DOE/PC/92546--T13

Technical Progress Report For The Project

RECEIVED

AUG 05 1996

OSTI

NEW CONCEPT FOR COAL WETTABILITY EVALUATION AND MODULATION

DOE Project Grant: DE-FG22-92PC92546

Principle Investigator: Weibai Hu
Report Period: April 1, 1995 - June 30, 1995

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER

19980406 122

U.S. DOE Patent Clearance is not required
prior to publication of this document

RECEIVED
USDOE/PETC
95 JUL 17 AM 11:05
ACQUISITION & ASSISTANCE DIV.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

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 carried out to study kinetic floatability 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 kerosene, benzene, amyl-xanthate as collector. The test results confirmed that there are good agreement between the experimental observation and the theoretical hypothesis about the new concept of the surface wettability and floatability of the coal and pyrite.

The experimental results show that the coal surface adsorbed strongly by kerosene, show very good hydrophobicity of the coal surface, and the floatability of coals increase rapidly in the kerosene-water systems. The amyl-xanthate has strong collectability for Upper Freeport coal and mineral pyrite, has medium collectability for Pittsburgh No.8 coal and Illinois No.6, and has weak collectability for coal pyrite. The test results found that the benzene has weak collectability for the five samples.

The Kinetic Floatability Test with kerosene as Collector

The mini-cell flotation test are conducted for Upper Freeport coal, Pittsburgh No.8 coal,

Illinois No.6 coal, coal pyrite and Colorado mineral pyrite with kerosene as collector and the dosage of kerosene 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 the test results, the rank of kinetic floatability for five samples are:

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

From Figure 1, it can be seen that coals have better floatability than the coal pyrite and mineral pyrite with kerosene as collector.

The Kinetic Floatability Test with Benzene as Collector

The mini-cell flotation test results of the five samples with benzene 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 benzene is weak collector for coal and pyrite.

The Kinetic Floatability Test with Amyl-xanthate as Collector

The mini-cell flotation tests are carried out for five samples with 22 mg/l amyl-xanthate as collector. The test results are listed in Table 3, it indicates that amyl-xanthate behaves very strong collectability for Upper Freeport coal and mineral pyrite, but has very weak collectability for coal pyrite.

The results of the kinetic floatability of five samples by amyl-xanthate are plotted in Figure

3. It shows that Upper Freeport coal and Colorado mineral pyrite behave most floatability, and coal pyrite behaves the least floatability in the amyl-xanthate-water systems. The amyl-xanthate can be selected as a collector in the separation of Upper Freeport coal and coal pyrite.

The Kinetics of Relative Floatability Evaluation

The flotation rate constant of kinetic floatability of five samples in the distilled water, kerosene-water, benzene-water, and amyl-xanthate-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 one of coal pyrite and mineral pyrite with kerosene as collector. It also indicates that the flotation rate constant is small for five samples in the flotation of benzene-water system. The flotation rate constant of Upper Freeport coal and mineral pyrite is largest, that of Pittsburgh No.8 coal and Illinois No.6 coal is medium, and that of coal pyrite is smallest using the amyl-xanthate as collector.

The Hu's evaluation of relative floatability of five samples between kerosene, benzene, and amyl-xanthate vs distilled water (or $K_{\text{kerosene}}/K_{\text{H}_2\text{O}}$, $K_{\text{benzene}}/K_{\text{H}_2\text{O}}$, and $K_{\text{amly-xanthate}}/K_{\text{H}_2\text{O}}$) are presented in Table 5. The results show that kerosene can modify the coal surface but the floatability of coal pyrite and mineral pyrite not change significantly. From Table 5, it can be seen that all values of $K_{\text{benzene}}/K_{\text{H}_2\text{O}}$ for five samples are small, it indicate that benzene can not be selected as collector in separation of the coal and pyrite. The Hu's evaluation of relative floatability of five samples for xanthate is an interesting that the amyl-xanthate is a good modifier for Upper Freeport coal and mineral pyrite, but is weak collector for coal pyrite.

FUTURE WORK

In the next quarter, the kinetics of the floatability of five samples by mini-cell flotation

with collector frother and both will be continue.

Table 1 Kinetic Floatability of Five Samples with Kerosene as Collector

Time (minutes)	Yield (%)				
	Upper Freeport	Pittsburgh No.8	Illinois No.6	Coal Pyrite	Mineral pyrite
0.5	26.663	25.106	20.791	1.923	0.943
1.0	35.663	35.380	34.497	2.629	2.332
2.0	49.072	49.383	48.814	3.515	2.909
4.0	75.332	72.660	60.677	4.115	4.158
8.0	88.578	85.314	64.231	4.638	4.804
16.0	89.541	86.597	67.494	6.052	5.773
36.0	91.110	87.377	70.211	7.729	7.107
64.0	92.210	87.877	71.501	8.238	7.417
96.0	92.731	88.303	72.010	8.546	7.910

Table 2 Kinetic Floatability of Five Samples with Benzene as Collector

Time (minutes)	Yield (%)				
	Upper Freeport	Pittsburgh No.8	Illinois No.6	Coal Pyrite	Mineral Pyrite
0.5	7.517	7.412	8.003	0.563	0.450
1.0	13.380	12.563	11.723	0.921	0.731
2.0	15.251	14.021	12.492	1.895	1.244
4.0	17.891	15.897	14.078	2.568	1.758
8.0	19.850	17.332	15.375	3.510	1.937
16.0	21.531	19.033	16.432	4.556	2.442
32.0	23.031	20.561	17.209	5.487	3.069
64.0	23.371	20.998	17.739	6.031	3.511
96.0	23.921	21.010	18.039	6.252	3.873

Table 3 Kinetic Floatability of Five samples with amyl-xanthate as Collector

Time (minutes)	Yield (%)				
	Upper Freeport	Mineral Pyrite	Pittsburgh No.8	Illinois No.6	Coal Pyrite
0.5	48.380	16.069	15.500	12.505	1.160
1.0	67.237	42.820	21.091	19.359	2.294
2.0	77.243	59.603	29.805	25.250	3.554
4.0	81.892	76.326	36.805	28.827	5.551
8.0	89.758	81.960	42.154	31.656	6.240
16.0	92.109	84.074	47.494	36.039	6.783
32.0	94.867	85.568	50.937	40.539	7.103
64.0	96.735	88.349	53.237	43.606	7.403
96.0	97.246	90.013	55.157	45.413	7.924

Table 4 Flotatio Rate Constant of Kinetic Floatability for Five Samples

Samples	K_{H_2O}	$K_{kerosene}$	$K_{benzene}$	$K_{amly-xanthate}$
Upper Freeport coal	0.02621	0.64504	0.03479	0.55520
Pittsburgh No.8 coal	0.00946	0.56322	0.02598	0.12410
Illinois No.6 coal	0.00719	0.19745	0.02019	0.10381
coal pyrite	0.00449	0.01403	0.01199	1.01324
Colorado mineral pyrite	0.00399	0.01381	0.00664	0.39059

Table 5 The Hu's Evaluation of Floatability between Kerosene, Benzene, and Amyl-xanthate vs Without Collector

Samples	$K_{\text{kerosene}}/K_{\text{H}_2\text{O}}$	$K_{\text{benzene}}/K_{\text{H}_2\text{O}}$	$K_{\text{amly-xanthate}}/K_{\text{H}_2\text{O}}$
Upper Freeport coal	29.3200	1.3274	21.1828
Pittsburgh No.8 coal	59.5370	2.7463	13.1184
Illinois No.6 coal	27.4618	2.8081	14.4381
coal pyrite	3.1247	2.6704	2.9488
Colorado mineral pyrite	3.4612	1.6642	97.8922

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

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

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

M98004032

Report Number (14) DOE/PC/92546--T13

Publ. Date (11) [199605]

Sponsor Code (18) DOE, XF

UC Category (19) UC-900, DOE/ER

DOE