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MONTHLY PROGRESS REPORT FOR NOVEMBER: ENVIRONMENTAL EFFECT AND CONTROL FOR COAL-WATER SYSTEMS

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December 8, 1980

TO: Charles Grua
FROM: Amos Newton and Phyllis Fox
RE: Monthly Progress Report for November
Environmental Effect and Control for
Coal-Water Systems
LBID-321

PHENOLS AND SLURRY WATER

The difficulty in methylating phenols in slurry water from Illinois
No. 6 coal has been solved. After spiking the water with an internal standard
of perdeutero phenol and adding NaOH, the solution is pre-extracted with
methylene chloride and hexane. These solvents remove the unidentified
material in this slurry water which catalyzes the hydrolysis of dimethyl
sulfate. When dimethyl sulfate is added to the cooled, pre-extracted solu­
tions and the mixture is stirred overnight, the yield of anisole from the
perdeuterated phenol is adequate.

No such problem was found with Peabody Black Mesa coal. The methyla­
tion of the slurry water from this coal was similar in behavior to that
from Wyodak Coal.

Table 1 shows a compilation of results of phenol yield and the absorp­
tion of various phenolics by the three coals under investigation. This
table shows that the three coals behave differently. Wyodak coal yields
close to the same phenol concentration in the slurry water whether or not
phenol is added before slurry preparation. Phenol is freely absorbed by
and extracted from Wyodak coal. Illinois No. 6 and Black Mesa coals yield
much less free phenol in coal slurry water and when phenol is added to the
water before slurry preparation, they do not absorb to the same concentra­
tion as was found without added phenol. The behavior of Black Mesa coal
shows less absorption of the phenolics in general, though 1-naphthol and 5-phenyl
phenol are almost completely absorbed. This behavior must be checked.
POLYNUCLEAR AROMATIC HYDROCARBONS IN COAL SLURRY WATER

It was previously found that perdeutero phenanthrene is absorbed from water and the concentration of phenanthrene in coal slurry water is less than 5 ppt (parts per trillion). All coals were checked for the absorption of a variety of polynuclear aromatics with the results shown in Table 2. Black Mesa coal shows incomplete absorption. Whether this is caused by lack of absorptive capacity or simply a slow rate of absorption must be checked. Even this coal removes more than 99.7% of the added material.

NITROGENOUS COMPOUNDS IN COAL SLURRY WATER

Several nitrogenous compounds which might be derived from coal were added to water at a concentration of 100 ppm each before slurry preparation. As shown in Table 3, these were each absorbed by the coal. Only quinoline was positively identified in the slurry water from Wyodak coal. More than 99.9% of each component was removed from the water by coal of any type tested.
Table 1. Phenol and phenolics in coal slurry waters from various coals made with and without added phenolics before slurry preparation.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Wyodak Coal</th>
<th>Illinois No. 6 Coal</th>
<th>Black Mesa Coal</th>
</tr>
</thead>
<tbody>
<tr>
<td>phenol (no addition)</td>
<td>9.0</td>
<td>&lt;2.0</td>
<td>1.2</td>
</tr>
<tr>
<td>phenol (added)</td>
<td>11.0</td>
<td>4.5</td>
<td>12.9</td>
</tr>
<tr>
<td>o-cresol (added)</td>
<td>&lt;0.5</td>
<td>0.02</td>
<td>7.4</td>
</tr>
<tr>
<td>2,6 dimethyl phenol (added)</td>
<td>&lt;0.5</td>
<td>&lt;0.01</td>
<td>14.5</td>
</tr>
<tr>
<td>Resorcinol (added)</td>
<td>&lt;0.5</td>
<td>&lt;0.005</td>
<td>23.8</td>
</tr>
<tr>
<td>1-naphthol (added)</td>
<td>&lt;0.5</td>
<td>&lt;0.005</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>4-phenyl phenol (added)</td>
<td>&lt;0.5</td>
<td>&lt;0.005</td>
<td>&lt;0.1</td>
</tr>
</tbody>
</table>

The initial concentration of each added component was 100 ppb.
Table 2. Absorption of polynuclear aromatic hydrocarbons from water during coal slurry formation.

<table>
<thead>
<tr>
<th>Compound(^a)</th>
<th>ppb concentration of compound in slurry water from:</th>
<th>Wyodak Coal</th>
<th>Illinois No. 6 Coal</th>
<th>Black Mesa Coal</th>
</tr>
</thead>
<tbody>
<tr>
<td>acenaphthene-(D_{10})</td>
<td>0.009</td>
<td>0.04</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>phenanthrene-(D_{10})</td>
<td>&lt;0.005</td>
<td>0.01</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>pyrene-(D_{10})</td>
<td>&lt;0.003</td>
<td>&lt;0.01</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>1,2 Benzanthracene-(D_{12})</td>
<td>&lt;0.003</td>
<td>&lt;0.01</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>chrysene-(D_{12})</td>
<td>&lt;0.003</td>
<td>&lt;0.01</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>p-Terphenyl-(D_{14})</td>
<td>0.003</td>
<td>&lt;0.01</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>perylene-(D_{12})</td>
<td>&lt;0.008</td>
<td>&lt;0.01</td>
<td>0.10</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)The initial concentration of each component was 100 ppb.
Table 3. The absorption of nirtrogenous compounds from water during coal slurry preparation.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Wyodak Coal</th>
<th>Illinois No. 6 Coal</th>
<th>Black Mesa Coal</th>
</tr>
</thead>
<tbody>
<tr>
<td>pyrrole</td>
<td>&lt;0.01</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>pyridine</td>
<td>&lt;0.01</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>aniline</td>
<td>&lt;0.01</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>quinoline</td>
<td>0.08</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>diphenyl amine</td>
<td>&lt;0.05</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
</tbody>
</table>

The initial concentration of each component was 100 ppb.
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