DOE/PC/92546--T12

Technical Progress Report For The Project

NEW CONCEPT FOR COAL WETTABILITY EVALUATION AND MODULATION

DOE Project Grant: DE-FG22-92PC92546

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Report Period: July 1, 1995 - September 30, 1995

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STATEMENT OF OBJECTIVE

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

The objective of the work is 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 mini-cell flotation tests are conducted to study kinetic floatability and kinetic collectability of coal and pyrite. The three coal, coal pyrite, and Colorado mineral pyrite samples are used in these tests. The kinetic floatability of the five samples have been tested with methanol, butanol, and hexanol as collector. The test results indicate that the kinetic floatability and kinetic collectability of coal is depended on the carbon chain length of alcohol. The test results show that as carbon chain length of alcohol increase, the floatability increase for coal samples.

The experimental results show that the coal surface adsorpted by hexanol. The floatability of coals increase rapidly in the hexanol-water systems. It confirmed that the hexanol begaves better collectability for coal particle surfaces.

The Kinetic Floatability Test with methanol as Collector

The mini-cell flotation test are conduced for Upper Freeport coal, Pittsburgh No.8 coal, Illinois No.6 coal, coal pyrite and Colorado mineral pyrite with methanol as collector and the dosage of methanol is 56 mg/l. The test results are listed in Table 1 and the kinetic floatability of

the five samples are illustrated at Figure 1.

From Figure 1, it can be seen that Upper Freeport coal has best floatability, and the coal pyrite and mineral pyrite have least floatability in methanol-water systems.

The Kinetic Floatability Test with Butanol as Collector

The mini-cell flotation test results of the five samples with butanol as collector are presented in Table 2 and the flotation yield vs flotation time of the five samples are plotted in Figure 2.

The rank of floatability of five samples are:

Upper Freeport coal > Pittsburgh No.8 coal > Illinois No.6 coal > coal pyrite > Colorado mineral pyrite.

Figure 2 shows that butanol is good collector for Upper Freeport coal and Pittsburgh No.8 coal. The test results indicate that the floatability of these two coal samples increase fast, and not change significantly for coal pyrite and mineral pyrite.

The Kinetic Floatability Test with hexanol as Collector

The mini-cell flotation tests are carried out for five samples with 56 mg/l hexanol as collector. The test results are listed in Table 3, it indicates that hexanol behaves very strong collectability for three coal samples, but has very weak collectability for coal pyrite and mineral pyrite.

The results of the kinetic floatability of five samples by hexanol are plotted in Figure 3. It shows that Upper Freeport coal and Pittsburgh No.8 coal behave most floatability, and mineral pyrite behaves the least floatability in the hexanol-water systems. The test results indicate that hexanol can be selected as a collector to use in the separation of coal/ coal pyrite.

The Evaluation of Kinetics of Relative Floatability

The flotation rate constant of kinetic floatability of five samples in the distilled water, methanol-water, butanol-water, and hexanol-water systems are presented in Table 4. From table 4, it can be seen that the flotation rate constant of the coal samples is larger than that of coal pyrite and mineral pyrite with methanol, butanol, and hexanol as collector. It also indicates that the flotation rate constant increase with carbon chain length of alcohol increase for five samples in the flotation. The flotation rate constant of three coal samples increase fast using the hexanol as collector.

The Hu's evaluation of relative floatability of five samples between methanol, butanol, and hexanol vs distilled water ($K_{\text{methanol}}/K_{\text{H}_2\text{O}}$, $K_{\text{butanol}}/K_{\text{H}_2\text{O}}$, and $K_{\text{hexanol}}/K_{\text{H}_2\text{O}}$) are presented in Table 5. The results show that methanol can not used as collector of coal. It exhibits weak collectability for coal. From Table 5, it can be seen that butanol can be selected as collector in separation of the Upper Freeport coal/pyrite and Pittsburgh No.8 coal/pyrite. The Hu's evaluation of relative floatability of five samples, $K_{\text{hexanol}}/K_{\text{H}_2\text{O}}$ indicate that the hexanol is a good collector for three coal surfaces, but is weak collector for coal pyrite and mineral pyrite.

FUTURE WORK

This project finished at September 30, 1995. The final report will be submitted in nearfuture.

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	7.031	6.340	1.074	0.986	0.221
1.0	9.751	8.441	1.825	1.332	0.386
2.0	12.092	10.652	2.714	1.864	0.644
4.0	16.365	13.947	4.477	2.320	1.010
8.0	22.114	20.013	5.368	2.813	1.566
16.0	28.080	24.502	8.059	3.184	1.980
36.0	32.989	29.346	11.542	3.686	2.474
64.0	38.346	34.673	13.544	4.058	3.019
96.0	42.357	39.036	14.059	4.494	3.468

Table 2 Kinetic Floatability of Five Samples with Butanol as Collector

Time (minutes)	Yield (%)				
	Upper Freeport	Pittsburgh No.8	Illinois No.6	Coal Pyrite	Mineral Pyrite
0.5	36.017	16.501	1.569	0.443	0.240
1.0	47.826	24.311	3.229	0.569	0.449
2.0	55.720	40.044	5.160	1.543	0.983
4.0	64.909	57.970	9.903	2.292	1.329
8.0	71.606	62.396	14.360	3.412	2.418
16.0	76.292	66.473	21.680	5.106	3.835
32.0	80.883	69.867	26.646	6.483	4.564
64.0	84.790	72.421	28.996	7.314	5.077
96.0	86.550	75.012	30.206	7.915	5.477

Table 3 Kinetic Floatability of Five samples with Hexanol as Collector

Time (minutes)	Yield (%)				
	Upper Freeport	Illinois No.6	Pittsburgh No.8	Coal Pyrite	Mineral Pyrite
0.5	64.369	21.820	11.757	0.377	0.397
1.0	87.209	38.214	25.437	1.248	0.911
2.0	91.318	60.483	35.483	2.419	2.022
4.0	94.867	79.934	43.443	3.569	3.125
8.0	96.880	85.660	49.072	4.449	4.185
16.0	97.418	89.691	54.889	5.760	5.214
32.0	97.918	92.574	58.369	7.766	6.928
64.0	98.218	95.348	60.718	8.762	7.828
96.0	98.518	95.869	62.218	9.231	8.328

Table 4 Flotation Rate Constant of Kinetic Floatability for Five Samples Without Collector and Methanol, Butanol, and Hexanol as Collector

Samples	K_{H_2O}	K_{methanol}	K_{butanol}	K_{hexanol}
Upper Freeport coal	0.1435	0.2057	0.3976	0.7454
Pittsburgh No.8 coal	0.1138	0.1738	0.3286	0.6993
Illinois No.6 coal	0.1033	0.1495	0.2837	0.5473
coal pyrite	0.0640	0.1235	0.1588	0.1934
Colorado mineral pyrite	0.0566	0.0988	0.1377	0.1638

Table 5 The Hu's Evaluation of Floatability between Methanol, Butanol, and Hexanol vs Water

Samples	$K_{\text{kerosene}}/K_{\text{H}_2\text{O}}$	$K_{\text{benzene}}/K_{\text{H}_2\text{O}}$	$K_{\text{hexanol}}/K_{\text{H}_2\text{O}}$
Upper Freeport coal	1.4334	2.7707	5.1944
Pittsburgh No.8 coal	1.5272	2.8875	6.1450
Illinois No.6 coal	1.4472	2.7464	5.2982
coal pyrite	1.9296	2.4813	3.0219
Colorado mineral pyrite	1.7456	2.4329	2.8931

Figure 1 The kinetic mini-cell flotation test results of five samples with methanol as collector

Figure 2 The kinetic mini-cell flotation test results of five samples with butanol as collector

Figure 3 The kinetic mini-cell flotation test results of five samples with hexanol as collector