GEOSTATISTICAL MODELLING AND ESTIMATION OF QUALITATIVE PARAMETERS OF THE BÈCHTÀÔW LIGNITE DEPOSIT (POLAND)

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Introduction

The Be³chatow lignite deposit is the largest lignite deposit in Poland. The Tertiary coal-bearing sediments occur in a deep tectonic trough. The lignite deposit may be divided into the main reservoir (the lower reservoir) and the upper reservoir (the upper reservoir) which together form the coal complex (Fig. 1. B). The main reservoir is about 20 m thick. The coal complex rests directly upon the Jurassic (Jurassic-Keuper) basement or upon Paleogene regolith (Fig. 1. C).

The basic sources of information on deposit are boreholes. They are irregularly spaced as a result of a missing mapping phase of exploration but provide relatively uniform coverage over the entire deposit area. The average spacing is about 140 m in the eastern part and 50 m in western part of the Be³chatow field (Fig. 2). Core data from each borehole was sampled and assayed for ash and sulphur contents, moisture and calorific value. These basic parameters control the quality of lignite deposit.

Scope of study, methods and data

The study aimed to determine the accuracy of mean values estimations of above-mentioned qualitative parameters for mining fields scheduled for extraction in one year (about 0.6-0.7 km²). Predictors of the accuracy were carried out on the block kriging procedure based on detailed geostatistical analysis. Lognormal and halfnormal variograms were calculated for each of the qualitative parameters. Variogram analysis provides classical statistical analogy. For both parameters for which the relative error of mean parameters estimation does not exceed 5% are regarded as fully satisfactory. The second purpose of the present study is to find the minimum number of borehole samples taken from drill cores and, thus, might lead to the cost reduction of future exploration. Data originated from about 1,200 boreholes drilled in the Be³chatow field (Fig. 2). After inspection of the data some of them were rejected because of too low core recovery or too high sampling and analytical errors.

Results

Generally, lignite from the Be³chatow field is characterized by (Table 1) low calorific value (2187 kcal/kg, in average), low sulphur content, high moisture and high vitrinite reflectance. Each parameter, especially sulphur content, shows strong skewness of the probability distribution (Fig. 3). Relative variability of studied qualitative parameters were calculated for both vertical and horizontal direction (Table 2). Variability of the ash and sulphur contents are higher than those of calorific value and moisture.

Table 1. Mean calorific value and sulphur content

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean value</th>
<th>Standard deviation</th>
<th>Correlation coefficient</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calorific value</td>
<td>2187</td>
<td>207</td>
<td>0.15</td>
<td>2400</td>
</tr>
<tr>
<td>Sulphur content</td>
<td>6.5</td>
<td>0.7</td>
<td>0.20</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Conclusions

The model recognition of geometry and structure of the Be³chatow lignite deposit requires the two-stage exploration. The obtained results demonstrate that, according to the presumed criteria, the 150x150 m or 250x250 m borehole grid ensures satisfactory accuracy of the estimation of mean-qualitative parameters for the fields scheduled for extraction during one year. Consequently, the first stage of exploration with an average borehole spacing about 140 m already ensures the required estimation accuracy of qualitative parameters. If the two-stage exploration is considered, the same accuracy can be attained if qualitative parameters are measured in each second borehole along the W-E line i.e., along the minimum variability direction for ash and sulphur contents. Therefore, the borehole density for both parameters can be reduced by half. This result is important for extraction in one year (about 0.6-0.7 km²).

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References


