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## FLOTATION OF MIXTURE OF COAL FROM JANKOWICE AND CHWAŁOWICE MINES

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### 1. Introduction

In the recent years the condition of the Polish mining industry has been strongly affected by the following factors:

- the political transformation
- international trends, the aim of which is to reduce the environmental impact of the coal industry
- the global economic crisis.

The political transformation in Poland, which took place at the beginning of the 1990's, initiated changes in the national energy policy, which resulted in the restructuring of the coal mining industry.

The result of restructuring processes was an oversupply of coal. Coal production became unprofitable. In the first years of the political transformation most financial resources were not invested in the industry, but used to reduce coal production in order to make it profitable. During the last two years these trends, which are destructive for the Polish coal mining industry, overlapped with the global economic crisis, which resulted in a further reduction of the demand for electrical energy and, obviously, coal.

The year 2009 was particularly difficult for the Polish mining industry. The decisions that the managements of coal mining companies and coal mines take are also influenced by the fact that customers increasingly demand higher quality coal, namely coal with a lower content of sulphur and ash. Such demands force coal producers to adjust their offer to market requirements.

To meet new market requirements, CW Południe is considering the transport of approximately 2000 t/d of fine coal, class 19 kJ/kg, granulation 0÷6 mm, which cannot find

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customers, to the KWK Jankowice. The decision to consider such an operation has been brought about by limited possibilities of preparing coal in the KWK Chwałowice, which result from the deficiency of the slurry-water circuit that the coal preparation plant possesses and the current situation on the market of unprepared fine coal. In the KWK Jankowice fine coal will be prepared and sold as class 23 kJ/kg or 27 kJ/kg. Also significant is the fact that due to a limited storage surface for coal assortments in the KWK Chwałowice, this operation can actually, in an extreme case, enable the KWK Chwałowice to avoid placing restrictions on coal output on account of the shortage of space on coal stock yards.

Carrying out this operation is possible for three reasons:

- The KWK Jankowice possesses an underground (open-top) bunker, which can accept and unload "foreign" coal or its own coal shipped in talbot cars.
- The distance between these two coal mines amounts only to 3 km, which ensures a relatively low cost of transport.
- Both coal mines sell steaming coal; therefore, their target customers are similar. The only difference may concern the percentage content of sulphur. However, it can be eliminated by adding skilfully and in adequate proportions fine coal from the KWK Chwałowice, which contains more sulphur, to the stream of fine coal from the KWK Jankowice.

The efficiency of the unloading line in the Coal Preparation Plant of the KWK Jankowice amounts to around 200 t/h of fine coal, which can be systematically prepared or sent to the coal stock yard.

As it is unknown how a mixture of the finest coal grains from two different coal mines can react during the process of flotation at the KWK Jankowice, which is a key one because of the necessity to maintain a closed slurry-water circuit, it has been decided to carry out a laboratory test. The aim of this test is to determine the influence of the admixture of fine coal from the KWK Chwałowice to the feed to be cleaned in a jig built into the KWK Jankowice technological line on the KWK Jankowice slurry-water circuit. In the future industrial trials will be carried out.

In investment terms flotation of fine coal is an expensive technology that allows to isolate coal concentrate, the grains of which do not exceed 700  $\mu\text{m}$ , from the circulating water of the coal preparation plant. Grains of this size are created in the process of coal extraction, its transport and preparation. The amount of fine coal ranges between 10 to 20% of the feed directed to the coal preparation plant. Coals from various coal mines differ in terms of their susceptibility to flotation. The process of flotation is also influenced by many other factors, such as content and interaction of mineral substances, granulometric content of fine coal. Moreover, technological factors, such as concentration of solid parts in the suspension, a manner of airing the flotation suspension, flotation time etc., must be taken into consideration.

The aim of this paper is to define the influence of the admixture of coal from the KWK Chwałowice on the results of flotation in the KWK Jankowice. This objective results from

current technological needs of the Coal Preparation Department of the KWK Jankowice, which has to process some amount of coal directed from the Chwałowice coal mine.

## **2. The Authors' own research**

The results of coal flotation have been analysed:

- coal from the KWK Jankowice,
- coal from the KWK Chwałowice,
- 50% mixture of coal from the KWK Jankowice and 50% mixture of coal from the KWK Chwałowice,
- 25% mixture of coal from the KWK Jankowice and 75% mixture of coal from the KWK Chwałowice,
- 75% mixture of coal from the KWK Jankowice and 25% mixture of coal from the KWK Chwałowice.

In order to examine the influence of the coal admixture from the KWK Chwałowice on the drainage of flotation waste, sedimentation trials of the waste suspension without a flocculant and with the reagent Magnafloc have been carried out.

## **3. General characteristics of coals extracted in coal mines**

The coal mine Jankowice extracts and produces commercial coal of the type 33. The following assortments of commercial coal are produced:

- Hard coal
  - Nut (type 33),
  - Nut II (type 33),
  - Hard II (typ 33).
- Medium coal
  - Pea (type 33).
- Calorific value of fine coals
  - calorific value fine coal (type 33) of the fuel value from 29 000 to 20 000 kJ/kg.
- Flotoconcentrate
  - Flotoconcentrate type 33.

Characteristic data of the commercial coal:

- Average ash content in commercial coal — 20.6%,
- Average content of sulphur in commercial coal — 0.61%,
- Average calorific value — 24 178 kJ/kg.

The coal mine Chwałowice extracts steaming coal of the 32.1 type, with average calorific value of 23 500 kJ/kg, average ash content of 16.4% and average sulphur content of 0.8% in the following assortments:

- nut,
- pea,
- fine coal.

The average annual extraction rate of the coal mine Chwałowice amounts to 10 000 t/d and the yearly extraction equals 2 million tonnes. Research results of the flotation of coal and its admixtures from the KWK Jankowice and Chwałowice.

### Flotation conditions

Our research has been carried in the laboratories of the AGH University of Science and Technology in Cracow. Flotation has been performed in the “Denver” laboratory flotation device with the chamber volume of 1 dm<sup>3</sup>.

The experiments have been carried out in accordance with the following parameters:

- density of feed — 100 g/dm<sup>3</sup>,
- the amount of reagent — 1 kg/ 1 Mg of dry mass.

The following flotation reagents have been used: Montanol and RF55.

Feed granularity — 100% below 0.5 mm.

Average ash content in the feed (in the analytic state):

- KWK Jankowice —  $A_J = 26.8\%$
- KWK Chwałowice —  $A_{Ch} = 30.2\%$

(The content of ash marked in the DKJ KWK Chwałowice:  $A_{ar} = 27.2\%$ , while  $W_{ex} = 6\%$ ).

The results of flotation have been presented in the tables below (Tab. 1 and 2).

TABLE 1

#### Flotation with the use of Montanol

Feed composition	Amount of concentrate $G_k$ , [%]	Amount of waste $G_o$ , [%]	Ash content in concentrate $A_{k1}$ , [%]	Ash content in concentrate $A_{k2}$ , [%]
Jankowice 100%	78	22	15.8	15.7
Jankowice 75%	76	24	14.9	14.7
Jankowice 50%	72	28	14.1	13.8
Jankowice 25%	73	27	14.6	13.9
Chwałowice 100%	66	34	13.1	13.3

**TABLE 2**  
**Flotation with the use of the RF 55 reagent**

Feed composition	Amount of concentrate $G_k$ , [%]	Amount of waste $G_w$ , [%]	Ash content in concentrate $A_{k1}$ , [%]	Ash content in concentrate $A_{k2}$ , [%]	Ash content in waste $A_{o1}$	Ash content in waste $A_{o2}$
Jankowice 100%	75	25	15.1	14.0	76.9	77.6
Jankowice 75%	79	21	16.6	15.3	69.1	69.1
Jankowice 50%	76	24	14.2	15.1	64.7	65.5
Jankowice 25%	69	31	13.9	13.9	63.9	63.9
Chwałowice 100%	60	40	12.9	12.9	63.7	63.8

## 4. Summary and conclusions

The results of flotation with the use of the RF 55 reagent are better than with the use of Montanol only, both for the coal from Jankowice and Chwałowice.

Chwałowice coal flotates better than Jankowice coal — the content of ash in the concentrate is lower by approximately 17%, whereas the amount of the concentrate is higher for Jankowice (even by 14%). The yield of ash is higher for Chwałowice (84.37%) than for Jankowice (71.73%).

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