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Investigating the ability to purify wastewater by using Activated Porous Carbon (APC) produced from waste surgical masks

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Since the early days of the year 2020, most people have been wearing face masks to protect themselves from COVID 19 pandemic. As a result of that, another environmental problem arises with waste face masks all over the world. Therefore, this study aims to convert commonly used, waste polypropylene surgical masks, into Activated Porous Carbon (APC) and compare its wastewater treatment applications with commercially available activated carbon (AC). Waste polypropylene surgical masks can be converted into APC through the two main processes called sulfonation and carbonization. First, waste masks were mixed with concentrated H_2SO_4 and heated under the temperature of 110 ˚C for the sulfonation. Then, the collected samples were carbonized by mixing with KOH in different mass ratios 1:1, 1:1.5 and 1:2 (samples: APC 1, APC 2 and APC 3 respectively) and again these samples were heated under the temperature of about 400 ˚C. Adsorption ability of activated carbon depends on porosity, surface area of the sample and also size of the substance that we want to remove from wastewater. According to the Scanning Electron Microscope (SEM) images of the samples, even though there is no any considerable porous structure on the all APC samples, roughly surface area of the APC 1 sample is higher than the other APC samples. This can be caused to the higher adsorption of the APC 1 sample. Here, the adsorption ability of the APC samples was tested by using two chemical dyes, four cations and four anions. According to the concentration reduction results of commercial AC sample and APC samples, a high concentration reduction was obtained from APC 1 for both Congo red and Methylene blue dyes. Molecular size of the two types of dyes can be caused to those results. Even though these two dyes are organic and aromatic compounds molecule size of the Congo red is larger than the Methylene blue. It allows to adsorb Congo red more effectively than the Methylene blue. When considering the results obtained for the cations and anions adsorption, APC samples showed lower capability compared to commercial AC. Among the tested APC samples, again APC 1 had the best adsorption ability. Further, obtained results for the ion adsorption clearly indicated there is high capability to adsorb large substances effectively than small substances. Ions in the solution directly affect the conductivity of the solution. Therefore, in this work conductivity values of three collected water samples were measured by changing the contacted time with the sample. According to the decrement of conductivity values, there is a considerable effect on the adsorption rate from the contacted time. Further, those conductivity results also showed the best ion adsorption ability of APC sample1 than the other samples. Hence, APC 1 sample with a 1:1 KOH mass ratio can be identified as the best adsorbent with good surface structure.

Keywords: Adsorption, Carbonization, Sulfonation, Waste masks