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Technical Progress Report For the Project

NEW CONCEPT FOR COAL WETTABILITY EVALUATION AND MODULATION

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STATEMENT OF OBJECTIVES

This project is concerned concept for coal surface wettability evaluation and modulation.

The objective of the work are to study the fundamental surface chemistry feature about the evaluation of the surface of coal, pyrite and coal pyrite, and also establish a new separation strategy which could contribute to the advanced coal cleaning for premium fuel application.

SCIENCE AND TECHNICAL PROGRESS

In this quarter, the capillary rise of three coals, colorado mineral pyrite, and coal pyrite in butanol, pentanol, and butyl ether have been tested. The test results shown that the kinetic wettability of the five samples in the alcohol homolog are dependent on the carbon chain length, as the length of the carbon chain is shorter, the surface wettability is the better.

Another test results shown that the kinetic wettability of coals are better than mineral pyrite and coal pyrite in the butyl ether.

THE KINETIC CAPILLARY RISE TEST IN BUTANOL

The capillary rise test results for Upper Freeport Coal, Pittsburgh No.8 Coal, Illinois No.6 coal, Colorado Mineral Pyrite , and Coal pyrite are illustrated at Figure 1 to 5. There are a linear relation between the h^2 and time.

The Hu's indices of kinetic wettability for three coal, mineral pyrite, and coal pyrite samples are listed in table 1. From table 1 the rank of Hu's indices of kinetic wettability for five samples in Butanol are:

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

test results also shown that Upper Freeport Coal, Pittsburgh No.8 Coal, and Illinois No.6 Coal behave butyl-ether-philicity are very close, besides Upper Freeport Coal behaves most butyl ether-philicity and Colorado Mineral Pyrite shows least butyl-ether-philicity.

THE RELATIVE KINETICS OF CAPILLARY RISE TEST AND WETTABILITY EVALUATION

The Hu's evaluation of wettability of $H_{H_2O}/H_{Butanol}$ and $H_{H_2O}/H_{Pentanol}$ for five samples are listed respectively in table 4 and 5. It indicates that in water/butanol, water/pentanol system, Upper Freeport Coal is very little hydrophilicity or better floatability than Coal Pyrite. It also can be seen that in these systems, Pittsburgh No.8 Coal have a little hydrophilicity, or better floatability than Coal Pyrite. It means that if butanol and pentanol are used as flotation collector, coal will be selectively separated from coal pyrite. This has been verified by our investigation elsewhere.

The Hu's evaluation of wettability of $H_{H_2O}/H_{Butyl-Ether}$ for five samples are listed in table 6. It indicates that in water/butyl-ether system, Upper Freeport Coal has little hydrophilicity, or better floatability than Coal pyrite. It also can be seen that in this system, Pittsburgh No.8 Coal and Illinois No.6 Coal have a little hydrophilicity, or better floatability than Coal Pyrite. It means that if butyl-ether is used as collector, coal will be selectively separated from coal pyrite. This is very useful for flotation and oil-agglomeration reagents evaluation and selection in practice.

The Hu's evaluation of wettability of $H_{Butanol}/H_{Kerosene}$ and $H_{Pentanol}/H_{Kerosene}$ for five samples are listed in table 7 and 8. It shows that the five samples have lower propanol-philicity than kerosene.

The Hu's evaluation of wettability of $H_{Butyl-Ether}/H_{Kerosene}$ for five samples are listed in table

9. It is very interesting to note that the five samples have more butyl ether-philicity than kerosene. This is very helpful for flotation reagents evaluation and selection in practice.

FUTURE WORK

In the next quarter, the wettability of five samples in the MIBC(4-Methanol 2-Pentanol), α -terpineol and pyridine will be tested.

Table 1 Hu's Indices of Kinetic Wettability, H , in Butanol

Sample Name	H_{butanol}
Upper Freeport Coal	0.1286
Pittsburgh No.8 Coal	0.1220
Illinois No.6 Coal	0.0827
Colorado Mineral Pyrite	0.0693
Coal Pyrite	0.0656

Table 2 Hu's Indices of Kinetic Wettability, H , in Pentanol

Sample Name	H_{pentanol}
Upper Freeport Coal	0.1269
Pittsburgh No.8 Coal	0.0907
Illinois No.6 Coal	0.0730
Colorado Mineral Pyrite	0.0619
Coal Pyrite	0.0539

Table 3 Hu's Indices of Kinetic Wettability, H , in Butyl Ether

Sample Name	$H_{\text{butyl ether}}$
Upper Freeport Coal	0.3437
Pittsburgh No.8 Coal	0.3355
Illinois No.6 Coal	0.3056
Coal Pyrite	0.1995
Colorado Mineral Pyrite	0.1564

Table 4 The Evaluation of Wettability between water vs Butanol

Sample Name	$H_{\text{H}_2\text{O}}/H_{\text{Butanol}}$
Upper Freeport Coal	0.0000
Pittsburgh No.8 Coal	0.0951
Illinois No.6 Coal	1.7533
Coal Pyrite	2.2134
Colorado Mineral Pyrite	4.0289

Table 5 The Evaluation of Wettability Between water vs Pentanol

$$H_{H_2O}/H_{\text{pentanol}}$$

Sample Name	$H_{H_2O}/H_{\text{pentanol}}$
Upper Freeport Coal	0.0000
Pittsburgh No.8 Coal	0.1279
Illinois No.6 Coal	1.9863
Coal Pyrite	2.6939
Colorado Mineral Pyrite	4.5105

Table 6 The Evaluation of Wettability Between water vs Butyl Ether

$$H_{H_2O}/H_{\text{butyl ether}}$$

Sample Name	$H_{H_2O}/H_{\text{butyl ether}}$
Upper Freeport Coal	0.0000
Pittsburgh No.8 Coal	0.0346
Illinois No.6 Coal	0.4745
Coal Pyrite	1.3995
Colorado Mineral Pyrite	1.7852

Table 7 The Evaluation of Wettability Between Butanol vs Kerosene

$$\frac{H_{\text{butanol}}}{H_{\text{kerosene}}}$$

Sample Name	$\frac{H_{\text{butanol}}}{H_{\text{kerosene}}}$
Illinois No.6 Coal	0.6696
Upper Freeport Coal	0.7451
Pittsburgh No.8 Coal	0.7503
Colorado Mineral Pyrite	0.7726
Coal Pyrite	0.8099

Table 8 The Evaluation of Wettability Between Pentanol vs Kerosene

$$\frac{H_{\text{pentanol}}}{H_{\text{kerosene}}}$$

Sample Name	$\frac{H_{\text{pentanol}}}{H_{\text{kerosene}}}$
Pittsburgh No.8 Coal	0.5578
Illinois No.6 Coal	0.5911
Coal Pyrite	0.6654
Colorado Mineral Pyrite	0.6901
Upper Freeport Coal	0.7352

**Table 9 The Evaluation of Wettability Between Butyl Ether vs
Kerosene $H_{\text{butyl ether}}/H_{\text{kerosene}}$**

Sample Name	$H_{\text{butyl ether}}/H_{\text{kerosene}}$
Colorado Mineral Pyrite	1.7436
Upper Freeport Coal	1.9913
Pittsburgh No.8 Coal	2.0633
Coal Pyrite	2.4630
Illinois No.6 Coal	2.4745

Figure 1 The Kinetics Capillary Rise Test Results of Upper Freeport Coal in Butanol

Figure 2 The Kinetics Capillary Rise Test Results of Pittsburgh No.8 Coal in Butanol

Figure 3 The Kinetics Capillary Rise Test Results of Illinois No.6 Coal in Butanol

Figure 4 The Kinetics Capillary Rise Test Results of Colorado Mineral Pyrite in Butanol

Figure 5 The Kinetics Capillary Rise Test Results of Coal Pyrite in Butanol

Figure 6 The Kinetics Capillary Rise Test Results of Upper Freeport Coal in Pentanol

Figure 7 The Kinetics Capillary Rise Test Results of Pittsburgh No.8 Coal in Pentanol

Figure 8 The Kinetics Capillary Rise Test Results of Illinois No.6 Coal in Pentanol

Figure 9 The Kinetics Capillary Rise Test Results of Colorado Mineral Pyrite in Pentanol

Figure 10 The Kinetics Capillary Rise Test Results of Coal Pyrite in Pentanol

Figure 11 The Kinetics Capillary Rise Test Results of Upper Freeport Coal in Butyl Ether

Figure 12 The Kinetics Capillary Rise Test Results of Pittsburgh No.8 Coal in Butyl Ether

Figure 13 The Kinetics Capillary Rise Test Results of Illinois No.6 Coal in Butyl Ether

Figure 14 The Kinetics Capillary Rise Test Results of Coal Pyrite in Butyl Ether

Figure 15 The Kinetics Capillary Rise Test Results of Colorado Mineral Pyrite in Buty Ether

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