Modern technical and IT solutions in the System of Quality Control of the Run of Mine at LW “Bogdanka” S.A. coal mine

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Abstract. In underground coal mines, one of the primary sources of waste rock in the ore is the phenomenon of roof fall. This phenomenon increases the contamination of the ROM (Run of Mine) with waste rock, which in turn increases the operating costs of the mine. Exploitation of thinner and thinner seams, the use of plough technology, the increasing speed of mining – all these factors related to the mining technology used significantly affect the cleanliness of the coal seam exploitation. More accurate identification of the causes of increased spoil contamination by waste rock and forecasting its level at the stage of mining planning can allow the application of appropriate countermeasures, often even before the start of mining. The authors believe that monitoring the amount and sources of waste rock in longwalls and headings can provide a basis for developing a method for forecasting the mining plant’s yield. The article presents methods of modeling roof rock fall, which are the result of the work of the Team of the Division of Mineral Resources Acquisition of the Polish Academy of Sciences and LW “Bogdanka” S.A. In the future the proposed methodology can be used to analyze the course of roof rock fall, calculate the mass of roof rock fall, and calibrate a continuous system for measuring the quality of ROM in mine excavations.

1 Introduction

Modern technical and IT solutions have revolutionized the quality control system in coal mining, ensuring that the “run of mine” (ROM) coal meets the required standards before processing or distribution. One of the most significant advancements is the use of automated sampling systems and real-time monitoring technologies [1]. These systems automatically collect coal samples at various stages of the mining process, such as at conveyor belts, to assess quality parameters like moisture, ash content, and calorific value [2]. By using sensors and online analyzers, these systems provide continuous, accurate data, reducing the reliance on manual sampling, which can be time-consuming and prone to errors [3]. This automation leads to more consistent and reliable quality control, helping companies maintain product standards and meet regulatory requirements.

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In addition to automated sampling, advanced data analytics and machine learning algorithms are now integral to coal quality management [4, 5]. These IT solutions analyze vast amounts of data collected from various sources within the mine, such as geological models, equipment performance, and environmental conditions [6, 7]. By processing this data in real time, predictive models can be developed to forecast the quality of coal in different sections of the mine, allowing for more informed decision-making [8, 9]. The machine learning algorithms can predict when and where poor-quality coal might be extracted, enabling operators to adjust mining plans or processing techniques proactively [10]. This predictive capability improves overall efficiency and ensures that only coal meeting quality standards is sent for processing or shipment.

Furthermore, the integration of IT solutions with enterprise resource planning (ERP) systems enhances the overall management of the quality control process. Modern ERP systems can seamlessly link data from the mine's quality control operations with other aspects of the business, such as inventory management, supply chain logistics, and customer relations [8, 11, 12]. This integration ensures that any quality issues identified at the mine site are quickly communicated to downstream processes, minimizing the risk of delivering substandard coal to customers [13]. These systems facilitate compliance reporting and traceability, ensuring that all quality control processes are documented and aligned with industry regulations. The result is a more efficient, transparent, and responsive quality control system that supports the operational and commercial objectives of the coal mining company [14].

The integration of remote sensing technologies, as explored by [15], offers additional benefits by providing precise data for monitoring mining operations and ensuring that the quality control processes are aligned with the geological characteristics of the mining site . Furthermore, the application of terrestrial laser scanning, as discussed by [16], can be used to monitor the physical aspects of mining operations, thereby supporting the ERP system with accurate, real-time data that contributes to maintaining the quality standards of the mined materials.

Underground mining in the Lublin Coal Basin, which has been carried out for more than 40 years, was for 30 years based exclusively on the shearer mining technique. It required constant operation of the shearer in the longwall and movement of the operator behind the operated machine. The constant presence of the operator in the longwall, as well as the dimensions of the shearer and the longwall conveyor, determine that the shearer technique in this design can be used effectively in longwalls with a height of more than 1.6 m.

The "Bogdanka" mine has improved the technology of longwall mining using the shearer mining technique to a satisfactory level in its previous mining activities. As a result, it has achieved a high concentration of exploitation, high productivity and favorable economic results, when mining seams with a thickness of more than 1.6 meters. This technique, in the case of Lubelski Węgiel "Bogdanka" S.A., in seams 2.0 ÷ 2.5 m thick, makes it possible to achieve daily extraction from a single longwall of up to 20.000 Mg of coal ROM, and up to 15.000 Mg in longwalls 1.6 ÷ 2.0 m thick [4].

In low shearer longwalls there is both a natural and forced by the geometric dimensions of the longwall equipment tendency to increase the height of the longwall, which is most often realized by ripping the floor and the roof of the exploited seam. This leads to contamination and, at the same time, deterioration of the quality of the excavated material.

Considering the rational and effective exploitation of coal resources located in seams of small thickness, LW "Bogdanka" S.A. in 2010 started mining with the use of ploughing technology, based on solutions tested in German mining [4].

The effective implementation of ploughing technology at LW "Bogdanka" S.A. has been recognized as an undertaking of strategic importance for the development of the "Bogdanka" mine and has been consistently implemented since 2010, when the first plough (research) longwall equipped with the new fully automated Bogdanka-1 ploughing complex was launched.

The implementation of plough technology was to ensure that two goals were met simultaneously:

– enabling the economic exploitation of seams less than 1.6 m thick, allowing the mineable coal resource base to be expanded to include those in seams 1.2 to 1.6 m thick;

– improving the quality of the excavated material by reducing the amount of waste rock taken from the roof and bottom thanks to "clean" mining.

Both goals have been achieved, and the topic of limiting the amount of waste rock from roof fall and floor ripping has resulted in the construction of an ICT infrastructure that is not to be found in any other European underground coal mine.

2 Methods

2.1 Strategies to reduce and control spoil pollution

The efficiency of raw material extraction and mineral utilization is significantly influenced by the level of contamination in the excavated material. More contamination can lead to reduced efficiency and increased costs in processing the minerals. It is well understood and widely accepted that the properties of mined coal often fall short of the quality initially observed during the exploration of the deposit [17]. This discrepancy between expected and actual coal quality can be attributed to various factors, including the presence of impurities. Consequently, the management of contamination becomes crucial in ensuring optimal resource utilization. Addressing this challenge can lead to more effective and sustainable mining operations [18].

The phenomenon of ROM contamination sometimes also called dilution is defined as a reduction in the quality parameters of the extracted mineral in a specific phase of the mining process and the organizational unit of the mining plant, caused by geological-mining or technological factors. Contamination understood in this way leads to an increase in the cost of mining and the need to enrich the mineral, thereby reducing the efficiency of the implemented production process. Contamination of ROM in mines most commonly occurs due to:

– waste rock ripping during mining of the deposit;

– the presence of any irregularities in the formation of the deposit;

– the occurrence of collapses of weakly compacted roof rocks.

A common term in the literature [19 – 21] is "off-seam contamination", which is the intentional or unintentional mixing of layers above and below the coal seam during mining. To date, in the Polish mining industry, perhaps apart from the activities of the Bogdanka, Piast and Bolesław Śmiały mines – the problem of "off-seam contamination" has not been a priority [22]. This is since there is now a widespread belief in the industry that the difficulties associated with ROM contamination are solved by mines at processing plants, through the use of appropriate enrichment technologies. However, due to changes in mining waste regulations, the costs associated with the management and disposal of tailings are also increasing [23]. It should also be remembered that the gravity enrichment used in processing plants is not a fully effective process. This applies, for example, in the case of the presence of lighter contaminating formations, such as coal shale, which, as undesirable material, ends up in the enriched coal in significant quantities.

In addition to the effects of contamination on production costs at the face, its negative impact on the costs of all subsequent processes should also be mentioned. Fig. 1 shows the impact of contamination on the main technological operations within the mine's production cycle [22].

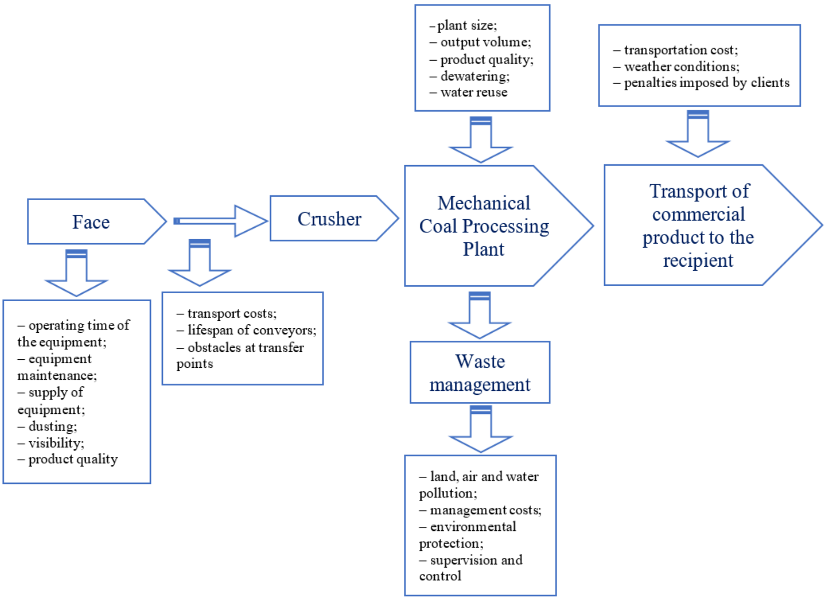

Fig. 1. Impact of contamination on an operation within the production cycle (own elaboration based on [22]).

In global mining, the anti-contamination/dillution principle developed in Canada captured by the slogan "recognize – design – mine" is very popular, with the main emphasis on prevention [18]. This method is based on two basic rules boiling down to the statement that:

– preventing pollution is better than controlling it;

– if contamination cannot be prevented, it must be controlled.

As Butcher [19] writes, the essence of the "recognize" and "design" members is prevention, while the "mine" member is responsible for control. It may seem that all mining operations should be designed so that pollution does not occur, so the "mine" part should be ignored. However, in many cases, mining systems, which excessively reduce pollution – leading in theory to "clean" mining, in practice do not meet the criterion of economic viability of the mining operations, mainly because the scale of production is too small.

In the conditions of global mining, pollution mitigation using the "recognize" principle with the large-scale use of chamber mining systems boils down to recognizing the deposit and the surrounding waste rock both geologically and geotechnically. This reconnaissance is necessary to determine the likelihood of a particular type of contamination and to define the boundaries of the mining blocks. On the other hand, pollution reduction using the "design" principle is simply the selection of the most appropriate mining system in terms of the geological and mining conditions present.

Control of spoil contamination using the "mine" principle (mining control) focuses on preventing excessive contamination by limiting the ripping of waste rock. To this end, it is necessary to select persons responsible for regularly inspecting spoil discharge points and main haulage transfer points for extraction cleanliness [18].

In Polish conditions, the exploitation of increasingly thinner seams, the use of plough technology, the increasing speed of mining progress significantly affect the cleanliness of the coal seam, and thus also the profitability of the production process carried out. At the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences (PAN) in Krakow, the Mineral Raw Materials Extraction Laboratory Team has developed its own approach to identifying the causes of increased spoil contamination with waste rock and forecasting its level, especially at the stage of reconnaissance and mining planning. This approach makes it possible to apply appropriate and effective countermeasures, often even before the longwall is put into operation, and minimize the amount of contamination. Such a method of limiting losses related to spoil contamination could not be feasible if it were not for the fact that LW "Bogdanka" S.A. is currently one of the few mines in Poland with a state-of-the-art IT planning environment for modeling and scheduling mining works that allows a team of geologists, surveyors and miners to develop models and work schedules for a given cutting variant, production level and expected spoil quality. The process of planning and accounting for production, implemented at LW "Bogdanka" S.A., corresponds to the best solutions of this type currently in the world [4].

2.2 Planning and scheduling of mining production according to the idea of "recognize and design"

Currently, in a modern mining company, the mining planning process must begin and end with a model of the deposit; the more accurate this model is, the more frequently it is updated and analyzed in detail, the more complete our knowledge of the ongoing production process and accompanying disturbances will be. As mining practice shows, the collection and correct interpretation of geological data from both the exploration phase and subsequent access and preparatory works must be the first and most important point in the production planning process [24, 25].

What is important, the digital model of the deposit is a source of information not only for geologists, but also for other departments of the mine, such as the mining production planning department, deposit quality control, or areas dealing with natural hazards [26]. The proper access of the deposit and the operation of the mining plant depend on its correctness [27]. Thus, its main goals are to document the degree of deposit exploration, prepare mining projects of the access and exploitation of deposits, and the ongoing scheduling of mining operations. A properly constructed deposit model also allows you to carry out an economic analysis of the entire mining enterprise, taking into account the qualitative variability of the final product and changes in the raw materials market [26 – 28].

Currently available software on the market allows the creation of three types of models: block, grid and mixed. Block models are mainly used for igneous deposits and seam deposits of significant thickness. This method of modeling allows to represent the image of the deposit in the form of computational blocks. The size of these blocks depends on the size, structure, complexity of the deposit and the computing power of the computer at the user's disposal. Greater variability of deposit parameters forces the user to use smaller and smaller computational blocks, so that the resulting model is as close as possible to the actual image of the interpreted deposit. This contributes to the high time consumption of executing the block model when analyzing very large and variable deposits [8].

Grid models, on the other hand, are best for seam deposits, which is why they are used most often in the modeling of coal deposits. These models are created by superimposing a grid on the surface to be modeled. Reference points are most often the locations of boreholes. The values of a given parameter at a grid node are then estimated using interpolation. There are many interpolation methods in IT tools. Among the most used are the kriging and inverted distance methods. In addition to these two methods, there is triangulation, the method of least squares or nearest neighbor, among others. A characteristic feature of grid models is that they are independently created and independently visualized and analyzed [17].

As already mentioned, the deposit model, as a spatial visualization of the deposit, is the basis for proper management of any mining plant. Currently, its role is becoming increasingly important in the Polish mining industry, which is why geological data based on which a digital model of the deposit is created is the starting point of any schedule. Their collection and skillful use allow for the correct construction of the geological model. This is important because it translates into the results of subsequent stages of work and, consequently, the final result. Discrepancies between the model and reality significantly affect the differences between planned and achieved production parameters [21, 30].

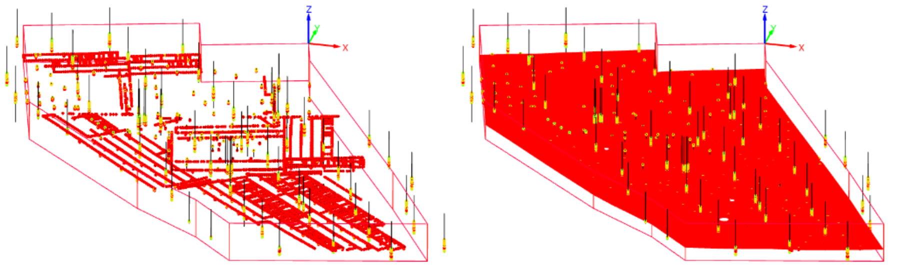

Fig. 2. Coal seam model on the background of exploration boreholes and mine excavation profiling.

The stratigraphic model of the Bogdanka deposit was built based on surface boreholes (Fig. 2), underground test boreholes and mine excavation profiling. It was built by interpolation and superposition of coordinates of stratigraphic statements and surfaces. It covers 13 documented coal seams, for which models were generated for coal quality parameters describing: calorific value, ash content, sulfur content and coal density. On the basis of the stratigraphic model prepared in this way, a rock fall model of the roof rocks was built.

2.3 Geological surveys carried out in the face of the longwall and headings

Before it was decided to use the block model of the deposit to predict the roof fall in the conditions of the Bogdanka mine, in order to learn about its genesis, the team of the Division of Mineral Resources Acquisition of the Polish Academy of Sciences, expanded by a group of young geologists, carried out a series of underground geological observations and measurements at LW "Bogdanka" S.A. over a period of 8 months.

The main emphasis of the measurements was on the observations made on the longwalls and in the headings. Geological profiles of the longwalls were made every 25 ÷ 40 meters, depending on the conditions in the excavation (sometimes the mining furrow was so small that profiles could not be made at equal intervals).

Fig. 3. Geological observations were performed using laser telemeters.

The measurements carried out by geologists in longwall faces with a height of less than 1.5 m were carried out using a laser telemeter, with which the following were measured: the thickness of the seam, the thickness of lithological separations (with an indication of the roof fall) and the leveling of the longwall workings. The measurements also included information on the position of the coal seam floor in relation to the armored conveyor (Fig. 3).

If any geological disturbances were found on the longwall, detailed notes with geological sketches were made. Based on all available data, geological cross-sections were made across the longwall, which were then subject to analysis performed together with the mining supervisor.

Measurements in the headgate and tailgate headings were taken every 20 meters with observation of the roof and more frequent profiling in case of any geological disturbances. Mapping from both longwalls and headings was then used to create geological cross sections. The knowledge gained from the observations was fully utilized during the construction of the block model of the projected roof rock fall.

3 Results and descussions

3.1 Block model of predicted fall of roof rocks

The created model was intended to represent the full lithology: overburden, coal seams, seam partings, and interbed rock. The most important element of the built model was to verify the ability to represent and analyze the fall of the roof rocks.

The block model was created on the basis of a previously made stratigraphic model of the Bogdanka deposit created by interpolation and superposition of coordinates of stratigraphic statements and surfaces. The modeling process involved importing information from the Geological Database, which was exported in the form of tables with lithological data within the deposit. The lithology information used to build the model came from the heading and longwall profiles described above.

It should be noted that data from underground boreholes were not used to build the model, as they are drilled into the roof of the heading, making them cover area outside the analyzed seam, the area of main interest. The range of the built model was set at 4 m above the seam and 3 m below the seam, where the most relevant zone from the point of view of the analyzed roof fall is 2 m above the seam. The model was created inside the solid that limits its area. The built model made it possible to represent the course of the roof fall and to estimate the mass of the roof fall or the selected lithology, if we set the densities for individual rock types.

To check the final effect of block modeling of falling of roof rocks, summed up thicknesses of each lithology in the roof fall were made, based on the results of the performed longwall profiling and the information extracted from them, and X, Y coordinates were assigned to them. Having the distribution and volume of the measured fall, isoline maps were generated.

Maps were made separately for each mining division. When generating the maps, an inverse distance interpolator to the power of 2 and an interpolation grid every 2 meters were used. Five class intervals were used in generating the maps, each with a different range of data. This was due to the high variability of the amount of roof fall ranging from 0 to 1.6 meters, with most of the fall not exceeding 20 cm.

3.2 System of continuous control of spoil contamination in the conditions of LW Bogdanka SA

At LW "Bogdanka" S.A., the fight against pollution began in earnest when the exploitation of thin seams began. This is mainly due to the geological and mining conditions in which this mine had to operate, exploiting a deposit with a thickness of even less than 1.4 meters. The concept of quality control, developed by PAS in conjunction with Bogdanka, is part of the policy of controlling the purity of the deposit's exploitation, which is being implemented in the global mining industry. The policy of limiting contamination, consistently created in recent years by the management of the LW "Bogdanka" mining plant operation, comes down to the fight against the phenomenon with both technological and organizational-economic methods, which can be called the method of "rational action" included in the framework of the widely understood "art of mining".

One of the first steps that were taken to reduce pollution was the construction of a system for continuous control of basic coal quality parameters, including continuous measurement of ash content, moisture content and calculation of calorific value in mixed coal pulp transported by conveyor belts, combined with a system of mine scales. The introduction of these solutions was intended to lead to the management of the mine's production line in the mining and processing part, with a particular focus on stabilizing the quality of the feed and improving it.

The system currently in operation at LW Bogdanka for controlling the quality parameters of the excavated material, which includes SysKon400 measuring devices installed on the district haulage lines, monitors all the mine's longwall faces. Fig. 4 presents the idea of continuous x-raying of the ROM haulage strips with a beam of gamma rays.

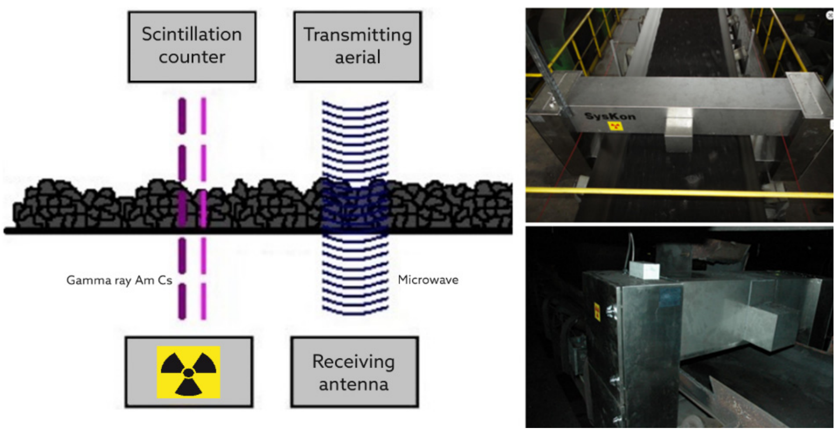

Fig. 4. Operation diagram of the ROM quality analyzer [31].

It was the first system of its kind in the Polish mining industry. It is notable for incorporating measuring devices within the underground section of the mine, which continuously monitor the quality parameters of the extracted coal. These devices were installed across all production lines, including longwalls, ensuring comprehensive oversight (Fig. 5). The system represents a significant advancement in the monitoring and management of coal quality in Polish mining operations.

The SysKon400 emits a gamma ray beam that has two energy levels derived from cesium and americium isotopes. Moisture content is measured by measuring the phase shift and attenuation of microwaves in a significant volume of the measured stream, allowing calculation of ash and moisture content and calorific value of coal. The mass of coal is determined using an isotope scale integrated into the device. The measurements continuously monitor the quality of the ROM transported by the conveyor belt. The SysKon400 measuring devices, according to the manufacturer's specifications, have an accuracy of up to 2% for ash content and an accuracy of up to 1% for moisture content, and up to 2% for spoil weight (Fig. 6). The devices are equipped with reporting software, which makes it possible to quickly determine the proportion of individual components in the excavated material, such as coal, partings of waste rock in the coal seam, roof subsidence, floor stripping [31].

Fig. 5. SysKon400, system ciągłej kontroli parametrów jakościowych węgla w LW “Bogdanka” S.A.

Fig. 6. SysKon System-Skan analyzers (left) and SysKon500 (right) [31].

Continuous control of excavated material contamination at LW “Bogdanka” S.A. is based on the use of SysKon400 analyzers underground, currently supplemented by SysKon 500, SysKon System-Skan and SysKon-Skan Lab analyzers used at various links of the mine's transport line - from the district haulage from longwall faces, through the lines of the system transporting the feed to the coal processing plant, to SysKon System-Lab laboratory analyzers. They make it possible to measure the content of many elements (including C, Fe, Si, S, Al, Ca, H) in the streams of any mineral (so far the analyzers have been implemented in hard coal, lignite and limestone mines).

By analyzing the data from [31], we obtained several crucial visualizations and measurements. Fig. 7 provides a detailed cross-section of the excavated material as it moves along the conveyor belt, highlighting both the height of the material stream (measured in centimeters on the left axis) and its calorific value (expressed in kJ/kg on the right axis). This visualization offers valuable insights into the flow and energy content of the material. The comprehensive data presented enables a better understanding of the material characteristics and operational efficiency.

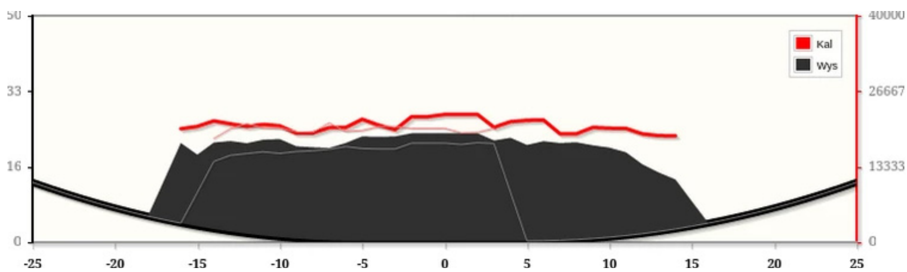

Fig. 7. Cross-section of the excavated material on the conveyor belt with visualization of the height of the excavated material stream (cm – left axis) and the calorific value of the excavated material (kJ/kg – right axis).

The results of measurements performed by the analyzers are integrated into a supervisory system that allows viewing and visualization of the measurement results from the user panel in the form of a web page [31]. Fig. 8 illustrates the measurement of the excavated material using the activation method, a technique designed to determine its elemental composition. This method involves irradiating the material and analyzing the resulting emissions to identify and quantify various elements. The visual representation provides a clear understanding of the elemental distribution within the excavated material. Such detailed analysis is crucial for assessing material quality and optimizing processing. The data obtained from this method contributes significantly to evaluating the material's suitability for different applications.

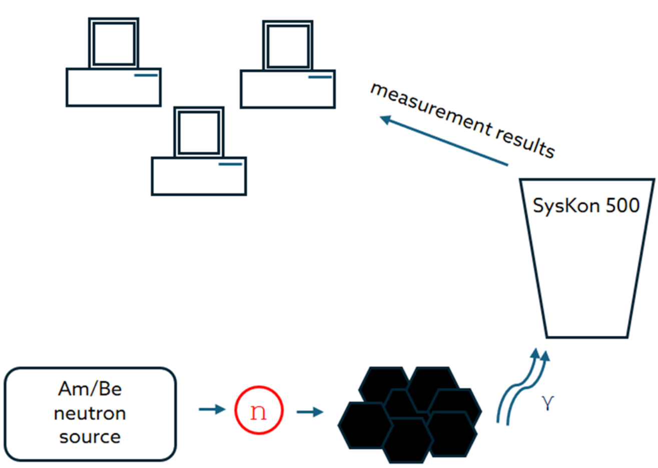

Fig. 8. Measurement of excavated material using the activation method (determination of elemental composition).

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Fig. 9 presents an example view of the SysKon user panel, offering a comprehensive look at the system's interface. This visual demonstrates the layout and functionality of the panel, including key features and navigation elements. By examining this example, users can gain insight into how to interact with the system effectively. The interface design facilitates ease of use and ensures that critical data is readily accessible for efficient monitoring and management.

Fig. 9. Example view of the SysKon user panel.

Figs. 10 and 11 provide additional examples that highlight the system's data analysis capabilities. Either the Fig. 10 shows a sample of an hourly report, which includes detailed information on various metrics recorded over the past hour. This report offers insights into operational performance and allows for real-time monitoring of key parameters.

SYSKON Raport (Chwilowy)

Za okres Od: 2022-02-08 08:00 Do: 2022-02-08 09:00

Lp.	Data	Fe	Al	S	Na	Ca	K	Wilg.	Si	Cl	Mg	Masa (t)
1	2022-02-08 08:00 - 08:05	0,92	3,24	-	-	43,47	0,44	11,79	14,46	-	-	-
2	2022-02-08 08:05 - 08:10	1,03	3,16	-	-	44,83	0,48	7,58	12,53	-	-	21
3	2022-02-08 08:10 - 08:15	1,09	3,29	-	-	44,36	0,50	7,73	12,89	-	-	40
4	2022-02-08 08:15 - 08:20	1,14	3,39	-	-	43,97	0,51	8,65	13,67	-	-	41
5	2022-02-08 08:20 - 08:25	1,03	3,25	-	-	44,31	0,48	9,11	13,39	-	-	32
6	2022-02-08 08:25 - 08:30	1,07	3,23	-	-	44,63	0,47	8,98	12,32	-	-	35
7	2022-02-08 08:30 - 08:35	1,15	3,50	-	-	43,77	0,52	8,49	13,44	-	-	35
8	2022-02-08 08:35 - 08:40	1,06	3,28	-	-	44,05	0,49	10,22	13,48	-	-	33
9	2022-02-08 08:40 - 08:45	1,09	3,27	-	-	45,24	0,48	8,71	11,32	-	-	35
10	2022-02-08 08:45 - 08:50	1,06	3,35	-	-	44,26	0,49	10,34	13,23	-	-	21
11	2022-02-08 08:50 - 08:55	1,14	3,45	-	-	44,58	0,50	9,01	12,57	-	-	11
12	2022-02-08 08:55 - 09:00	-	-	-	-	-	-	-	-	-	-	-
	Średnia:	1,09	3,31	0,00	0,00	44,37	0,49	8,83	12,92	0,00	0,00	306

Drukuj

Fig. 10. Example hourly report.

Fig. 11, on the other hand, presents a graph of transient values, illustrating the fluctuations of specific data points over time. This graphical representation helps in understanding the dynamic behavior of the system and identifying any irregularities. Together, these figures demonstrate the system's ability to generate comprehensive reports and visualizations, aiding in more effective decision-making and performance evaluation. The detailed analysis provided by these tools is essential for optimizing operations and ensuring accurate data interpretation.

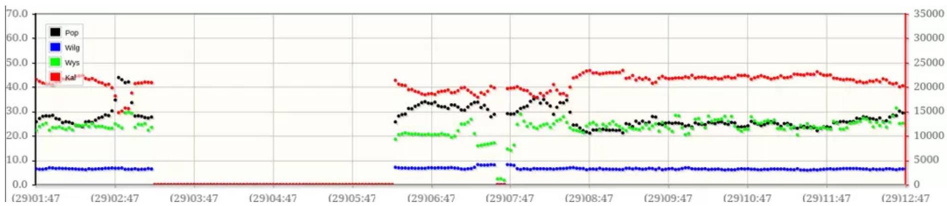

Fig. 11. Example graph of trasient values [31].

The SysKon system and a modern IT environment for multivariate geological-mining planning is at the heart of the methodology prepared by MEERI PAS for Bogdanka for performing and analyzing underground geological observations with an aim to reduce the amount of waste rock and increase the accuracy of ROM quality predictions.

Effective monitoring of mining processes requires collecting relevant samples and subjecting them to comprehensive analysis. In order to better manage such information, a system that provides real-time, high-quality data is essential, as it clearly influences the mining supervisor's decision-making. However, it all begins and ends with the traditional diligent work of the mining geologist, whose measurements and observations can allow additional use and authentication of the data coming out of continuous ROM quality control equipment [32].

4 Conclusions

The process of spoil contamination represents an unfavorable phenomenon closely linked with significant costs that are often unavoidable. Addressing this issue effectively requires a comprehensive, consistent, and methodical approach.

An exemplary strategy for combating this problem is Canada's "Recognize, Design, Mine" method, which emphasizes prevention as a primary focus. Although it may seem self-evident that preventing contamination is preferable to managing it, or that if prevention is not feasible, control measures are necessary, these statements are validated by the tangible benefits that mining companies experience from reducing spoil contamination. For many years, LW Bogdanka SA has been actively working to reduce coal spoil contamination through the continuous monitoring system using SysKon400 measurement devices and an advanced IT environment for multivariate geological-mining planning.

This integration of the SysKon400 system with a detailed geological model allows for a deeper understanding of disturbances within the deposit and may pave the way for a new approach to produc0tion accounting, transitioning from a pay-per-ton model to one based on the quality of the final product. The continuous spoil contamination control method described, leveraging SysKon400 and advanced IT tools, aligns with the development of an "Intelligent Mine" at Bogdanka – a forward-looking initiative incorporating innovative technical solutions aimed at enhancing mining efficiency while ensuring underground safety and minimizing environmental impact.

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