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Synthesis of Magnetic Carbon from Pomace: It's Adsorption Performance

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Abstract

One of the most important sources of food waste is the food industry. Most of the waste in food industry is by-products of fruit processing industries such as the juice industry. Proper management of these wastes can provide economic benefits and preserves the environment from pollution caused by their excessive accumulation. As an example, during the industrial production of pomegranate juice, important amounts of pomace (approximately 50% in fresh weight) are generated (Cano-Lamadrid, M. et al., 2018). As alternative to landfilling, these wastes can be used to produce additives in foods and materials. In this study, the production of magnetic carbon from pomegranate pomace and its Cr(VI) adsorption performance has been investigated. Magnetic carbons (MCs) is gaining attention for the adsorption of contaminants from aqueous solutions due to their easy separation (Singh, P. et al.,2019). More importantly Red mud (RM) and chemical sludge has been used an iron source. Both pose serious environmental problem (Kazak, O., 2021). In this way, this study aimed to show that multi-faceted benefits can be achieved to ensure waste elimination and to obtain a potential alternative adsorbent for the removal of Cr (VI) from aqueous solution. In this work, raw pomace, torrefied pomace and hydrochar derived from pomace were used as carboneous precursors. The mixing of iron containing wastes with carbon precursers were carried out by two ways: mechanical mixing and empregnation with their acid leachate. Then iron loaded carboneous precursors were thermally treated with N_2, CO_2 and H_2O. Firstly, the magnetic properties of carbons were determined by a hand-held external magnet to provide knowledge whether the carbons show magnetism or not. Further experiments were carried out by selecting 4 magnetic carbons (raw pomace derived carbons) according to the magnetic property, magnetic carbon yield and iodine number. The XRD patterns of all carbons exhibited characteristic peaks correspond to Fe_3O_4 and the zero-valent iron. The magnetic carbons showed S_{BET} values between 219 and 357 $m^2\ g^{-1}$. It is noteworthy that the different iron compounds formed during the activation-pyrolysis process were proven to have potential catalytic activity due to the well-developed porosity. The hysteresis loops indicate that all carbons exhibit typical superparamagnetic with saturation magnetization (Ms) values of between 5.41 and 9.61 d emu g^{-1}. Since the Ms of all magnetic carbons are greater than 1 emu g^{-1}, they can be magnetically separated after adsorption process. It is worth mentioning that the Ms of magnetic carbons prepared using biomass and iron-

rich solid wastes in this study are comparable to previously reported in the literature for magnetic carbon prepared from different biomasses using ferric chloride. The Cr(VI) adsorption was studied as a function of pH, adsorbent dosage and contact time by batch method. The adsorption isotherms were fitted to Langmuir isotherm. The determined adsorption capacities of magnetic carbons were ranged between 41.67 – 86.21 mg g^{-1}, which is comparable to that of other magnetic carbons.

Keywords: Pomegranate pomace; Magnetic carbon; Red Mud; Cr(VI); Adsorption

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