ANALYSIS OF THE INEFFICIENT WASTE ROCK FLOW MOVEMENTS IN THE COAL MINE TECHNOLOGICAL SCHEME

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Despite the intensive green energy development in the world leading countries, the thermal electricity generation based on coal combustion in Ukraine has being significant importance, since its share is 35% [1, 2]. Nevertheless, every year it becomes more and more costly to extract coal of acceptable coal quality. It is associated with the difficult mining and geological coal seam conditions.

The primary coal production is concentrated in the Western Donbas. There are 8 coal mines, which produce 70% of total Ukraine coal production [3, 4]. In the Western Donbas, thin coal seams are being developed with a geological thickness not exceeding 1.0 m, with a weighted average thickness for all mines of 0.83 m, which ranges from 0.71 to 0.95 m. At the same time the mining thicknesses in the longwall faces is 1.05 due to technological characteristics of mining equipment and the established safety standards. Thus, the shearer cuts coal seam soil by a size equal to the specified difference between mining and geological thicknesses.

As a result, mined coal from faces contaminated by undercut waste rocks, which significantly deteriorates its quality and requires enrichment processes at surface factories. Therefore, for example, if during the development of medium and thick coal seams with a parent ash content of 10-15% is mined, then during the development of thin and very thin seams the ash content increases to 40-50% due to undercutting.

The conducted researches on the example of the Heroiv Kosmosu mine PJSC “DTEK Pavlohradvuhillia”, which is of one of the largest coal mines in the Western Donbas, has been established annual rock yield (1.3 million tons) on the surface for the main types of mining operations (Fig. 1).

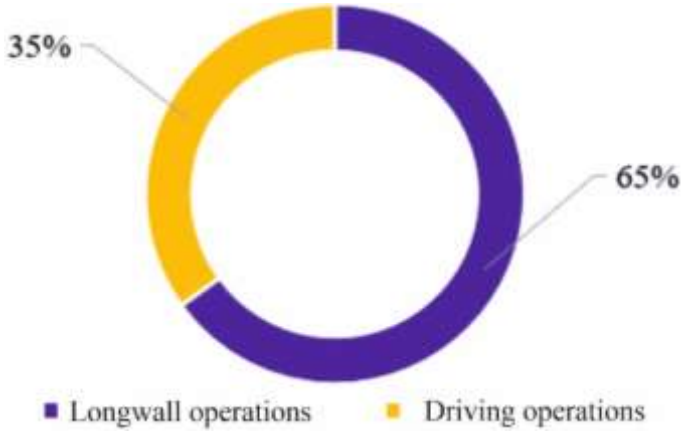

Figure 1. Specific weight of rock yield on surface
by type of mining in the mine technological system.

One of the most important reasons for the ecological state deterioration in the mining regions is the accumulation of waste dumps in the coal mine allotments, which occupy valuable land areas [5, 6]. To prevent dangerous deformations of the earth's surface, the accumulated mine waste rock from the dumps is used as an backfilling material [6, 7].

In the world practice of developing coal deposits with medium and thick seams (1.2-3.5 m), for the utilization of waste mine rocks, the technologies of backfilling are used for the safety of mining operations under industrial facilities [7, 8]. However, at the same time, mine rocks from the day's surface are laid into the underground space, which were previously issued from the mine during mine workings. The issues of complete rock leaving in the mined-out space in the process of mining operations without their release to the surface is paid not enough attention.

The technological process the movement of mine rock streams from the source of their formation in the mine to the day surface entails significant costs for mining enterprises. First of all, these are unproductive transport costs – equipment power consumption, wear of equipment elements, costs of enrichment, and storage of rocks on the day surface. The costs of piling rocks today are of particular importance, since the legislation of Ukraine adopted a law on increasing the environmental tax (3 times) for the disposal of mining waste of IV hazard class, which directly include mine rocks. These aspects should stimulate coal mines to search for ways to introduce new technologies that ensure low-waste production.

Further, the technological processes of the mine are considered, which ensure the movement of waste rocks in a mixture with mined coal, which is formed during the development of a thin coal seam. The transport chain of underground and surface movement of rocks from the stope the source of their formation to the place of their storage has been compiled (Fig. 2).

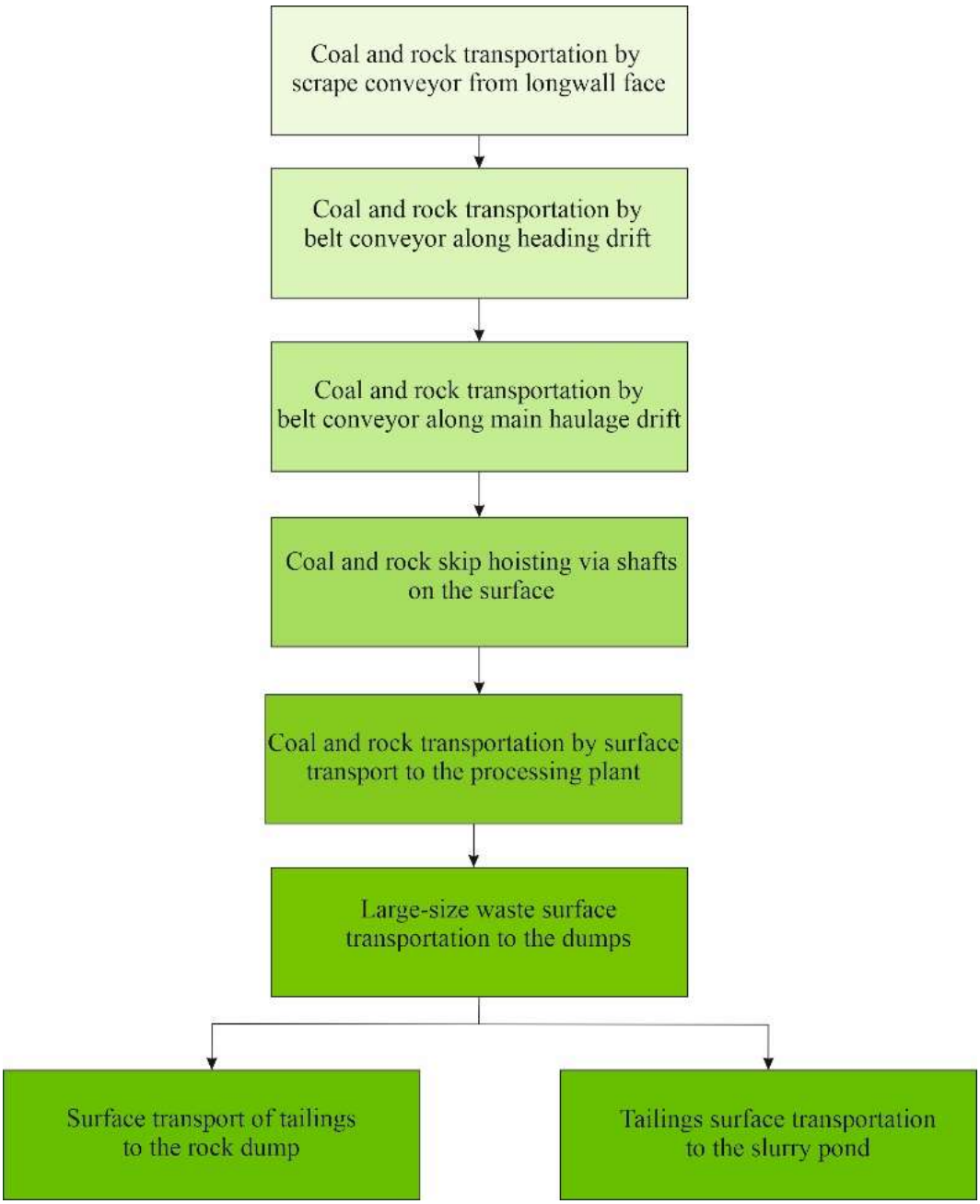

Figure 2. The movement of mine rocks of stope workings from the source of their formation to the surface objects of their storage.

Analysis of Figure 2 shows that when coal is mined from thin coal seams with an ash content of 40-50%, the transport chain for the movement of mined coal mixed with rocks is complex, multistage and costly. In stages 1-4, during the transportation of mined coal, economic damage is observed in the form of blank costs for energy consumption of conveyor drives and a lifting machine due to the presence of rock, instead of which there could be 80-90% of pure coal in the total mass without the need for undercutting. As our analysis shows, a significant cost component is occupied by the distance of transportation of rock mass from the mine to the processing plant, since transport costs increase sharply due to fuel consumption, which can be 60-80%. When mining pure coal with a parent ash content of 10-15%, there is no need for processing and transportation of enrichment products to dumps and tailings, and coal is shipped to thermal power plants in the mined form.

With the obvious ineffectiveness waste rock flow movements from the stopping faces it should be considered the possibility of separating coal and rock directly at the place of their formation. The rational solution is the use of selective technology for extracting coal from thin coal seams and filling rocks into the worked-out space, while coal with a parent ash content of 10-18% is mined. The authors are fruitfully working on improving the technology of selective technology and have already received certain scientific and practical results [9, 10].

The movement of the waste rock flow of developing works in the mine scheme differs in that when the mine rocks are released to the surface, they are immediately transported to the waste dump, usually located next to the mine. The development of technologies for the waste rock leaving from development operations in the mine is also an important and priority area, which also allows to reduce the unproductive costs of moving waste rocks both in the underground space and on the surface.

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