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Synthesis of Low Cost Activated Carbon from Agriculture Wase for Wastewater Treatment

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Extended Abstract

Although biological wastewater is considered the most widely used system to treat wastewater, it is not suitable for many industrial wastes that contain inhibitory substances for the growth of bacteria [1]. Therefore, adsorption is considered an vital process in industrial wastewater treatment and can be regarded as the most cost-effective and easy process for removing heavy metals from industrial wastewater [2, 3]. Activated carbon has been the adsorbent extensively used over the past years. It is highly effective in removing heavy metals; however, the cost-effectiveness of adsorption technology depends on using a low-cost adsorbent [4]. The low-cost adsorbents must be abundant and available in nature, effective and efficient in heavy metal removal. Agricultural wastes are gaining increased attention among low-cost adsorbents as they are abundant in nature and require proper disposal [5]. In this study, five different agricultural wastes were collected from the local market, named a) peanut husk, b) corn straw, c) banana peel, d) wheat straw, and e) orange peel. The agriculture wastes were washed several times with double distilled water, dried in an oven at 105 ℃ for 24 hours, and then grained and sieved. For Activation, dried and sieved agriculture waste was placed in a 1000 ml glass container. A concentrated phosphoric acid (85% H3PO4) was carefully poured into the containers until full impregnation at 25 ℃ and an impregnation time of 24 hours. Then left in air for partial dryness and dried in an oven for one hour at 120 ℃ until fully dry. As a final step, the activated waste materials were collected in ceramic tubes and subjected to a temperature of 500 ℃ in a furnace for 2 hours in an oxygen-deficient atmosphere. The final activated carbon was heavily washed with distilled water in a 1000 mm glass container and dried using filter papers and suction pumps until the pH of the washing water became neutral.

The different types of agricultural waste activated carbon were examined using the following methods of experiments were used for physical and chemical characterization of the different activated carbons: Scanning Electron Microscopy microscopy (SEM), Energy dispersive X-ray (EDX), Brunauer–Emmett–Teller specific surface area (BET SSA), Fourier transform infrared spectroscopy (FTIR). The experiments proved the successful synthesis of activated carbon. Peanut husk showed the most elevated specific surface among the test agriculture waste, with 926, 565, 393, 433, and 792 m^2/g for peanut husk, corn straw, banana peel, wheat straw, and orange peel, respectively. As a next step for the research, the products will be tested against the adsorption of heavy metals from industrial wastewater. Batch experiments will be done to study the effect of adsorbent dose, pollutant concentration, pH, and contact time on the removal efficiency of different heavy metals. Using agricultural waste as adsorbents for wastewater treatment could be sustainable solutions for industries in developing countries with agricultural activities, where these wastes are abundant. Many of these developing countries are suffering from a lack of appropriate central sanitation services [6], requiring sustainable solutions for environmental problems.

References

[1] A. Elawwad, M. Hazem, "Minimization of sludge production in an integrated UASB - continuous flow sequencing batch reactor system", Desalination and Water Treatment, vol. 91, pp. 206-213, 2017.
[2] S.M. Safwat, N.Y. Mohamed, M.N.A. Meshref, A. Elawwad, "Adsorption of Phenol onto an Aluminum Oxide Nanoparticles: Performance Evaluation, Mechanism Exploration, and Principal Component Analysis (PCA) of Thermodynamics", *Adsorption Science and Technology*, vol. 2022, 2022.
[3] N.G. Mostafa, A.F. Yunnus, A. Elawwad, "Adsorption of Pb(II) from Water onto ZnO, TiO2, and Al2O3: Process Study, Adsorption Behaviour, and Thermodynamics", *Adsorption Science and Technology*, vol. 2022, 2022.

[4] A. Adly, N.G. Mostafa, A. Elawwad, "Adsorption of phosphorus onto nanoscale zero-valent iron/activated carbon: removal mechanisms, thermodynamics, and interferences", *Water Reuse*, vol. 12 (1), pp. 111–130, 2022.
[5] V. Gupta, Suhas, "Application of low-cost adsorbents for dye removal – A review", *Journal of environmental management*, vol. 90, pp. 2313-42, 2009
[6] A. Elawwad, M. Rageb, H. Abdel-Halim, "An economical, environmental, and social comparison between vacuum and gravity sewers in decentralized sanitation systems, with Egypt as a case study", *Journal of Water, Sanitation and Hygiene for Development*, vol. 5 (4), 614-619, 2015.