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Mining

Slime heavy medium cyclone advantages in coal production

Slime heavy medium cyclone is used for coarse slime separation in many new coal preparation plants. This article demonstrates how it reduces ash content in clean coal, coarse slime entering the float processing, production costs and increases economic efficiency.

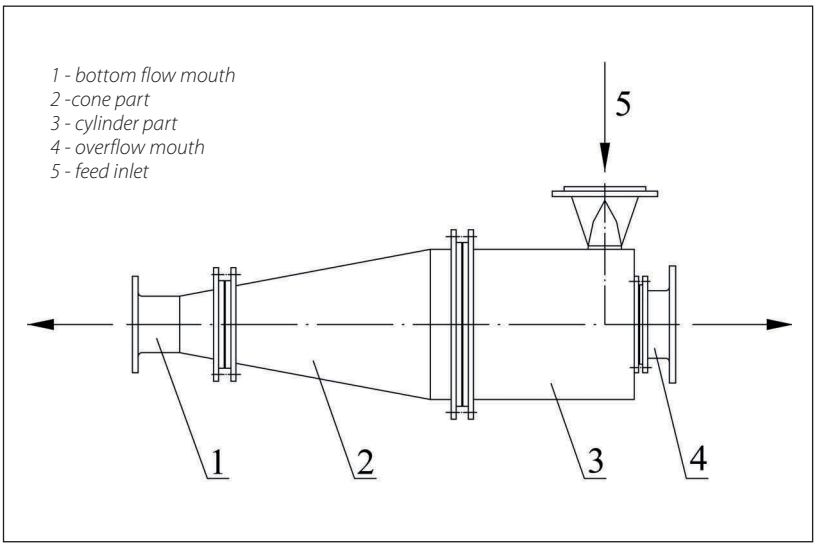

Figure. 1 FHMC200 slime heavy medium cyclone.

This paper introduces the working principle of FHMC200 slime heavy medium cyclone and makes a comprehensive calculation and quantitative analysis on its separation effect. This is based on a performance assessment method of heavy medium coal separation equipment, probable deviation, imperfection, quantity efficiency, ash error and total complex content were analyzed, through which real accurate technological indexes and technical-economic indexes were gained.

Slime heavy medium cyclone is a new device used for coarse slime separation. It is used more and more in new coal preparation plants for its characteristics of simple structure, large handling capacity, high separation accuracy and good treatment effect of oxidized coal or weathered coal. To further understand technology of slime heavy medium cyclone, this paper implemented a comprehensive analysis on its technical effect of fine slime separation.

Structural features

FHMC200 slime heavy medium cyclone is a heavy medium cyclone with a diameter of 200mm. FHMC is the abbreviation of fine heavy medium cyclone. The main structure is cylinder-cone structure (Figure 1). The inlet is 36mm × 36mm, with a taper angle of 20°. Diameters of the bottom flow mouth and overflow mouth in the experiment are 60mm and 80mm, respectively.

As shown in Figure 2, materials and suspension are injected into the cylinder under certain pressure along the tangential direction, forming strong rotational flows. One of the flows form a downward external rotational flow in the inner wall of cyclone and the other one form an upward internal rotational flow around the cyclone axis. The internal rotational flow with negative pressure takes in air, thus forming an air column along the axial cyclone. Under strong centrifugal force, light products in the material move upward with the internal rotational flow and finally discharge from the overflow mouth. On the contrary, heavy products move downward with the external rotational flow and finally discharge from the bottom flow mouth.

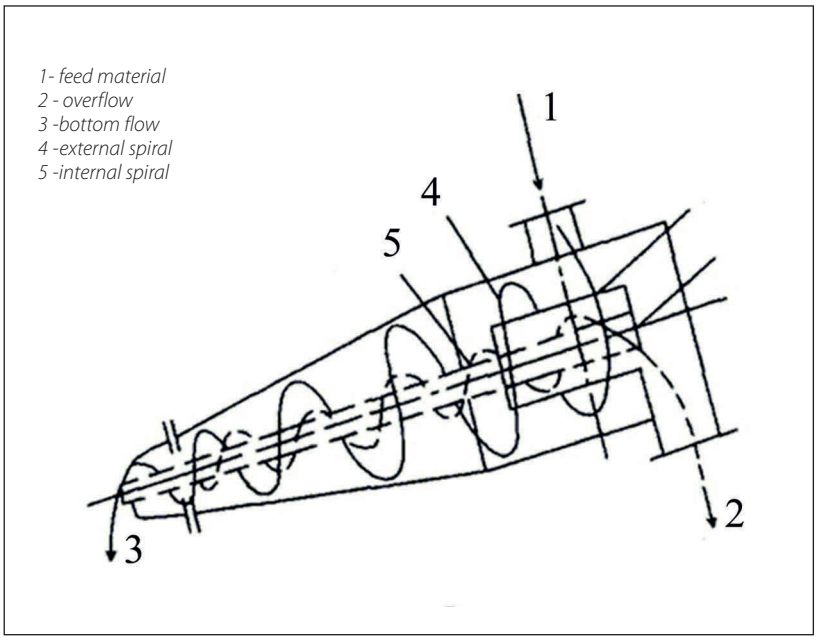

Figure2. Workflow of slime heavy medium cyclone.

Fine slime separation of slime heavy medium cyclone is accomplished in the centrifugal force field by taking advantages of the Archimedes principle. Due to the strong centrifugal force field, gravity of particles could be neglected. Therefore, joint force (F) of particles at radius (r) is:

$$F=V(\delta-\rho)\frac{V_\tau^2}{r}$$

where ρ—— density of suspension, kg/m^3;
V—— particle volume, m^3;
δ—— material density, kg/m^3;
vτ—— tangential velocity of particles at r, m/s.

It can be known from above equation that:

When δ>ρ, F is positive. High-density particles are thrown to external rational flow and then discharged from the bottom flow mouth.

When δ<ρ, F is negative. Low-density particles move to internal rational flow and then discharged from the overflow mouth[1].

Slime heavy medium processing could solve the problem of poor slime separation efficiency caused by ambiguous lower limit of large-diameter heavy medium cyclone. Slime heavy medium cyclone in service environment shall meet:

1) use finer heavy medium
2) reduce cyclone diameter
3) increase pressure of material feeding.

The lower limit of separation can reach 0.045mm as long as these conditions are satisfied. However, usage of micro particle medium will increase medium expenses and medium recycle difficulty, thus causing large medium consumption. Therefore, micro particle medium is seldom used in practical production. On the other hand, over small diameter of cyclone will restrict its handling capacity. As a result, the separation lower limit couldn't reach 0.045mm. According to domestic and foreign experiences of field production, effective separation range of slime heavy medium is 1~0.1mm[2].

Detection and assessment method

Feed materials of one slime heavy medium cyclone in one coal preparation plant in Tangshan were taken as test samples. In the test, feed pressure, feed density, overflow density and bottom flow density were set 130 kpa, 1.26 kg/L, 1.07 kg/L and 2.09 kg/L, respectively. Magnetic substance content in feed materials was 50% and the true density was 4.55kg/L. Content of particles smaller than 0.045 mm was 80%.

"Slime heavy medium processing could solve the problem of poor slime separation efficiency."

Figure 3 is the physical experimental platform and Table 1 shows screening results of feed materials and products.

In Table 1, ash content of overflow and ash content of feed material when particle size is smaller than 0.1mm are

Particle size/mm	Feed material		Overflow		Bottom flow	
	Productivity /%	Ash content/%	Productivity /%	Ash content/%	Productivity /%	Ash content/%
>0.25	3.39	17.82	3.07	7.26	8.59	33.80
0.25~0.1	21.52	13.49	22.10	8.18	28.72	43.10
<0.1	75.09	30.27	74.83	27.89	62.69	60.62
Total	100.00	26.24	100.00	22.90	100.00	53.28

Table 1. Screening results of feed materials and products.