APPLICATION OF FRACTIONATION DEVICE FOR REMOVAL
OF HIGH-ASH ADMIXTURES FROM LOW-GRADE COALS

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The results are presented for the investigations into improvement of quality of low-grade coals by refining in vertical water streams. The regularities obtained make it possible to predict the results of coal retreatment in fractionation device.

Coal, refining, ash content, rejects, device

At present, there is a problem on improving the quality of low-grade power-generating coals with high ash content due to rock admixtures formed by mixing of coal mass and rock during mining. So, the coal mined can be considered as a coal — rock mixture, where the heavy fraction is represented by ballast high-ash admixtures. For each product of coal-mining enterprise, mass share of admixtures is normalized by technical specifications. For example, according to technical specifications 0320-053-00161878-00, for power-generating coal of grade CC, the mass share of admixtures is to be no more than 2.5%. Effective removal of rock will improve the quality of coal; also there won’t be violated technical specifications and fine imposed.

This paper is aimed at determination of optimal technological parameters of refining (improvement of quality) for coals from various black-coal deposits of the South-Yakutsk Basin.

The principal technological scheme of experimental device is described in [1, 2]. The data obtained were processed by the procedures of calculating the fractionation analysis results with determination of yield and ash content of total drowned fractions [3]. The graphs proving efficient removal of rock inclusions are shown in Fig. 1. It is apparent that for size grades of 6—10, 3—6, and 1—3 mm with ash content more than 50%, rejects amounted to 5, 6, and 30%, respectively. According to Table 1, the ash content of refined coal is 16.0% at its yield of 90.5%. Without high-ash size grade of 0—1 mm, mixture of the refined size grades of 6—10, 3—6, and 1—3 mm has ash content of 10.3% and yield of 62.5% as compared to original coal.

Using these data as the base, it is possible to calculate efficient removal of ballast fractions with different ash content per dry mass \( A^d \) of coal sample and to select the required scheme of controlling the quality of coal, which is favored by preliminary separation of coal into size grades. For Chulmakansk coal \( A^d =19.3 \) %, removal of rock admixtures is the most efficient for high-ash size grade of 1—3 mm \( A^d =23.3 \) %. The ash content of power-generating coals of 6—10 and 3—6 mm sizes is low \( A^d =10.6 \) % and \( A^d =12.4 \) %, respectively; therefore, refining is senseless, but enrichment is realizable in order to produce coke concentrate. The experimental results are presented in Table 1.
Fig. 1. Interconnection of drowned coal fraction yield (rejects) and its ash content in separation of coal into size grades: 1 — 1 – 3 mm; 2 — 3 – 6 mm; and 3 — 6 – 10 mm

In this paper, a method is considered for separation of coals into useful components and ballast fractions in upward vertical stream of water by fractionation device (FD). The water stream velocity governs the efficiency of mixture separation. During the investigations, the average velocity of water passage in fractionation chamber was used.

The basic technological parameters of coal refining in FD are the velocity of water in chamber part, where the material is separated (v, m/s), ash content of rejects ($A_p^d$, %), and their relative amount ($\gamma_p^d$, %). The problem of constructing a mathematical dependence between these indices can be divided into two stages: determination of particular dependences for each size grade of separate coals and establishment of general dependences for any size grade of any coal.

The data were analyzed with the help of the least square method [4, 5]. For all dependences, the determination and correlation coefficients are calculated, as well as regression coefficients at significance level of 0.05 and significance of correlation coefficients were tested by the Student distribution and the Fisher criterion, respectively.

The dependences between the ash content of rejects and the velocity of water in FD, which are depicted in Fig. 2, are approximated by the equation:

$$A_p^d = b_0 + (b_1 v)^{b_2},$$

where $b_0$, $b_1$, and $b_2$ are the regression coefficients. For the size grades under consideration, the equations are obtained that allow high-accurate estimation of ash content of removed fractions with respect to velocity of water in FD.

<table>
<thead>
<tr>
<th>Rejected, %</th>
<th>Refined coal, %</th>
<th>Refined coal + size grade of 0 – 1 mm, %</th>
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</thead>
<tbody>
<tr>
<td>$\gamma_p^d$</td>
<td>$A_p^d$</td>
<td>$\gamma_k^d$</td>
</tr>
<tr>
<td>16.9</td>
<td>35.0</td>
<td>51.1</td>
</tr>
<tr>
<td>13.8</td>
<td>40.0</td>
<td>58.2</td>
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<tr>
<td>9.5</td>
<td>50.0</td>
<td>62.5</td>
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</tbody>
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