World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:13, No:01, 2019

Acceleration of Adsorption Kinetics by Coupling Alternating Current with Adsorption Process onto Several Adsorbents

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Abstract : Applications of adsorption onto activated carbon for water treatment are well known. The process has been demonstrated to be widely effective for removing dissolved organic substances from wastewaters, but this treatment has a major drawback is the high operating cost. The main goal of our research work is to improve the retention capacity of Tunisian biomass for the depollution of industrial wastewater and retention of pollutants considered toxic. The biosorption process is based on the retention of molecules and ions onto a solid surface composed of biological materials. The evaluation of the potential use of these materials is important to propose as an alternative to the adsorption process generally expensive, used to remove organic compounds. Indeed, these materials are very abundant in nature and are low cost. Certainly, the biosorption process is effective to remove the pollutants, but it presents a slow kinetics. The improvement of the biosorption rates is a challenge to make this process competitive with respect to oxidation and adsorption onto lignocellulosic fibers. In this context, the alternating current appears as a new alternative, original and a very interesting phenomenon in the acceleration of chemical reactions. Our main goal is to increase the retention acceleration of dyes (indigo carmine, methylene blue) and phenol by using a new alternative: alternating current. The adsorption experiments have been performed in a batch reactor by adding some of the adsorbents in 150 mL of pollutants solution with the desired concentration and pH. The electrical part of the mounting comprises a current source which delivers an alternating current voltage of 2 to 15 V. It is connected to a voltmeter that allows us to read the voltage. In a 150 mL capacity cell, we plunged two zinc electrodes and the distance between two Zinc electrodes has been 4 cm. Thanks to alternating current, we have succeeded to improve the performance of activated carbon by increasing the speed of the indigo carmine adsorption process and reducing the treatment time. On the other hand, we have studied the influence of the alternating current on the biosorption rate of methylene blue onto Luffa cylindrica fibers and the hybrid material (Luffa cylindrica-ZnO). The results showed that the alternating current accelerated the biosorption rate of methylene blue onto the Luffa cylindrica and the Luffa cylindrica-ZnO hybrid material and increased the adsorbed amount of methylene blue on both adsorbents. In order to improve the removal of phenol, we performed the coupling between the alternating current and the biosorption onto two adsorbents: Luffa cylindrica and the hybrid material (Luffa cylindrica-ZnO). In fact, the alternating current has succeeded to improve the performance of adsorbents by increasing the speed of the adsorption process and the adsorption capacity and reduce the processing time.

Keywords : adsorption, alternating current, dyes, modeling
Conference Title : ICAAHA 2019 : International Conference on Adsorption Analysis and Heterogeneous Adsorption
Conference Location : Paris, France
Conference Dates : January 24-25, 2019