Adsorption Behavior of Petroleum Hydrocarbons onto High Carbon Content Fly ashes

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ABSTRACT

The amount of high carbon content fly ash (HCCFA) production has been increasing in last decade due to introduction low nitrogen oxide burners to coal-burning power plants. HCCFA has no value as a concrete additive and requires high landfilling costs. The objective of this study was to take advantage of the unburned carbon inside HCCFA and use it as an adsorbent medium for organic contaminants. Seven different fly ashes with varying carbon contents obtained from six different electrical power plants located in Maryland were employed in the testing program. To understand the carbon type and distribution, petrographic analyses were performed on all fly ashes. A series of batch adsorption tests were performed to characterize organic contaminant adsorption capacity of all HCCFA and to investigate the adsorption isotherms of fly ash and non-polar organic compounds. Naphthalene and o-xylene were chosen as commonly encountered organic contaminants. The results of petrographic analyses indicated that three distinct carbon forms exist in all fly ashes. Nonlinear regression analyses conducted following the batch adsorption tests with naphthalene yielded Freundlich adsorption isotherms for majority of the fly ashes. The ashes with high carbon contents yielded significantly higher isotherm coefficients for naphthalene as compared to o-xylene. Freundlich isotherm coefficients were well correlated with carbon content of the fly ashes as well the carbon types that are reactive in adsorption. The tests with o-xylene indicated that the adsorption behavior of HCCFA can be modeled using a Langmuir isotherm. Similar to naphthalene adsorption, the carbon content was the primary reason for the adsorption of o-xylene onto ash particles.

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