Implementing Nontoxic Modified Biochar Enhanced Filtration for the Efficient Removal of Emerging Contaminants in an Aqueous Solution

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Many water sources contain emerging contaminants (contaminants whose water presence has only recently been confirmed) that lead to debilitating health and environmental effects, yet current standard water treatment processes cannot remove most emerging contaminants from water. This project researches the usage of doped biochar enhanced with metal oxide nanoparticles for removing specific emerging contaminants, namely pharmaceuticals, pesticides, microplastics, and oil, from water. Biomass content derived from either coconut shell or rice husk, both of which are abundant natural scrap materials, was individually pyrolyzed into biochar. Further, each biochar sample was separately tested with the enhancement of synthesized Fe_3O_4 and MnO_2 nanoparticles. With biochar's advantageous adsorption properties further improved by the increased surface area available for sequestration of contaminants through the addition of metal oxide nanoparticles, it was expected that an efficient contaminant removal method would be devised. Pharmaceutical and pesticide removals were measured using liquid chromatography mass spectrometry, microplastic removal was measured using digital WiFi light microscopy, and oil removal was measured using light spectrometry. Coconut shell biochar enhanced by the addition of Fe_3O_4 nanoparticles was the most effective design tested, removing 65.69% of acetaminophen and 50.09% of ibuprofen (pharmaceuticals), 66.29% of DEET (pesticide), 56.26 % of PETE microplastics, and approximately 71.83% of gasoline oil. This demonstrates considerably efficient removal through this inexpensive, environmentally-friendly, easily-implementable, and sustainable method. A prototype of a water filter with sand and biochar filtration was developed using 3D modeling software.