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Opinion

Changes in Particle Size Distribution of Coal During its Transportation from the Face to the Mine Storage

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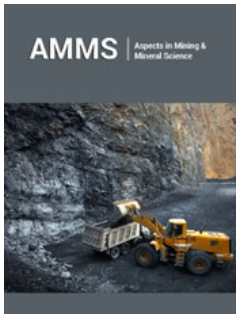

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Opinion

Underground coal mining is a significant part of total coal production. Thick and medium-thickness coal seams are mined by long fully-mechanized longwalls using shearers [1]. Quantitative assessment of particle size distribution is of considerable interest in solving many problems associated with the operation of coal mines. The particle size of transported coal affects the volume of methane released into the mine air [2,3]. The volume of fine particles moved by air creates an explosive dust-gas mixture [4,5]. The particle size distribution of coal affects the congelation of particles [6], the wear of the pan line of the armored face conveyor [7], and the efficiency of its operation [8,9]. The initial breakage of coal occurs when the seam is destroyed by the cutting drum of a shearer. The output of sized coal is 62.7-72.0% [10-12]. Coal broken in the face undergoes further degradation because of coal transportation by an armored face conveyor, reloading to a scraper feeder, multiple reloading from one belt conveyor to another directly or through a bunker with a feeder, and moving by the surface transport system and storing. Coal degradation in the process of transportation is clearly confirmed by float-and-sink analysis of the coal from 2451 longwall (Polenovskiy seam) of S.M. Kirov mine of OAO SUEK-Kuzbass [13]. The share of large - more than 25mm - fractions decreases from 35% in the face to 6% in the surface storage. While the share of small - 0-1mm - fractions increases from 7% in the face to 18% in the storage.

Studies conducted in the mines of Kyrgyzstan [14] established the dependence of coal degradation on the coal transportation means and their parameters, as well as on the characteristics of the transported coal. The results of these studies allow quantifying the degradation processes. The output of coal slack from degradation of coal transported by the armored face conveyor depends on the length of transportation and the coal hardness:

$$W = k\left(3,7 + 0,008L - 2,8f\right), \%$$

where W - coal slack output, %; k - coefficient taking into account the influence of the armored face conveyor type on coal degradation (for reverse armored face conveyor - 11-1,0, armored face conveyor - 2-0,8, scraper feeder - 63-0,65); L - length of transportation, m; f - coal hardness coefficient according to M.M. Protodyakonov (for steam coals of Kuzbass f = 0.5-1.5). The results of the calculations show that the transportation of coal by a 300-400m long armored face conveyor increases the yield of slack by 2.2-2.7% (at f=1.0). This means that the output of sized coal will decrease by this amount, and the output of fine coal will increase. Further, the coal moves along the conveyor line. If we assume that the movement of coal on the conveyor belt does not affect the formation of slack, then reloading from conveyor to conveyor contributes to additional degradation. It was established [14] that the output of 0-13mm fines depends on the height of the fall, the coefficient of coal hardness and the design of the receiving section of the conveyor loading station:

$$W = 4k_2 \frac{H}{f} \cos\alpha, \%$$

where: k_2 - coefficient taking into account the material of the base on which the coal falls; (k_2=0,4 - on a rubber band; k_2=0,57 - on a coal bedding; k_2=1,0 - on a metal plate); H-drop height, m; α - base angle, degrees.

Conclusion

The established dependences of coal degradation on the transportation means and their parameters, as well as on the physical and mechanical properties of loads, make it possible to quantify the conveyor line. In addition, the dependence of coal degradation on the height of the fall makes it possible to improve the receiving sections of the loading points of conveyors by changing the angle of inclination of the charge chute.

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