Proceedings of the International Conference on New Trends in Transport Phenomena
Ottawa, Ontario, Canada, May 1-2 2014
Paper No. 88

Production and Use of Heavy Oil Fly Ash Based Activated Carbon: Surface Properties and Affect of Surface Charge Properties on to Mass Transfer of Cationic Dyes

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Extended Abstract

The electric power plants all over world using heavy oil as an energy source produce huge amounts of heavy oil fly ash (OFA) as a waste material. As the OFA waste poses a serious challenge in terms of handling and disposal, a sound and professional solution, other than a simple disposal practice, is urgently needed. In this regard, the conversion of OFA into activated carbon (AC) offers the dual advantage of an environmentally sound OFA waste handling solution that eventually produces an industrial grade product that can be used for a variety of pollution control applications. This will also reduce the burden on the receiving landfills & consequently respective negative environmental impacts, and in turn minimize the community conerns related to disposal and health effects of such waste material. Considering this, the present work aims to produce a high value activated carbon (AC) using an OFA waste. Some earlier studies do report some progress in that direction. For example caramuscio et al. (2003) used heavy oil fly ash for the preparation of activated carbon. The raw fly ash were pyrolyzed at 900°C followed by CO_2 initiated physical activation process at temperature range of 800-900 °C for different times followed by specific surface area determination. Davini (2002) studied treatment of the heavy oil fly ash with acidic solutions and physical activation. The respective AC sample showed high specific surface area values (BET nitrogen adsorption isotherm) and surface basic characteristics. For the present study several AC samples were produced using chemical activation method. The variables included phosphoric acid strength (w/w %), impregnation ratio (R; volume of acid to weight of fly ash), and furnace temperature. The AC samples produced showed moderate SSA_{BET} values. Furthermore the zeta potential which is an important surface property parameter relates the surface charge properties indicating the potential for possible adsorption of opposite charge at controlled pH values. The pH_{zpc} value for respective OFA based AC sample was noted to be on acidic side indicating presence of carboxylic groups on the produced AC surface. As pH plays an important role in surface speciation of several functional groups at the AC surface such as carboxylic groups, the adsorption of target adsorbates with pH dependent speciation will also vary with varying pH. For the present case cationic dyes showed increased adsorption as the solution pH increased indicating high adsorption at negatively charged AC surface. This indicated a strong electrostatic interaction between the anionic functional groups at the AC surface and dissolved cationic dyes. More details with surface speciation based adsorption trends and to what degree they affect the mass transfer of cationic dyes onto produced AC surface sites will be presented later.

Acknowledgement

The author is thankful to KACST for providing research grant for this work through NSTIP Project # 11-ENV2142-04. The author is also thankful to the Civil and Environmental Engineering Department at KFUPM for providing the laboratory facilities and Deanship of Scientific Research (DSR - KFUPM) for facilitating the grant related matters.

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