Liquid Chromatographic Analysis of Coal Surface Properties

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**Quarterly Progress Report
For the Period April - June 1992**

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I. Statement of Work

The main objectives of this proposed research are to refine further the inverse liquid chromatography technique for the study of surface properties of raw coals, treated coals and coal minerals in water, to evaluate relatively surface properties of raw coals, treated coals and coal minerals by inverse liquid chromatography, and to evaluate flotability of various treated coals in conjunction with surface properties of coals.

Coals such as Pittsburgh seam coal, Illinois #6 coal, Wyodak coal are chosen as representatives of high-rank bituminous coal, high volatile bituminous coal and subbituminous coal, respectively. Coal minerals such as pyrite and dolomite are chosen as representative coal minerals.

Alcohols such as methanol, ethanol, isopropanol, isobutanol, tert-butanol, heptanol, 1-hexadecanol, 2-methyl-pentanol, 4-methyl-2-pentanol (methylisobutyl carbinol), n-octanol, s-octanol, and cyclohexanol as probe compounds are utilized to evaluate hydrophilicity of coals and coal minerals.

N-alkanes such as hexane, heptane and octane, and stearic acid are employed as probe compounds to evaluate hydrophobicity of coals and coal minerals. Aromatic compounds such as benzene and toluene as probe compounds are used to examine aromaticity of coal surface. Aromatic acids such as o-cresol m-cresol, p-cresol, phenol and 8-naphthol are used to detect aromatic acidic sites of coal surface.

Hydrophilicity, hydrophobicity and aromaticity of surfaces for either raw coals or treated coals in water are relatively determined by evaluating both equilibrium physical/chemical adsorption and dynamic adsorption of probe compounds on various raw coals and treated coals to compare affinities of coals for water.

Dynamic adsorption experiments will be conducted in a batch reactor equipped with a magnetic stirrer. A given amount of raw/treated coals or coal minerals, and a given amount of an aqueous solution with a known concentration of a probe compound are introduced in a batch reactor at room temperature. Concentrations of probe compounds at various contact durations are determined with a HPLC, equipped with a RI detector.

Equilibrium adsorption experiments are performed in a packed column at room temperature. A given amount of coals or coal minerals is packed in an empty HPLC column. An aqueous solution of a probe compound of interest is passed through the coal bed packed in the column. Concentrations of the effluent from the column are evaluated with the RI detector.

II Project Status

The RI detector, the solvent delivery pump for the RI detector, the pump for the pre-treatment of the coal-packed column, the sample injection system, the power conditioner, the recorder and the integrator were set up, and operations of these experimental equipment were familiarized during the period of April - June 1992. Linear responses of the RI detector were examined, using 3-15 ppm isopropanol aqueous solutions. Reproducibilities of experimental data on adsorption of isopropanol on 60-200 mesh Illinois #6 coal were tested with the above-mentioned experimental equipment.

The coals such as Illinois #6 coal (DECS-2; Randolph county), Adaville #7 coal (DECS-7; Wyoming state, Lincoln county), Wyodak coal (DECS-8; Wyoming state, Campbell county) and Pittsburgh #8 coal (DECS-12; Pennsylvania state, Greene county) from the coal bank of the Pennsylvania State were sieved to obtain 60-200 mesh particle sizes, and were thoroughly washed with distilled water to get rid of fine particles.

Ms. Katanya M. Bolling and Ms. Natasha A. Bostic, senior chemical engineering students, worked as research assistant for this project.

Experimental procedures of obtaining experimental data on equilibrium adsorption of probe compounds on coal were developed. A computer program was developed to compute equilibrium adsorption of probe compounds on coal with experimental data. Developments of experimental procedures of obtaining experimental data on dynamic adsorption of probe compounds on coal were attempted, but not finalized.

III Future Experimental Plans

Experiments on equilibrium adsorption of various alcohols on Illinois #6 coal will be conducted to investigate surface properties of this coal in the presence of water. Experimental procedures on dynamic adsorption of probe compounds on coal will be finalized during the next quarter. Some experimental data will be presented to the Miami AIChE annual meeting in November 1992.

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