykorystannia osadiv stantsii biolohichnoho znezaliznennia dlia osadzhennia ioniv vazhkykh metaliv iz zvorotnykh stokiv halvanichnoho vyrobnytstva. Ekolohiia. Liudyna. Suspilstvo. Kyiv, 93–95.

14. Angelova, R., Slavov, L., Iliev, M., Mitova, M., Blagoev, B., Nedkov, I., Groudeva, V. (2015). Biogenic iron oxides from labor atory cultivated Leptothrix sp. for application in the bionanotechnology. Annuaire de l'Université de Sofia "St. Kliment Ohridski". First National Conference of Biotechnology, 100, 231–238.

BIOTESTING OF PLASMA-CHEMICALLY ACTIVATED WATER WITH THE USE OF HYDROBIONTS (p. 44-50)

Alexandr Pivovarov
Ukrainian State University of Chemical Technology, Dnipro, Ukraine
ORCID: http://orcid.org/0000-0001-7849-0722

Svitlana Mykolenko
Dnipropetrovsk State Agrarian and Economic University, Dnipro, Ukraine
ORCID: http://orcid.org/0000-0002-1959-1141

Olena Honcharova
Dnipropetrovsk State Agrarian and Economic University
ORCID: http://orcid.org/0000-0002-9702-7458

The study has determined the influence of plasma-chemically activated water and its level of toxicity on test objects. It has been established that the reaction of biological objects is positive, which is reflected in their livelihood. The obtained research results show that the nature of the influence of water of different structures on the species composition of the selected test objects depends on the individual properties of each of them. The influence of plasma-chemically activated water on the functional properties of Riccia fluitans, Lémna mínor L., Paramecium caudatum, Artemia salina and Cyprinus carpio has been investigated. The completed tests have helped supplement and substantiate the already existing idea about the properties of the plasma-chemically activated water and the possibilities of its use in the processing of raw materials and the manufacturing of finished products.

In the course of the research, it was found that the Paramecium caudatum survival was 87–89.5 %, with no toxic effects of the plasma-chemically activated water on these objects. The cultivation of Artemia salina in water that had been pre-treated by the proposed method showed that the number of viable organisms had increased by 60–70 % compared with the reference. The obtained results of studying the influence of the plasma-chemically activated water on the development of Riccia fluitans and Lémna mínor L. indicate that the activation of growth processes is 7–39 % higher than in the reference. It has been determined that the cultivation of Cyprinus carpio in the treated water contributes to increasing the survival rate as it improved the test objects by 13 % and 6 %, respectively, as to the reference. Using the method of gas-discharge diagnostics has shown that the treatment of water with nonthermal plasma for 30 minutes contributes to increasing its biopotential. Consequently, the obtained results indicate the expediency of using plasma-chemically activated water for the production of food and feed. The established positive changes support information on the safety of using plasma-chemically activated water as a component of the food chain and prove the practical value of a comprehensive approach to innovative methods of preparing raw materials.

Keywords: plasma-chemically activated water, biotesting, hydrobionts, gas discharge visualization.

References

1. Qu, X., Alvarez, P. J. J., Li, Q. (2013). Applications of nanotechnology in water and wastewater treatment. Water Research, 47 (12), 3931–3946. doi: 10.1016/j.watres.2012.09.058

2. Korotkov, K. G., Matravers, P., Orlov, D. V., Williams, B. O. (2010). Application of Electrophoton Capture (EPC) Analysis Based on Gas Discharge Visualization (GDV) Technique in Medicine: A Systematic Review. The Journal of Alternative and Complementary Medicine, 16 (1), 13–25. doi: 10.1089/acm.2008.0285

3. Garvey, M., Hayes, J., Clifford, E., Rowan, N. (2013). Ecotoxicological assessment of pulsed ultraviolet light-treated water containing microbial species andCryptosporidium parvumusing a microbiotest test battery. Water and Environment Journal, 29 (1), 27–35. doi: 10.1111/wej.12073

4. Martinez-Huitle, C. A., Brillas, E. (2008). Electrochemical Alternatives for Drinking Water Disinfection. Angewandte Chemie International Edition, 47 (11), 1998–2005. doi: 10.1002/anie.200703621

5. Pivovarov, A. A., Kravchenko, A. V., Tishchenko, A. P., Nikolenko, N. V., Sergeeva, O. V., Vorob'eva, M. I., Treshchuk, S. V. (2015). Contact nonequilibrium plasma as a tool for treatment of water and aqueous solutions: Theory and practice. Russian Journal of General Chemistry, 85 (5), 1339–1350. doi: 10.1134/s1070363215050497

6. Naitali, M., Kamgang-Youbi, G., Herry, J.-M., Bellon-Fontaine, M.-N., Brisset, J.-L. (2010). Combined Effects of Long-Living Chemical Species during Microbial Inactivation Using Atmospheric Plasma-Treated Water. Applied and Environmental Microbiology, 76 (22), 7662–7664. doi: 10.1128/aem.01615-10

7. Vergolyas, M. R., Goncharuk, V. V. (2016). Toxic effects of heavy metals on the hydrobionts' organism. Journal of Education, Health and Sport, 6 (6), 436–444.

8. Maslennikov, P. V., Chupahina, G. N., Krasnopyorov, A. G. (2013). Ispol'zovanie metoda gazorazryadnoy vizualizacii pri ocenke antioksidantnogo statusa rasteniy v usloviyah toksicheskogo deystviya kadmiya. Vestnik Baltiyskogo federal'nogo universiteta im. I. Kanta, 7, 14–21.

9. Malik, M. A. (2009). Water Purification by Plasmas: Which Reactors are Most Energy Efficient? Plasma Chemistry and Plasma Processing, 30 (1), 21–31. doi: 10.1007/s11090-009-9202-2

10. Huang, Y.-R., Hung, Y.-C., Hsu, S.-Y., Huang, Y.-W., Hwang, D.-F. (2008). Application of electrolyzed water in the food industry. Food Control, 19 (4), 329–345. doi: 10.1016/j.foodcont.2007.08.012

11. Pelletier, J. E., Laska, M. N., Neumark-Sztainer, D., Story, M. (2013). Positive Attitudes toward Organic, Local, and Sustainable Foods Are Associated with Higher Dietary Quality among Young Adults. Journal of the Academy of Nutrition and Dietetics, 113 (1), 127–132. doi: 10.1016/j.jand.2012.08.021

12. Pivovarov, A. A., Mykolenko, S. Yu., Tyshhenko, G. P. (2012). Mikrostrukturni osoblyvosti tista na osnovi rozchyniv, piddanyh diyi kontaktnoyi nerivnovazhnoyi plazmy. Food science and technology, 1, 67–70.

13. Issa-Zacharia, A., Kamitani, Y., Miwa, N., Muhimbula, H., Iwasaki, K. (2011). Application of slightly acidic electrolyzed water as a potential non-thermal food sanitizer for decontamination of fresh ready-to-eat vegetables and sprouts. Food Control, 22 (3-4), 601–607. doi: 10.1016/j.foodcont.2010.10.011

14. Mykolenko, S. Yu., Pivovarov, A. A., Tischenko, A. P. (2014). Increasing of microbiological stability of bakery products with using plasmachemical techologies. Eastern-European Journal of Enterprise Technologies, 2 (12 (68)), 30–36. doi: 10.15587/1729-4061.2014.23712

15. Mykolenko, S., Stepanskiy, D., Tishenko, A., Pivovarov, O. (2014). Investigation of the effect of water exposed to non-equilibrium contact plasma onto Saccharomyces cerevisiae yeast. Ukrainian Food Journal, 3 (2), 218–227.

16. Misra, N. N., Tiwari, B. K., Raghavarao, K. S. M. S., Cullen, P. J. (2011). Nonthermal Plasma Inactivation of Food-Borne Pathogens. Food Engineering Reviews, 3 (3-4), 159–170. doi: 10.1007/s12393-011-9041-9

17. Mykolenko, S. Yu., Sokolov, V. Yu., Pen'kova, V. V. (2016). Doslidzhennya texnologichnyh aspektiv vyrobnyctva hliba iz dyspergovanoyi zernovoyi masy z vykorystannnyam dodatkovoyi pidgotovky syrovyny. Zernovi produkty i kombikormy, 4 (64), 10–15.

18. Morgalev, Y. N., Khoch, N. S., Morgaleva, T. G., Gulik, E. S., Borilo, G. A., Bulatova, U. A. et. al. (2010). Biotesting nanomaterials: Transmissibility of nanoparticles into a food chain. Nanotechnologies in Russia, 5 (11-12), 851–856. doi: 10.1134/s1995078010110157

19. Goncharova, O. V., Pugach, A. M. (2016). Harmonizatsiya ta biotekhnolohichne onovlennia metodiv determinatsiyi yakosti biolohichnoi produktsyi. Young Scientist, 9 (36), 111–114.

20. Korotkov, K. G. (2007). Principy analiza v GRV bioehlektrografii. Sankr-Peterburg: Renome, 286.

21. Vainshelboim, A., Hayes, M., Momoh, K. S., Raatsi, C., Peirce, S., Korotkov, K., Prijatkin, N. (2005). GDV Technology Applications for Cosmetic Sciences. 18th IEEE Symposium on Computer-Based Medical Systems (CBMS'05). doi: 10.1109/cbms.2005.56

22. Kobets, A. S., Honcharova, O. V., Puhach, A. M. (2016). Pat. No. 111577 UA. Sposib vyznachennia zhyvykh zarodkiv v period inkubatsyi yaiets. MPK G01N 33/08, A01K 43/00. No. u201606065; declareted: 03.06.2016, published: 10.11.2016, Bul. No. 21.

23. Metodyka vyznachennia hostroi letalnoi (KND 211.1.4.055-97) i khronichnoi (KND 311.1.4.056-97) toksychnoi vody na rakopodibnykh Ceriodaphnia affinis Lilljebord (1997). Kyiv, 17.

24. Korotkov, K. G., Yakovleva, K. G. (2014). Primenenie metoda GRV-bioehlektrografii v medicine (obzor literatury). Vestnik Sankt-Peterburgskogo universiteta, 2, 175–187.

25. Shields, R. J. (2001). Larviculture of marine finfish in Europe. Aquaculture, 200 (1-2), 55–88. doi: 10.1016/s0044-8486(01)00694-9

STUDY OF FUNCTIONING OF A VORTEX TUBE WITH A TWO-PHASE FLOW (p. 51-60)

Valery Shaporev
National Technical University
«Kharkiv Polytechnic Institute», Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-1652-4688

Inna Pitak
National Technical University
«Kharkiv Polytechnic Institute», Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-5073-2942

Oleg Pitak
National Technical University
«Kharkiv Polytechnic Institute», Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-5912-4604

Serhii Briankin
National Technical University
«Kharkiv Polytechnic Institute», Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-0444-9107

As a result of consideration of the phenomena occurring in the vortex tubes, it has been established that there are two forms of swirling dust-gas flow. The circumferential velocity profile in the zone of swirler and return flow is close to the quasi-solid type of rotation. In the peripheral zone, it is close to the quasi-potential type. It has been established by simulation that in the zone of quasi-solid rotation and subsequent transition to a quasi-solid flow, aggregation of particles takes place due to an intense collision of the dust particles drifting to the walls of the vortex tube. There is a 5 to 10 times increase in the determining particle size depending on the value of their specific surface area. In the zone of quasi-potential flow, the bulk of the solid dust particles is concentrated near the tube walls in a zone close to the boundary layer and the dust-free gas concentrates in a zone close to the axial flow. Taking into account the effect of uneven distribution of the braking temperature and consequently creation of a positive gradient of gas temperatures from the tube axis to the walls, thermodynamic and kinetic conditions arise for destruction of CO, NO_x, SO_x gas impurities (in the case of hot gas with a temperature above 673 K). Thus, when preparing a dusty gas stream from a process source before feeding it to the dust collector, the vortex tube creates conditions for complex purification of the gas stream from dust and gas impurities. Also, efficiency of dust removal in the main unit increases to 99.9 %. This will make it possible to lower the industrial negative impact on atmosphere and reduce threat of global consequences for future generations.

Keywords: dry cleaning, dust flow, vortex tube, Ranque effect, hydrodynamics, dust collection efficiency, agglomeration of particles, mathematical model.

Refrences

1. Chekalova, L. V. (2004). Ekotekhnika. Zashchita atmosfernogo vozduha ot vybrosov pyli, aerozoley i tumanov. Yaroslavl': Rus', 424.

2. Zaytsev, O. N. (2002). Issledovanie protsessov lokalizatsii teplovyh vybrosov zakruchennymi potokami. Ekotekhnologiya i resursosberezhenie, 6, 70–72.

3. Osipenko, V. V., Osipenko, V. D. (2009). Pat. No. 2430971 RU. Sposob suhoy ochistki domennogo gaza. MPK C21B 7/22. No. 2009132782/02; declareted: 31.08.2009; published: 10.10.2011, Bul. No. 28.

4. Evans, P., Federston, U. B. (2008). Pat. No. 2415718 RU. Tsiklon s vhodnym patrubkom-separatorom i obvodnymi trubami dlya otvoda melkih chastits. MPK B04 C5/02 (2006.01), B04 C5/12 (2006.01), C21 B7/22 (2006.01). No. 2009134521/05; declareted: 13.02.2008; published: 10.04.2011, Bul. No. 10.

5. Grunewald, G. (2010). Initial soil development in alkaline waste of soda production. Der Andere Verlag, 119.

6. Richard, O. M. (2014). Environmental engineering: principles and practice. Wiley-Blackwell, 662.

7. Vetoshin, A. G. (2016). Inzhenernaya zashchita okruzhayushchey sredy ot vrednyh vybrosov. Moscow: Infra-Inzheneriya, 416.

8. Zlygostev, A. S. Metody ochistki i obezvrezhivaniya ventilyatsionnyh i tekhnologicheskih vybrosov. Zelenaya planeta. Available at: http://ecologylib.ru

9. Hitrova, I. V., Novozhilova, T. B. (2004). Tekhnologiya utilizatsyi gazovyh vybrosov, tverdyh othodov i shlakov. Kharkiv: NTU «KhPI», 218.

10. Grivko, E. V., Ishanova, O. S. (2013). Otsenka stepeni antropogennoy preobrazovannosti prirodno-tekhnogennyh sistem. Orenburg: OOO IPK "Universitet", 128.

11. Amirov, R. Ya., Urakaev, I. M., Gareev, R. G. (2000). Tekhnologicheskie sistemy: Protsessy, konstruktsii, effektivnost'. Ufa: Gilem, 600.

12. Batluk, V. A., Melnikov, O. V., Mirus, O. V. (2011). Zalezhnist efektyvnosti pylovlovlennia vidtsentrovoinertsiynykh aparativ vid konstruktsyi bunkera. Promyslova hidravlika i pnevmatyka, 2 (32), 44–47.

13. Shaporev, V. P., Vasyliev, M. I. (2011). Deiaki aspekty modeliuvannia prystroiu kontaktuvannia faz. Promyslova hidravlika i pnevmatyka, 2 (32), 41–43.

14. Kutepov, A. M., Latkin, A. S. (1999). Vihrevye protsessy dlya modifikatsyi dispersnih sistem. Moscow: Nauka, 270.

15. Bogomolov, A., Sergina, N., Kondratenko, T. (2016). On Inertial Systems, Dust Cleaning and Dust Removal Equipment, and Work Areas in the Production of Aerated Concrete from the Hopper Suction Apparatus CSF. Procedia Engineering, 150, 2036–2041. doi: 10.1016/j.proeng.2016.07.290

16. Chelnokov, A. A., Mironchik, A. F., Zhmyhov, I. N. (2016). Inzhenernye metody ohrany atmosfernogo vozduha. Minsk: Vysheyshaya shkola, 397.

17. Thakare, H. R., Monde, A., Parekh, A. D. (2015). Experimental, computational and optimization studies of temperature separation and flow physics of vortex tube: A review. Renewable and Sustainable Energy Reviews, 52, 1043–1071. doi: 10.1016/j.energy.2015.03.058

18. Volkov, K. N., Deryugin, Yu. N., Emel'yanov, V. N., Karpenko, A. G., Kozelkov, A. S., Teterina, I. V. (2014). Metody uskoreniya gazodinamicheskih raschetov na nestrukturirovannyh setkah – Moscow: FIZMATLIT, 536.

19. Landau, L. D., Lifshits, E. M. (2013). Teoreticheskaya fizika. Vol. I. Moscow: «FIZMATLIT», 224.

20. Molochko, F. I. (2015). O sushchnosti vihrevogo effekta Ranka-Hil'sha. Problemy obshchey energetiki, 4 (43), 58–60.

21. Yahno, O. M., Matiega, V. M., Krivosheev, V. S. (2004). Gidrodinamicheskiy nachal'nyy uchastok. Chernovtsy, 145.

22. Zuykov, A. L. (2014). Gidravlicheskoe modelirovanie kontrvihrevyh techeniy. Vestnik MGSU, 6, 114–125.

23. Akhmetov, D. G., Akhmetov, T. D. (2015). Swirl flow in vortex chamber. Science Bulletin, 6 (4), 109–120. doi: 10.17117/nv.2015.04.109

24. Frumin, V. M., Gut, V. M., Burin, V. L. et. al. (2016). Sposoby suhoy ochistki gaza kal'tsinatsyi ot sodovoy pyli. Himiya i tekhnologiya osnovnoy himicheskoy promyshlennosti, 78, 52–57.

25. Gutsol, A. F. (1997). The Ranque effect. Uspekhi Fizicheskih Nauk, 167 (6), 665–687. doi: 10.3367/ufnr.0167.199706e.0665

26. Shaporev, V. P., Pitak, I. V., Vasil'ev, M. I. (2015). To a question about the nature of the relationship of water to calcium hydroxide. Visnyk NTU «KhPI», 50 (1159), 121–127.

27. Shaporev, V. P., Kogut, M. D. (1996). Priblizhennoe reshenie uravneniya koagulyatsyi s nekotorymi model'nymi yadrami. Ekologiya himicheskoy tekhniki i biotekhnologyi, 2, 73–77.

28. Pitak, I. V. (2014). Study of experimental-industrial design of rotary vortex machine. Technology audit and production reserves, 3 (2 (17)), 33–38. doi: 10.15587/2312-8372.2014.26212

29. Kolyadin, E. A. (2007). Vliyanie zakrutki potoka gazov na konvektivnyi teploobmen v utilizatsionnyh gazotrubnyh kotlah. Vestnik Astrahanskogo gosudarstvennogo tekhnicheskogo universiteta, 2 (37), 159–162.

30. Bona, C., Palenzuela-Luque, C., Bona-Casas, C. (2009). Elements of Numerical Relativity and Relativistic Hydrodynamics. Lecture Notes in Physics. doi: 10.1007/978-3-642-01164-1

31. Konovalov, V. I., Orlov, A. Yu., Gatapova, N. T. (2010). Sushka i drugie tekhnologicheskie protsessy s vihrevoy trubkoy Ranka-Hil'sha: vozmozhnosti i eksperimental'naya tekhnika. Estnik TGTU, 16 (4), 803–825.

32. Bochkarev, V. V. (2016). Optimizatsiya himiko-tekhnologicheskih protsessov. Moscow: Yurayt, 263.

33. Korkodinov, Ya. A., Hurmatullin, O. G. (2012). Primenenie effekta Ranka-Hil'sha. Vestnik Permskogo natsional'nogo issledovatel'skogo universiteta, 4, 42–53.

34. Protopopov, R. Ya., Filenko, O. N., Shaporev, V. P. (2012). About reactor modeling for organic impurities thermal neutralization. Eastern-European Journal of Enterprise Technologies, 2 (12 (56)), 22–26. Available at: http://journals.uran.ua/eejet/article/view/3925/3593

35. Protopopov, R. Ya. (2012). Analiz termichnoho metodu zneshkodzhennia hazovykh vykydiv vid orhanichnykh spoluk. Inovatsiini shliakhy modeliuvannia bazovykh haluzei promyslovosti, enerho- ta resursozberezhennia, okhorona navkolyshnoho seredovyshcha. Kharkiv: UkrHNTTs «Enerhostal», 379–386.

36. Tovazhnyans'kiy, L. L., Pertsev, L. P., Shaporev, V. P. (2004). Teploenergetika pogruzhnogo goreniya v reshenyi problem teplosnabzheniya i ekologyi Ukrainy. Intehrovani tekhnolohii ta enerhozberezhennia, 3, 3–12.

DEVELOPMENT OF THE METHOD OF EVALUATION OF THE LEVEL OF ENVIRONMENTAL SAFETY OF HOUSING ACCOMMODATION AND ITS APPROBATION
(p. 61-69)

Petro Sankov
SHEI «Prydniprovs'ka State Academy of Civil Engineering and Architecture», Dnipro, Ukraine
ORCID: http://orcid.org/0000-0002-0898-7992

Ivan Trifonov
SHEI «Prydniprovs'ka State Academy of Civil Engineering and Architecture», Dnipro, Ukraine
ORCID: http://orcid.org/0000-0002-3278-6197

Nataliia Tkach
SHEI «Prydniprovs'ka State Academy of Civil Engineering and Architecture», Dnipro, Ukraine
ORCID: http://orcid.org/0000-0002-2695-3980

Vladimir Hilov
SHEI «Prydniprovs'ka State Academy of Civil Engineering and Architecture», Dnipro, Ukraine
ORCID: http://orcid.org/0000-0002-3014-5820

Volodymyr Bakharev
Kremenchuk Mykhailo Ostrohradskyi National University, Kremenchuk, Ukraine
ORCID: http://orcid.org/0000-0001-9312-654X

Oleg Tretyakov
O. M. Beketov National University of Urban Economy in Kharkiv, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-0457-9553

Svetlana Nesterenko
O. M. Beketov National University of Urban Economy in Kharkiv, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-8255-109X

The method of estimating the level of ecological safety of a housing accommodation by environmental factors: physical, chemical, microclimatic and aesthetic is presented. Groups of danger factors in the structure of such a category of life quality as "Environmental safety of a dwelling house" are formed.

The analysis of modern scientific studies showed that the vast majority of researchers use the survey method when assessing the quality of dwellings. This approach is justified in terms of the ease of processing the results. However, when using this approach, it is difficult to avoid subjectivity in assessment.

Qualimetric tables have been compiled for the scoring assessment of the selected environmental hazards factors. Based on the values of the hazard factors scoring assessment and their weight determination, a formula is proposed for determining the numerical value of the integral indicator of the environmental safety of the dwelling.

The application of the developed method allows:
– assessing the existing environmental safety level of residential premises to manage its quality, in terms of both new construction and reconstruction;
– justifying the choice of new architectural projects regarding environmental safety in the room;
– estimating the cost of a premise when it is purchased on the primary or secondary market in the conditions of equivalence of all other parameters such as location, the state of the infrastructure of the district, etc.

Keywords: environmental safety, danger factor, dwelling, integral indicator, score, qualimetric table.

Refrences

1. Sorokina, T. S. (2009). Vsesvitnia orhanizatsiya okhorony zdorovia. Vol. 2. Istoriya medytsyny u dvokh tomakh. Available at: http://bibliograph.com.ua/423/39.htm
2. Ushakova, Yu., Bihunova, Yu., Yurchuk, K., Toshyna, L., Tkach, N., Hilov, V., Sankov, P. (2017). Rozrobka kryteryiv ekolohichnoi bezpeky zhytlovykh prymishchen. Tendentsyi ta perspektyvy rozvytku nauky i osvity v umovakh hlobalizatsyi, 25, 35–38
3. Sankov, P., Tkach, N., Trifonov, I., Iliev, I., Blyzniuk, A. (2017). Residential Environmental and Ecological Safety of Person. IJISET – International Journal of Innovative Science, Engineering & Technology, 4 (4), 278–281. Available at: http://ijiset.com/vol4/v4s4/IJISET_V4_I04_31.pdf
4. Tsygankov, A. V., Beloglazova, A. S. (2011). Kompleksnaya otsenka effektivnosti sistem konditsionirovaniya vozduha v pomeshcheniyah zhilyh zdaniy. Vestnik MAH, 4, 33–36. Available at: http://www.refportal.com/upload/files/10_18.pdf
5. Senitkova, I. (2014). Impact of indoor surface material on perceived air quality. Materials Science and Engineering: C, 36, 1–6. doi: 10.1016/j.msec.2013.11.032
6. Maksimova, M. G. (2014). Otsenka komfortnosti gorodskoy kvartiry po kriteriyam ekologicheskoy bezopasnosti otdelochnyh materialov i predmetov byta. Vestnik Permskogo natsional'nogo issledovatel'skogo politekhnicheskogo universiteta, 2, 15–24. Available at: http://vestnik.pstu.ru/urbanistic/archives/?id=&folder_id=4001
7. Verloock, L., Joseph, W., Goeminne, F., Martens, L., Verlaek, M., Constandt, K. (2014). Assessment of Radio Frequency Exposures in Schools, Homes, and Public Places in Belgium. Health Physics, 107 (6), 503–513. doi: 10.1097/hp.0000000000000149
8. Urbinello, D., Joseph, W., Huss, A., Verloock, L., Beekhuizen, J., Vermeulen, R. et. al. (2014). Radio-frequency electromagnetic field (RF-EMF) exposure levels in different European outdoor urban environments in comparison with regulatory limits. Environment International, 68, 49–54. doi: 10.1016/j.envint.2014.03.007
9. Carpenter, D. O. (2014). Excessive Exposure to Radiofrequency Electromagnetic Fields May Cause the Development of Electrohypersensitivity. Altern. Ther. Health Med., 20 (6), 40–42.
10. Chauhan, N., Chauhan, R. P., Joshi, M., Agarwal, T. K., Aggarwal, P., Sahoo, B. K. (2014). Study of indoor radon distribution using measurements and CFD modeling. Journal of Environmental Radioactivity, 136, 105–111. doi: 10.1016/j.jenvrad.2014.05.020
11. Rekomendatsyi VOZ po kachestvu vozduha v pomeshcheniyah: syrost' i plesen'. Syrost' i plesen' (2009). WHO, 273. Available at: http://www.euro.who.int/__data/assets/pdf_file/0018/246321/E92645r.pdf?ua=1
12. Paunovic, K., Belojevic, G. (2014). Burden of myocardial infarction attributable to road-traffic noise: A pilot study in Belgrade. Noise and Health, 16 (73), 374. doi: 10.4103/1463-1741.144415
13. Harding, A.-H., Frost, G., Tan, E., Tsuchiya, A., Mason, H. (2013). The cost of hypertension-related ill-health attributable to environmental noise. Noise and Health, 15 (67), 437. doi: 10.4103/1463-1741.121253

14. San'kov, P. N., Gilev, V. V., Makarova, V. N., Tkach, N. A., Baharev, V. S. (2015). Opredelenie dostovernosti metoda ekspress-otsenki shumovogo zagryazneniya selitebnyh territoriy po rezul'tatam eksperimental'nyh issledovaniy. Ekolohichna bezpeka: naukovyi zhurnal, 2, 96–100.

15. Hiremath, R. B., Balachandra, P., Kumar, B., Bansode, S. S., Murali, J. (2013). Indicator-based urban sustainability – A review. Energy for Sustainable Development, 17 (6), 555–563. doi: 10.1016/j.esd.2013.08.004

16. Huang, L., Wu, J., Yan, L. (2015). Defining and measuring urban sustainability: a review of indicators. Landscape Ecology, 30 (7), 1175–1193. doi: 10.1007/s10980-015-0208-2

17. Glebova, I., Khabibrahmanova, R. (2014). Life Quality Evaluation in the Million-plus Population Cities of Russia: Results of Empirical Research. Procedia Economics and Finance, 14, 236–242. doi: 10.1016/s2212-5671(14)00707-2

18. Streimikiene, D. (2014). Housing Indicators for Assessing Quality of Life in Lithuania. Intellectual Economics, 8 (1), 25–41. doi: 10.13165/ie-14-8-1-02

19. Bezsonov, Y., Andreev, V. (2016). Justification and formalization of approach to regional environmental safety evaluation. Eastern-European Journal of Enterprise Technologies, 2 (10 (80)), 9–18. doi: 10.15587/1729-4061.2016.64843

20. Ovsiannikova, T. Y., Nikolaenko, M. N. (2015). Quality assessment of urban environment. IOP Conference Series: Materials Science and Engineering, 71, 012051. doi: 10.1088/1757-899x/71/1/012051

21. Yoade, A. O., Adeyemi, O. O., Adeyemi, B. A. (2015). An assessment of housing and neighbourhood quality condition in Ilesa, Nigeria. Analele Universitatii din Oradea, Seria Geografie, 2/2015, 242–252.

22. Ibem, E. O., Amole, O. O. (2011). Assessment of the qualitative adequacy of newly constructed public housing in Ogun State, Nigeria. Property Management, 29 (3), 285–304. doi: 10.1108/02637471111139437

23. Sanni-Anibire, M. O., Hassanain, M. A. (2016). Quality assessment of student housing facilities through post-occupancy evaluation. Architectural Engineering and Design Management, 12 (5), 367–380. doi: 10.1080/17452007.2016.1176553

24. Xiong, Y., Krogmann, U., Mainelis, G., Rodenburg, L. A., Andrews, C. J. (2015). Indoor air quality in green buildings: A case-study in a residential high-rise building in the northeastern United States. Journal of Environmental Science and Health, Part A, 50 (3), 225–242. doi: 10.1080/10934529.2015.981101

25. Du, L., Prasauskas, T., Leivo, V., Turunen, M., Pekkonen, M., Kiviste, M. et. al. (2015). Assessment of indoor environmental quality in existing multi-family buildings in North-East Europe. Environment International, 79, 74–84. doi: 10.1016/j.envint.2015.03.001

26. Delsante, I. (2016). Urban environment quality assessment using a methodology and set of indicators for medium-density neighbourhoods: a comparative case study of Lodi and Genoa. Ambiente Construido, 16 (3), 7–22. doi: 10.1590/s1678-86212016000300089

27. DBN V.1.2-8-2008. Osnovni vymohy do budivel i sporud bezpeka zhyttia i zdorovia liudyny ta zakhyst navkolyshnoho pryrodnoho seredovyshcha (2008). Kyiv: Minrehion Ukrainy, 22.

28. DSTU B EN 15251:2011. Rozrakhunkovi parametry mikroklimatu prymishchen dlia proektuvannia ta otsinky enerhetychnykh kharakterystyk budivel po vidnoshenniu do yakosti povitria, teplovoho komfortu, osvitlennia ta akustyky (EN 15251:2007, IDT) (2012). Kyiv: Minrehion Ukrainy, 71.

29. DBN V.1.1 – 31:2013. Zakhyst terytoryi, budynkiv i sporud vid shumu (2014). Kyiv: Minrehion Ukrainy, 54.

30. Normy radiatsyinoi bezpeky Ukrainy (NRBU-97): DHN 6.6.1. – 6.5.001-98 (1997). Kyiv: Ministerstvo okhorony zdorovia, 34.

31. Samoylyuk, E. P., San'kov, P. N., Makovetskiy, B. I., Chelnokov, A. V., Gilev, V. V., Naumenko, S. S. (2012). Ekspress-metodika otsenki kachestva sistemy zelenyh nasazhdeniy (KBZHD oblasti blagopoluchiya "rekreatsiya"). Makyivka: DonDABA, 23–27.