

ISB-INMA-TEH

AGRICULTURAL AND MECHANICAL ENGINEERING

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ENGINEERING**

**Bucharest
2022**

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APPLICATION OF BIOCHAR OF DIFFERENT GENESIS: APPLIED ASPECTS OF ACTIVATION

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ЗАСТОСУВАННЯ БІОЧАРУ РІЗНОГО ПОХОДЖЕННЯ: ПРИКЛАДНІ АСПЕКТИ АКТИВАЦІЇ

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ABSTRACT

The paper considers various biochar activation processes in bioprocesses, particularly in anaerobic digestion, to intensify the production of biogas and biofertilizer. Based on the literature research study, the applied aspects of biochar activation processes in the agricultural and bioenergy sectors were analyzed, with small-scale laboratory experiments to verify theoretical hypotheses. Ultrasonic pretreatment was performed with a power of 200 W and a frequency of 30 kHz. The biochar was also subjected to microscopy. After ultrasound treatment, changes in the structure of biochars of different genesis were detected, which is also consistent with changes in the ORP values of activated biochars. A comparative thermogravimetric analysis of biochar samples was carried out.

ТЕЗИ

У статті розглядаються різні варіанти активації біоугілля у біопроцесах, зокрема в анаеробному збродженні, для інтенсифікації виробництва біогазу та біодобрив. На основі вивчення літератури було проаналізовано прикладні аспекти процесів активації біоугілля у сільськогосподарському та біоенергетичному секторах, а також проведено дрібномасштабні лабораторні експерименти для перевірки теоретичних гіпотез. Ультразвукова попередня обробка проводилася при потужності 200 Вт та частоті 30 кГц. Біочар також піддавався мікроскопії. Після ультразвукової обробки були виявлені зміни в структурі біочарів різного генезису, що також узгоджується зі зміною значень ОВП активованих біочарів. Порівняльний термогравіметричний аналіз зразків біочара було проведено.

INTRODUCTION

Today, the use of biochar in various spheres of human economic activity has become increasingly widespread. Biochar is a solid material containing carbon with a large amount of hard-mineralized aromatic structures, obtained by carbonization of renewable organic biomass at high temperatures and without oxygen access (pyrolysis) (*Edinburgh Research Explorer Biochar Quality Mandate (BQM) Version 1.0*, n.d.).

Periodically, the term "biochar" is associated with the term "charcoal," which is obtained in the process of producing lumpy charcoal, which does not correspond to the definition of biochar. Biochar is also a plant-derived charcoal with a carbon content of 93-99% and the absence of harmful and toxic impurities. Due to its main properties - purity and absence of impurities, as well as high carbon saturation, biochar can be used in agriculture - both in animal husbandry and in the agricultural sector (*Kamarudin et al., 2022*) (*Kamarudin et al., 2022*).

Biochar as an additive in agriculture has the following advantages (*Biochar, the benefits of using natural soil fertilisers – Proposition, 2020*):

- speeds up plant growth and development as the soil is constantly heated;
- removes residues from the soil of chemicals that were applied earlier (herbicides, pesticides, and other pesticides);

- promotes the functioning of microorganisms in the soil, which have a positive effect on crop yields;
- increases soil porosity, provides oxygen access to plant roots, and air circulation;
- improves the composition of infertile soils (alumina, sandy, loam and sandy soils);
- neutralize soils with increased acidity;
- protects soil from some pests (nematodes, wireworm);
- prevents purulent processes;
- preserves and supports nutrients and necessary microelements in the soil, and eliminates the problem of their leaching.

It also serves as a raw material for the production of activated carbon, is used for drinking water and wastewater treatment, for the elimination of toxins and disinfection, and is used in segments of industry where there is a need for pure carbon. For example, in Germany, biochar is actively used in agriculture as ready-to-use mail mixed and as a soil substrate. It is also used as a food additive for cattle, birds and pets. Biochar is a high-value-added processed product with a very broad testing potential; its production solves the current problem of waste recycling, contributes to the introduction of "green technology" and the production of bioenergy (*Biochar And The Biomass Recycling Industry | BioCycle, 2011*).

Of particular importance in some biochemical processes is the high resistance to the chemical reaction and resistance to swelling of adsorbents. In this aspect, carbon adsorbents compare favorably with mineral- and polymer-based adsorbents, which opens up wide opportunities for their practical use. In this direction, we can also consider biochars, and there are electrochemical features of biochars, which are now actively investigated and can be applied in biogas technologies.

Regarding the activation of coals of different nature, a number of works (*Bisaria et al., 2022; Peter et al., 2019, 2020; Y. Wu et al., 2016*) studied the effect of the type of processing (mechanical, ultrasonic) on the degree of dispersion, density of carbon powders, and their morphology; samples of "carbon powders" with sieve properties obtained by different methods determined their structural characteristics (*Stavitskaya, 2009*).

Ultrasound treatment is a means of active influence on various structures of substances (*Moskalenko & Danilov, 2009*):

- on the course of heat and mass exchange processes in substances;
- on the structure of solids and processes of their contact interaction.

The use of ultrasonic sound in technological processes of production and processing of materials and substances allows (*Kamarudin et al., 2022; L. Wu et al., 2022; Moskalenko & Danilov, 2009*):

- reduce the cost of a process or product;
- obtain new products or improve the quality of existing ones;
- to intensify traditional technological processes or stimulate the implementation of new ones.

In this regard, the problem of identifying the nature of the specific effects of acoustic ultrasonic vibrations on the processes of deep processing of raw materials is relevant. The idea of the implementation of combined processes in obtaining active coals of different genesis, including biochar, has been developed in a number of studies (*Kizito et al., 2022; Kobayashi & Kuramochi, 2022; Liu et al., 2022; Zhang et al., 2022; Zhao et al., 2022*). The technology for obtaining charcoal by combined pyrolysis-vapor-gas activation using alternating electric current has been proposed. Ways of directed regulation of the porous structure parameters and adsorption properties of wood active carbons have been investigated. Processes of activation of coals at processing by a constant electrolytic field by a voltage in a diapason 1.5-30 V lead to the reception of hydrogen-activated charcoal. When used in aqueous solutions, this charcoal is negatively charged, sending hydrogen ions into the solution and attracting cations, which intensifies the purification process (*Belyaev, 2000*).

Rapid pyrolysis of biomass pretreated with mineral acid produces high-quality biofuels, but the biochar resulting from this process has not been characterized, and its effectiveness as an additive for anaerobic digestion (AD) is unknown. This study reports the effect of the physicochemical properties of two different biochars on AD of urban sludge: one was produced by pyrolysis of raw corn cobs (BC-1) and the other was produced by pretreatment of the same corn cobs with sulfuric acid (BC-2). BC-1 had higher carbon content, alkalinity and specific surface area, but lower ash and sulfur content than BC-2. Both biochars contained volatile fatty acids and residual sugars that serve as substrates for anaerobic bacteria to improve biogas / methane production. When biochars were added to AD, their effect on biogas production showed opposite

trends. In general, the results showed that the effect of biochar on AD depends on the properties of the biochar, and the choice of a suitable biochar is important to ensure higher biogas production and to maintain a stable process (Zhou *et al.*, 2020).

A study (Wambugu *et al.*, 2019) evaluated the effect of biochar addition on anaerobic digestion (AD) of food waste. Of the five biochar tested, Fe, Co, Ni, and Mn leached in very small amounts (<10 mg/kg), while treated wood waste and willow pyrochar leached large amounts of K (1,510 and 1,969 mg/kg), respectively. AD experiments were carried out in a 1:1 inoculum:substrate ratio, at 30°C and under stirring conditions. The results showed that the volume of biogas produced by treatment with hydrosugar from brewery residues and pyrosugar from treated wood was lower than that produced by a control that used only food waste. Food waste supplemented with 1.5 ml of micronutrients produced the highest amount of biogas, 588 ml/g COD (CH₄ content 48%). In addition, two identical upflow anaerobic sludge reactors (UASB), that is, the control reactor and the biochar supplemented reactor, operated at 30°C, with organic loading rates (OLR) ranging from 3.4 to 7.8 g COD/L per day. The average COD removal efficiency in the control reactor and the biochar-added reactor was 47% and 77% at OLRs of 6.9 to 7.8 g COD/L. per day, respectively. The results clearly show that the type of biochar and its trace element concentration play a key role in determining its effectiveness in improving the production of biogas from food waste (Wambugu *et al.*, 2019).

Biochar can receive and give out electrons, as in microbial fuel cells, where biochar can be activated and used as an anode and cathode (Patwardhan *et al.*, 2022). However, the electrical conductivity of biochar is not based on a continuous flow of electrons, as in copper wire; it is based on continuous electron hopping, which is important for the functioning of biochar as a microbial electron mediator or so-called electron boat, which facilitates even inter-species transfers. Because of the relatively large size of the biochar particles, the electron transfer capacity of the biochar carbon matrices can lead to the exchange of electrons over considerable distances, allowing greater access to alternative acceptors, such as those of minerals, for oxygen-free microbial respiration. We assume that it can also be used effectively in electrolysis processes of the substrate to intensify anaerobic digestion, which requires experimental studies.

Thus, the purpose of this work is to study the possible applied use of biochar in anaerobic digestion with an experimental study of the effect of ultrasonic treatment on the properties of biochar.

MATERIALS AND METHODS

Ultrasonic pretreatment was performed in a stainless steel tube section with a total working volume of 250 ml. Ultrasonic equipment, consisting of 3 transducers, with a power of 200 W and a frequency of 30 kHz was placed in the section.

Fig. 1 shows the laboratory experimental installation of ultrasonic treatment.

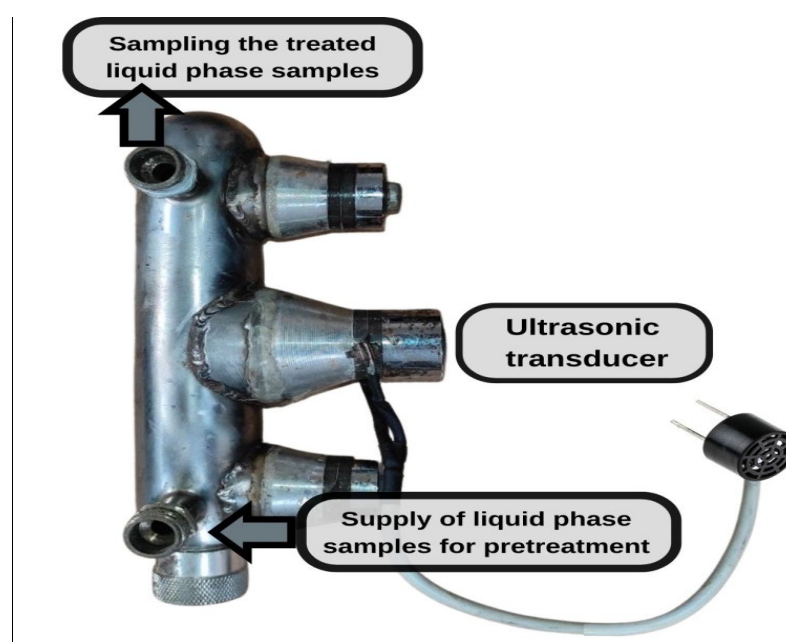


Fig. 1 - Laboratory device for ultrasonic treatment

The ultrasonic treatment unit works as follows: The treated liquid enters the treatment tank through special holes in which the solution is poured manually, which provides uniform distribution over the entire cross-sectional area of the chamber. Ultrasonic vibrations are formed in the process. The direction of propagation of the ultrasonic vibrations is perpendicular to the surfaces of the smooth transitions. Thus, the ultrasonic field with the intensity necessary and sufficient for the formation and maintenance of the developed cavitation mode is created in the entire space between the walls of the unit and the surface of the radiator in the internal volume of the tank.

Temperature mode - 35 °C. Processing time: 1 min. Light microscopy was used to identify changes in the structure of the samples using a biological XS-5520 microscope with a video camera.

A comparative thermogravimetric analysis of biochar samples made from wood residues and corn stalks was carried out to obtain information about their thermal stability using the derivatograph Q-1500D of the "F. Paulik-J. Paulik-L. Erdey" system. Differential mass loss and heating effects were recorded. The measurements results were processed with the software package supplied with the device. Samples of wood and bark biomass were dynamically analyzed at a heating rate of 10°C/min in the air atmosphere. The weight of the samples was 100 mg. Aluminum oxide was used as the reference substance.

RESULTS

Results of ultrasound treatment of biochars of different genesis

In the study, two types of biochar were taken: one produced from corn residues, the other by pyrolysis of wood residues from the furniture industry (Fig.2).

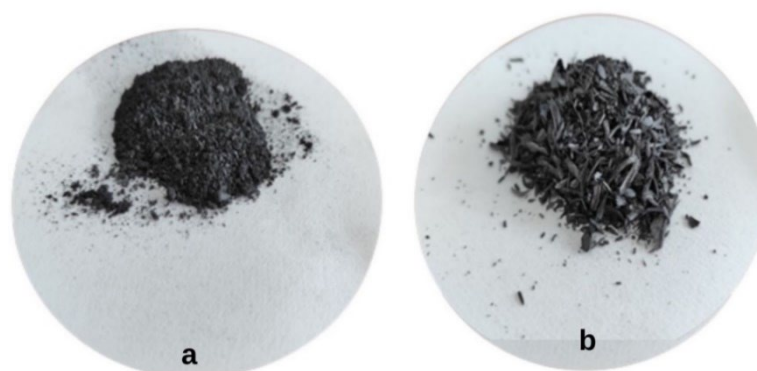


Fig. 2 – Biochars:

a - from plant residues (corn); b - from wood residues from the furniture industry.

Table 1 shows the pH and ORP values before and after ultrasonic treatment of biochars of different genesis.

Table 1

Changes in the parameters of the treated liquid phase with biochar					
Composition	Volume of water	Sonication treatment	TDS	pH	ORP
2.5 g biochar (a)	250 ml	before treatment	363	10.5	-49
		after treatment	457	10.5	-20
before treatment		844	11.3	-50	
after treatment		746	11.22	-50	

Microcopying of the biochars was also performed. It should be noted that the initial high porosity of biochar (b), compared to biochar (a) (Fig. 3).

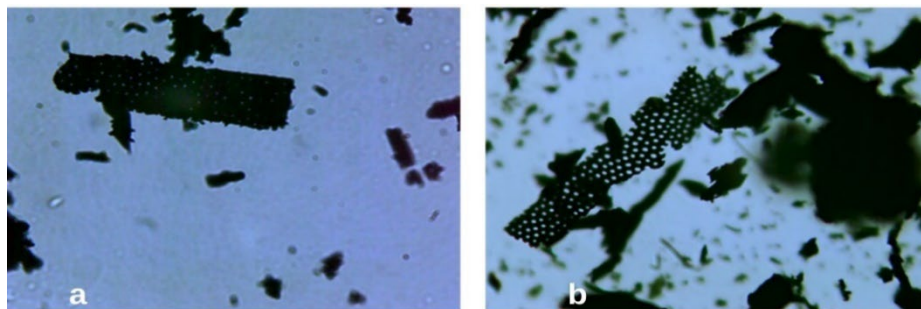


Fig. 3 - Biochars before treatment, microscopy, 40x magnification:
a - from plant residues (corn); b - from wood residues from the furniture industry.

After ultrasound treatment, more influence was revealed on biochar (a) during microscopy, which is also consistent with the change in its ORP values (it increased from -49 to -20 mV). The structure of biochar (a) became much more homogeneous with high fine fraction content, when drying preparations for microscopy of biochar (a) it sorbed water better compared to biochar (b) (Fig. 4 and 5).

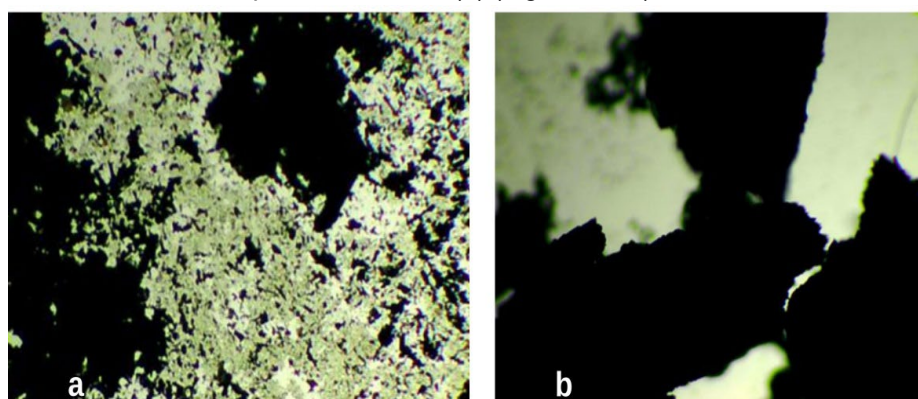


Fig. 4 - Biochars after treatment, microscopy, 4x magnification:
a - from plant residues (corn); b - from wood residues from the furniture industry.

Without treatment

Ultrasonic treatment

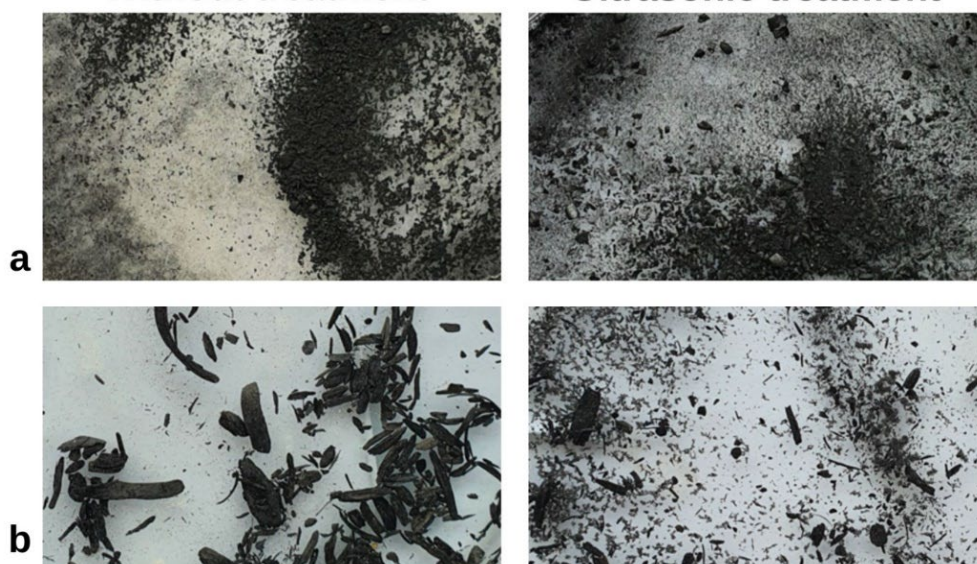


Fig. 5 - Comparison before and after ultrasonic treatment:
a - from plant residues (corn); b - from wood residues from the furniture industry.

The TG and DTG combustion curves were analyzed for thermal stability of the two types of biochar made from wood residues and corn stalk (Fig.6).

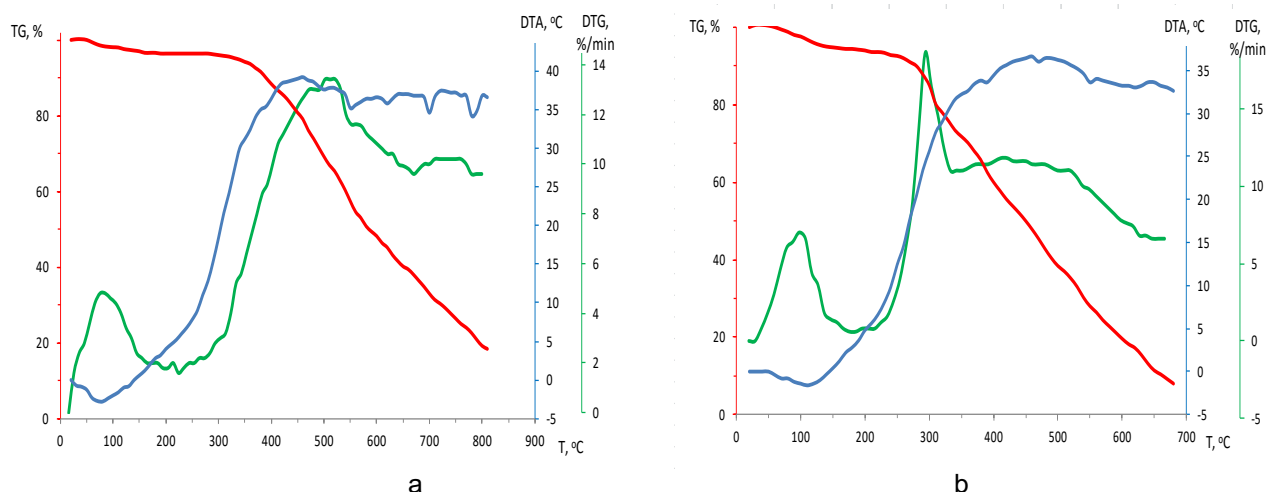


Fig. 6 - TG, DTA and DTG of biochar produced from:
a - wood residues; b - corn biomass

According to the DTG curves the first thermal peaks that occurred within 75 - 100°C. As visible in Fig. 6, the moisture of the biochars produced was retained after the preliminary pyrolysis procedure, which is consistent with the findings of Li and Chen (2018). Thus, these types of biochar can be used as water sorbents to improve moisture retention in the soil. The thermal peaks at 200 - 400 °C are associated with the loss of hemicellulose and cellulose, whereas the peaks at 370 - 550°C are associated with the thermal decomposition of lignin. The sharp peak fixed at 300 - 480°C fixed for biochar from corn biomass can be explained as a result of the autocatalytic reaction of hemicellulosic, cellulosic, and lignocellulosic components (Yang *et al.*, 2007). Thus, the pyrolysis process was a reason for the formation of more thermostable substances in the tested biochar samples.

Formalization of the direction of use of biochar together with digestate in soil bioremediation processes

Anaerobic digestion is an effective method for processing raw materials of organic origin. The passage of raw material and its composition is one of the key points of processing. Anaerobic digestion can be successful even with heavy metal contaminated raw materials provided that biochar is added as an additive. Accordingly, the study (Wang *et al.* 2021), although the environmental risk of heavy metals (HM) in digestate can potentially increase during anaerobic digestion of contaminated feedstock, states that biochar contributes to the passivation of heavy metals in the process.

Furthermore, HM passivation by (Wang *et al.* 2021) also obtained the result of increased biogas productivity in an example of contaminated pig manure. The methane yield increased up to 26% with the addition of additives up to 7% biochar (on a dry weight basis). Different groups of heavy metals were also found to passivate faster at different concentrations of biochar (5% and 7%).

Fig. 7 shows the main characteristics of biochar conditioning a successful combination with digestate for soil remediation applications. In the process of obtaining the target product of biofuel, digestate is formed, which is an important product for the restoration of soil quality. To maintain the normal functioning of the soil-biota system of soils contaminated with HMs and radionuclides, a comprehensive approach to cleaning and increasing productivity is necessary. Biochar and digestate independently of each other have properties to reduce the concentration of heavy metals in soil solution. A study (van Poucke *et al.*, 2020) compares the potential of biochar in different raw materials and digestate applications to highlight the potential to immobilize metals in soil and aquatic systems, reducing phytotoxicity.

Biochar and products based on it as agents for the immobilization of toxic substances, including HM contained in the soil, can be an environmentally friendly solution for soil remediation.

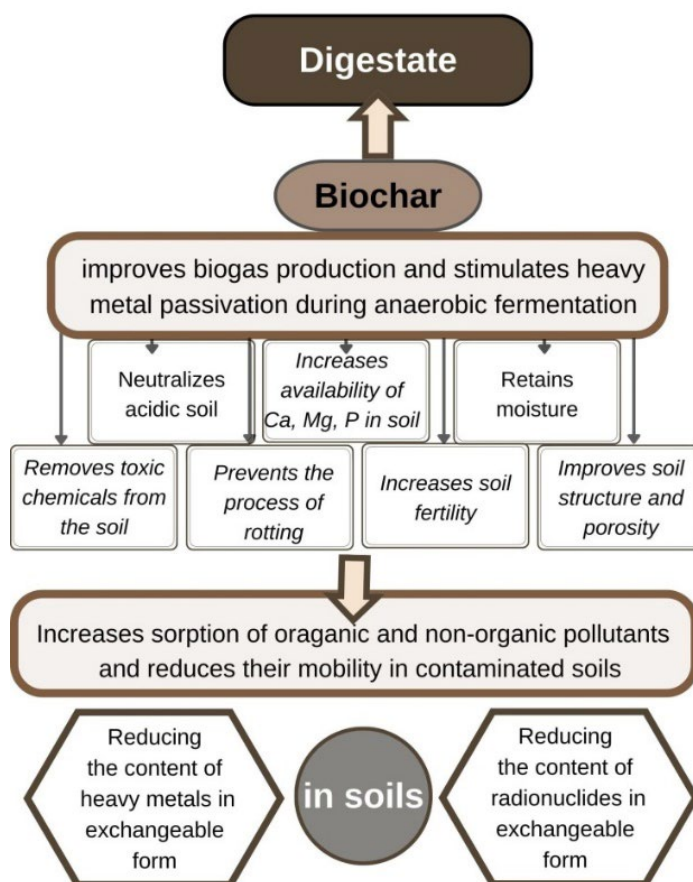


Fig. 7 - Impact of biochar on the soil structure

The use of biochar helps solve the problem of the bioavailability of heavy metals as a result of the direct application of its mixture to rigid digestate. (Xue *et al.*, 2021) conducted an experiment using fruit biochar and porcine digestate to clean cadmium-contaminated greenhouse soil. The advantages of co-application were the ability to maintain a more stable pH and electrical conductivity and to effectively improve the properties of organic matter of soil with a reduction in the activity of a particular group of heavy metals. It was shown that the bioavailability of heavy metals and enzyme activity are related to the proportion of biochar-digestate mixing.

Research by Anae *et al.* (2021) also looked at the microbiological characteristics of the combination, where the study showed the promising potential of digestate as a source of nutrients and bacteria for soil bioremediation. In summary, biochar-digestate can be engineered by bioengineering to contain selected microbial consortiums that will incorporate a biochemical system that will facilitate remediation of contaminated soil beyond conventional methods. A related study Šimanský *et al.* (2022) demonstrates different effects of a biochar-based composite application, depending on soil texture, cation exchange capacity, organic carbon content, and stability of the humic substance.

The work found that for productive, fertile, and alkaline soils uncontaminated with HM, changes in macronutrient regime after the application of biochar-based composite are insignificant but can be influenced by soil texture. However, the application of such composites with fertilizers leads to changes in the physical and chemical properties of the soil and a variety of benefits in sandy and loamy soils. It was traced the dependence after the application of composites that the immobilization of heavy metals is caused by the higher content of organic carbon and fulvic acids in sandy soils, soils, while in loamy soil their elimination depended on the higher content of available phosphorus.

Based on these and previous studies, we have developed a scheme (Fig. 8) that positively influenced the use of biocomposite based on digestate and biochar in combination with phytoremediation.

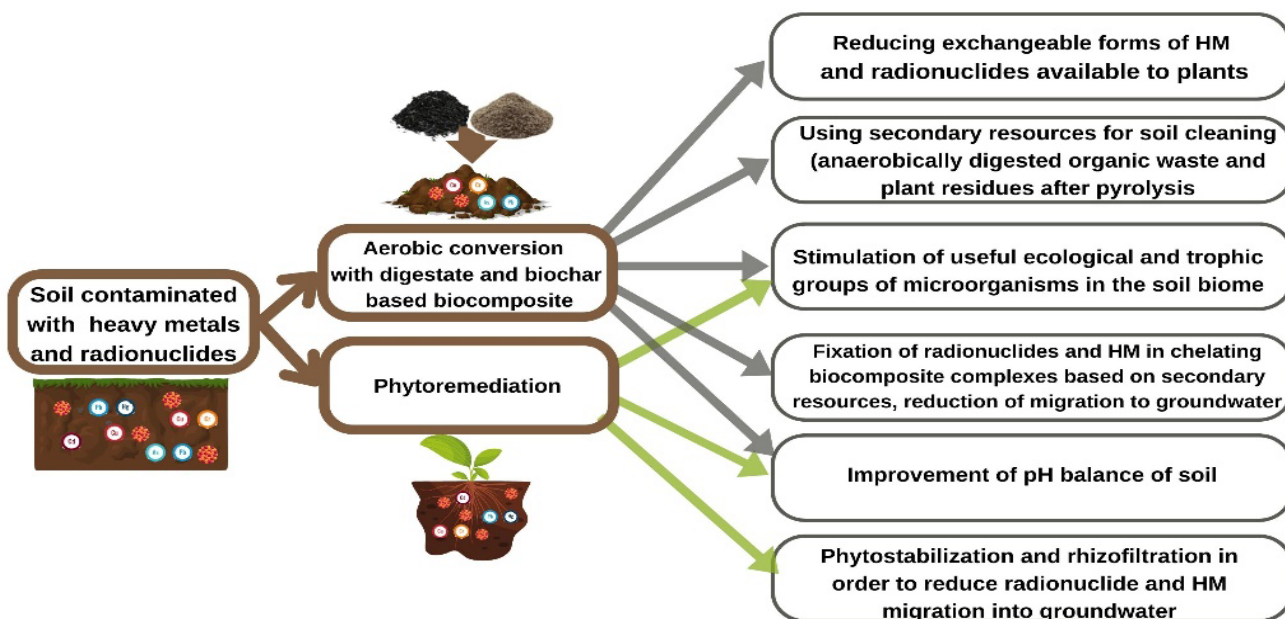


Fig. 8 - Impact of remediation methods for soils contaminated with heavy metals and radionuclides

Furthermore, digestate pyrolysis to produce biochar has been investigated in recent years (Ayaz *et al.*, 2022; Chen *et al.*, 2019; N. Wang *et al.*, 2022; Zuo *et al.*, 2020), as pyrolysis can stabilize the metals in biochar.

The potential applications of biochar derived from high moisture digestate could be as an adsorbent to remove contaminants, as a soil amendment to enhance plant growth, and as a catalyst to improve bioprocessing (N. Wang *et al.*, 2022).

Although conventional technologies exist to address contaminated soils, the use of biochar-based biocomposite as an effective recoverable adsorbent for enhanced bioremediation is considered by many researchers to be a promising strategy to mitigate the effects of co-contamination of soils with HM and radionuclides.

CONCLUSIONS

Biochar is an effective adsorbent with a wide range of applications in terms of its physicochemical characteristics. The activation of biochar affects the morphological structure of the particles and leads to a certain change in the physicochemical parameters of the substance with the biochar compound. Furthermore, an opportunity to use biochar in biogas technology in various combinations is considered.

However, combinations of biochar and digestate as an effective soil improver for the remediation of soils contaminated with heavy metals and radionuclides are recommended to be the focus of further research. Biocomposites based on digestate and biochar have the advantage of cleaning and improving soil conditions and plant growth and can be found in different combinations.

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REFERENCES

- [1] Anae, J., Ahmad, N., Kumar, V., Thakur, V. K., Gutierrez, T., Yang, X. J., Cai, C., Yang, Z., & Coulon, F. (2021). Recent advances in biochar engineering for soil contaminated with complex chemical mixtures: Remediation strategies and future perspectives. *Science of The Total Environment*, 767, 144351. <https://doi.org/https://doi.org/10.1016/j.scitotenv.2020.144351>
- [2] Ayaz, M., Stulpinaite, U., Feiziene, D., Tilvikiene, V., Akthar, K., Baltrėnaitė-Gedienė, E., Striugas, N., Rehmani, U., Alam, S., Iqbal, R., Toleikiene, M., & Doyeni, M. (2022). Pig manure digestate-derived biochar for soil management and crop cultivation in heavy metals contaminated soil. *Soil Use and Management*, 38(2), 1307–1321. <https://doi.org/10.1111/sum.12773>
- [3] Biochar And The Biomass Recycling Industry | BioCycle. (n.d.). Retrieved July 7, 2022, from <https://www.biocycle.net/biochar-and-the-biomass-recycling-industry/>
- [4] Bisaria, K., Singh, R., Gupta, M., Mathur, A., & Dixit, A. (2022). Novel acoustic-activated alkali-functionalized *Trapa bispinosa* peel biochar for green immobilization of chlorpyrifos from wastewater: artificial intelligence modelling and experimental validation. *Biomass Conversion and Biorefinery*. <https://doi.org/10.1007/s13399-022-02898-z>
- [5] Chen, H., Osman, A. I., Mangwandi, C., & Rooney, D. (2019). Upcycling food waste digestate for energy and heavy metal remediation applications. *Resources, Conservation & Recycling: X*, 3, 100015. <https://doi.org/https://doi.org/10.1016/j.rcrx.2019.100015>
- [6] Edinburgh Research Explorer Biochar Quality Mandate (BQM) version 1.0. (n.d.).
- [7] Kamarudin, N. S., Dahalan, F. A., Hasan, M., An, O. S., Parmin, N. A., Ibrahim, N., Hamdzah, M., Zain, N. A. M., Muda, K., & Wikurendra, E. A. (2022). Biochar: A review of its history, characteristics, factors that influence its yield, methods of production, application in wastewater treatment and recent development. *Biointerface Research in Applied Chemistry*, 12(6), 7914–7926. <https://doi.org/10.33263/BRIAC126.79147926>
- [8] Kizito, S., Jjagwe, J., Mondono, S. W., Nagawa, C. B., Bah, H., & Tumutegyeize, P. (2022). Synergetic effects of biochar addition on mesophilic and high total solids anaerobic digestion of chicken manure. *Journal of Environmental Management*, 315. <https://doi.org/10.1016/j.jenvman.2022.115192>
- [9] Kobayashi, T., & Kuramochi, H. (2022). Optimized production conditions and activation of biochar for effective promotion of long-chain fatty acid degradation in anaerobic digestion. *Bioresource Technology*, 358. <https://doi.org/10.1016/j.biortech.2022.127393>
- [10] Liu, Y., Jiang, Z., Fu, J., Ao, W., Ali Siyal, A., Zhou, C., Liu, C., Dai, J., Yu, M., Zhang, Y., Jin, Y., Yuan, Y., & Zhang, C. (2022). Iron-biochar production from oily sludge pyrolysis and its application for organic dyes removal. *Chemosphere*, 301. <https://doi.org/10.1016/j.chemosphere.2022.134803>
- [11] Patwardhan, S. B., Pandit, S., Kumar Gupta, P., Kumar Jha, N., Rawat, J., Joshi, H. C., Priya, K., Gupta, M., Lahiri, D., Nag, M., Kumar Thakur, V., & Kumar Kesari, K. (2022). Recent advances in the application of biochar in microbial electrochemical cells. *Fuel*, 311. <https://doi.org/10.1016/j.fuel.2021.122501>
- [12] Peter, A., Chabot, B., & Loranger, E. (2019). Enhancing Surface Properties of Softwood Biochar by Ultrasound Assisted Slow Pyrolysis. *IEEE International Ultrasonics Symposium, IUS, 2019-October*, 2477–2480. <https://doi.org/10.1109/ULTSYM.2019.8925793>
- [13] Peter, A., Chabot, B., & Loranger, E. (2020). The influence of ultrasonic pre-treatments on metal adsorption properties of softwood-derived biochar. *Bioresource Technology Reports*, 11. <https://doi.org/10.1016/j.biteb.2020.100445>
- [14] Šimanský, V., Jonczak, J., Chlpík, J., & Polláková, N. (2022). The status of heavy metals in arable soils of contrasting texture treated by biochar – an experiment from Slovakia. *Journal of Environmental Science and Health, Part A*, 57(1), 1–17. <https://doi.org/10.1080/10934529.2021.2020503>

- [15] van Poucke, R., Egene, C. E., Allaert, S., Lebrun, M., Bourgerie, S., Morabito, D., Ok, Y. S., Ronsse, F., Meers, E., & Tack, F. M. G. (2020). Application of biochars and solid fraction of digestate to decrease soil solution Cd, Pb and Zn concentrations in contaminated sandy soils. *Environmental Geochemistry and Health*, 42(6), 1589–1600. <https://doi.org/10.1007/s10653-019-00475-4>
- [16] Wambugu, C. W., Rene, E. R., van de Vossenberg, J., Dupont, C., & van Hullebusch, E. D. (2019). Role of Biochar in Anaerobic Digestion Based Biorefinery for Food Waste. *Frontiers in Energy Research*, 7. <https://doi.org/10.3389/fenrg.2019.00014>
- [17] Wang, J., Hao, X., Liu, Z., Guo, Z., Zhu, L., Xiong, B., Jiang, D., Shen, L., Li, M., Kang, B., Tang, G., & Bai, L. (2021). Biochar improves heavy metal passivation during wet anaerobic digestion of pig manure. *Environmental Science and Pollution Research*, 28(1), 635–644. <https://doi.org/10.1007/s11356-020-10474-z>
- [18] Wang, N., Chen, Q., Zhang, C., Dong, Z., & Xu, Q. (2022). Improvement in the physicochemical characteristics of biochar derived from solid digestate of food waste with different moisture contents. *Science of The Total Environment*, 819, 153100. <https://doi.org/https://doi.org/10.1016/j.scitotenv.2022.153100>
- [19] Wu, L., Zhao, X., & Bi, E. (2022). Predicting the effect of dissolved humic acid on sorption of benzotriazole to biochar. *Biochar*, 4(1). <https://doi.org/10.1007/s42773-022-00134-5>
- [20] Wu, Y., Zhang, P., Zhang, H., Zeng, G., Liu, J., Ye, J., Fang, W., & Gou, X. (2016). Possibility of sludge conditioning and dewatering with rice husk biochar modified by ferric chloride. *Bioresource Technology*, 205, 258–263. <https://doi.org/10.1016/j.biortech.2016.01.020>
- [21] Xue, S., Chen, F., Wang, Y., Shao, Z., Zhang, C., Qiu, L., Ran, Y., & He, L. (2021). Effects of Co-Applications of Biochar and Solid Digestate on Enzyme Activities and Heavy Metals Bioavailability in Cd-Polluted Greenhouse Soil. *Water, Air, & Soil Pollution*, 232(4), 140. <https://doi.org/10.1007/s11270-021-05089-0>
- [22] Zhang, Y., Jeyakumar, P., Xia, C., Lam, S. S., Jiang, J., Sun, H., & Shi, W. (2022). Being applied at rice or wheat season impacts biochar's effect on gaseous nitrogen pollutants from the wheat growth cycle. *Environmental Pollution*, 306. <https://doi.org/10.1016/j.envpol.2022.119409>
- [23] Zhao, X., Xu, K., Wang, J., Wang, Z., Pan, R., Wang, Q., Li, S., Kumar, S., Zhang, Z., & Li, R. (2022). Potential of biochar integrated manganese sulfate for promoting pig manure compost humification and its biological mechanism. *Bioresource Technology*, 357. <https://doi.org/10.1016/j.biortech.2022.127350>
- [24] Zhou, H., Brown, R. C., & Wen, Z. (2020). Biochar as an Additive in Anaerobic Digestion of Municipal Sludge: Biochar Properties and Their Effects on the Digestion Performance. *ACS Sustainable Chemistry & Engineering*, 8(16), 6391–6401. <https://doi.org/10.1021/acssuschemeng.0c00571>
- [25] Zuo, L., Lin, R., Shi, Q., & Xu, S. (2020). Evaluation of the Bioavailability of Heavy Metals and Phosphorus in Biochar Derived from Manure and Manure Digestate. *Water, Air, & Soil Pollution*, 231(11), 553. <https://doi.org/10.1007/s11270-020-04924-0>
- [26] Belyaev Ye. Yu. (2000). Production and application of activated charcoal for environmental purposes. *Chemistry of Plant Raw Materials*, 2, 5-15.
- [27] Biochar, the benefits of using natural soil fertilisers – Proposition. Retrieved July 7, 2022, from <https://propozitsiya.com/ru/gidrotermalnaya-karbonizaciya-biomassy-put-k-resheniyu-ekologicheskikh-problem>
- [28] Moskalenko T.V. & Danilov O.S. (2009). Influence of ultrasound on the degree of extraction of humic acids from the Kagalassky lignite deposit. *Science and Education*, 1, 43-45. Stavitskaya G.G..(2009). Uniformly Porous Nanosize Carbon Materials of Aerogel Type with Molecular-Sieve Properties. *Nanosystems, Nanomaterials, Nanotechnologies*, 7(3), 683–699.

CONTENTS

No.	Article Title & Authors	page
1.	CONTROL OF ANNUAL AND PERENNIAL WEEDS ON UNCULTIVATED LAND COMBATAREA BURUIENILOR ANUALE ȘI PERENE DE PE TERENURILE NECULTIVATE Marga GRĂDILĂ, Daniel JALOBĂ, Valentin Marius CIONTU, Raluca Monica CRISTEA, Victor PETCU, Eugen MARIN, Cătălina TUDORA	14
2.	APPLICATION OF BIOCHAR OF DIFFERENT GENESIS: APPLIED ASPECTS OF ACTIVATION ЗАСТОСУВАННЯ БІОЧАРУ РІЗНОГО ПОХОДЖЕННЯ: ПРИКЛАДНІ АСПЕКТИ АКТИВАЦІЇ Yelizaveta CHERNYSH, Mykola KHARYTONOV, Viktoriia CHUBUR, Vladimir SHTEPA, Hynek ROUBIK	22
3.	EFFECT OF USING A SOYBEAN OIL AND DIESEL FUEL MIXTURE ON THE POWER AND EXHAUST EMISSIONS OF A TRACTORS DIESEL ENGINE UTJECAJ KORIŠTENJA MJEŠAVINE SOJINOG ULJA I DIZELSKOG GORIVA NA RADNE KARAKTERISTIKE I EMISIJE ISPUŠNIH PLINOVA TRAKTORSKOG DIZEL MOTORA Igor KOVAČEV, Mateja GRUBOR, Karlo ŠPELIC, Stjepan PLIESTIĆ, Stjepan SITO, Nikola BILANDŽIJA	32
4.	SAFFRON MECHANIZED HARVESTING (Crocus sativus L; Fam. Iridaceae) RECOLTAREA MECANIZATĂ A ȘOFRANULUI (Crocus Sativus L; Fam. Iridaceae) Adriana MUSCALU, Cătălina TUDORA, Cristian SORICĂ, Oana MÎRZAN, Margareta NAIE, Tudor Elena BARCANU, Eduard DUMITRU, Dorin Ioan SUMEDREA	42
5.	SEEDS TREATMENT WITH BIOINOCULANTS FOR WINTER WHEAT CULTIVATION IN THE MARGINAL LANDS ОБРОБКА НАСІННЯ БІОІНОКУЛЯНТАМИ ДЛЯ ВИРОЩУВАННЯ ОЗИМОЇ ПШЕНИЦІ НА МАРГІНАЛЬНИХ ЗЕМЛЯХ Mykola KHARYTONOV, Oleksandr MYTSYK, Valentina PASHOVA, Svitlana LEMISHKO, Oleksandr IZHBOLDIN, Laura MEJIAS	48
6.	INSIGHTS INTO ENDOPHYTIC FUNGAL COMMUNITIES OF SUAEDA MARITIMA AND SALICORNIA EUROPAEA PERSPECTIVE ASUPRA COMUNITĂȚILOR FUNGICE ENDOFITE DIN SUAEDA MARITIMA ȘI SALICORNIA EUROPAEA Lorena-Roxana GURAU, Ioan RADU, Daniel JALOBĂ, Andreea COSOVEANU, Leonard ILIE	56
7.	WINDROW COMPOSTING AND COMPOSTING SITES MANAGEMENT. A REVIEW COMPOSTAREA DE TIP WINDROW ȘI MANAGEMENTUL SITURILOR DE COMPOSTARE. UN REVIEW Ana-Maria CONSTANTIN, Sorin Ștefan BIRIȘ, Lucreția POPA, Vasilica ȘTEFAN, Ioan Ciprian MIRON, Ana-Maria TABARASU	62
8.	INTELLIGENT EQUIPMENT FOR MAINTENANCE OF AGRICULTURAL CROPS IN PROTECTED SPACES ECHIPAMENT INTELIGENT PENTRU ÎNTREȚINEREA CULTURILOR AGRICOLE ÎN SPAȚII PROTEJATE Dan CUJBESCU, Cătălin PERSU, Lucian DUMITRESCU, Ion MURGESCU, Bogdan Alexandru ONOSE, Ștefan Adrian ȘONTEA, Emilian MIREA	72
9.	ENERGY RECOVERY OF BIOMASS IN THE CONTEXT OF EUROPEAN TARGETS VALORIFICAREA ENERGETICĂ A BIOMASEI ÎN CONTEXTUL ȚINTELOR EUROPENE Iuliana GĂGEANU, Adriana BĂDULESCU, Valentina ISAC, Ana-Maria TĂBĂRAȘU, Cătălin PERSU, Dan CUJBESCU, Gabriel GHEORGHE	78
10.	THE USE OF MEDICINAL AND AROMATIC PLANTS IN AGRICULTURE TO FIGHT PESTS BUT ALSO AS FERTILIZERS. A REVIEW UTILIZAREA PLANTELOR MEDICINALE ȘI AROMATICE ÎN AGRICULTURĂ PENTRU COMBATAREA DĂUNĂTORILOR DAR ȘI CA ÎNGRĂȘĂMINTE. O REVIZUIRE Ana-Maria TĂBĂRAȘU, Sorin Ștefan BIRIȘ, Mihaela BEGEA, Dragoș ANGHELACHE, Ana-Maria CONSTANTIN	84
11.	CONSIDERATIONS REGARDING THE USE OF TOOLS FOR IMPROVING QUALITY MANAGEMENT IN AN ORGANIZATION CONSIDERAȚII PRIVIND UTILIZAREA INSTRUMENTELOR DE ÎMBUNĂȚĂȚIRE A MANAGEMENTULUI CALITĂȚII ÎNTR-O ORGANIZAȚIE Carmen BRĂCĂCESCU, Oana-Diana CRISTEA, Raluca-Veronica BRĂCĂCESCU	92
12.	ESTIMATION OF THE PRODUCTIVE POTENTIAL DEPENDANCE OF SWEET SORGHUM HYBRIDS ON SOIL NUTRITION MANAGEMENT ОЦІНКА ПРОДУКТИВНОГО ПОТЕНЦІАЛУ ЦУКРОВОГО СОРГО ЗАЛЕЖНО ВІД ЗАБЕЗПЕЧЕННЯ ГРУНТУ ПОЖИВНИМИ РЕЧОВИНАМИ Mykhailo BABENKO, Mykola KHARYTONOV, Nadia MARTYNOVA, Volodymyr KOZECHKO, Hynek ROUBIK	98
13.	STUDY ON THE ANTHROPIC IMPACT ON THE ENVIRONMENT STUDIUL PRIVIND IMPACTUL ANTROPIC ASUPRA MEDIULUI Raluca-Lucia DINCULOIU, Mioara CIOBANU, Carmen-Otilia RUSĂNESCU, Viviana Carmen CIUCĂ, Mihaela BEGEA, Ana-Maria TĂBĂRAȘU, Sorin IORDACHE	106

No.	Article Title & Authors	page
14.	<p>THE STATE OF LAND COVER IN THE FLOODPLAIN OF THE SAMARA RIVER CAUSED WITH LONG-TERM COAL MINING СТАН ЗЕМЕЛЬНОГО ПОКРИВУ В ЗАПЛАВІ РІЧКИ САМАРИ, ПОВ'ЯЗАНИЙ З БАГАТОРІЧНИМ ВИДОБУТКОМ ВУГІЛЛЯ Mykola KHARYTONOV, Olga TITARENKO, Susan TRUMBORE, Gerd GLEIXNER</p>	116
15.	<p>THE PROSPECTS OF THE WASTE-BASED BIOSTIMULANTS PRODUCTION FOR AGRICULTURE LES PERSPECTIVES DE LA PRODUCCIÓ DE BIOSTIMULANTS A BASE DE RESIDUS PER A L'AGRICULTURA Laura MEJIAS, Oscar MARTÍNEZ-AVILA, Mabel MORA, Omar CASTAÑO, Mykola KHARYTONOV</p>	124
16.	<p>RECOVERY OF WASTE FROM THE WINE INDUSTRY - GRAPE SEED OIL VALORIFICAREA DEȘEURILOR DIN INDUSTRIA VINULUI - ULEIUL DIN SÂMBURI DE STRUGURI Nicoleta Alexandra VANGHELE, Andreea MATAACHE, Ancuța - Alexandra PETRE</p>	136
17.	<p>THE CURRENT STATE REGARDING THE STRUCTURE AND KINEMATIC SCHEME OF THE MECHANISM WITH RETARDABLE FINGERS STADIUL ACTUAL PRIVIND STRUCTURA ȘI SCHEMA CINEMATICA A MECANISMULUI CU DEGETELOR ESCAMOTABILE Ioan Ciprian MIRON, Ana – Maria CONSTANTIN, Lucreția POPA, Vasilica ȘTEFAN</p>	142
18.	<p>VALORIZATION OF MICROALGAE IN WASTEWATER TREATMENT AND BIODIESEL PRODUCTION VALORIFICAREA MICROALGELOR ÎN TRATAREA APELOR UZATE ȘI PRODUȚIA DE BIODIESEL Nicoleta UNGUREANU, Valentin VLĂDUȚ, Sorin-Ștefan BIRIȘ, Mădălina IVANCIU (POPA), Mariana IONESCU</p>	148
19.	<p>MANAGEMENT OF BY-PRODUCTS AND WASTE FROM POULTRY MEAT INDUSTRY GESTIONAREA SUBPRODUSELOR ȘI DEȘEURILOR DIN INDUSTRIA CĂRNII DE PĂSĂRE Nicoleta UNGUREANU, Valentin VLĂDUȚ, Sorin-Ștefan BIRIȘ, Mirela DINCĂ, Neluș–Evelin GHEORGHITĂ</p>	158
20.	<p>SUSTAINABILITY IN AQUACULTURE SUSTENABILITATEA ÎN ACVACULTURĂ Iulian VOICEA, Florin NENCIU, Cătălin PERSU, Mihai MATAACHE, Dan CUJBESCU, Remus OPRESCU, Corina MOGA, Vlad Nicolae ARSENOAIA, Mădălina ȘTEFAN</p>	170
21.	<p>DETERMINATION OF ENERGY CONSUMPTION AND CARBON DIOXIDE EMISSIONS RELATED TO FUEL CONSUMPTION FOR AGRICULTURAL MECHANIZATION APPLICATIONS TARIMSAL MEKANİZASYON UYGULAMALARINDA YAKIT TÜKETİMİ İLE İLGİLİ ENERJİ TÜKETİMİ VE KARBONDİOKSİT EMİSYONLARININ BELİRLENMESİ Ozdemir S., Ayhan B., Ozturk HH., Bereket Barut Z</p>	176
22.	<p>SPECIFIC MEASURES FOR ENERGY SAVING IN SOIL TILLAGE TOPRAK İŞLEMEDE ENERJİ TASAARUFU İÇİN ÖZEL ÖNLEMLER Ozdemir S., Ayhan B., Ozturk HH., Bereket Barut Z</p>	180
23.	<p>FEASIBILITY ANALYSIS OF FLUTED ROLLER DISPENSER APPLICATION FOR PRECISION FERTILIZATION SOONRULLDOSAATORI RAKENDATAVUS TÄPPISVÄETAMISEL Tormi LILLERAND, Märt REINVEE, Indrek VIRRO, Jüri OLT</p>	186
24.	<p>NEW TECHNOLOGIES FOR GROWING VEGETABLES IN ARTIFICIAL ENVIRONMENTS WITH MICROCLIMATE MONITORED AND CONTROLLED THROUGH CURRENT INTELLIGENT SYSTEMS NOI TEHNOLOGII DE CULTURĂ A LEGUMELOR ÎN MEDII ARTIFICIALE CU MICROCLIMAT MONITORIZAT ȘI CONTROLAT PRIN INTERMEDIUL SISTEMELOR INTELIGENTE ACTUALE Laurențiu Constantin VLĂDUȚOIU, Constantin VLAD, Cristian SORICĂ, Iulia Andrea GRIGORE, Ancuta Alexandra PETRE, Elena SORICĂ, Mario CRISTEA, Ionel Lucian DUMITRESCU, Mariana TOMA</p>	196
25.	<p>INNOVATIVE TECHNICAL EQUIPMENT FOR SOIL RELEASE, CRUST CRUSHING AND WEED DESTRUCTION FOR LIVER PLANTS MAINTENANCE TECHNOLOGY ECHIPAMENT TEHNIC INOVATIV PENTRU AFÂNAREA SOLULUI, SPARGEREA CRUSTEI ȘI DISTRUGEREA BURUIENILOR DESTINAT TEHNOLOGIEI DE ÎNȚEȚINERE A PLANTAȚIILOR DE VIȚĂ-DE-VEIE Dorin Ioan SUMEDREA, Andrei TĂNASE, Alina FLOREA, Adriana MUSCALU</p>	206
26.	<p>VALUE ADDITION TO BROKENS OF RICE AND PULSE INDUSTRIES THROUGH PREPARATION OF RICE ANALOGUES Ambrish GANACHARI, Udaykumar NIDONI, H. SHARANAGOUDA, KT. RAMAPPA, Nagaraj NAIK, S VANISHREE, PF MATHAD</p>	212
27.	<p>DIGITALIZATION OF THE FOOD SYSTEM AS A MEANS TO PROMOTE FOOD AND NUTRITION SECURITY- A REVIEW DIGITALIZAREA SISTEMULUI ALIMENTAR CA MIJLOC DE PROMOVARE A SECURITĂȚII ALIMENTARE ȘI NUTRIȚIONALE - O REVIZUIRE Andreea MATAACHE, Mihai Gabriel MATAACHE, Mariana EPURE, Nicoleta VANGHELE, Ancuta Alexandra PETRE, Andreea ENEA</p>	220

No.	Article Title & Authors	page
28.	<p>RESEARCH ON THE PRACTICES AND APPLICATION OF ROBOTS IN THE CONTEXT OF THE DIGITIZATION OF AGRICULTURE</p> <p>CERCETĂRI PRIVIND PRACTICILE ȘI APLICAREA ROBOȚILOR ÎN CONTEXUL DIGITALIZĂRII AGRICULTURII</p> <p>Ancuta Alexandra PETRE, Nicoleta VANGHELE, Andreea MATACHE, Iulia Andrea GRIGORE, Laurențiu VLĂDUȚOIU</p>	232
29.	<p>FISH FARMING IN DIFFERENT PROTECTED SYSTEMS</p> <p>CREȘTEREA PEȘTELOR ÎN DIFERITE SISTEME PROTEJATE</p> <p>Iulian VOICEA, Florin NENCIU, Andreea MATACHE, Anca PETRE, Nicoleta VANGHELE, Corina Ioana MOGA, Vlad Nicolae ARSENOAIA, Andra LEONTE</p>	242
30.	<p>ANALYSIS OF CONSTRUCTIVE SOLUTIONS OF TILLERS INTENDED FOR USE IN SMALL FARMS AND HOUSEHOLDS</p> <p>ANALIZA SOLUȚIILOR CONSTRUCTIVE DE MOTOCULTOARE DESTINATE UTILIZĂRII ÎN FERME MICI ȘI GOSPODĂRII</p> <p>Mădălina IVANCIU (POPA), Sorin-Ștefan BIRIȘ, Nicoleta UNGUREANU, Valentin VLĂDUȚ</p>	248
31.	<p>SELECTION OF THE TYPE OF WHEAT FLOUR IN THE DEVELOPMENT OF A REFERENCE MATERIAL FOR THE ANALYSIS OF THE WET GLUTEN CONTENT</p> <p>SELECȚIA TIPULUI DE FĂINĂ DE GRÂU ÎN DEZVOLTAREA UNUI MATERIAL DE REFERINȚĂ PENTRU ANALIZA CONȚINUTULUI DE GLUTEN UMED</p> <p>Alina CULEȚU, Mihaela MULȚESCU, Iulia-Elena SUSMAN, Augustina PRUTEANU</p>	258
32.	<p>SELECTION OF SACCHAROMYCES AND NON-SACCHAROMYCES AUTOCHTHONOUS YEAST STRAINS FOR THE PRODUCTION OF WINES WITH IMPROVED QUALITIES</p> <p>SELECTIA DE TULPINI DE DROJDII AUTOHTONE SACCHAROMYCES ȘI NON-SACCHAROMYCES PENTRU OBTINEREA DE VINURI CALITATIV SUPERIOARE</p> <p>Marian ION, Elena BRÎNDUȘE, Carmen BĂLȚATU</p>	264
33.	<p>ANALYSIS OF THE CYLINDRICAL GEAR WHEELS IN THE GEAR OF THE CENTRAL DRUM OF THE CABLEWAY</p> <p>ANALIZA ROȚILOR DINȚATE CILINDRICE DIN ANGRENAJUL TAMBRULULUI CENTRAL DE LA FUNICULARUL FORESTIER</p> <p>Daniel LATES, Claudiu OPREA</p>	272
34.	<p>ADAPTIVE NEURO-FUZZY MODEL FOR THE CONTROL SYSTEM OF THE CLINKER GRINDING PROCESS IN BALL MILLS IN CEMENT FACTORIES</p> <p>MODEL ADAPTIV NEURO-FUZZY PENTRU SISTEMUL DE CONTROL AL PROCESULUI DE MACINARE A CLINKERULUI ÎN MORILE CU BILE DIN FABRICILE DE CIMENT</p> <p>George IPATE, Cristian CIOBANU, Gheorghe VOICU, Filip ILIE, Florentina MANAILA, Petru CARDEI, Iuliana GAGEANU, Dan CUJBESCU</p>	278
35.	<p>WASTEWATER MANAGEMENT FROM THE MUNICIPALITY OF ALEXANDRIA, TELEORMAN COUNTY</p> <p>GESTIONAREA APELOR UZATE DIN MUNICIPIUL ALEXANDRIA, JUDEȚUL TELEORMAN</p> <p>Eugen MARIN, Dana Mădălina MARIN, Victor Viorel SAFTA, Carmen Otilia RUSĂNESCU, Gigel PARASCHIV</p>	288
36.	<p>MANAGEMENT OF INDUSTRIAL AND HOUSEHOLD WASTE FROM THE MUNICIPALITY OF CRAIOVA</p> <p>GESTIONAREA DEȘEURILOR INDUSTRIALE ȘI MENAJERE DIN MUNICIPIUL CRAIOVA</p> <p>Maria CIOBANU, Carmen-Otilia RUSĂNESCU, Gigel PARASCHIV, Gheorghe VOICU, Sorin Ștefan BIRIȘ, Raluca-Lucia DINCULOIU, Ana-Maria TĂBĂRAȘU</p>	294
37.	<p>CURRENT TECHNOLOGIES OF CONDITIONING AND PROCESSING OF BERRIES - A REVIEW</p> <p>TEHNOLOGII ACTUALE DE CONDITIONARE ȘI PROCESARE A FRUCTELOR DE PADURE – O REVIZUIRE</p> <p>Augustina PRUTEANU, Mihaela NITU, Iuliana GĂGEANU, Alina CULEȚU</p>	300
38.	<p>INFLUENCE OF THE CHEMICAL PROPERTIES OF BIOMASS ON THE USE AS BIOFUEL</p> <p>INFLUENȚA PROPRIETĂȚILOR CHIMICE ALE BIOMASEI ASUPRA UTILIZĂRII CA BIOCOMBUSTIBIL</p> <p>Ana-Maria TĂBĂRAȘU, Iuliana GĂGEANU, Dragoș ANGHELACHE, Aura Elena MĂNĂILĂ</p>	310
39.	<p>SOIL TILLAGE TOOLS INFLUENCE ON ENERGY CONSUMPTION</p> <p>INFLUENȚA SCULELOR DE PRELUCRARE A SOLULUI ASUPRA CONSUMULUI DE ENERGIE</p> <p>Marius Ioan GHEREȘ, Teodor RUSU, Marinela GHEREȘ, Ioan-Liviu SCURTU, Ancuta-Nadia JURCO, Mario CRISTEA</p>	318
40.	<p>CONTROL OF CULTIVATED PLANT PATHOGENS IN THE CONDITION OF CLIMATE CHANGE</p> <p>COMBATEREA PATOGENILOR PLANTELOR CULTIVATE ÎN CONDITIILE SCHIMBĂRII CLIMATICE</p> <p>Marian LIXANDRU, Sergiu FENDRIHAN</p>	324
41.	<p>STUDIES ON THE POSSIBILITY OF KEEPING SEEDING DEPTH CONSTANTLY AT PRECISION SOWERS</p> <p>STUDII PRIVIND POSIBILITATEA PĂSTRĂRII CONSTANTE A ADÂNCIMII DE SEMANAT LA SEMĂNĂTORILE DE PRECIZIE</p> <p>Ion SĂRĂCIN, Ionel OBRETIN, Valentina NEGULESCU, Gheorghe PĂTRĂCHISIU, Nicoleta FLORICA, Ioan Alexandru SĂRĂCIN, Gabriel GHEORGHE</p>	328

No.	Article Title & Authors	page
42.	<p>THE CONTRIBUTION OF BEE POLLINATION IN THE CONTEXT OF SUSTAINABLE AGRICULTURE. A REVIEW CONTRIBUȚIA POLENIZĂRII ALBINELOR ÎN CONTEXTUL AGRICULTURII DURABILE. O REVIZUIRE <i>Andreea MATACHE, Ancuta Alexandra PETRE, Nicoleta VANGHELE</i></p>	334
43.	<p>TOWARD ZERO-POLLUTION, AN EDGE UTOPIA IN VINEYARD FIELD. THE TZP-UTOPIA-F2F CONCEPT: DIGITALLY PROMOTES THE TRANSPARENT PATH OF GRAPES IN THE FARM TO FORK VALUE CHAIN; PART I: SMART-FIELD OF THE FARM, FIRST RELEVANT LINK OF TRANSPARENT PATH OF GRAPES IN THE FARM TO FORK VALUE CHAIN. A REVUE SPRE ZERO-POLUARE, O UTOPIE DE FRONTIERĂ ÎN CÂMPUL PODGORIEI. CONCEPTUL TZP-UTOPIA-F2F: PROMOVEAZĂ DIGITAL TRASEUL TRANSPARENT AL STRUGURILOR ÎN LANȚUL VALORIC DE LA FERMĂ LA FURCULIȚĂ; PARTEA I: DOMENIU-INTELIGENT AL FERMEI, PRIMA VERIGĂ RELEVANTĂ A TRASEULUI TRANSPARENT AL STRUGURILOR DIN LANȚUL VALORIC DE LA FERMĂ LA FURCULIȚĂ. O SINTEZĂ <i>Constantin VÎLCU, Steve VANLANDUIT, Resul KARA, Aurora RANCA, Mohamed BOUROUAH, Tom SAVU, Valentin VLADUT, Edmond MAICAN</i></p>	344
44.	<p>THE INFLUENCE OF THE TILLAGE SYSTEM ON THE WEEDING DEGREE AND MAIZE YIELD IN TRANSYLVANIAN PLAIN IINFLUENȚA SISTEMULUI DE LUCRARE A SOLULUI ASUPRA GRADULUI DE ÎMBURUIENARE ȘI PRODUCȚIEI DE PORUMB, ÎN CÂMPIA TRANSILVANIEI <i>Felicia CHEȚAN, Cornel CHEȚAN</i></p>	356
45.	<p>ASPECTS REGARDING THE USE OF ONION POWDER IN BAKERY INDUSTRY ASPECTE PRIVIND UTILIZAREA PUDREI DE CEAPĂ ÎN PANIFICAȚIE <i>Elena-Madalina STEFAN, Gabriel-Alexandru CONSTANTIN, Gheorghe VOICU, Gabriel MUȘUROI, Irina-Aura ISTRATE, Mariana Gabriela MUNTEANU, Iulian VOICEA</i></p>	364
46.	<p>ASPECTS REGARDING THE COMPACTION OF CARDBOARD WASTE IN VERTICAL PRESSES WITH DISCONTINUOUS FLOW ASPECTE PRIVIND COMPACTAREA DEȘEURILOR DIN CARTON ÎN PRESE VERTICALE CU FLUX DISCONTINUU <i>Gheorghe VOICU, Mircea-Bucur LAZEA, Gabriel-Alexandru CONSTANTIN, Paula TUDOR, Elena-Madalina STEFAN, Iulian-Claudiu DUȚU</i></p>	370
47.	<p>VARIATION OF ENERGY CONSUMPTION AND SPECIFIC SURFACE BLAINE RESULTING FROM SIMULATION OF CLINKER GRINDING IN A CEMENT MILL VARIAȚIA CONSUMULUI DE ENERGIE ȘI A SUPRAFEȚEI SPECIFICE BLAINE REZULTATE ÎN URMA SIMULĂRII MĂCINĂRII CLINCHERULUI ÎNTR-O MOARA DE CIMENT <i>Cristian CIOBANU, Gheorghe VOICU, Irina-Aura ISTRATE, Paula VOICU, Mariana-Gabriela MUNTEANU</i></p>	378
48.	<p>EMODIN EXTRACTION METHODS FROM POLYGONACEAE PLANTS METODE DE EXTRAȚIE A EMODINEI DIN PLANTE CE APARTIN FAMILIEI POLYGONACEAE <i>Lavinia-Diana-Nicoleta BARBU, Oana-Alina BOIU-SICUIA, Sorina DINU, Cristina Maria LUMĂNARE, Daniel-Nicolae COJANU, Narcisa BĂBEANU</i></p>	388
49.	<p>RESEARCH OF OCCUPATIONAL RISKS ON MECHANIZED PROCESSES IN ANIMAL HUSBANDRY ДОСЛІДЖЕННЯ ПРОФЕСІЙНИХ РИЗИКІВ НА МЕХАНІЗОВАНИХ ПРОЦЕСАХ У ТВАРИНИЦТВІ <i>Oleksandr VOINALOVYCH, Oleg HNATIUK, Vasyi KHMELOVSKYI, Tamara BILKO, Oksana ACHKEVYCH</i></p>	398
50.	<p>BIOCHAR FROM RESIDUAL VEGETABLE AGRICULTURAL BIOMASS AMENDMENT FOR INCREASING AGRICULTURAL PRODUCTION AND ENERGY STOCK BIOCHARUL DIN BIOMASĂ AGRICOLĂ VEGETALĂ REZIDUALĂ AMENDAMENT PENTRU CREȘTEREA PRODUCȚIEI AGRICOLE ȘI STOC ENERGETIC <i>Erol MURAD</i></p>	406
51.	<p>INSTALLATION FOR MONITORING, CONTROL AND REMOTE DIAGNOSIS OF WOODBREAKER WITH DRIVING FROM LAPTOP OR SMART PHONE INSTALATIE DE MONITORIZARE, CONTROL SI DIAGNOZA LA DISTANTA A UNUI SPĂRGĂTOR LEMNE CU CONDUCERE DE PE LAPTOP SAU TELEFON INTELIGENT <i>Gabriela MATACHE, Mihai IONEL, Valentin BARBU, Ioan PAVEL, Iulian DUMITRU</i></p>	414
52.	<p>COMPARATIVE ANALYSIS OF BIOMASS THERMAL GENERATORS ANALIZA COMPARATIVA PRIVIND GENERATOARELE TERMICE PE BIOMASA <i>Gheorghe SOVAIALA, Gabriela MATACHE, Ioan PAVEL, Cristian SORICA, Andrei PATRUT, Iulian DUMITRU</i></p>	420

No.	Article Title & Authors	page
53.	EXPERIMENTAL STUDIES AND RESEARCH ON A INSTALLATION FOR THE PRODUCTION OF VOLATILE OILS FROM MEDICINAL PLANTS BY DISTILLATION STUDII ȘI CERCETĂRI EXPERIMENTALE ASUPRA UNEI INSTALAȚII PENTRU PRODUCEREA ULEIURILOR VOLATILE DIN PLANTE MEDICINALE PRIN DISTILARE Evelin-Anda LAZA, Dragos Vasile NICA, Cristina MĂNĂILĂ	430
54.	PRODUCTION OF <i>BEAVERIA BASSIANA</i> FUNGAL BIOMASS ON DIFFERENT NUTRIENT SUBSTRATES PRODUCEREA DE BIOMASĂ FUNGICĂ <i>BEAVERIA BASSIANA</i> PE DIFERITE SUBSTRATURI NUTRITIVE Lidia FICIU, Ana Maria ANDREI, MIHELA NIȚU	436
55.	AGRICULTURAL AND OTHER WASTES USED IN THE CONSTRUCTION INDUSTRY DEȘEURILE AGRICOLE ȘI ALTE TIPURI DE DEȘEURI UTILIZATE ÎN INDUSTRIA CONSTRUCȚIILOR Gabriel POPESCU, Nicoleta Raluca JIANU, Ioana Corina MOGA, Iulian VOICEA, Aneta CHIVOIU, Mirela SIMION, Elena Laura TROANĂ	442
56.	DYNAMIC MODEL FOR DECISION LOGICS OF NITROGEN MANAGEMENT IN RAS MODEL DINAMIC PENTRU LUAREA DE DECIZII LOGICE PENTRU MANAGEMENTUL AZOTULUI ÎN RAS Vasile Daniel GHERMAN, Vily Marius CIMPOIASU, Corina MOGA, Radu POPA	448
57.	PRECISION AGRICULTURE, THE IMPORTANCE OF USING DRONES IN AGRICULTURE FOR EFFECTIVE COST MANAGEMENT AGRICULTURA DE PRECIZIE, IMPORTANȚA UTILIZĂRII DRONELOR ÎN AGRICULTURĂ PENTRU UN MANAGEMENT EFICIENT AL COSTURILOR Mario CRISTEA, Mihai Gabriel MATACHE, Andreea Iulia GRIGORE, Laurentiu VLADUTOIU, Iulian DUMITRU, Sorin Ștefan BIRIȘ, Nicoleta UNGUREANU, Robert Dorin CRISTEA, Marius GHEREȘ	454