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Technical Progress Report For the Project

NEW CONCEPT FOR COAL WETTABILITY EVALUATION AND MODULATION

DOE Project Grant: DE-FG22-92PC92546

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STATEMENT OF OBJECTIVE

This project is concerned with the new concept for coal surface wettability and floatability and modulation.

The objective of the work is to study the fundamental surface chemistry features about the evaluation of the surface wettability and floatability of coal and pyrite, and establish a new separation strategy which could contribute to advanced coal-cleaning for premium fuel application.

SCIENCE AND TECHNICAL PROGRESS

In this quarter, the Hallimond-tube tests were conducted for the three coals, Colorado mineral pyrite, and coal pyrite samples. The kinetic floatability of collectors with different carbon chain length alcohol as methanol, ethanol, and propanol are tested. The test results indicate that there are good agreement between the experimental observation and the hypothesis about the new concept of the surface wettability and floatability of the coal and pyrite.

These test results shown that as the carbon chain length of alcohol increase the wettability decrease. However, as the carbon chain length of alcohol increase, the floatability increase for the coal samples.

The Kinetic Floatability Test With Methanol As Collector

The Hallimond-tube test results for Upper Freeport Coal, Pittsburgh No.8 Coal, Illinois No.6 coal, Colorado Mineral Pyrite, and Coal Pyrite with methanol as collector are listed in table 1 and illustrated in Figure 1 to 5.

In these tests, the methanol dosage is 170 mg/l. From figures, it can be seen that the rank of the kinetic floatability for five samples are as:

Upper Freeport Coal > Pittsburgh No.8 coal > Illinois No.6 Coal > Coal Pyrite
> Colorado Mineral Pyrite.

It indicate that the kinetic floatability of coals is more floatable than coal pyrite with methanol as collector.

The Kinetic Floatability Test With Ethanol As Collector

The Hallimond-tube test results for the five samples with ethanol as collector are listed in the table 2. It indicates the function between the flotation yield and times.

The Kinetic floatability of the five samples with ethanol as collector are shown on Figure 6 to 10. In these tests, the ethanol dosage is 170 mg/l. The rank of the floatability for the five samples are:

Upper Freeport Coal > Pittsburgh No.8 Coal > Illinois No.6 coal > Coal Pyrite
> Colorado Mineral Pyrite.

It can be seen that Upper Freeport Coal behave most floatability and Colorado Mineral Pyrite behaves the least floatability on the ethanol-water system.

The Kinetic Floatability Test With Propanol As Collector

The Hallimond-tube test results for the five samples with propanol as collector are listed in the table 3. The test dosage of the propanol is 170 mg/l.

The kinetic floatability of the five samples with propanol as collector are illustrated at Figure 11 to 15.

The rank of the kinetic propanol-philicity (or collectivity for a collector) for the

five samples are:

Upper Freeport Coal > Pittsburgh No.8 Coal > Illinois No.6 Coal > Coal Pyrite
> Colorado Mineral Pyrite.

It indicates that the coal behaves the propanol-philicity than coal pyrite and mineral pyrite in the propanol-water system.

The Kinetics of the Wettability and Floatability Evaluation

The ratio of the kinetics of Hallimond-tube test results between different media is the measure of the relative floatability (collectivity). The Hu's evaluation of the floatability of the five samples in the system of the methanol-water, ethanol-water, and propanol-water are shown in table 1, 2 and 3. From table 1, 2 and 3, it can be seen that as the carbon chain length increase the coal floatability increase accordingly. No significant change of the floatability of coal pyrite and mineral pyrite in the alcohol-water system.

Table 1, 2, 3, 4, 5 and 6, indicate that the kinetic floatability(Hallimond-tube test) of collectivity and the kinetic wettability(capillary rise test) have different values in single methanol, ethanol, and propanol system and binary methanol-water, ethanol-water, and propanol-water system. As the carbon chain length of alcohol increase, the kinetic wettability decrease in the single alcohol system; however, as the carbon chain length increase, the floatability increase in the binary alcohol-water system.

The difference between the kinetic wettability and kinetic floatability shown that the interfacial energy of the solid/liquid, solid/air, and liquid/liquid in the binary methanol-water, ethanol-water, and propanol-water system are different to the single

methanol-water, ethanol-water, and propanol-water system are different to the single system. The studies and evaluation reveal the incompatibility between wettability and floatability.

FUTURE WORK

In the next quarter, the test of kinetic floatability of the five samples with other alcohol homolog as collector will continue.

Table 1 Kinetic Floatability of Five Samples With Methanol As Collector

Time (minutes)	Yield (%)				
	Upper Freeport	Pittsburgh No.8	Illinois No.6	Coal Pyrite	Mineral Pyrite
0.5	4.79	4.34	3.10	1.09	1.17
2.0	11.55	8.44	7.86	2.32	1.48
5.0	18.19	13.94	12.46	3.18	1.89
10.0	27.82	21.51	17.29	4.74	2.53
15.0	36.85	29.34	22.78	5.65	3.17

Table 2 Kinetic Floatability of Five Samples With Ethanol As Collector

Time (minutes)	Yield (%)				
	Upper Freeport	Pittsburgh No.8	Illinois No.6	Coal Pyrite	Mineral Pyrite
0.5	3.77	4.44	3.66	0.39	0.41
2.0	11.93	8.21	8.49	1.18	1.27
5.0	21.26	16.11	13.22	2.39	1.88
10.0	31.26	25.25	20.16	4.08	2.59
15.0	39.53	33.52	26.32	5.98	3.79

Table 3 Kinetic Floatability of Five Samples With Propanol As Collector

Time (minutes)	Yield (%)				
	Upper Freeport	Pittsburgh No.8	Illinois No.6	Coal Pyrite	Mineral Pyrite
0.5	11.44	6.07	3.41	0.44	0.69
2.0	24.08	14.04	9.85	1.68	1.42
5.0	33.69	21.51	15.15	3.27	2.78
10.0	40.53	29.81	22.48	4.18	3.62
15.0	47.20	38.32	31.07	6.18	4.92

Table 4 Hu's Indices of Kinetic Wettability, H, in Methanol

Samples	Methanol
Upper Freeport Coal	0.3661
Pittsburgh No.8 coal	0.3599
Illinois No.6 Coal	0.2430
Colorado Mineral Pyrite	0.2169
Coal Pyrite	0.2030

Table 5 Hu's Indices of Kinetic Wettability, H, in Ethanol

Samples	Ethanol
Upper Freeport Coal	0.1650
Pittsburgh No.8 Coal	0.1625
Illinois No.6 Coal	0.1095
Colorado Mineral Pyrite	0.0999
Coal Pyrite	0.0907

Table 6 Hu's Indices of Kinetic Wettability, H, in Propanol

Samples	Propanol
Upper Freeport Coal	0.1560
Pittsburgh No.8 Coal	0.1296
Illinois No.6 Coal	0.0969
Colorado Mineral Pyrite	0.0801
Coal Pyrite	0.0598

Figure 1 The Kinetic Flotation Test Results of Upper Freeport Coal With Methanol As Collector

Figure 2 The Kinetic Flotation Test Results of Pittsburgh No.8 Coal With Methanol As Collector

Figure 3 The Kinetic Flotation Test Results of Illinois No.6 Coal With Methanol As Collector

Figure 4 The Kinetic Flotation Test Results of Coal Pyrite With Methanol As Collector

Figure 5 The Kinetic Flotation Test Results of Colorado Mineral Pyrite With Methanol As Collector

Figure 6 The Kinetic Flotation Test Results of Upper Freeport Coal With Ethanol As Collector

Figure 7 The Kinetic Flotation Test Results of Pittsburgh No.8 Coal With Ethanol As Collector

Figure 8 The Kinetic Flotation Test Results of Illinois No.6 Coal With Ethanol As Collector

Figure 9 The Kinetic Flotation Test Results of Coal Pyrite
With Ethanol As Collector

Figure 10 The Kinetic Flotation Test Results of Colorado Mineral Pyrite With Ethanol As Collector

Figure 11 The Kinetic Flotation Test Results of Upper Freeport Coal With Propanol As Collector

Figure 12 The Kinetic Flotation Test Results of Pittsburgh No.8 Coal With Propanol As Collector

Figure 13 The Kinetic Flotation Test Results of Illinois No.6 Coal With Propanol As Collector

Figure 14 The Kinetic Flotation Test Results of Coal Pyrite With Propanol As Collector

Figure 15 The Kinetic Flotation Test Results of Colorado Mineral Pyrite With Propanol As Collector

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