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Separation of Ultra Clean Anthracite

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It is very important to separate the ultra clean coal from anthracite as fuel for diesel engines from the effective use point of coal. To use anthracite in mixed fuel, it must be separated to be ultra clean coal. In previous researches, they employed physic–chemical methods to separate ultra clean coal from bituminous coal and brown coal. We invented a system by which ultra clean coal can be produced from anthracite in our country.

An investigation on dispersion–agglomeration–flotation of anthracite less than 10μm was carried out by means of Orthogonal Array design experiments methodology, SEM (scanning electron microscope) and microphotograph measurements. The massive coal samples containing –25mm raw coal were crushed and ground to be –1mm in a dry rod mill. Thereafter, it was ground in the planetary mill (PM 400/2; medium Al_2O_3) and ground products were used in dispersion, agglomeration, and flotation. The hexametaphosphate with purity of 99%, diesel oil and pine oil were used without further purification. The dispersion of anthracite sample was carried out by the dosage change of sodium hexametaphosphate in a cylindrical vessel of 250mL capacity with agitation speed of 500rpm for 5 min (JJ–1, XINRUIYIQI). The emulsification of diesel–water mixtures (volume ratio: 10%) was conducted with an ultrasonic generator (XH–300A) under the condition of frequency 40KHz, power 200W and batching time 5 min. The agglomeration tests of the sample were carried out with milk white emulsified diesel oil as a collector, and with functions of pulp concentration, agitating time, and agitating speed, using the agitator (JJ–1, XINRUIYIQI). After that, the dispersed sample and emulsified diesel oil were transferred to 500mL XFD flotation machine (mechanical agitation) and conditioned for 2min. The test of every flotation stage was only roughing and conducted for 7min.

Ash content and S/N ratio value was calculated by L16.

The minimum ash content under optimum condition is predicted to be obtained within the range of 3.50±0.09%. In other words, the optimum conditions for minimum ash content will be as follows: sodium hexametaphosphate dosage is 1.4kg/t; agitating speed is 2 300rpm; agitating time is 12min; diesel oil dosage is 12kg/t; pulp concentration is 7%. The influence of parameters on the ash content is found to be in the following order: sodium hexametaphosphate dosage (39.17%)>pulp concentration (22.0%)>agitating speed (20.39%) > agitating time (10.82%)>diesel oil dosage (1.58%).

The confirmation experiment was conducted under optimum conditions to verify the Taguchi results.

The confirmation experiment yielded an experimental ash content of 3.4% in roughing, which is smaller than the value observed in the test of single factors. In the experimental process of 3 cleaner/2 scavenge flotation of the close–circuit, the result showed the ash content of final ultra–clean coal significantly decreased to 1.1%, yield rate was 45.8%, and combustible recovery was 51.52%.

SEM observations showed that the full liberation of raw components could be achieved when they are ground to smaller than 10μm. Sodium hexametaphosphate dosage of 1.4kg/t, agitating speed of 2 300rmp, agitating time of 12min, diesel oil dosage of 12kg/t, and pulp concentration of 7% are recommended for optimal dispersion–agglomeration–rougher flotation conditions.

Our results could be applied to processing methods for other minerals that useful minerals were disseminated to ultra–fine size.