CHEMICAL AND TECHNOLOGICAL SYSTEMS

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EFFECT OF PROCESSING AT THE STEEL VACUUM PROCESSING UNIT (SVPU) ON DESULFURIZATION OF UNMODIFIED AND MODIFIED KP-2 STEEL

page 4–8

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The object of the research is the processes of statistical processing of the chemical composition of KP-2 wheel steel. One of the most problematic places in the smelting of modern steel is the stability of the chemical composition due to the use of uncontrolled content of scrap, charge and standard modifiers, which are made by the fused method.

To eliminate this problem, multifunctional modifiers were used during the study. This is due to the fact that the KP-2 steel modification method proposed in this article has a number of features. In this case, the influence modifiers of multifunctional action on the installation of vacuum processing of steel on desulfurization of wheel steel KP-2, obtained under the conditions of the open joint-stock company «Interpipe NTRP» (Dnipro, Ukraine), is established. In particular, when treating a steel melt with multifunctional modifiers, not only a refining effect occurs, but also an increase in the stability of the chemical composition and level of mechanical characteristics of the KP-2 wheeled steel. This is confirmed by the coefficients of variation and interfusion difference presented in the article (span), obtained by statistical processing of a large data set – 442 serial heats and 1 modified (6 wheels).

Thanks to the multifunctional modification, the level of mechanical characteristics and the quality of the finished wheels really increases. Compared with similar mass-produced materials, such as FeSi, FeCa, FeMn, SiCa, the use of new multifunctional modifiers in KP-2 wheel steel provides a significant reduction in the mass fraction of sulfur than in the same metal that is processed in the traditional way. It is established that the use of multifunctional modifiers changes the shape of non-metallic inclusions to globular and reduces their number, which also increases the level of mechanical properties of KP-2 wheel steel. The obtained coefficients of variation prove that the mechanical characteristics of KP-2 modified steel are more stable than in serial melts of the same steel. This will increase the demand and quality of these railway wheels.

Keywords: modifiers of multifunctional action, chemical composition of steel, mechanical properties of steel, non-metallic inclusions.

References

1. Polishko, S. A., Markova, I. A., Ivchenko, T. I., Nosova, T. V. (2012). Vliyanie elementov na parametry mekhanicheskikh svoystv seriynoy i modifitsirovannoy stali St1kp. *Metallurgiya i gornorudnaya promyshlennost', 4,* 73–75.
2. Shapovalov, V. P., Shapovalov, O. V., Shapovalova, O. M., Polishko, S. O. (2011). Pat. No. 93684 UA. *Rozkysliuvach-modyfikator dlia obrobky rozplaviv stalei i splaviv.* MPK: C22C 35/00, C21C 1/00, C22B 9/10, C21C 7/06, C22C 1/06. No. a200801124; declareted: 30.01.2008; published: 10.03.2011; Bul. No. 5, 4.
3. Ren, Y., Zhang, L., Yang, W., Duan, H. (2014). Formation and Thermodynamics of Mg-Al-Ti-O Complex Inclusions in Mg-Al-Ti-Deoxidized Steel. *Metallurgical and Materials Transactions B, 45 (6),* 2057–2071. doi: http://doi.org/10.1007/s11663-014-0121-0
4. Ostash, O. P., Andreiko, I. M., Kulyk, V. V., Prokopets, V. I. (2012). Tsyklichna trishchynostiikist stalei zaliznychnykh kolis typu KP-2 i KP-T za vplyvu ekspluatatsiinykh temperaturno-sylovykh faktoriv. *Problemi mekhanyky zheleznodorozhnoho transporta: Bezopasnost dvyzhenyia, dynamyka, prochnost podvyzhnoho sostava, enerhosberezhenye.* Dnipropetrovsk: DNUZhT, 105–106.
5. Tatarchenko, D. M. (2014). *Metallurgiya chuguna, zheleza i stali v obshhedostupnom izlozhenii.* Moscow: Kniga po Trebovaniyu, 491.
6. Lychagina, T., Nikolayev, D., Sanin, A., Tatarko, J., Ullemeyer, K. (2015). Investigation of rail wheel steel crystallographic texture changes due to modification and thermomechanical treatment. *IOP Conference Series: Materials Science and Engineering, 82,* 1–6. doi: http://doi.org/10.1088/1757-899x/82/1/012107
7. Liu, K. P., Dun, X. L., Lai, J. P., Liu, H. S. (2011). Effects of modification on microstructure and properties of ultrahigh carbon (1.9 wt. % C) steel. *Materials Science and Engineering: A, 528 (28),* 8263–8268. doi: http://doi.org/10.1016/j.msea.2011.07.038
8. Pryhunova, A. H., Petrov, S. S. (2016). Budova metalevykh rozplaviv i yii vzaiemozviazok z tverdym stanom. *Metaloznavstvo ta obrobka metaliv, 2,* 17–27.
9. Brebbia, C., Connor, J. J.; Newkirk, J. W., Popov, A. A., Zhilin, A. S. (Eds.) (2018). *Progress in Materials Science and Engineering.* Springer, 203. doi: http://doi.org/10.1007/978-3-319-75340-9
10. Mirsado, O., Milenko, R., Omer, B., Salejman, M. (2011). Alloys with modified characteristics. *Mater in Technol, 45 (5),* 485–489.
11. Maślak, M., Skiba, R. (2015). Fire Resistance Increase of Structural Steel through the Modification of its Chemical Composition. *Procedia Engineering, 108,* 277–284. doi: http://doi.org/10.1016/j.proeng.2015.06.148
12. Polishko, S. (2017). Effect of modification on the formation of nonmetallic inclusions in KP-T wheel steel. *Tekhnicheskaya mekhanika, 4,* 112–118.
13. Polyshko, S. A. (2017). Stabylyzatsyia khymycheskoho sostava pri viplavke kolesnoi staly klassa «S». *Visnyk Dnipropetrovskoho natsionalnoho universytetu imeni Olesia Honchara. Seriia Raketno-kosmichna tekhnika, 1,* 78–85.
14. DSTU GOST 10791-2016. *Kolesa tsel'nokatanye* (2016). Standartinfo, 29.
15. Voynov, A. R., Ri, E. X. (2018). *Tekhnologiya kompleksnoy obrabotki staley na agregate «kovsh-pech'» (ladle-furnace).* Khabarovsk: Tikhookeanskiy gosudarstvennyy universitet, 64.

ECOLOGY AND ENVIRONMENTAL TECHNOLOGY

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DEVELOPMENT OF A METHOD FOR OBTAINING SORBENT FROM BAGASSE OF SWEET SORGHUM FOR NEUTRALIZATION OF SOIL CONTAMINATION BY HEAVY METAL IONS

page 9–15

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The object of research is the industrial waste of plant raw materials of sweet sorghum (lignocellulosic bagasse) and a modified sorbent created on its basis for cleaning soils contaminated with heavy metal ions. Traditionally, the modification of plant materials to obtain sorbents involves the oxidation (hydrolysis) of plant material under

the action of strong mineral acids at high temperature. After acid treatment, alkaline activation and repeated washing of the sorbent is carried out until neutral wash water. The yield of the sorbent is 20–30 % by weight of raw materials. In addition, a significant amount of decomposition products and large volumes of hazardous wastewater are generated. Therefore in the course of the study, a mercerization method was used to obtain a sorbent – treating lignocellulosic bagasse with an alkali solution.

The main components of lignocellulosic bagasse are lignin and cellulose, connected in biopolymer complexes. In their raw form, they have weak sorption properties through the fibrillary structure and low content of free functional groups in them. Under the conditions of the mercerization process, the molecular bonds between the fibers of the biopolymers are partially destroyed and the solution of low molecular weight polysaccharides is dissolved. The structural framework of the lignocellulosic matrix is preserved, and its ability to swell is growing. Integrity is preserved, vegetable fibers improve their structural-porous structure by increasing the internal adsorption surface. The optimal conditions for the mercerization process are a hydro module of 1:10 with an initial alkali concentration of 120 g/l. The maximum sorption values of heavy metal ions increase by a factor of 2–3. The sorbent yield reaches 60–80 %. In addition, the advantage of this method is the absence of harmful wastewater.

The developed method can be used for processing waste and other plant materials (corn, sunflower, sugar cane, etc.), and the resulting sorbent is used in agricultural technologies for neutralization of soils contaminated with heavy metal ions.

Keywords: waste mercerization, sorbent for cleaning soils, sweet sorghum, lignocellulosic bagasse.

References

1. Vasil'ev, A. (2000). Sovremennye podkhody k resheniyu problemy zagryazneniya pochv tyazhelymi metallami. *Ekotekhnologii i resursosberezhenie, 5,* 47–52.
2. Ellis, D. I. (2008). Intehrovani inzhenerni ta naukovi metody pererobky zabrudnenykh gruntiv. *Khimiia v interesakh staloho rozvytku, 2,* 285.
3. Kulakow, P. A., Pidlisnyuk, V. V. (Eds.) (2010). *Application of Phytotechnologies for Cleanup of Industrial, Agricultural and Waste Water Contamination.* Dordrecht: Vetlag: Springer, 196. doi: http://doi.org/10.1007/978-90-481-3592-9
4. Witters, N., Mendelsohn, R. O., Van Slycken, S., Weyens, N., Schreurs, E., Meers, E. et. al. (2012). Phytoremediation, a sustainable remediation technology? Conclusions from a case study. I: Energy production and carbon dioxide abatement. *Biomass and Bioenergy, 39,* 454–469. doi: http://doi.org/10.1016/j.biombioe.2011.08.016
5. Yakovishina, T. F. (2008). Ecological estimation of the sorbent-meliorate influence to the fertility agrochemical indexes by the detox cation of the heavy metals in the soil. *Ekolohiia i pryrodokorystuvannia, 11,* 153–158. URL: http://dspace.nbuv.gov.ua/handle/123456789/14402
6. Slizovskiy, I. B., Kelsey, J. W., Hatzinger, P. B. (2010). Surfactant-facilitated remediation of metal-contaminated soils: Efficacy and toxicological consequences to earthworms. *Environmental Toxicology and Chemistry, 30 (1),* 112–123. doi: http://doi.org/10.1002/etc.357
7. Lopes, C., Herva, M., Franco-Uría, A., Roca, E. (2011). Inventory of heavy metal content in organic waste applied as fertilizer in agriculture: evaluating the risk of transfer into the food chain. *Environmental Science and Pollution Research, 18 (6),* 918–939. doi: http://doi.org/10.1007/s11356-011-0444-1
8. Khokhlov, A. V., Khokhlova, L. I, Breus, I. P. (2009). Perspektivy ispol'zovaniya immobilizovannykh mikroorganizmov-destruktorov dlya ochistki ekosistem ot ksenobiotikov. *Gigiena i sanitariya, 5,* 91–96.
9. Belyaev, E. Yu., Belyaeva, L. E. (2000). Ispol'zovanie rastitel'nogo syr'ya v reshenii problem zashhity okruzhayushhey sredy. *Khimiya v interesakh ustoychivogo razvitiya, 8,* 763–772.
10. Hryhorenko, N. O., Shtanheieva, N. I., Kupchyk, L. A. (2017). Pererobka vidkhodiv tsukrovoho sorho (bahasy) z metoiu otrymannia sorbentiv. *Tsukor Ukrainy, 3,* 33–36.
11. Hryhorenko, N. O., Kupchyk, L. A., Denysovych, V. O. (2018). Vyluchennia ioniv midi lihnifikovanoiubahasoiu iz vodnykh vytiazhok grunti. *Naukovi dopovidi NUBiP Ukrainy, 2 (72).* Available at: http://journals.nubip.edu.ua/index.php/Dopovidi/article/view/10638/9355
12. Kartel', N. T., Kupchik, L. A., Nikolaychuk, A. A. (2007). Sintez i svoystva biosorbentov, poluchennykh na osnovetsellyulozno-ligninovogo rastitel'nogo syr'ya – otkhodov agropromyshlennogo kompleksa. *Sorbtsionnye i khromatograficheskie protsessy, 7 (3),* 489–498.
13. Rogovin, Z. A. (1972). *Khimiya tsellyulozy.* Moscow: Khimiya, 520.
14. Smolin, A. S., Dubovyy, V. K., Komarov, D. Yu., Kanarskiy, A. V. (2016). Pennyy sposob formovaniya fil'troval'noy bumagi na tsellyuloznoy osnove. *Vestnik Tekhnologicheskogo universiteta, 19 (15),* 86–88.
15. Dubovoy, E. V., Koverninskiy, I. N., Smolin, A. S., Kanarskiy, A. V. (2017). Adgezionnye svoystva steklyannogo volokna i povyshenie prochnosti bumagi dobavkoy merserizovannoy tsellyulozy. *Vestnik Tekhnologicheskogo universiteta, 20 (12),* 53–55.
16. Azarov, V. I., Burov, A. V., Obolenskaya, A. V. (1999). *Khimiya drevesiny i sinteticheskikh polimerov.* Saint Petersburg, 627.
17. Chae, D. W., Choi, K. R., Kim, B. C., Oh, Y. S. (2003). Effect of Cellulose Pulp Type on the Mercerizing Behavior and Physical Properties of Lyocell Fibers. *Textile Research Journal, 73 (6),* 541–545. doi: http://doi.org/10.1177/004051750307300613
18. Wang, J., Chen, C. (2009). Biosorbents for heavy metals removal and their future. *Biotechnology Advances, 27 (2),* 195–226. doi: http://doi.org/10.1016/j.biotechadv.2008.11.002
19. GOST 20255.1-89. (2002). *Ionity. Metody opredeleniya staticheskoy obmennoy emkosti. Vveden 1991-01-01.* Moscow: Izd-vo standartov, 5.
20. Klark, E., Eberkhard, K. (2007). *Mikroskopicheskie metody issledovaniya materialov.* Moscow: TEKHNOSFERA, 326–339.
21. *DSTU 4287:2004. Yakist gruntu. Vidbyrannia prob.* (2004). Chynnyi vid 2004-04-30. Kyiv: Derzhspozhyvstandart Ukrainy, 9.
22. DSTU 4770.1:2007. (2007). *Yakist gruntu. Vyznachennia vmistu rukhomykh spoluk marhantsiu (tsynku, kadmiiu, zaliza, kobaltu, midi, nikeliu, khromu, svyntsiu) v grunti v bufernii amoniino-atsetatnii vytiazhtsi z rN 4,8 metodom atomno-absorbtsiinoi spektrofotometrii. Chynnyi vid 2009-01-01.* Kyiv: Derzhspozhyvstandart Ukrainy, 18.
23. Borowski, M. (Eds.) (2011). *Perovskites. Structure, Properties and Uses.* New York: Nova Science Publishers, 586.
24. Sedin, A. V., Orlovskaya, T. V., Gavrilin, M. V. (2014). Ispol'zovanie metoda IK-spektroskopii dlya analizarastitel'nogosyr'ya. *Sovremennye problemy nauki i obrazovaniya, 1,* 45–49.
25. Hryshko, V. M., Syshchykov, D. V., Piskova, O. M. et. al. (2012). *Vazhki metaly: nadkhodzhennia v grunty, trans lokatsiia u roslynakh ta ekolohichna bezpeka.* Donetsk: Donbas, 304.

FOOD PRODUCTION TECHNOLOGY

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OPTIMIZATION OF THE COMPOSITION OF FAT SYSTEMS OF NEW GENERATION

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Fats are an integral part of human nutrition. The increased content of trans-isomers in their composition causes a number of cardiovascular diseases and metabolic disorders. A promising approach to solving the problem of minimizing the content of trans-isomers of fatty acid in the composition of food products is the creation of a new generation of fat systems – the oleogel, which is the subject of the presented research. As the dispersion medium of the oleogel, high-oleic sunflower oil is used, in contrast to the oil of traditional varieties, it is possible to obtain systems with enhanced oxidation resistance. The dispersed phase of these fat systems is beeswax, tripalmitin and monoacylglycerols. The choice of a complex of these components is based on their properties to create in oleogels a three-dimensional structure with desired thermomechanical characteristics. At present, there is not enough information about the dependence of the main characteristics of the oleogel on the ratio of ingredients of dispersed phase. In particular, one of the most problematic places in the oleogel technology is its thermal stability, which significantly affects the parameters of production, transportation, as well as storage conditions and periods. To solve this problem, the methodology of the response surface is used in the work. The determination of the unknown values of the parameter vector is carried out by applying regression analysis algorithms. The minimization of the deviation functional is performed by finding the appropriate combinations of experimental predictor series. As a result of research, a mathematical model is developed, which allows, based on data on the component composition of the oleogel, to predict its thermal stability. Reasonably rational mass fractions of the components of the dispersed phase of the oleogel: the content of beeswax is 3.27 wt. %; content of tripalmitin is 3.07 wt. % and the content of monoacylglycerol is 4.70 wt. %, at which the maximum value of the response function is reached. The results will serve as a scientific basis for the development of technological parameters of the industrial production of fat systems of the new generation, the conditions and terms of their storage and transportation.

Keywords: oleogel technology, industrial production of fat systems, thermomechanical characteristics, thermal stability of the oleogel.

References

1. Nekrasov, P. O., Piven, O. M., Nekrasov, O. P., Gudz, O. M., Kryvonis, N. O. (2018). Kinetics and thermodynamics of biocatalytic glycerolysis of triacylglycerols enriched with omega-3 polyunsaturated fatty acids. *Voprosy Khimii i Khimicheskoi Tekhnologii, 5,* 31–36.
2. Tkachenko, N., Nekrasov, P., Makovska, T., Lanzhenko, L. (2016). Optimization of formulation composition of the low-calorie emulsion fat systems. *Eastern-European Journal Of Enterprise Technologies, 3 (11 (81)),* 20–27. doi: http://doi.org/10.15587/1729-4061.2016.70971
3. Tkachenko, N., Nekrasov, P., Vikul, S. (2016). Optimization of formulation composition of health whey-based beverage. *Eastern-European Journal Of Enterprise Technologies, 1 (10 (79)),* 49–57. doi: http://doi.org/10.15587/1729-4061.2016.59695
4. Booker, C., Mann, J. (2008). Trans fatty acids and cardiovascular health: Translation of the evidence base. *Nutrition, Metabolism And Cardiovascular Diseases, 18 (6),* 448–456. doi: http://doi.org/10.1016/j.numecd.2008.02.005
5. Kavanagh, K., Sajadian, S., Jenkins, K. A., Wilson, M. D., Carr, J. J., Wagner, J. D., Rudel, L. L. (2010). Neonatal and fetal exposure to trans-fatty acids retards early growth and adiposity while adversely affecting glucose in mice. *Nutrition Research, 30 (6),* 418–426. doi: http://doi.org/10.1016/j.nutres.2010.06.006
6. Kummerow, F. A., Zhou, Q., Mahfouz, M. M., Smiricky, M. R., Grieshop, C. M., Schaeffer, D. J. (2004). Trans fatty acids in hydrogenated fat inhibited the synthesis of the polyunsaturated fatty acids in the phospholipid of arterial cells. *Life Sciences, 74 (22),* 2707–2723. doi: http://doi.org/10.1016/j.lfs.2003.10.013
7. Kwon, Y. (2015). Effect oftrans-fatty acids on lipid metabolism: Mechanisms for their adverse health effects. *Food Reviews International, 32 (3),* 323–339. doi: http://doi.org/10.1080/87559129.2015.1075214
8. Zulim Botega, D. C., Marangoni, A. G., Smith, A. K., Goff, H. D. (2013). Development of Formulations and Processes to Incorporate Wax Oleogels in Ice Cream. *Journal of Food Science, 78 (12),* 1845–1851. doi: http://doi.org/10.1111/1750-3841.12248
9. Lim, J., Hwang, H.-S., Lee, S. (2016). Oil-structuring characterization of natural waxes in canola oil oleogels: rheological, thermal, and oxidative properties. *Applied Biological Chemistry, 60 (1),* 17–22. doi: http://doi.org/10.1007/s13765-016-0243-y
10. Moghtadaei, M., Soltanizadeh, N., Goli, S. A. H. (2018). Production of sesame oil oleogels based on beeswax and application as partial substitutes of animal fat in beef burger. *Food Research International, 108,* 368–377. doi: http://doi.org/10.1016/j.foodres.2018.03.051
11. Ojijo, N. K. O., Kesselman, E., Shuster, V., Eichler, S., Eger, S., Neeman, I., Shimoni, E. (2004). Changes in microstructural, thermal, and rheological properties of olive oil/monoglyceride networks during storage. *Food Research International, 37 (4),* 385–393. doi: http://doi.org/10.1016/j.foodres.2004.02.003
12. Rocha-Amador, O. G., Gallegos-Infante, J. A., Huang, Q., Rocha-Guzman, N. E., Moreno-Jimenez, M. R., Gonzalez-Laredo, R. F. (2014). Influence of Commercial Saturated Monoglyceride, Mono-/Diglycerides Mixtures, Vegetable Oil, Stirring Speed, and Temperature on the Physical Properties of Organogels. *International Journal of Food Science, 2014,* 1–8. doi: http://doi.org/10.1155/2014/513641
13. Da Pieve, S., Calligaris, S., Co, E., Nicoli, M. C., Marangoni, A. G. (2010). Shear Nanostructuring of Monoglyceride Organogels. *Food Biophysics, 5 (3),* 211–217. doi: http://doi.org/10.1007/s11483-010-9162-3
14. Toro-Vazquez, J. F., Alonzo-Macias, M., Dibildox-Alvarado, E., Charó-Alonso, M. A. (2009). The Effect of Tripalmitin Crystallization on the Thermomechanical Properties of Candelilla Wax Organogels. *Food Biophysics, 4 (3),* 199–212. doi: http://doi.org/10.1007/s11483-009-9118-7
15. Yang, S., Li, G., Saleh, A. S. M., Yang, H., Wang, N., Wang, P. et. al. (2017). Functional Characteristics of Oleogel Prepared from Sunflower Oil with β-Sitosterol and Stearic Acid. *Journal of the American Oil Chemists' Society, 94 (9),* 1153–1164. doi: http://doi.org/10.1007/s11746-017-3026-7
16. Okuro, P. K., Malfatti-Gasperini, A. A., Vicente, A. A., Cunha, R. L. (2018). Lecithin and phytosterols-based mixtures as hybrid structuring agents in different organic phases. *Food Research International, 111,* 168–177. doi: http://doi.org/10.1016/j.foodres.2018.05.022
17. Kouzounis, D., Lazaridou, A., Katsanidis, E. (2017). Partial replacement of animal fat by oleogels structured with monoglycerides and phytosterols in frankfurter sausages. *Meat Science, 130,* 38–46. doi: http://doi.org/10.1016/j.meatsci.2017.04.004
18. Okuro, P. K., Tavernier, I., Bin Sintang, M. D., Skirtach, A. G., Vicente, A. A., Dewettinck, K., Cunha, R. L. (2018). Synergistic interactions between lecithin and fruit wax in oleogel formation. *Food & Function, 9 (3),* 1755–1767. doi: http://doi.org/10.1039/c7fo01775h
19. Buerkle, L. E., Rowan, S. J. (2012). Supramolecular gels formed from multi-component low molecular weight species. *Chemical Society Reviews, 41 (18),* 6089–6102. doi: http://doi.org/10.1039/c2cs35106d
20. Myers R., Montgomery D., Anderson-Cook C. *Response surface methodology: process and product optimization using designed experiments.* Hoboken: John Wiley & Sons, 2016. 825 p.

REPORTS ON RESEARCH PROJECTS

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ANALYSIS OF THE RESEARCH RESULTS OF THE ZEOLITE DRYING PROCESS

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The object of research is the zeolite drying process by radiation method. Loose zeolite of two fractions (0–1 mm and 0–5 mm) are used as prototypes. Drying occurs at a layer thickness of zeolite equal to 3 and 5 mm. According to the source of thermal energy, an electric infrared emitter of ceramic type with a nominal electric power of 1 kW is used. The influence of the zeolite fractions, the thickness of the zeolite layer during drying, and the heat flux density on the kinetics of the drying process is established. The numerical values of the zeolite drying time in different periods of drying are determined. According to the analysis of the research results of zeolite drying by a radiation method, it is established that the kinetic laws of this process are similar to the process of drying capillary-porous bodies. The duration of the drying periods depends on the heat flux density and decreases with increasing heat flux density. An increase in the value of the zeolite fractions intensifies the drying process in the warm-up periods and the first drying period, but does not affect the drying rate in the second period. Also a certain influence of the drying process parameters on the moisture content at the end of the first period. The temperature of the zeolite in the first period of drying is not constant, but increases. This indicates an excess of thermal energy supplied during this period. Analysis of the research results also shows that the drying time of the zeolite fraction 0–5 mm is less than the fraction 0–1 mm. Therefore, it is advisable to dry the zeolite fraction of 0–5 mm and, if necessary, further grind after the drying process. This will reduce energy costs and production time of the zeolite as a whole. The obtained curves of zeolite drying allow to predict the nature of the process and can be used to design drying plants.

Keywords: zeolite drying, drying time, radiation drying method, infrared radiation, drying curves.

References

1. *Tseolit prirodnyy.* Available at: https://www.zeolite.com.ua
2. Pritul's'ka, N. V., Bondarenko, E. V. (2015). Research of prospects for using zeolites in the food industry. *Eastern-European Journal of Enterprise Technologies, 5 (11 (77)),* 4–9. doi: http://doi.org/10.15587/1729-4061.2015.51067
3. Chester, A. W., Derouane, E. G. (Eds.) (2009). *Zeolite characterization and catalysis.* Springer, 360. doi: http://doi.org/10.1007/978-1-4020-9678-5
4. Rybachuk, V. D. (2016). Doslidzhennia mikrokhvylovoi sushky hranul tseolitu pyrodnoho ta yii vplyvu na tekhnolohichni vlastyvosti. *Annaly Mechnykovskoho instytutu, 2,* 59–64.
5. Korinchuk, D. M., Chalaiev, D. M., Korinchevska, T. V., Dabizha, N. O. (2012). Optymizatsiia parametriv protsesu reheneratsii sharu sorbentu adsorbtsiinoho teploakumuliatora. *Naukovi pratsi Odeskoi natsionalnoi akademii kharchovykh tekhnolohii, 41 (1),* 197–201.
6. Nikitenko, N. I., Snezhkin, Yu. F., Sorokovaya, N. N. (2011). Matematicheskaya model' i metod rascheta dinamiki nepreryvnoy sushki. *Naukovi pratsi Odeskoi natsionalnoi akademii kharchovykh tekhnolohii, 39 (2)*, 10–16.
7. Nikitenko, N. I., Snezhkin, Yu. F., Sorokovaya, N. N. (2009). Matematicheskoe modelirovanie diffuzionno-fil'tratsionnogo teplomassoperenosa pri regeneratsii tverdykh sorbentov v adsorbere s razvitoy poverkhnost'yu teplopodvoda. *Promyshlennaya teplotekhnika, 31 (5),* 20–28.
8. Djaeni, M., Bartels, P., Sanders, J., Straten, G. van, Boxtel, A. J. B. van. (2007). Process Integration for Food Drying with Air Dehumidified by Zeolites. *Drying Technology, 25 (1),* 225–239. doi: http://doi.org/10.1080/07373930601161096
9. Djaeni, M., Bartels, P., Sanders, J., van Straten, G., van Boxtel, A. J. B. (2007). Multistage Zeolite Drying for Energy-Efficient Drying. *Drying Technology, 25 (6),* 1053–1067. doi: http://doi.org/10.1080/07373930701396535
10. Djaeni, M., Bartels, P. V., van Asselt, C. J., Sanders, J. P. M., van Straten, G., van Boxtel, A. J. B. (2009). Assessment of a Two-Stage Zeolite Dryer for Energy-Efficient Drying. *Drying Technology, 27 (11),* 1205–1216. doi: http://doi.org/10.1080/07373930903263210
11. Marchevsky, V., Novokhat, O., Tsepkalo, O. (2015). Paper drying process for corrugation (fluting) using radiant energy. *Ukrainian Journal of Food Science, 2,* 310–321.
12. Karvatskii, A., Marchevsky, V., Novokhat, O. (2017). Numerical modeling of physical fields in the process of drying of paper for corrugating by the infrared radiation. *Eastern-European Journal of Enterprise Technologies, 2 (5 (86)),* 14–22. doi: http://doi.org/10.15587/1729-4061.2017.96741
13. Marchevskyy, V. M., Novokhat, O. A., Telestakova, V. V. (2018). Kinetychni zakonomirnosti sushinnia kartonu, napovnenoho tseolitom. *Internauka, 8.* Available at: https://www.inter-nauka.com/issues/2018/8/3725

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ANALYSIS OF THE TECHNOLOGICAL AND MORPHOLOGICAL PECULIARITIES OF BRONZED POWDERS PRODUCTION FROM THE SWARF WASTES

page 24–26

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The object of research is the technology of practical production of metal powders from swarf waste of aluminum bronze with their subsequent use as pigments for printing processes. In the course of research, it is found that the developed surface of the swarf particles, numerous defects in the form of macro- and microcracks, splittings and pores, a specific microrelief are favorable prerequisites for their grinding. Experimental developments of fine structure have shown that in the process of swarf chips due to additional deformation, the dislocation density and the magnitude of the micro curvatures of crystal lattice of powder particles increases. The use of a rolling combine with a set of vibrating screens makes it possible to use further fine grinding of swarf waste. The study of the shape and state of the surface on optical and scanning microscopes provided the necessary information to explain the processes occurring during swarf grinding. The obtained result shows that micro-studies of the swarf formation zone in БаАЖ 9–4 makes it possible to study the texturing mechanism for the structural components of the alpha phase, the eutectoid in the formed chip. This made it possible to predict the nature of changes in the latter during grinding. The analysis of the nature of the destruction of the surface of the swarf elements of aluminum bronze in the grinding processes make it possible to confirm the inheritance of the morphological, structural, and physicochemical regularities of the latter by newly formed powder particles, as well as the possibility of obtaining a dispersed metallic pigment for use in the printing industry. The obtained positive results make it possible to implement experimental developments on the use of non-ferrous alloy swarf waste for the manufacture of metal powders. Due to this, it is possible to selectively grind the particles to the desired size and use the resulting powder fractions for their intended purpose. These wastes can be a very promising raw material for their use, despite the scale of created metal particle wastes from alloyed metals and alloys, especially in the context of the development of the newest resource-saving technologies in Ukraine.

Keywords: bronzing powders, swarf waste, rolling mill, morphological features, plastic deformation, fine structure.

References

1. Ogura, K. (2006). Technology for Powder Production and Evaluation of Powders. *Journal of the Japan Society of Powder and Powder Metallurgy, 53 (4),* 340. doi: http://doi.org/10.2497/jjspm.53.340
2. Frykholm, R., Takeda, Y., Andersson, B.-G., Carlström, R. (2016). Solid State Sintered 3-D Printing Component by Using Inkjet (Binder) Method. *Journal of the Japan Society of Powder and Powder Metallurgy, 63 (7),* 421–426. doi: http://doi.org/10.2497/jjspm.63.421
3. Zhang, Y., Ye, H., Liu, H. (2012). Preparation and characterization of blue color aluminum pigments Al/SiO2/PB with double-layer structure. *Powder Technology, 217*, 614–618. doi: http://doi.org/10.1016/j.powtec.2011.11.035

4. Kitsomboonloha, R., Bera, T., Dutta, J. (2008). Direct Synthesis of Anisotropic Metal Particles by Ink Jet Printing Technique. *Advanced Materials Research, 55-57,* 585–588. doi: http://doi.org/10.4028/www.scientific.net/amr.55-57.585
5. Kronberger, R., Wienstroer, V. (2017). 3-D printer FSS using printing filaments with enclosed metal particals. *Progress in Electromagnetics Research Symposium-Fall (PIERS-FALL).* Singapore. doi: http://doi.org/10.1109/piers-fall.2017.8293245
6. Ishida, Y., Nakagawa, G., Asano, T. (2007). Inkjet Printing of Nickel Nanosized Particles for Metal-Induced Crystallization of Amorphous Silicon. *Japanese Journal of Applied Physics, 46 (9B),* 6437–6443. doi: http://doi.org/10.1143/jjap.46.6437
7. Voloshin, V. S. (2007). *Priroda otkhodoobrazovaniya.* Mariupol: Renata, 666.
8. Babaei, V., Hersch, R. D. (2016). Color Reproduction of Metallic-Ink Images. *Journal of Imaging Science and Technology, 60 (3),* 305031–3050310. doi: http://doi.org/10.2352/j.imagingsci.technol.2016.60.3.030503
9. Martin, J. H., Yahata, B. D., Hundley, J. M., Mayer, J. A., Schaedler, T. A., Pollock, T. M. (2017). 3D printing of high-strength aluminium alloys. *Nature, 549 (7672),* 365–369. doi: http://doi.org/10.1038/nature23894
10. Liu, X., Tarn, T.-J., Huang, F., Fan, J. (2015). Recent advances in inkjet printing synthesis of functional metal oxides. *Particuology, 19,* 1–13. doi: http://doi.org/10.1016/j.partic.2014.05.001
11. Kyrychok, P. O., Roik, T. A., Morozov, A. S., Savchenko, K. Yi. (2009). Perspektyvy vykorystannia struzhky aliuminiievoi bronzy v polihrafichnykh protsesakh. *Tekhnolohiia i tekhnika drukarstva, 3,* 81–89.
12. Morozov, A. S., Savchenko, E. I. (2008). Ispol'zovanie metallicheskikh pigmentov pri izgotovlenii etiketki i upakovki. *Upakovka, 2,* 28–31.
13. Morozov, A. S., Ivasenko, M. V., Shakhovaia, O. V. (2013). Obrobka metalizovanykh koloidnykh system. *Tekhnolohiia i tekhnika drukarstva, 2,* 47–53.
14. Morozov, A. S. (2012). Pat. No. 68391 UA. *Metalizovana farbova plivka.* MPK: C09D 11/20 (2012.01). No. u201110329; declareted: 23.08.2011; published: 26.03.2012, Bul. No. 6.

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STUDYING THE PROCESS OF PHENOL SULFOMETHYLATION IN THE TECHNOLOGY OF WATER SOLUBLE SURFACTANTS

page 27–29

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The object of research is the reaction of phenol sulfomethylation in an aqueous medium, with the aim of obtaining water-soluble non-toxic products based on it used as surfactants. One of the most problematic places is the need to maintain the stability of the system and the content of a given pH with the introduction of the sulfonate agent: the reaction temperature is 125–130 °C, the polycondensation time is 8 hours, the reaction takes place under pressure. This method produces a reaction product that is a fairly complex mixture of monomers, dimers, trimmers and free phenol. Also, during the reaction of phenol sulfomethylation in an aqueous medium, the reaction mass is formed, which is a two-phase system: the upper organic layer is phenols, the lower layer is an aqueous solution of the formaldehyde bisulfite derivative. Significant disadvantage of this method is the relatively low yield of the target product and the high temperature of the reaction. In the course of the research, the reaction of phenol sulfomethylation under micellar catalysis is studied. The optimal amount of starting materials and the amount of phase transfer catalyst are determined. The use of these catalysts makes it possible to improve the main technological parameters: reduce the reaction temperature from 125–130 °C to 75–80 °C, shorten the process time to 1 hour, carry out the process at atmospheric pressure. The advantage of this technology is also non-waste, single-stage production and is available to Ukrainian raw materials. During the study, a product is obtained that has properties characteristic for surfactant: with increasing molecular weight, the surface tension of aqueous solutions increases and leads to a decrease in surface activity. Thus, according to the results of studies of the technological characteristics of the obtained samples of surfactants, they can be used as anion-active surfactants, used as stabilizers in the production of organic dyes, textile auxiliaries and as plasticizers for concrete.

Keywords: phenol sulfomethylation, phenol-aldehyde resin (Novolac), sodium bisulfite, interfacial catalysis, surfactants.

References

1. Cui, Y., Hou, X., Wang, W., Chang, J. (2017). Synthesis and Characterization of Bio-Oil Phenol Formaldehyde Resin Used to Fabricate Phenolic Based Materials. *Materials, 10 (6),* 668. doi: http://doi.org/10.3390/ma10060668
2. Zoumpoulakis, L., Simitzis, J. (2001). Ion exchange resins from phenol/formaldehyde resin-modified lignin. *Polymer International, 50 (3),* 277–283. doi: http://doi.org/10.1002/pi.621
3. Zhuravlev, V. A., Murashkina, T. V. (2005). Issledovanie protsessa i sostava produktov sul'fometilirovaniya fenola. *Vestnik Kuzbasskogo gosudarstvennogo tekhnicheskogo universiteta. Khimicheskaya tekhnologiya, 6,* 85–87
4. *Ionnyy obmen i ego primenenie* (1959). Moscow: Akademiya nauk, 320.
5. *Aromatic Compounds* (2018). Organic Chemistry. De Gruyter, 303–307. doi: http://doi.org/10.1515/9783110565140-018
6. Gilbert, E. (2002). Recent Developments in Preparative Sulfonation and Sulfation. *Synthesis, 1969 (1),* 3–10. doi: http://doi.org/10.1055/s-1969-34188
7. Sokolenko, N. M., Popov, E. V., Ruban, E. V., Fastovetskaya, E. V. (2016). The use of phenolic wastewater in coke production technologies plasticizing additives for concrete. *Visnik of the Volodymyr Dahl East Ukrainian national university, 5 (229),* 14–18.
8. Yusibova, Yu. M., Isak, A. D., Popov, E. V. (2014). Technology based surfactants phenol derivatives. *Visnik of the Volodymyr Dahl East Ukrainian national university, 9 (216),* 186–190.
9. Demlov, E., Demlov, Z.; Yanovskaya, L. A. (Ed.) (1987). *Mezhfaznyy kataliz.* Moscow: Mir, 465.
10. GOST 6848-79. Dispergator NF tekhnicheskiy. *Tekhnicheskie usloviya. Izmeneniya N 1, 2 (soderzhanie nerastvorimykh v vode veshhestv v pereschete na sukhoy produkt, soderzhanie sul'fata natriya v pereschete na sukhoy produkt).* Available at: http://docs.cntd.ru/document/gost-6848-79

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INFLUENCE OF UV RADIATION IN PRE-SOWING TREATMENT OF SEEDS OF CROPS

page 30–32

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The object of research is the seeds of crops: wheat, barley, rapeseed and carrots. The effect of ultraviolet (UV) radiation on seeds of agricultural enterprises of crops in pre-sowing treatment (germination energy and germination capacity) is investigated, which is aimed at solving the problem of the agro-industrial complex, namely increasing the quantity and quality of the crop. In the course of experimental work, low-pressure ultraviolet discharge lamps are used, in which the radiation maximum falls at 254 nm. To measure doses of UV radiation, a Tensor-31 radiometer (Ukraine) is used, which provides measurements in the wavelength range of 200–400 nm. The research results of growth processes (germination energy and germination) showed that for seeds of winter soft wheat, the optimal UV dose is 400–600 J/m^2, at which the germination energy increases by 7–12 %, and the germination capacity by 9–15 %. For winter barley, the optimal dose is 250 J/m^2, at which the germination capacity increases by 23 % compared with control samples, and for spring barley, 900–1000 J/m^2, at which the increase in germination capacity is 80 %. When seeds are irradiated, the maximum indicators of germination energy and seed germination capacity are observed at doses of 80–100 J/m^2, at which the germination energy increases by 20–26 %, and the germination capacity by 16 %. When comparing the effect on rapeseeds of different spectral regions of the UV range of 200–400 nm, an increase in germination energy and germination capacity of 6–9 % for area C is noted. When treating carrot seeds, it is found that UV irradiation stimulates growth processes: seed germination capacity increased by 27–29 % at doses of 120–150 J/m^2. This pattern of positive effect of UV irradiation on the growth processes of crops is observed in the process of growth, which contributes to an increase in yield.

Keywords: UV irradiation, irradiation dose, pre-sowing treatment of seeds, germination capacity and germination energy.

References

1. Rifna, E. J., Ratish Ramanan, K., Mahendran, R. (2019). Emerging technology applications for improving seed germination. *Trends in Food Science & Technology, 86,* 95–108. doi: http://doi.org/10.1016/j.tifs.2019.02.029
2. Shapar, L. V. (2017). *Nasinnieva produktyvnist sortiv ripaku ozymoho zalezhno vid strokiv sivby ta norm vysivu v umovakh pivdennoho stepu Ukrainy.* Kherson, 219.
3. Araújo, S. de S., Paparella, S., Dondi, D., Bentivoglio, A., Carbonera, D., Balestrazzi, A. (2016). Physical Methods for Seed Invigoration: Advantages and Challenges in Seed Technology. *Frontiers in Plant Science, 7.* doi: http://doi.org/10.3389/fpls.2016.00646
4. Goussous, S. J., Samarah, N. H., Alqudah, A. M., Othman, M. O. (2010). Enhancing seed germination of four crop species using an ultrasonic technique. *Experimental Agriculture, 46 (2),* 231–242. doi: http://doi.org/10.1017/s0014479709991062
5. Bessonova, L. A., Kamenir, E. A. (1991). Pogloshhenie rentgenovskogo izlucheniya obolochkami semyan pshenitsy. *Fiziologiya i biokhimiya kul'turnykh rasteniy, 23 (6),* 582–588.
6. Savel'ev, V. A. (1990). Obrabotka semyan pshenitsy ul'trafioletovymi luchami. *Vestnik sel'skokhozyaystvennoy nauki, 3,* 133–135.
7. Gadzhimusieva, N. T., Asvarova, T. A., Abdulaeva, A. S. (2014). Effekt vozdeystviya infrakrasnogo i lazernogo izlucheniya na vskhozhest' semyan pshenitsy. *Fundamental'nye issledovaniya, 11 (9),* 1939–1943.
8. Tykhomyrov, A. A., Sharupych, V. P., Lysovskyi, H. M. (2000). *Svetokultura rastenyi.* Novosybyrsk: Yzd-vo Sybyrskoho otdelenyia Rossyiskoi Akademyy Nauk, 213.
9. Chervinskyi, L. S., Romanenko, O. I. (2016). Vymohy do spektralnoho skladu shtuchnykh dzherel optychnoho vyprominiuvannia dlia vyroshchuvannia roslyn u sporudakh zakrytoho hruntu. *Enerhetyka i avtomatyka, 3,* 88–95.
10. Zhukova, T. A. (2017). Vliyanie dliny volny lazernogo izlucheniya na effektivnost' prorastaniya semyan i formirovanie rostka pshenitsy. *Agrarnaya nauka v usloviyakh modernizatsii i innovatsionnogo razvitiya,* 82–84.
11. *DSTU 4138-2002. Nasinnia silskohospodarskykh kultur. Metody vyznachennia yakosti* (2003). Kyiv, 173.
12. Semenov, A. O., Kozhushko, H. M., Balia, L. V. (2015). Non-ozone germicidal lamps for units of photochemical and photobiological action. *Technology Audit and Production Reserves, 4 (1 (24)),* 4–7. doi: http://doi.org/10.15587/2312-8372.2015.46953
13. *MVU 11-038-2007. Dzherela ultrafioletovoho vyprominiuvannia: metodyka vykonannia vymiriuvan parametriv ultrafioletovoho vyprominiuvannia* (2007). Kharkiv: NNTs «Instytut metrolohiiu», 33.
14. Semenov, A. O., Kozhushko, H. M., Sakhno, T. V. (2018). Effects of preventive UV-inflammation on the development and productivity of potatoes. *Bulletin of Poltava State Agrarian Academy, 1,* 18–22. doi: http://doi.org/10.31210/visnyk.2018.01.02
15. Semenov, A. O., Burhu, Yu. H., Kozhushko, H. M., Marenych, M. M., Sakhno, T. V. (2018). Influence of ultraviolet radiation on germination, sprouting and growth processes of wheat. *Bulletin of Poltava State Agrarian Academy, 4,* 70–75. doi: http://doi.org/10.31210/visnyk2018.04.10
16. Semenov, A. O., Kozhushko, H. M., Sakhno, T. V. (2018). Efficiency of germination of seeds in pre-sowing irradiation by its UV radiation of different spectral composition. *Bulletin of Poltava State Agrarian Academy, 3,* 27–31. doi: http://doi.org/10.31210/visnyk2018.03.04
17. Semenov, A., Kozhushko, G., Sakhno, T. (2018). Influence of pre-sowing UV-radiation on the energy of germination capacity and germination ability of rapeseed. *Technology Audit and Production Reserves, 5 (1 (43)),* 61–65. doi: http://doi.org/10.15587/2312-8372.2018.143417

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RESEARCH OF INFLUENCE OF ULTRASOUND ON THE EXTRACTION PROCESS OF VEGETABLE OIL

page 33–35

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The object of research is the process of oil extraction without using and using ultrasound for various solvents and types of plant materials. Extraction of oil provides maximum degreasing of vegetable raw materials in comparison with other methods, in particular by mechanical pressing. The extraction process is carried out by mass transfer and consists of mass transfer from the surface of solid particles of pre-ground vegetable raw materials and molecular diffusion inside the particles. The mass return from the surface of solid particles to the solution depends on the hydrodynamic conditions of washing the particles and occurs mainly due to convective diffusion. Various physical factors are used to intensify the process of extracting oil from vegetable raw materials, but the most promising is ultrasound. In the course of the study, the ultrasonic device UZP-6-1 (manufacturer: MEDPROMPRYLAD, Ukraine) is used. Extraction of oil from flax seeds is carried out by extraction with gasoline and methylene chloride, and for soybean meal is used with methylene chloride. For a comparative evaluation of the effect of ultrasound on the extraction of oil from various raw materials for flax seeds and soybean meal, experiments are carried out without using ultrasound. The research results show that extraction with methylene chloride from flax seeds and soybean meal under ultrasound conditions increases the oil yield. This is due to the fact that under the action of ultrasonic waves, there is a movement of fluid around solid particles, due to alternating powerful ultrasonic pressure and hydraulic shocks at the moment of collapse of cavitation cavities. Ultrasonic cavitation has a destructive effect on solid particles and leads to the appearance of additional microcracks on the surface. This contributes to the acceleration of diffusive mass transfer inside solid particles. This makes it possible to reduce the duration of the extraction process and increase the productivity of the extraction equipment. Thus, when extracting oil from crushed flax seeds with methylene chloride under ultrasound conditions, the oil yield increases by 4.5 %.

Keywords: ultrasonic oil extraction with solvents, extraction gasoline, methylene chloride from crushed flax seeds and soybean meal.

References

1. Beloborodov, V. V. (1966). *Osnovnye protsessy proizvodstva rastitel'nykh masel*. Moscow: Pishhevaya promyshlennost', 478.
2. Ionescu, M., Ungureanu, N., Biriş, S., Voicu, G., Dilea, M. (2013). Actual methods for obtaining vegetable oil from oilseeds. *International Conference on Thermal Equipment, Renewable Energy and Rural Development*, 167–172.
3. Topare, N. S., Raut, S. J., Renge, V. C., Khedkar, S. V., Chavan, Y. P., Bhagat, S. L. (2011). Extraction of oil from algae by solvent extraction and oil expeller method. *International Journal of Chemical Sciences, 9 (4),* 1746–1750.
4. Hussain, S., Shafeeq, A., Anjum, U. (2018). Solid liquid extraction of rice bran oil using binary mixture of ethyl acetate and dichloromethane. *Journal of the Serbian Chemical Society, 83 (7-8),* 911–921. doi: http://doi.org/10.2298/jsc170704023h
5. Zhmatova, G. V., Nefedov, A. N., Gordeev, A. S., Kilimnik, A. B. (2005). Intensification Methods of Extracting Biologically Active Substances from Vegetative Raw Materials. *Transactions TSTU, 11 (3),* 701–707.
6. Grasso, F. V., Montoya, P. A., Camusso, C. C., Maroto, B. G. (2012). Improvement of Soybean Oil Solvent Extraction through Enzymatic Pretreatment. *International Journal of Agronomy, 2012,* 1–7. doi: http://doi.org/10.1155/2012/543230
7. Li, H., Pordesimo, L., Weiss, J. (2004). High intensity ultrasound-assisted extraction of oil from soybeans. *Food Research International, 37 (7),* 731–738. doi: http://doi.org/10.1016/j.foodres.2004.02.016
8. Li, Z., Yang, F., Yang, L., Zu, Y.-G. (2016). Ultrasonic Extraction of Oil fromCaesalpinia spinosa (Tara) Seeds. *Journal of Chemistry, 2016,* 1–6. doi: http://doi.org/10.1155/2016/1794123
9. Abdolshahi, A., Majd, M. H., Rad, J. S., Taheri, M., Shabani, A., Teixeira da Silva, J. A. (2013). Choice of solvent extraction technique affects fatty acid composition of pistachio (Pistacia vera L.) oil. *Journal of Food Science and Technology, 52 (4),* 2422–2427. doi: http://doi.org/10.1007/s13197-013-1183-8
10. Novitskiy, B. G. (1983). *Primenenie akusticheskikh kolebaniy v khimiko-tekhnologicheskikh protsessakh*. Moscow: Khimiya, 192.

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INVESTIGATION OF INFLUENCE OF INULIN MADE FROM CYCORIA ON STRUCTURAL-MECHANICAL PROPERTIES OF WHEAT DOUGH

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Bread made from wheat flour in chemical composition is not well balanced for vital ingredients. One of its drawbacks is that with a high content of carbohydrates in it there is little dietary fiber, therefore, it is promising to enrich it with inulin-compliant products. The inclusion of inulin made from chicory in the recipe of wheat bread to influence the formation of the rheological properties of the dough, which will affect the quality of the finished products. Therefore, the object of research in the work is the dough of wheat flour of the first grade, the recipe of which includes inulin made from chicory. During the research, inulin made from chicory «Cosucra» (Belgium) is used in the amount of 5, 10, 15 % by weight of flour. It is established that the addition of inulin leads to an increase in the elastic properties of the dough, especially with an increase in the dose of inulin by more than 10 %. Increasing the dose of inulin up to 15 % and more along with an increase in the elastic characteristics reduces the dough elasticity, causing a significant deterioration in the volume of products. It is proven that a decrease in the specific volume of products and an increase in the elastic characteristics of the crumb are the limiting factors of using inulin products in the formulation of more than 10 % by weight of the flour. Use in the formulation of inulin bread in the amount of 10 and 15 % by weight of flour due to the increase in the elastic properties of the dough leads to a significant deterioration in the volume of products. The taste and aroma of inulin products are inherent in wheat bread. Due to the inclusion of inulin wheat bread in the recipe, the products acquire prebiotic properties, however, the effectiveness of using inulin to improve the quality of finished products is possible with dosing 5 % by weight of flour. For greater enrichment of bakery products with dietary fiber, it is possible to use the dosage of inulin 10 % by weight of flour, but to apply technological measures to improve the quality of products.

Keywords: wheat bread, chicory inulin, elastic properties of dough, dough elasticity.

References

1. Bashta, A. O., Ivchuk, N. P. (2016). Perspektyvy vykorystannia inulinovmisnoi syrovyny v profilaktytsi neinfektsiinykh khronichnykh zakhvoriuvan. Rozrobka tekhnolohii pshenychnoho khliba z pidvyshchenoiu kharchovoiu tsinnistiu. *Problemy starenyia y dolholetyia, 25 (2),* 222–229
2. Terenda, N. O. (2015). Smertnist vid sertsevo-sudynnykh zakhvoriuvan yak derzhavna problema. *Visnyk naukovykh doslidzhen DVNZ «Ternopilskyi derzhavnyi medychnyi universytet imeni I. Ya. Horbachevskoho», 4,* 11–13.
3. Apolinário, A. C., de Lima Damasceno, B. P. G., de Macêdo Beltrão, N. E., Pessoa, A., Converti, A., da Silva, J. A. (2014). Inulin-type fructans: A review on different aspects of biochemical and pharmaceutical technology. *Carbohydrate Polymers, 101,* 368–378. doi: http://doi.org/10.1016/j.carbpol.2013.09.081
4. Cummings, J. H., Macfarlane, G. T., Englyst, H. N. (2001). Prebiotic digestion and fermentation. *The American Journal of Clinical Nutrition, 73 (2),* 415–420. doi: http://doi.org/10.1093/ajcn/73.2.415s
5. Liu, J., Willför, S., Xu, C. (2015). A review of bioactive plant polysaccharides: Biological activities, functionalization, and biomedical applications. *Bioactive Carbohydrates and Dietary Fibre, 5 (1),* 31–61. doi: http://doi.org/10.1016/j.bcdf.2014.12.001

6. Morris, C., Morris, G. A. (2012). The effect of inulin and fructo-oligosaccharide supplementation on the textural, rheological and sensory properties of bread and their role in weight management: A review. *Food Chemistry, 133 (2),* 237–248. doi: http://doi.org/10.1016/j.foodchem.2012.01.027
7. Ziobro, R., Korus, J., Juszczak, L., Witczak, T. (2013). Influence of inulin on physical characteristics and staling rate of gluten-free bread. *Journal of Food Engineering, 116 (1),* 21–27. doi: http://doi.org/10.1016/j.jfoodeng.2012.10.049
8. Salinas, M. V., Puppo, M. C. (2015). Optimization of the formulation of nutritional breads based on calcium carbonate and inulin. *LWT – Food Science and Technology, 60 (1),* 95–101. doi: http://doi.org/10.1016/j.lwt.2014.08.019
9. Rubel, I. A., Pérez, E. E., Manrique, G. D., Genovese, D. B. (2015). Fibre enrichment of wheat bread with Jerusalem artichoke inulin: Effect on dough rheology and bread quality. *Food Structure, 3,* 21–29. doi: http://doi.org/10.1016/j.foostr.2014.11.001
10. Sirbu, A., Arghire, C. (2017). Functional bread: Effect of inulin-type products addition on dough rheology and bread quality. *Journal of Cereal Science, 75,* 220–227. doi: http://doi.org/10.1016/j.jcs.2017.03.029
11. Lebedenko, T. Ie., Pshenyshniuk, H. F., Sokolova, N. Iu. (2014). *Tekhnolohiia khlibopekarskoho vyrobnytstva. Praktykum.* Odessa: Osvita Ukrainy, 392.
12. Drobot, V. I. (Ed.) (2015). *Tekhnokhimichnyi kontrol syrovyny ta khlibobulochnykh i makaronnykh vyrobiv.* Kyiv: NUKhT, 902.