4C2. Coal Water Mixture Production Technology (CWM)

Technology overview

1. Coal slurry overview

The fact that coal is a solid causes some challenges; it requires more complex handling than a fluid does, environmental measures must be undertaken to prevent the dispersion of its dust, and a lot of space is required to store it. Utilizing it in a slurry form offers the potential to make the use of coal cleaner, comparable to heavy oil. One type of coal slurry, coal oil mixture (COM), is prepared by adding heavy oil to coal. This is different than another slurry, coal water mixture (CWM), a mixture of coal and water. While COM is convenient for burning and while it was tested before CWM, it failed to catch on because of the demand for heavy oil for other uses. CWM, on the other hand, poses no problems relative to spontaneous combustion or dust dispersion and can be handled as an easy-to-treat liquid. Conventional coal slurry, without additives could be piped but, due to an approximate 50% water content, exhibited poor long-run stability, and required dehydration before firing. High-concentration CWM can now, as a result of studies on the particle size distribution of coal and the development of a dispersant and other additives, be kept fluid as well as stable even when less water is added, allowing it to be directly combusted without being de-watered. The inclusion of only a small amount of additives stabilizes the coal-water slurry in which coal particles of a certain size distribution are uniformly dispersed, constituting a weight concentration of approximately 70%.

2. Characteristics of high-concentration CWM

The typical characteristics of high-concentration CWM (Chinese coal CWM) are shown in Table 1 below.

Table 1 Characteristics of high-concentration CWM

Coal concentration (wt%)	68-70
Higher heating value (kcal/kg)	5,000-5,200
Lower heating value (kcal/kg)	4,600-4,800
Apparent consistency (mPa-s)	1,000
Specific gravity (-)	1.25
Ash content (wt%)	6.0
Sulfur content (wt%)	0.2
Grains of 200 mesh or less (%)	80-85

1) Coal type

In general, high-carbonization, low-inherent moisture (about 5% or less in approximate analysis), and low-oxygen content (about 8% or less in ultimate analysis) coal is suitable for high-concentration CWM.

2) Additives

Additives consist of dispersants and stabilizers. A dispersant functions to disperse coal particles into slurry, using electrostatic repulsion effects or steric repulsion effects; sodium sulfonate from naphthalene, polystyrene, polymethacrylate, polyolefine, and the like are used here. Additives, including the stabilizers CMC and xanthan gum, are used to prevent coal particles in the slurry from settling.

3) Particle size distribution

For higher concentration and stability CWM, the size of the pulverized coal should preferably be distributed over a wide range rather than narrowly distributed. Standard particle sizes used are roughly as shown in Table 2.

Table 2 Grain size distribution of high-concentration CWM

Maximum grain size	150-500 μm
Average grain size	10-20 μm
Grains of 74 μm or less	80% or more
Fine grains of several micrometers or less	Around 10%

4) Rheological characteristics

CWM's fluidity has characteristics of a non-Newtonian fluid but can be characterized as approaching a Bingham fluid. The fluidity characteristics also change, depending upon the type of coal, concentration, additives, and flow state. The apparent viscosity is roughly 1,000mPa-s (at room temperature and shear speed of 100/s).

5) Heating value

The heating value depends upon the type of coal used. An average lower heating value is 4,600-4,800kcal/kg.

3. Manufacturing process for high-concentration CWM

High-concentration CWM can be produced by pulverizng coal into a particle size distribution suitable for CWM, selecting the correct additives (a dispersant and a stabilizer), and appropriately blending the coal, water, and additives to manufacture a highly-concentrated, low-viscosity, highly-stable, and good-quality CWM. A diagram of the CWM manufacturing process is shown in Figure 1.

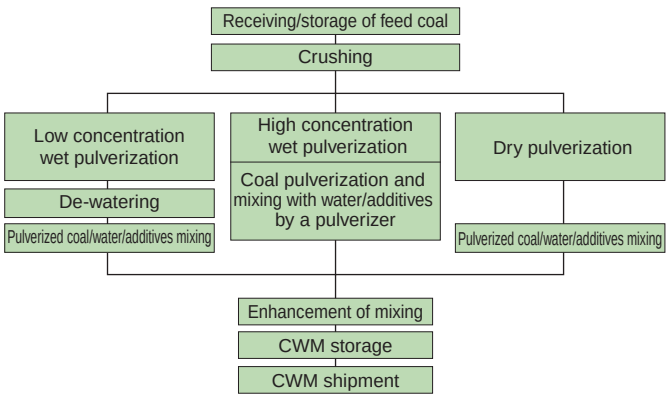

Fig. 1 CWM manufacturing process

Coal water mixture (CWM)