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Knowledge-based Modeling and Multi-objective Optimization of Production in Underground Coal Mines • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

In this paper a modern approach to the modeling and optimization of production in underground hard coal mines is presented. It begins with definitions and concepts linked to the planning processes associated with mining in hard coal mines. The main assumptions of the knowledge-based modeling of longwall characteristics are presented, as well as formulas for the optimization function. The use of mine planning knowledge discovered by Data Mining techniques is suggested as well as statistical analysis and application of the evolutionary algorithm, which is used as an optimization technique, to search for the best solutions in the engagement of longwall equipment in planned longwall faces. According to assumed criteria: the expected value of the net output of coal from the mining company [t/months] and the standard deviation of the net output of coal from the mining company [t/months]). Because of the multi-objective nature of the problem, a special evolutionary algorithm, MOEA-MPO, was designed. In this paper, we attempt to solve the problem of optimizing mining production for d longwall faces and n equipment installations with adequate constraints. MOEA-MPO deals with a population of N individuals representing candidate solutions linked to the optimization problem. Each individual encodes an integer vector \mathbf{x} of length d , where each coordinate x_i of the vector \mathbf{x} corresponds to the number of the equipment installation assigned to the i -th longwall face (therefore, $x_i \in \{1, 2, \dots, n\}$). In the proposed algorithm, three types of mutation operators as well as a crossover operator were implemented. The main elements and results obtained are described in the paper.

Keywords: mine planning, modeling, optimization, knowledge base, evolutionary algorithm

KAZIMIERZ CZOPEK, BEATA TRZASKUŚ-ŻAK

Managing of receivables in the case of reserves in mine winding capacity • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

This article presents two methods for the managing of receivables in the case of incomplete mine winding capacity. The first method is to apply one of various discount variants, specifically, to propose a discount to trade contractors in exchange for increased product purchases. In the second method, there is proposed an extended payment period for recipients in the form an extension of the trade credit system, with the same product sales price, but with a requirement of increased purchases by recipients is proposed. Both methods require free production capacity and the acceptance of the proposed solutions by recipients.

Keywords: receivables management, receivables

MALWINA KOLANO, JAKUB MAZUREK

The results of the research on physical and mechanical properties of rock analogues and moon soils • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

The article concerns the testing of the physical-mechanical properties of rock analogues and moon soils. The materials tested are mainly: loose material (JSC 1A, Chenobi, AKG2010, Phobos) and firm highly-porous (Foam), as well as firm

slightly-porous material (material analogue of Phobos moons). In this article the results of volumetric density/bulk density determination, and the determination of porosity, coefficient of consolidation and compressive and shear strength tests are looked at. The tests were done within the international project entitled Instrument "CHOMIK" ("HAMSTER") of Phobos Sample Return Mission, conducted by Space Investigation Center, Polish Academy of Science.

Keywords: *rock analogues, moon soils, physical-mechanical properties*

TOMASZ MARCINISZYN, ADAM SIERADZKI, RYSZARD POPRAWSKI

Resonance phenomenon in the quartzite from Jegłowa (Poland) • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

The quartzite rock has been characterized by dielectric investigation. On the basis of complex dielectric measurements in a wide temperature (50–320 K) and frequency (10^2 – $3 \cdot 10^7$ Hz) ranges the resonance at about 20 MHz was found. The proposed method is based on the resonance phenomenon which allows for the detection of grains of quartz and calculates their size in the studied material. Based on this method, the average size of the quartz grains (0.16 mm and 0.14 mm) embedded into quartzite was determined. Dielectric measurements of the quartzite samples annealed at 800°C, 900°C and 1000°C were performed. Results from the analysis using X-ray fluorescence (XRF) showed that the chemical composition remains unchanged after the thermal treatment, despite of the well-known crystal structure changes.

Keywords: *quartzite, piezoresonance, dielectric measurements*

BERNARD NOWAK, KRZYSZTOF FILEK

Indirect mine air-cooling by cooler of water • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

Indirect cooling of mine air via a membrane cooler, fed by cold water passed through an evaporator cooled by refrigerant, has been presented in this work. On the basis of the results of air, water and refrigerant enthalpy and mass of vapour in the air, mathematical equations have been determined. Sudden and concentrated changes in parameters were also introduced and heat exchanger cooling times taken into consideration. Based on the model, the exemplary calculations of temperature and humidity changes in cooled air in the water cooler and the temperature of cooled water in the evaporator were established; the results obtained have also been summarized in a table. The heat power of air cooler – from the air side (with divided into sensible capacity of cooling and latent capacity of drying) and from the water and evaporator side – from the water side and from the refrigerant side was calculated.

Keywords: *air-conditioning of mine, air cooler of water, refrigerator, refrigerant R507*

KRZYSZTOF POLAK, ROBERT RANOSZ

The methodology of assessing the value of a water reservoir • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

The objective of this article is to present the methodology of assessing the value of water reservoirs as well as the need for conducting such assessment. The paper discusses the methods most often applied for the utilization of pits reclaimed in water mode. The choice of the method used for the assessment of water reservoirs depends on the mode of utilization and the economic possibilities of the reservoir. The basic methods used for the assessment of the value of the mentioned reservoirs include: the economic approach or the comparative method (in specific cases one may also use the mixed method). The first of these methods may be used only when the property will be used for economic purposes while in the majority of other cases the comparative method is used. The article presents examples of water real estate valuations in Poland.

Keywords: *valuation, comparative method, water reservoir, utilization of pits*

Research review of the influence of millisecond delay on intensity and structure of vibrations induced with blasting works in Polish strip mines • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

In the article research presented and results reviewed referring to the subject of the influence of millisecond delays on intensity and frequency structure of vibrations induced by blasting works in Polish strip mines of raw rock materials. It demonstrates how opinions have changed due to the new possibilities of inducing delay. The conclusions presented have taken many years to compile.

Keywords: *millisecond blasting, blasting works, ground vibration*

NATALIA SCHMIDT-POŁOŃCZYK

Computer modeling of a fire hazard and evacuation of transportation tunnels with longitudinal ventilation system • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

In recent years more and more tunnel construction project investments in Poland have focused on the fact that safety has not been given enough attention. One of the most serious risks in a tunnel is that of an explosion of fire. In the case of a fire in a road tunnel, one of the most important factors is tunnel user self-evacuation. This article presents an evaluation of the possibility of evacuation using various calculation methods in relation to the fire hazard related to road tunnels.

Keywords: *safety in road tunnels, fires in tunnels, fire safety, evacuation*

NIKODEM SZŁĄZAK, DARIUSZ OBRACAJ, MAREK BOROWSKI, JUSTYNA SWOLKIEŃ, MAREK KORZEC

Monitoring and controlling methane hazard in excavations in hard coal mines • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

At present Polish mining regulations require the use of methane monitors with short or fast response times for current switchboard types when methane hazards co-exist with rock-burst hazards. According to regulations the number and location of sensing devices for methane monitors should be consistent with the conditions present in any given monitored area. This article presents an analysis of regulations referring to a control system and methane hazard monitoring. The analysis takes the Polish legislative system into consideration and looks at regulations in selected countries with well-developed mining industries. Methods for methane hazard control in blind headings with auxiliary ventilation and in mining areas are also discussed. Methods are illustrated by using examples of monitoring methane hazard control in driven roadways and in longwalls ventilated by U and Y systems.

Keywords: *methane monitors, methane hazard control, longwall ventilation system, work safety in mines*

NIKODEM SZŁĄZAK, DARIUSZ OBRACAJ, BARTŁOMIEJ GŁUCH

Estimation of microclimate conditions at longwall excavations in hard coal mines • AGH Journal of Mining and Geoengineering • Vol. 37, No. 1, 2013

Problems associated with microclimates in Polish hard coal mines are becoming more and more frequent. In the near future these conditions may worsen as it becomes necessary to carry out more concentrated mining production at deeper levels. Difficulties surrounding underground microclimates can lead, not only to a decline in labor productivity, but also health risks and threats to the lives of the miners themselves. This article presents

an analysis of microclimates in longwall mines based on popular microclimate indicators: relative index of air cooling power K_{ra} , equivalent French temperature TFR , equivalent temperature of climate t_{ek} , and wet-bulb globe temperature index ($WGBTp$). Workers' thermal comfort is assessed on the basis of measurement results of air flow parameters in longwall mines. The assessment was carried out on the basis of effective temperature ATE and thermal discomfort indicators depending on the thermal insulation of clothing, metabolic rate or acclimatization. Polish legislation taking into account other microclimate indicators for full-time and shortened work periods is also presented.

Keywords: *hard coal mines, thermal work conditions, microclimate indicators*