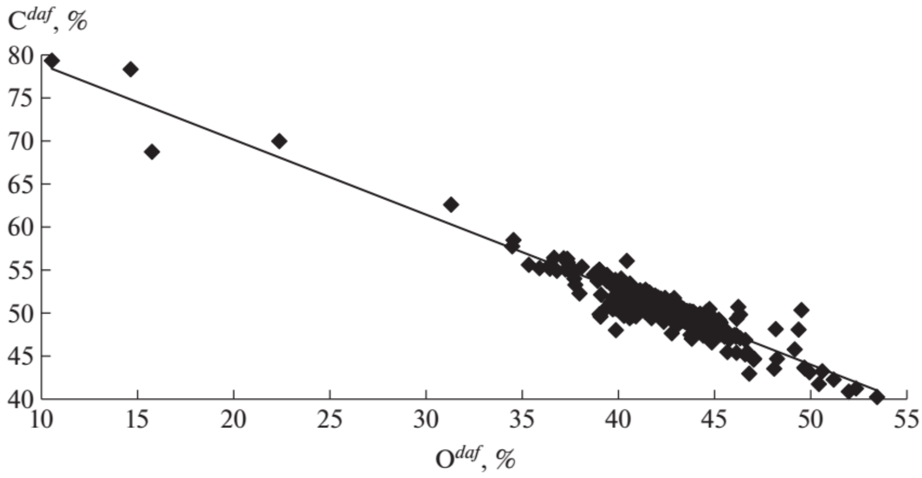

Fig. 1. Relationship between C^{daf} and O^{daf}.

The statistical analysis of the test relationships showed that they were generally characterized by satisfactory accuracy, as evidenced by the high values of determination coefficients ($R2 > 0.849$).

The only exceptions were mathematical relationships between the C/H ratios and C^{daf} ($R2 = 0.345$) or H^{daf} ($R2 = 0.562$).

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COKING OF STAMPED COAL BATCH. YIELD OF CHEMICAL PRODUCTS

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Given that coal may be oxidized and the yield of ammonia and hydrogen sulfide cannot be predicted from the volatile matters, mathematical formulas describing the yield of the basic coking products as a function of the elemental composition of the initial stamped coal batch are derived. It *is found that, with increase in the content of gas coal (and hence in the volatile matter) in the stamped batch, the coke yield declines, but there is a higher yield of tar, benzene, carbon dioxide, pyrogenetic moisture, and coke-oven gas.*

Keywords: *coal, coke, coking batch, stamping, coking, product yield, mathematical formulas*

The yield and quality of coking products characterize the performance of coke plants. Prediction methods for the yield of coke and other coking products has been complicated by the significant variation in batch composition, because Ukrainian coke plants are making greater use of imported coal.

Today, several laboratory methods may be used to determine the yield of coke and other products (tars, raw benzene, ammonia, hydrogen sulfide, carbon dioxide, pyrogenetic moisture, and coke-oven gas) in coking.

We consider method of Coking of small weighed portions (Ukrainian State Standard DSTU 7689:2015 [1] or Russian State Standard GOST 18635–73 [2]) and method of Determination of the yield of coke and other coking products in a 5-kg laboratory furnace [3].

1. COKING OF A WEIGHED SAMPLE

We select 13 samples of coal concentrates employed at Arcelor Mittal Krivoy Rog [4].

Note that, in assessing the correlation of the elemental content with the coal's metamorphic stage, we find an aberrant point. More detailed analysis indicates a relatively high analytical moisture content in that case (2.7%); that may correspond to oxidation of the coal [5].

With greater metamorphic development, the coke yield increases, while the yield of tars, raw benzene (the sum of benzene and unsaturated compounds), pyrogenetic moisture, and coke-oven gas decreases.

Given that the yield of ammonia and hydrogen sulfide cannot be predicted from the volatile matters, we develop equations for calculating the product yield from the elemental composition of the initial coal.

We present the corresponding equations, as well as the determination coefficient R2 and standard error SE.

On the basis of the equations, the product yield may be predicted by elemental analysis of the coal. These predictions are more accurate than those based on the volatile matters.

The equations correspond to elemental analysis of the initial coal in the loose state and do not take account of its compaction to ~1.15 t/m3 on stamping. Accordingly, we use a 5-kg laboratory furnace for the coking of stamped batch.

2. COKING IN A LABORATORY FURNACE

In the work present the composition of the coking batches and summarize the properties and elemental composition of the initial coal concentrates and batches. The content of gas-group coals varies (from 30 to 60%) in the coal batches.

Analysis of the characteristics indicates that the batches are similar in ash content and total sulfur conreflection coefficient and reflectogram of vitrinite.

As a result of the coking carried out, data on the yield of the product and its characteristics were obtained.

Product yield depends on the content of gas coal (the volatile matters) in the initial batch. With increase in content of gas coal (volatile matters), we note decrease in the coke yield and increase in the yield of tars, raw benzene, carbon dioxide, pyrogenetic moisture, and coke-oven gas. The yield of ammonia and hydrogen sulfide depends primarily on the composition of the coal's organic mass.

Equations are given for predicting the output of products from a stamped batch with the corresponding statistical indicators.

The coke samples have similar ash content and total sulfur content. The volatile matters in the coke is 0.5–0.7%. That indicates adequate conditioning. Analysis shows that the product yield is closely correlated with the volatile matters of the initial batch. With increase in the volatile matters, the coke yield declines. We also note increase in the yield of tars, raw benzene, carbon dioxide, pyrogenetic moisture, and coke-oven gas. The yield of ammonia and hydrogen sulfide mainly depends on the composition of the coal's organic mass.

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ДОСЛІДЖЕННЯ УМОВ ОТРИМАННЯ ТОЛУОЛЬНОГО ЕКСТРАКТУ ТА ГУМІНОВИХ КИСЛОТ З БУРОГО ВУГІЛЛЯ

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