BIOLOGICAL TREATMENT OF CHROMIUM IN WASTEWATER

Sh.Asimov, D.Mirzayeva, E.Egamberdiev, S.Turabdjanov

Tashkent State Technical University named after Islam Karimov

Abstract. *The possibilities of using higher algae in the treatment of chromic wastewater were studied and analyzed. Chromium (Cr) tolerance of the high alga Azolla caroliniana was determined, and wastewater treatment processes with high chromium retention were analyzed based on chromium-adapted cultures of Azolla. Chromium sorption levels in the dry mass of Azolla were determined.*

Key words. *Wastewater, algae, ecosystem, Azolla caroliniana, sorption, biodiversity, sustainability.*

Introduction. Today, the huge amount of waste water containing harmful chemicals is causing serious environmental problems. Biological treatment of wastewater is distinguished by its importance in ensuring the stability of the man-made ecosystem. In particular, treatment of wastewater contaminated with harmful chemicals on the basis of high algae is of great importance from the point of view of ecology and environmental protection. In the production process, effluents from tanneries, paper mills, coal mines and thermal power stations are extremely dangerous for aquatic ecosystems due to the presence of Cr.

Especially in a period of rapid development of the industry, scientific research is being carried out on acute environmental problems caused by the incomplete purification of chemical and harmful substances in the waste water of leather processing enterprises.

In this regard, it is necessary to determine the toxic properties of chromium in wastewater, to use chromium as one of the main tools in electroplating, leather processing, metal preparation and polishing in light industry, to improve the method of biological treatment of wastewater coming out of leather processing enterprises and treated by physico-chemical methods, to reprocess leather special attention is paid to the fact that the formation of large amounts of sulfites, ammonium nitrogen, and protein compounds in processing plants leads to a sharp change in the ecosystem.

Research methods. As we know, many species of higher algae, blue-green algae, are widely used to remove metals from wastewater, including toxic chemicals.

Research results and their analysis. During our research, in order to study the practical aspects of experimental work, the joint enterprise "PENG-SHENG" LLC, located in the Syrdarya region of the Republic of Uzbekistan, which is considered one of the largest enterprises in the country in terms of production capacity, was selected.

It is known that in different countries of the world there are different requirements for the maximum amount of chromium in the waste water coming out of the enterprise. For example, in the Russian Federation, the amount of trivalent chromium is 0.5 mg/l, and the amount of hexavalent chromium is 0.1 mg/l. The same parameters in the countries of the European Union are defined as chromium ($^{+3}$) 0.5-5.0 mg/l, and chromium ($^{+6}$) 0.1-0.5 mg/l.

In the course of our research, it was found that the content of the wastewater from the 1st pipe of the leather processing enterprise from the Shorozak ditch contains 1.55 mg/l of chromium ($^{6+}$), sulfates and nitrites.

In the course of research, the processes of mechanical and physical cleaning of intermediate biomasses from the tanning and processing shop of JV "PENG-SHENG CHARM" LLC to processing, tempering and then chemical processing, and biological processing as the last stage were analyzed.

During the research, the chemical composition of the wastewater of the leather processing enterprise after chemical treatment was determined under production conditions.

Table 1.

Composition of wastewater from tanning and processing plant

№	Substances	Standard concentration amount, mg/l	Study results, mg/l
1.	Sulphur-containing crucible	10,7	36,2
2.	Carbon disulfide	5,0	7,8
3.	Anionic SPAV	20,0	208
4.	Sulfides	1,0	6,4
5.	pH	6,5 — 8,5	6,5 to 8,5
6.	Mixed particles	500	3750
7.	Dry residue	2000	3500
8.	Total nitrogen	30,0	42,5
9.	Ammonium nitrogen	2,5	9,72
10.	Nitrite nitrogen	3,3	9,9
11.	Nitrate nitrogen	45,0	68,4
12.	Ammonium ions	2,5	12,5
13.	Chlorides	350	700
14.	Phosphates	2,5	16,2
15.	Fluorine ion Fluorine ions	1,5	2,7
16.	COD	500	1500
17.	BOD_{20}	15 - 30	90
18.	BOD_5	11,3 - 22,6	67,8

According to the obtained results, high amounts of Ca (240000), Mg (100000), K (61000), and Mn (410), Fe (920) were found in the wastewater after chemical treatment.

These chemical substances are the most important elements in the cultivation of azolla culture, which ensure the adaptability of the culture to adverse conditions.

In the research, it was noted that the amount of hexavalent chromium in the wastewater after chemical treatment is 54,000. Therefore, it was noted that there is a need to improve the chemical cleaning process implemented at the leather tanning and processing enterprise.

The high chromium content in the waste water coming out of this chemical process was observed in the process of processing the main chemical reagents manually in the chemical reservoir at the enterprise.

Table 2.

Analysis of elements found in large quantities in the wastewater of a leather processing enterprise

B	Na	Mg	Al	P	K	Ca	Cr	Mn	Fe
Initial chemical composition of wastewater (ppm, mkg/g, g/t)									
310	1300	100000	2700	4600	61000	240000	54000	410	920
Chemical composition of wastewater after chemical and biological treatment									
160	220000	35000	900	1100	58000	130000	2200	90,0	390
After chemical and biological treatment, the composition of wastewater after treatment with Azolla									
10,0	3000	28000	390	810	13000	82000	**230**	71,0	280

So, the human factor may have a negative impact on this process. Therefore, it was recommended to install new automated additional equipment at the enterprise.

When the chemical composition of the wastewater coming out of the enterprise after chemical and biological treatment was studied, it was observed that the amount of magnesium decreased by 35%, the amount of potassium decreased by 5%, and the amount of calcium decreased by 7.2%. It was noted that it decreased to mg/l. However, it was noted that the amount of chromium was not reduced to the required level.

Therefore, biological treatment with Azolla culture was carried out for 7 days and 10 days in industrial conditions. In the researches, it was noted that the amount of chromium was 0.011 mg/l on the 10th day of growing Azolla in wastewater after chemical biological treatment leaving the enterprise (Fig. 1).

It is known from scientific sources that the biomass of azolla cultures used in wastewater treatment is collected and used as animal feed, sometimes it is recommended as a nitrogen-phosphorous fertilizer for agricultural crops if its chemical composition prevents it from being given to livestock.

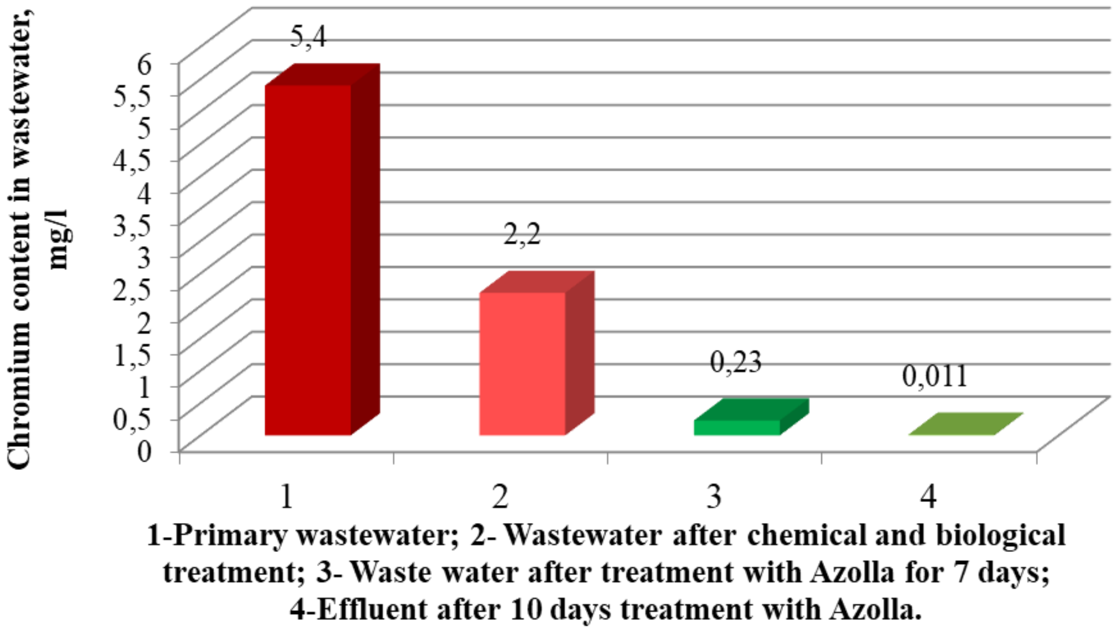

Figure 1. Indicators of biological treatment of chromic wastewater

In the course of research, the accumulation of chromium and mineral salts in the biomass of Azolla culture grown for 7 and 10 days in chromium-containing wastewater and their uniform distribution in the biomass were investigated. When the obtained results were analyzed, it was noted that the sigma weight of O in different spectra of biomass was in the range of 0.83% to 0.92%, and the total weight was from 43.29% to 38.36%.

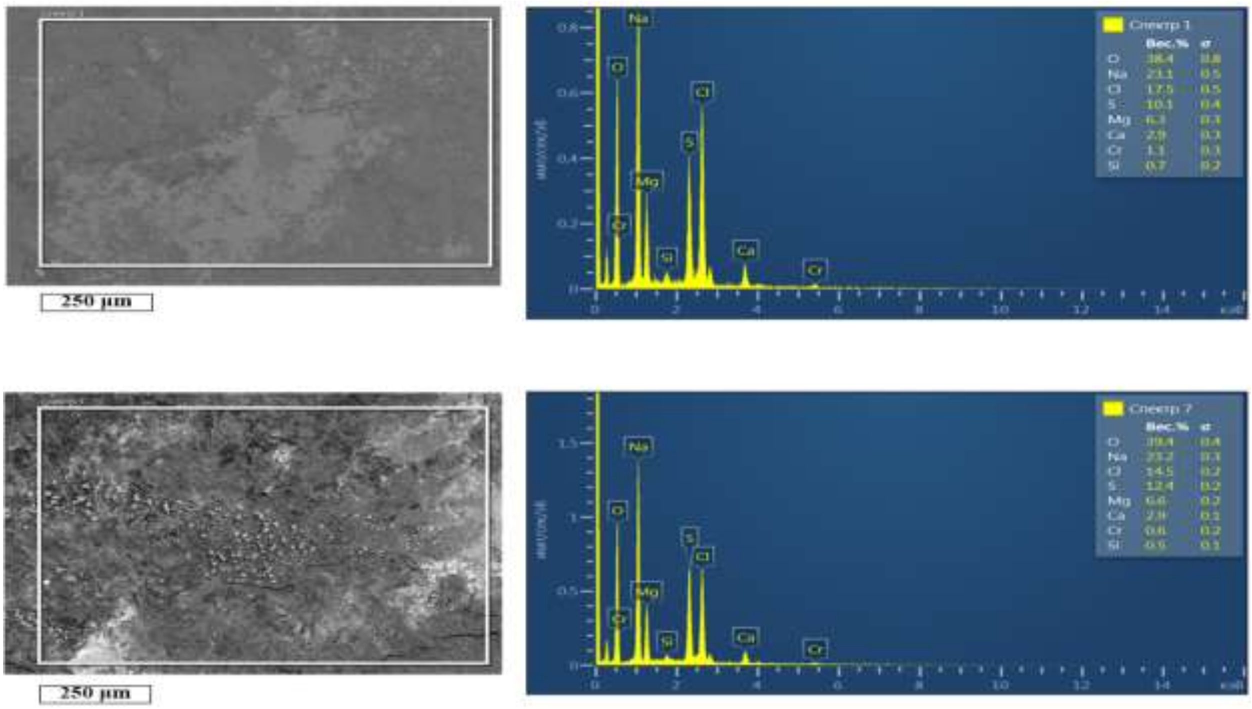

Figure 2. Chromium adsorption on Azolla biomass in production experiments

Figure 2 shows the data on the distribution of chromium in Azolla biomass, where it can be observed that the sigma weight of chromium varies from 0.16 to 0.30%, and the weight percent varies from 0.56% to 1.09% in a non-uniform order.

Conclusion. Analyzing the obtained results, it was observed that the accumulation of chromium and mineral salts in the dried biomass of azolla culture adsorbed was different.

This shows that it cannot be used in agricultural fields due to the amount of mineral salts and high chromium, and secondly, the accumulated chemical elements are not distributed in the same plane in the biomass. Therefore, it is desirable to dispose of the Azolla biomass formed in the bioremediation process by burying it in a special landfill together with the sludge from the 2nd settling basin.

REFERENCES

1. Туробжонов С.М., Азимов Ш.Ш., Хўжамшукуров Н.А., Кучкарова Д. Azolla caroliniana ёрдамида оқова сувларни хромдан тозалаш. ЎзМУ хабарлари. 2021. №3/2/1. 124-128 б. (03.00.00. №9)
2. Хўжамшукуров Н.А., Азимов Ш.Ш., Туробжонов С.М., Кучкарова Д. Макрофитларнинг хромга (Cr (VI) бўлган толерантлиги. ЎзМУ хабарлари. 2021. №3/2/1. 133-137 б. (03.00.00. №9)
3. Azimov Sh., Khujamshukurov N., Murodkhodjaeva Z., Turabjanov S., Kuchkarova D. 2022. Bioremediation of Chromium Based on Macrophytes. Int.J.Curr.Microbiol.App.Sci. 11(02): 432-440. (03.00.00. №25).
4. Азимов Ш.Ш., Хўжамшукуров Н.А., Туробжонов С.М., Кучкарова Д., Нигматуллаева М.Г. Устойчивость макрофитов к хрому и очистка хрома изсточных вод с помощью Azolla caroliniana. Universum: технические науки: электрон. научн. журн. 2022. 1(94). 85-88 б. (03.00.00. №1)
5. Туробжонов С.М., Хўжамшукуров Н.А., Азимов Ш.Ш. 2022. Инновационные способы модернизации в технологии очистки воды. Инновации в нефтегазовой отрасли: электрон.научн.журн. №1/2022. -С.12-16.
6. Азимов Ш. Хўжамшукуров Н., Турабджанов., Кучкарова Д., Абдуллаев Х.Юксак сувўтининг хромнинг юқори даражадаги концентрациясига мослашган культураларини олиш. International Scientific and Technical conference Current issues of the power supply system, Tashkent, 25-26 November, 2021. Pp.488-190.

7. Азимов Ш. Хўжамшукуров Н., Турабджанов., Кучкарова Д., Абдуллаев Х. Азолла културасининг азотфиксация фаоллиги. International Scientific and Technical conference Current issues of the power supply system, Tashkent, 25-26 November, 2021. Pp. 486-488.

8. Азимов Ш. Хўжамшукуров Н., Турабджанов., Оқова сувларни тозалаш технологияларининг инсоният олдидаги аҳамияти. Электр энергиясини ишлаб чиқариш, узатиш ва тақсимлаш ҳамда ундан оқилона фойдаланишнинг долзарб муаммолари/ Республика миқёсида илмийтехникавий анжуман илмий ишлар тўплами, 2020 йил - Тошкент, 24-26 б.

9. Азимов Ш.Ш., Хужамшукуров Н., Кучкарова Д. Очистка хрома из сточных вод с помощью Azolla caroliniana. Трешниковские чтения - 2022: Современная географическая картина мира и технологии географического образования: мат-лы.всерос.науч.- практ.конф. с междунар.участ. (14-15 апреля 2022, г.Ульяновск). Ульяновск: ФГБОУ ВО «УлГПУ им. И.Н.Ульянова», 2022.– с. 8-9.

10. Azimov Sh.Sh. Analysis of the excisting scheme for wastewater treatment of galvanic production. Cutting Edge-Science 2022 international science and practical conference. Shawnee, USA, 2022 – 79-82 pp.

11. E.Egamberdiev, S. Turabdjanov, D. Mirzaeva, Kh. Khaydullaev, U. Sharipova, A. Shokhakimova, and O. Bakhtiyorov.: Effect of chitosan substance on the mechanical properties of paper obtained on the basis of flax cellulose. E3S Web of Conferences 371, 01045 (2023) https://doi.org/10.1051/e3sconf/202337101045

12. Igamqulova N.; Mengliev, Sh.; Egamberdiev E.: Reduction of waste disposed to the environment through recycling of unused methyldiethanolamine. E3S Web of Conferences 371, 01049 (2023) https://doi.org/10.1051/e3sconf/202337101049

13. Ergashev Y.; Egamberdiev E.; Mirkhodjaeva D.; Akmalova G.; Umarova M.; Kholdarov R.: Obtaining a filter material used in gas and air purification. E3S Web of Conferences 371, 01012 (2023) https://doi.org/10.1051/e3sconf/202337101012

14. Egamberdiev E.; Ergashev Y.; Turabdjanov S.; Abdumavlyanova M.; Makhkamov A.; Rashidov, Sh.; Karimov, Sh.: Effect of chitosan on the surface properties of cellulose-based paper obtained from the flax plant. E3S Web of Conferences 371, 01010 (2023) https://doi.org/10.1051/e3sconf/202337101010

15. Arslanov, Sh.; Turabdjanov S.; Azimova, Sh.; Azimov D.; Sultankhojaeva N.; Egamberdiev E.: Physico-chemical properties and research of acids contained in oils of Uzbekistan. E3S Web E3S Web of Conferences, 2023, 371, 01021

16. Ergashev Y.; Egamberdiev E.; Turabdzhanov S.; Akmalova G.; Isanova R.; Rashidov R.; Sobitov O.: Obtaining filter material from natural fiber composition and areas of its use. E3S Web of Conferences, 2023, 371, 01047

17. Egamberdiev E.; Turabdjanov S.; Akmalova G.; Mukhtarova N.; Ayubova I.; Mirzakhmedova M.; Rakhmonberdiev G.: Obtaining paper from composition of different fibers and its analysis. E3S Web of Conferences, 2023, 371, 01004

18. Egamberdiev, E.; Ergashev, Y.; Khaydullayev, K.; Husanov, D.; Rahmonberdiev, G. Obtaining paper samples using basalt fibers and studing the effect of natural glue obtained from chitosan on paper quality. Universum: technical science 2022, 4, 14-18, https://7universum.com/ru/tech/archive/item/13348.

19. Egamberdiev E.; Akmalova G.; Rahmonberdiev G. Obtaining paper products from cellulose-containing plants and researching its field of application. 3rd International Conference on Energetics, Civil and Agricultural Engineering, ICECAE 2022Virtual, Online13 October 2022до 16 October 2022Код 187394, DOI 10.1088/1755-1315/1142/1/012054

20. Egamberdiev E.; Makhkamov A.; Rakhimjonov B.; Khusanov D.; Akmalova G.; Mirzakhmedova M.; Rahmonberdiev G. Effectiveness of cleaning of sunflower oil with filter material made from composition of organic and inorganic fibers. 3rd International Conference on Energetics, Civil and Agricultural Engineering, ICECAE 2022Virtual, Online13 October 2022до 16 October 2022Код 187394, DOI 10.1088/1755-1315/1142/1/012050

21. M. Mirzakhmedova., D. Tukhtaboeva., E. Egamberdiev., G. Akmalova. Study of paper technology on the basis of reed cellulose. “Harvard educational and scientific review”, 2022. 149.

22. E.A. Egamberdiev., Y.T. Ergashev., Kh.Kh. Khaydullaev., G.Y. Akmalova., G.R. Rakhmonberdiev. The effect of chitosan on the surface properties of cellulose-based paper obtained from the stem of flaxseed. “Technical science and innovation”, 2022. 27.

23. Egamberdiev E.A., Makhkamov A.R., Rakhmonberdiev G.R. Obtaining wrapping paper used in furniture wrapping and quality delivery and determining its quality indicators // Tashkent state technical university named after Islam Karimov Technical science and innovation–Tashkent,– No. 2(12). 2022.– P. 33–39.

24. Egamberdiev E.A., Norboyev S.K. Extraction of cellulose nanocrystals from secondary paper waste and their use in paper production // Tashkent state technical university named after Islam Karimov Technical science and innovation –Tashkent,– No. 3(13). 2022.– P. 215–222.

25. Soatboev, K., Daddahodjaev, A., & Egamberdiev, E. (2023). Creation of mixed polyfunctional catalysts for hydration of acetylene in vapor phase. Educational Research in Universal Sciences, 2(5), 430–433. Retrieved from http://erus.uz/index.php/er/article/view/3167

26. Zokirbekov, J. K., Aliev, B. A., & Egamberdiev, E. A. (2023). Modified mineral sorbents for waste water treatment. Innovative Development in Educational Activities, 2(10), 155–157. Retrieved from https://openidea.uz/index.php/idea/article/view/1345

27. Zokirbekov, J. K., Aliev, B., & Egamberdiev, E. (2023). Effect of temperature on sorbents. Innovative Development in Educational Activities, 2(10), 158–161. Retrieved from https://openidea.uz/index.php/idea/article/view/1346

28. Zokirova , Z. Q. qizi, Egamberdiyev, E. A., & Sattarkulov , L. A. o‘g‘li. (2023). Installation of new types of basalt fiber filters in industry. SCHOLAR, 1(11), 122–125. Retrieved from https://researchedu.org/index.php/openscholar/article/view/3281

29. Zokirova Zilola Qaxramon qizi, Egamberdiyev Elmurod Abduqodirovich, & Sattarkulov Lazizbek Abror o‘g‘li. (2023). Use of cellulose based filters in the oil and gas industry. Ta’limni rivojlantirishda innovatsion texnologiyalarning o‘rni va ahamiyati, 1(1), 261–264. Retrieved from https://researchedu.org/index.php/konferensiya/article/view/3388

30. S.S. Aliev, E.A. Egamberdiev, G.Yu. Akmalova, G.U. Ilkhamov. Analysis of physical-mechanical properties of new type of wood-polymer composite materials. Vol. 3 No. 1 (2023): Harvard Educational and Scientific Review, 48-53

31. Turabdjanov , S., Egamberdiev, E., Iskandarov, A., & Zokirova, Z. (2023). Installation of new types of basalt fiber filters in industry. SCHOLAR, 1(10), 106–110. Retrieved from https://researchedu.org/index.php/openscholar/article/view/3109

32. Rashidov Sh.A., Egamberdiev E.A., Turabdjanov S.M. Obtaining cellulose nanocrystals and their use in paper production. Austrian Journal of Technical and Natural Sciences 1.2 2023, 3-8. https://doi.org/10.29013/AJT-23-1.2-3-8

33. E Egamberdiev, R Kholdarov, R Masharipov, O Muratkulov, G Akmalova, Ergashev Yo, M Mirzakhmedova. Effect of flocculinants on stability of paper materials Austrian Journal of Technical and Natural Sciences 1.2 2023, 9-12. https://doi.org/10.29013/AJT-23-1.2-9-12

34. Egamberdiev Elmurod, Ergashev Yorkinjon, Mahkamov Adham, Umarova Muattar, Akmalova Guzal. Obtaining oil filters from local fiber raw and its advantages. Universum: технические науки 8-3 (101) 2022 – P. 49-54.

35. Egamberdiev Elmurod, Ergashev Yorqinjon, Khaydullayev Khurshid, Husanov Dilshod, Rahmonberdiev Gappor. Obtaining paper samples using basalt fibers and studying the effect of natural glue obtained from chitosan on paper quality. Universum: технические науки 4-13 (97) 2022 – P. 14-18.

36. Gulnoza Iskhakova Elmurod Egamberdiev, Jamshid Ziyadullaev. Obtaining thermal insulation materials containing basalt fiber and cellulose. International scientific and practical conference modern views and research 2021/6, 10-11

37. G‘.R.Rakhmonberdiev E.A.Egamberdiev, G.Yu.Akmalova, Yo.T.Ergashev, M.M.Shakirova. The influence of different natural fibers applied on the quality index of the paper. American journal of research 2021/4, 48-57

38. G.Akmalov S.Arslanov, E. Egamberdiev. Physiologically active polymers with anti tuberculosis activity. International scientific and practical conference modern views and research 2021/2, 48-50.

39. G.Rakhmanberdiev E. Egamberdiev, Yo.Ergashev. Obtaining a filter material based on basalt fiber used for the oil industry. International scientific practical conference modern views and research 2021/2, 63-65

40. Toyir Safarov, Elmurod Egamberdiev, Yorqin Ergashev. Study of the effect of binders on paper materials made based on mineral fibers. Internationales Deutsches Akademika Aachener, Germany 2021, 40-43

41. S.Arslanov, E. Egamberdiev, G.Akmalova. Physiologically active polymers with antituberculosis activity. Modern views and research - 2021, January-February, 2021: Egham. 48-50

42. E. Egamberdiev, Yo.Ergashev, G.Rakhmanberdiev. Obtaining a filter material based on basalt fiber used for the oil industry. Modern views and research - 2021, January-February, 2021: Egham. 63-65

43. Aliev S.S., Rakhmanberdiev G.R., Sharafatdinov B. Study physical and mechanical properties of wood-polymer composition materials made on the basis of local wood flours and polyvinylchloride // “Technical science and innovation”, Tashkent State Technical University named after I.A. Karimov, Tashkent 2022, pp. 211-214.

44. Aliev S.S., Egamberdiev E.A., Akmalova G.Yu., Ilkhamov G.U. Analysis of physical-mechanical properties of new type of wood-polymer composite materials // Harvard Educational and Scientific Review. International Agency for Development of Culture, Education and Science. 0362-8027 47 Vol.3. Issue 3 Pages 48-53

45. Aliev S.S., Egamberdiev E.A., Juraev A.B., Ismatov M.N., Zokirova Z.Q. The Effect of Wood Fillers in Individual Conditions on Wood-Polymer Composites // “Technical science and innovation”, Tashkent State Technical University named after I.A. Karimov, Tashkent 2023, pp. 208-213.

46. Aliev S.S., Egamberdiev E.A., Akmalova G.Yu. Obtaining environmentally friendly polymer composite material from local wood flour // Al-Farabi Kazakh National University NJSC Faculty of Biology and Biotechnology Department of Biodiversity and Bioresources Research Institute for Problems of Biology and Biotechnology Research Institute for Ecological Problems. Almaty, 2023, pp.168-171