TECHNICAL NOTE

Effect of various gases on the column flotation of fine coal

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Abstract

Column flotation has proven to be the most effective technique for the flotation and recovery of ultrafine coal. The commercial application of columns in the coal industry is steadily increasing (Parekh et al., 1990; Yoon et al., 1992). For the flotation of coal or mineral air is used for generating bubbles. Using a conventional flotation cell, Miller and Mishra (1985) compared froth flotation behavior of fine coal using air, nitrogen and carbon dioxide gas. They concluded that carbon dioxide gas provided a higher rate of recovery and a lower ash content. The objective of the present study was to investigate the effect of various gases such as compressed air, nitrogen, argon, and carbon dioxide on the column flotation of fine coal.

Experimental

Upper Freeport coal containing 25.2% ash was used in the study. The coal was wet ground to 90% passing 325 mesh (45 µm) in a stirred ball mill. For the flotation studies, an 8% solids (by weight) suspension of the ground coal was used. Fuel oil (0.45 kg/t) and MIBC (0.45 kg/t) were used as flotation reagents. For the column flotation study, a 50.8-mm- (2-in.-) ID, 1.2-m- (4-ft-) high column was used. A ceramic porous disk was used at the bottom of the column to generate bubbles. Each test was carried out using a 1.6-L volume of the slurry.

Results and discussion

Figure 1 shows the effect of various gas flow rates on combustible recovery. As expected, combustible recovery increases with increasing air flow rate, and about an 80% combustible recovery was obtained using 1,000 mL/min of gas flow. For the carbon dioxide gas, more than 80% combustible recovery was obtained using only 500 mL/min of gas flow. Increasing the gas flow rate did not improve combustible recovery.

Figure 2 shows the effect of gas flow rates on the ash content of clean coal. Of all the gases studied, carbon dioxide provided the lowest ash content of 9%, irrespective of the gas flow rate.

The better results obtained with the carbon dioxide could be due to its high solubility (170 g/100 mL of water). The dissolved gas then precipitates onto the fine coal particles, making the flotation process more selective. Carbon dioxide has been reported to make coal surface more hydrophobic (Miller and Mishra, 1985). It is also known that carbon dioxide exhibits a high adsorption potential on the coal surface (Nandi and Walker, 1964).

Two flotation tests were conducted using a conventional Denver laboratory flotation machine and carbon dioxide gas instead of air. As shown in Table 1, the slurry saturated with CO_2 (using dry ice) provided about 10% higher combustible recovery than the one without saturation.

These data indicate that carbon dioxide gas is probably making the coal more hydrophobic. Miller and Mishra (1985) also reported similar results with a high-volatile bituminous coal.

Conclusions

Based on the test results, it can be concluded that:

- Compressed air, nitrogen and argon, when used as the floatation gas at a rate of 1,000 mL/min, produces a clean coal with 10% ash at about 80% combustible recovery for the Upper Freeport coal.
- Carbon dioxide gas was effective even at a lower flow rate of 500 mL/min, which produced a 9% ash coal with an 85% combustible recovery.
- CO_2 saturated slurry, when floated with CO_2 gas, provided a 10% higher combustible recovery.

References

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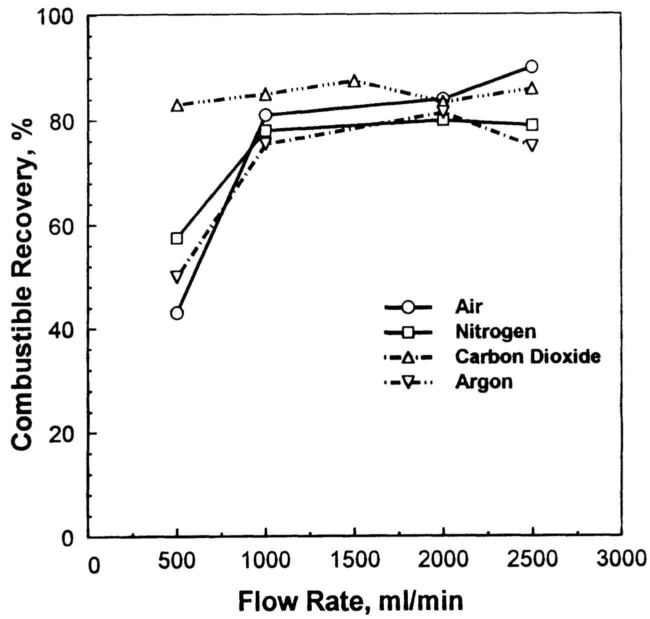

Figure 1 — The effect of gas flow rates on combustible recovery.

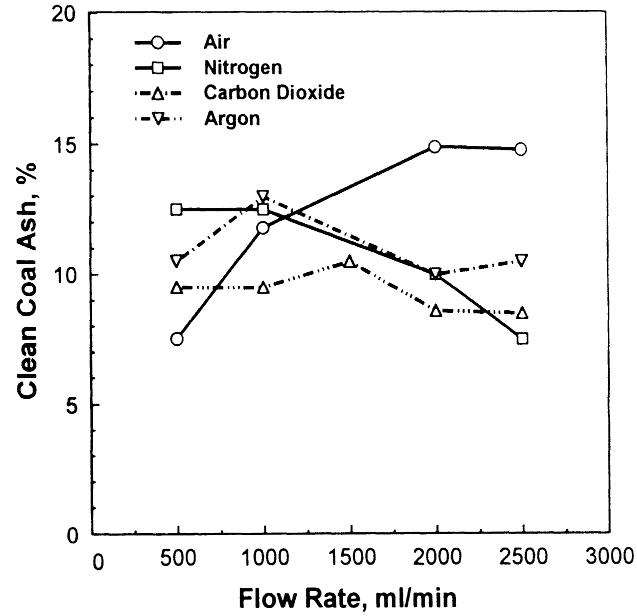

Figure 2 — The effect of gas flow rates on the ash content of the clean coal.

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Table 1 — Denver flotation test data using CO_2 gas (flow rate = 1,500 mL/min).

Test conditions	Ash, %	Combustible recovery, %
Slurry saturated with CO_2	7.90	77.5
Unsaturated	6.8	67.5