

## **RECOMMENDED SYSTEM WITHOUT PILLAR DEVELOPMENT OF METADEPOZIT IN THE CONDITION OF A SECTION "MARZQN NORTH", MINE "ERMA RIVER"**

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**ABSTRACT.** Conditions metadepozit under hor.515 at the "Marzyan" proposed variants system and technology without pillar working off the stocks in the area. Proposed are three main options and sub them. By deliberately selected and ranked in severity qualitative criteria is evaluated options. Based on the maximum assessment is recommended for application option "Chamber system with support columns." Set out the advantages and disadvantages of the preferred option.

**Keywords:** metadepozit, system of exploitation, evaluation, qualitative

## **REMOTE CONTROL OF THE MAN-MADE MASSIVES STATE AT THE MINING ENTERPRISES**

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**ABSTRACT.** The experience of exploitation of the dumping structures at the mining enterprises shows that large-scale and, in some cases, catastrophic accidents of the following structures happen as a rule with the lack of safe control of the man-made massives' state. So, development of the efficient means and methods of control is considered very actual and allows specifying the construction of the slope structures in time and develops the efficient measures to protect water-land resources. Using of the remote control methods allowing identifying the coefficient of the safety of the slopes stability and bearing capacity of the loose dumping foundations is directed towards the providing the industrial ecological safety of the dumping tails and provides the improvement of their economic characteristics. There were considered the results of the introduction of the system "Orfey-1" with the wireless transmitting of data at the objects of the Stolensky GOK (Kursk Magnet Anomaly, Central Russia).

**Keywords:** Remote Control, porous pressure, slope structures, landslades deformation

## **ORGANIZATION OF FACILITIES FOR CONSTRUCTION WASTE**

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**ABSTRACT.** The study of the organization of treatment sites of construction waste includes the definition of the activities, operations and facilities for their treatment and technological connections between them, determining the total capacity of the site depending on the terrain and the projected amount of waste. The article presents some basic conditions, for the selection sites, general machinery and equipment, minimal labor, based on was explore technological connections and plans installation of functional areas. The choice of one or another technological scheme plays an important role in the ability to provide a transport link with the existing road network size and configuration of the property, potential for expansion and more.

## **SOIL REINFORCEMENT WITH SYNTHETIC FIBRES**

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**ABSTRACT.** This report describes a laboratory program where the shear strength of a mixture of soil and mixed-grained soils with short synthetic fibers has been studied. The influence of the quantity of fiber on the shear strength of reinforced soils in the frame shear device and the triaxial shear device according to DIN 18137 was investigated. There have been non-reinforced and reinforced soil samples under loose and under medium-density storage, and in dry (sand only) and in a fully saturated condition comparatively studied. The results in relation to the shear strength are clear: fiber reinforcement increases the shear resistance substantially. The shear resistance of the soil increased with the increase in the proportion of fiber. The investigations show that the maximum fiber content is 0.25% to 1.0%. A larger proportion of fiber can mix the fibers with the soil not more homogeneous. An increased segregation during the sample preparation at higher fiber content is also observed.

## **NEW TOOLS THAT CAN BE USED IN VENTILATION NETWORKS**

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**ABSTRACT.** Explosion type phenomena which may occur at the level of a ventilation network generate changes of the network's structure determined mainly by the destruction of ventilation constructions. The flame front generates a high quantity of burning gases having an extremely high temperature, which leads to their rapid expansion. The phenomenon of the explosion causes serious disturbances in the ventilation system. May occur reversal of the direction of air flow, unventilated or poorly ventilated areas or destabilizing the functioning of active fan. These are a few reasons for that restore ventilation becomes priority. Within FFCS Coal RTD Programme was developed AVENTO project - Tools for Advanced Ventilation Methane Emissions and Control, which had one objective restore ventilation network, affected by explosion.

**Keywords:** ventilation, explosion, re- establishment ventilation network

## **IMPLEMENTATION OF NON-EXPLOSIVE TECHNOLOGY FOR MINING BY USING SURFACE MINER WIRTGEN 2500 SM IN KOZYAK QUARRY**

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**ABSTRACT.** Currently at 2016, the limestone quarrying in Kozjak pit, located next to Slivnitca city, Sofia municipality, is achieved using the drilling and blasting technique and an auxiliary mechanization. The extracted material, 0 – 500 mm in size, is then processed by means of a mobile crushing plant. Each of the following operations: drilling, blasting and primary crushing of the yielded limestone, aiming at reducing its size to 0 – 180 mm, increases the final sale price of the material and has a negative impact on the environment. The implementation of a without blasting technology into the quarry process by using the Surface Miner Wirtgen 2500 SM, would improve the pit productivity and will show positive results.

## **COMPARATIVE ANALYSIS BETWEEN TWO INSTALLATIONS FOR PROCESSING THE LIMESTONE MINED IN KOZYAK QUARRY**

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**ABSTRACT.** From 2008 to 2015 the processing of the extracted limestone in career "Kozjak" was performed using a crushing - sorting plant with two modes of operation: the first one aimed the production of fractions 0/4, 4/8, 8 / 12, 12/20, 22/50, 50/80 while the second mode of operation was used for producing material for back filling 0/80. At the end of 2015, in order to increase the yield and the quantity of the processed material, a new crush - sorting plant was constructed. This report characterizes and analyses in details both installations, a comparative analysis of their performance and efficiency was performed, pointing the benefits and the disadvantages of the two plants for processing of the harvested career inert material and the performance of the forecast quantities of extracted and refined limestone.

## **ROADABILITY OF A MINING DUMPER TRUCK ON ROADS WITH TRANSVERSE SLOPE**

**Stefan Pulev**

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**ABSTRACT.** This work investigates the motion of a mining dumper truck on a straight road with a significant transverse slope. A one-mass dynamic model with one degree of freedom is used. The angle around the longitudinal axis that passes through the truck's centre of mass is chosen as a generalised coordinate. The differential equation of the transverse angular vibrations is derived and solved analytically. It is assumed that a side overturn happens when the normal force of the road on the upper set of wheels reaches zero. The critical values of the road's transverse slope that may lead to a side overturn are calculated.

## **APPLICATION OF THE FINITE ELEMENTS FOR TESTING THE SLOPE STABILITY OF FU SHUN (CHINA) AND MARITZA-IZTOK OPEN PITS (BULGARIA)**

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**ABSTRACT:** The Finite Element Method (FEM) is a numerical method that appeared and has developed rapidly with the emergence and evolution of computers. The method is suitable for studying the condition and predicting the behavior of rock mass and is used where other methods, such as analytical ones are inapplicable. Initially, FEM was applied to solve the problem of linear elasticity theory but very soon three iterative approaches for solving nonlinear physical tasks were developed. Such are the tasks for the study of the stress and strain state of weak rocks. This paper discusses the application of FEM for slope stability analysis of Fu Shun and Maritza-Iztok open pits built mostly of clay varieties. The results obtained and the analyses are consistent with those obtained by traditional methods which are widely used in our current practice. Additional information obtained by FEM at each point of the rock mass allows gaining a full picture of the stress and strain state of the slopes and their stability.

**Keywords:** Finite element method (FEM), slope stability

## **PROGRAM REALIZATION OF A NONLINEAR STOCHASTIC MODEL IN MINING SUBSIDENCE - INCLINED SEAMS PART I**

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**ABSTRACT.** This paper is in the field of mining geomechanics. The investigation is focused on the mining subsidence when mining out underground ore bodies. As a basis, the nonlinear stochastic theory is proposed. The main equation is obtained as a nonlinear parabolic one with the assumption that the rock mass is a stochastic medium consisting of elastic parts. In this paper the plane problem for the nonlinear Fourier equation by mining out of inclined seams is solved numerically. An original algorithm for solving the plane problem is proposed. An efficient program realization on the basis of the HTML, CSS, PHP and Java Script technologies is proposed. A description of the programs used is included.

**Keywords:** Rock mechanics, mining subsidence, nonlinear stochastic theory, inclined seams, applied software

## **PROGRAM REALIZATION OF A NONLINEAR STOCHASTIC MODEL IN MINING SUBSIDENCE - INCLINED SEAMS PART II**

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**ABSTRACT.** This paper is in the field of mining geomechanics. The investigation is focused on the mining subsidence when mining out underground ore bodies. As a basis, the nonlinear stochastic theory is proposed. The main equation is obtained as a nonlinear parabolic one with the assumption that the rock mass is a stochastic medium consisting of elastic parts. In this paper the plane problem for the nonlinear Fourier equation by mining out of inclined seams is solved numerically. An original algorithm for solving the plane problem is proposed. An efficient program realization on the basis of the HTML, CSS, PHP and Java Script technologies is proposed. A description of the programs used is included.

**Keywords:** Rock mechanics, mining subsidence, nonlinear stochastic theory, inclined seams, applied software

## **FIRE ACCIDENTS IN ROAD TUNNELS – STATISTICS, ANALYSIS, MODELLING**

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**ABSTRACT.** For the period of 14 years (1995-2009) fire accidents in transport tunnels cause serious material damage and 1193 human lives. These events instigated greater requirements for safety system in transport tunnels. Yet at a design level safety system should be a part of the whole project documentation. Safety system incorporates different sub-systems which non-coordinated performance in accident might worsen the situation rather than improve it. This paper presents throughout statistics for fire incidents in transport tunnels making stress on most frequent reasons for their occurrence. The reflection of monitoring systems' parameters and accidental ventilation mode on accident development and elimination are discussed. Further applicable methods and approaches for accidental situations modeling are presented in order to study in advance ventilation system behavior and its interaction with other safety sub-system in the tunnel – monitoring and fire suppression systems.

**Keywords:** fire in road tunnels, emergency ventilation, fire suppression systems, safety system

## **WIND VENTILATION OF INDUSTRIAL EXPLOSIVES STORAGE FACILITIES**

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**ABSTRACT.** Ventilation of special facilities such as industrial explosive stores is a specific task predefined by the particular access regime, on the one hand and by the requirements for maintaining of exactly specified micro-climatic conditions therein, on the other hand. Mechanical ventilation is associated with special requirements in respect of electrical equipment, and often avoided its implementation. Under the current rules and instructions ventilation of stores is done through infiltration and directed by natural ventilation by opening windows and doors for a specified time. The human factor determines the possibility and advisability of ventilation of stores for industrial explosives, leading to unsatisfactory results. The paper discusses and presents one particular approach – ventilation of such premises by means of engineless wind driven ventilator. The necessary preconditions for implementation of such approach are analyzed – preliminary analyses, measurements and calculations, compliance with work regime and ventilation of explosive stores. Presented is a method for selecting the suitable windventilator and number of fans to provide ventilation. An example for windventilation of real stores for industrial explosives.

**Keywords:** ventilation, storage, industrial explosives, windventilator, natural ventilation, wind driven ventilator

## **INDOOR CARBON DIOXIDE CONCENTRATION OF A LECTURE HALL WITH NATURAL VENTILATION**

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**ABSTRACT.** Carbon dioxide (CO<sub>2</sub>) is one of the important parameters determining air quality in indoor rooms including classrooms and lecture halls. Its raising twice and sometimes a lot more times than the accepted norm (400 ppm - 1000 ppm, according to DIN-1946-6) adversely affects the concentration of attention and mental work of the students and the teacher. To provide and maintain an acceptable level of CO<sub>2</sub> concentration in the air in classrooms and workplaces it is necessary to performed continuously or periodically air ventilation. In the present work the results of the study of the spatial distribution of the carbon dioxide concentration and temperature in two lecture halls with a volume of 103 m<sup>3</sup> and 300 m<sup>3</sup> were presented. Furthermore, the evolution of these parameters depending on the number of people in the hall and the intensity of natural ventilation was tracked.

**Keywords:** Carbon dioxide, indoor air quality, natural ventilation.

## **TECHNOLOGICAL POSSIBILITIES FOR MAXIMUM MINERAL LIBERATION IN THE COMMINUTION CIRCUIT OF ASSAREL CONCENTRATOR**

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**ABSTRACT.** The comminution circuit (crushing, grinding, screening, classification etc.) in the mineral processing industry, could be qualify as a significant stage during the processing of the mineral raw materials, due to the necessity of the valuable minerals liberation from the gangue. Furthermore, the character of the comminution technologies could be described as a process of formation of newly mineral surfaces with defined particle size. The maximum liberation of the valuable mineral surfaces it is of great importance for the conventional mineral-separation processes, such as flotation, gravity concentration, magnetic and electrical separation. The aim of this paper is to review a part of the results, analysis and recommendations, obtained after the accomplished technological audit of the comminution circuit in Assarel concentrator. The scope of the research includes a development of sampling procedures for representative sampling of the main process streams in the Assarel concentrator, analysis and data preparation, on the basis of which a comments and recommendations covering the feasible technological methods allowing a maximum liberation of the valuable minerals, from which the quality of the flotation process strongly depends.

**Key words:** liberation, valuable minerals, technological audit, comminution

## **DYNAMICS OF A TWO-MASS RESONANCE SCREENING SYSTEM**

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**ABSTRACT.** A two-mass mechanical model of a resonance screening system with one degree of freedom is investigated. The differential equations of motion are derived and solved analytically. Graphs for the law of motion of the screening surfaces and for the of amplitude-frequency response of the vibrations are also provided.

## **DEVELOPMENT OF HYDROMETALLURGICAL PILOT PLANT PROCESS FLOWSHEET FOR COPPER AND PRECIOUS METALS RECOVERY FROM METALLURGICAL WASTES**

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**ABSTRACT.** The complete process flowsheet for hydrometallurgical copper and precious metals recovery from different metallurgical wastes will be the subject of a pilot plant test at the end of 2016. This pilot plant will treat the wastes through a fully integrated, custom built pilot plant with the major focus to confirm that these materials could be leached in an appropriate media and that the solvent extraction and zinc dust precipitation systems could be used to recover copper and precious as commercial products. The target waste materials will be those produced by electroplating shops, metal finishers and metal refineries like metallurgical slags and dusts, sludges from the wet dedusting of burned gases, and melting losses. The process selected for the pilot plant involves oxidative pressure leaching of the milled/wetted waste, conventional solid/liquid separation of the leach slurry in high rate filter press, copper solvent extraction and electrowinning, and recovery of precious metals as a Dore bullion product via leaching, zinc dust cementation and smelting. The pilot plant test goal will be to test and demonstrate the chemistry and processing of the metallurgical wastes over an extended period and to produce final products for evaluation and commercial sampling. The purpose of this paper is to review the proposed process flowsheet and characteristics of the processes used, and to comment on the potential to produce high quality copper and precious metals products from waste materials.

**Keywords:** metallurgical wastes, copper, precious metals, leaching, solvent extraction, precipitation

## **CEMENTATION OF PRECIOUS METALS FROM ACIDIC THIOUREA SOLUTION**

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**ABSTRACT.** The rapid development of non-cyanide recovery of precious metals leads to the need of study the follow methods to their cementation. Studies of the process cementation of gold and silver from an acidic thiourea solution are most often carried out with zinc, aluminum and iron powder, or by precipitation with sodium sulphide. Worldwide have been conducted numerous laboratory tests to determine the effectiveness of these methods. The obtained high degrees of cementation of valuable components give reason those methods to be considered suitable for use under particular conditions.

**Keywords:** cementation, iron powder, thiourea

## **CYANIDES CONCENTRATION AND SPECTROPHOTOMETRIC DETERMINATION, MEETING THE TIGHTEN REQUIREMENTS FOR SURFACE WATER MONITORING**

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**ABSTRACT.** Tightened requirements for surface water monitoring pose in front of small laboratories challenges related to determination of cyanides concentrations. A reliable simple method for cyanides preconcentration in real water samples, preserved by addition of NaOH to pH 12.0-12.5, is proposed. The optimum conditions found are: water samples evaporation, as alkalisied, at 70 °C, while being stirred or without stirring, for up to one hour to achieve 2.5-3.5 fold concentration of the sample. The cooled preconcentrated samples, can be analysed using Spectroquant® 1.09701 Cyanide Test, which corresponds to DIN 38405-13 and is analogous to ISO 6703, EPA 335.2, APHA 4500-CN-E, and ASTM D2036-09 D. Concentrations in the range of 0.001 – 0.005 mg/L free CN<sup>-</sup> can be determined with satisfying accuracy and reproducibility.

**Keywords:** cyanides, surface water, spectrophotometry, monitoring, ion exchange,

## **IMPACT OF PLUTONIUM RECYCLING ON NUCLEAR FUEL CYCLE'S MATERIAL BALANCE**

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**ABSTRACT.** Currently, the most widely used nuclear fuel type for power reactors is enriched uranium dioxide. The uranium-235 enrichment level is up to 5%. A certain amount of thermal energy is produced as a result of the nuclear fission reaction which leads to decreasing of the uranium-235 concentration to such levels that sustaining nuclear fission chain reaction becomes impossible. At this moment the spent fuel is discharged from the reactor and is replaced by fresh nuclear fuel. In order to use up all fissile isotopes in the fuel, the reactor must operate infinitely; therefore, some unused fissile material is left in the spent fuel – some 1% uranium-235 and about as much plutonium. Considering that the spent fuel discharged from a single light water reactor amounts at 20 to 30 tonnes, and there are more than 430 such reactors operating worldwide, those residual uranium-235 and plutonium could be considered as an additional energy resource. One way to recycle these isotopes is by spent fuel reprocessing, fissile material extraction and mixed uranium-plutonium oxide (MOX) fuel manufacturing. This fuel type could be used in the contemporary nuclear power reactors. This article considers the impact MOX fuel usage has on the needed amounts of uranium concentrate, enriched uranium, separative work, uranium enrichment plants' capacity, and the quantities of depleted uranium produced during uranium enrichment that are usually warehoused. The savings of uranium concentrate and separative work are analysed, as well as the effect the recycling has on the primary energy resource utilization.

**Keywords:** nuclear fuel cycle, plutonium, mixed uranium-plutonium fuel, MOX, material balance

## **TREATMENT OF OILY WASTEWATER**

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**ABSTRACT.** Oil drilling is accompanied by extraction of huge amount of water that contains dissolved and dispersed organic compounds. In this paper treatment of oily wastewater by coagulation is reported. The effect of two reagents on the coagulation and sedimentation processes is studied. The wastewater was analyzed before and after treatment.

**Keywords:** treatment, oil wastewater, Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, zeolite.

## **OILFIELD PRODUCED WATER - CHEMICAL COMPOSITION AND ASSESSMENT OF ITS IMPACT ON THE ENVIRONMENT**

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**ABSTRACT.** Waste water from crude oil production is often polluted by organic compounds, suspended solids, heavy metals and microorganisms. On one side discharge of oilfield produced water into natural water bodies could lead to environmental pollution and on the other side the contaminants hamper reuse of the water. The article presents the results of analysis of produced water from an oilfield in the Republic of Bulgaria - in terms of chemical composition, physicochemical and microbiological parameters. The data obtained show that produced water meets the legislation requirements and it cannot be considered as a source of environmental pollution. Field observations and analytical results revealed that most probably the microbial activity causes clogging and corrosion of the enterprise pipelines.

**Keywords:** oilfield produced water, oily wastewater

## CONTAMINATION AND TREATMENT OF OILFIELD PRODUCED WATER

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**ABSTRACT.** In the world economy the production of crude oil and natural gas still continue to play a major role for energy demand of the population. Produced water is more than 70% of the total fluid and it has increased gradually in the recent years instigating to new challenges in the industry and research. A large amount of produced water remains after the oil-water separation that is discharged in the sea, injected underground, re-used to boost oil production, recycled for irrigation, washing or drinking. Numerous treatment technologies are applied for produced water in order to meet the legislation requirements. This paper is a review about the origin and contamination of oilfield produced water, current treatment methods for produced water and perspectives for its utilization.

**Keywords:** oilfield produced water, treatment methods, oilfield wastewater

## NANOSIZED PARTICLES APPLY TO ARAMID FIBERS

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**ABSTRACT.** Examined non-flammable fabrics based on aramid suitable protective equipment for workers in the mining case. The system of aramid fibers is adequate protection at high temperatures, molten metal and mechanical loads. Finish treatment with the nano-emulsion based on silicon dioxide is applied in order to improve the physical and mechanical characteristics of the fabric. Testing is made for incombustibility, and strength is performed according to BDS EU ISO 13934 1: 2013. Scanning electron microscopy, detected nano-sized silicon particles on aramid fibers.

**Keywords:** nanoemulsions, silica, aramid fibers

## CEMENT WERK DER ZUKUNFT

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*HAYER NIAGARA GmbH*

**ABSTRACT: HAYER NIAGARA - Ihr starker Partner in der Aufbereitungstechnik.**

Die Kernkompetenz der HAYER NIAGARA GmbH sind die Lösungsfindung in den Bereichen Sieben, Waschen und Pelletieren. Hierfür bieten wir Gesamtlösungen, die individuelle Kundenwünsche integrieren und realisieren. Das Produktprogramm von der HAYER NIAGARA GmbH trägt der Prozesskette in den Bereichen Mining-, Industriemineralien, Chemie-, sowie Baustoff- und Recycling- Industrie Rechnung. Das aktuelle Angebotsspektrum der „Aufbereitungstechnik“ reicht von der Individuallösung mit Einzelmaschinen, über Systemkonfigurationen bis zur schlüsselfertigen Übergabe komplexer Anlagen. In Zusammenarbeit mit unseren Kunden oder auch mit führenden Engineeringfirmen und Verfahrensgebern entwickeln wir nachhaltige Lösungen zu vollsten Zufriedenheit unseren Kunden.

## ADSORPTION/DESORPTION OF ARSENATE ON/FROM GOETHITE AND HEMATITE

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**ABSTRACT.** Arsenic migrates in environment as anions and for that reason its mobility is not strong dependent on pH and redox conditions in the ecosystems. The main aim of this article was to study adsorption/ desorption processes of arsenates on the surface of crystalline ferric iron oxides (goethite and hematite) as the main mechanism to decrease the exposure of aquatic organisms to that pollutant. Adsorption and desorption isotherms as well as the relevant kinetic rate constants, determined by pseudo- first and pseudo-second order equation rate, were the main parameters for the adsorbents evaluation. The results shown that point of zero charge (PZC) of the relevant type iron oxide and the pH of treated waters were the key factors governing arsenate adsorption.

**Keywords:** arsenate, goethite, hematite, adsorption, point of zero charge (PZC), kinetic

## MODELING OF THE ATMOSPHERIC DISPERSION OF FINE PARTICLE MATTERS (PM<sub>10</sub>) RELEASED DURING THE OPERATION OF TPP "MARITZA EAST-2", BULGARIA

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**ABSTRACT.** The main aim of this article were modeling of PM<sub>10</sub> dispersion in the atmosphere released during the operation of TPP "Maritza East-2" and at what distance their concentration in the ground atmosphere could be higher than the relevant Maximum Admissible Concentration (MAC). The model was based on the following assumptions: the lignite consumption and the pollutant's emission rate to the atmosphere were constant, the atmosphere conditions (temperature, direction and wind speed, etc.) were also constant on hourly base, and the wind speed was higher than 0.9 m/s. Having in mind the lignite's ash content and the efficiency of electroprecipitators operation, 2.45 g PM<sub>10</sub> /m<sup>3</sup>s was calculated as the emission rate of the power plant to the atmosphere. PM<sub>10</sub> dispersion was modeled in dependence on the atmospheric stability categories which determined the effective plume-rise height ( $h_e$ ) in the atmosphere at the relevant climatic conditions and the specific values of pollutant dispersion coefficients ( $\sigma_y$ ,  $\sigma_z$ ). The wind rose for a period July 2015 – January 2016 determined that the plume released in the atmosphere will be transported in north direction to Nova Zagora town by means of south wind with prevailing wind speed up to 5 m/s. However, the model determined that the ground concentration of PM<sub>10</sub> would be higher than MAC during the night and at a distance of 6.25 km from TPP "Maritza East - 2" if the hour lignite consumption was higher than 2250 tone coals/ h as well as the ground wind speed was lower than 5 and 10 m/s for atmospheric stability classes E and D, respectively.

**Keywords:** particle matters (PM<sub>10</sub>), modeling, TPP, atmosphere stability categories

## **ANALYSIS OF THE SEDIMENT MICROBIAL FUEL CELLS OPERATION, PLANTED WITH DIFFERENT VEGETATION**

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**ABSTRACT.** Sediment microbial fuel cells (SMFC) are a relatively new technology, fundamentally different from the main microbial fuel cell, in which the oxidizable carbon compounds and other components of the sludge are used for energy production. The plant SMFCs transform the solar radiation into green electricity in a clean and efficient manner through the integration of roots of a living plant in the anodic compartment of a SMFC. This study is related to determination of the efficiency of SMFC where vegetate different plants. For the purposes of this study are used five sediment microbial fuel cells, three of which are planted with typical water plants (*Carex acuta*, *Carex disticha*, *Typha angustifolia*), one is inoculated with a mixed culture of algae (*Chlorella*, *Scenedesmus*, *Oscillatoria*) and the last sediment cell is used as a control. The substrate for sediment microbial fuel cells is selected after preliminary analysis of electrochemical parameters in different ratios soil - peat. After two months of vegetation were studied basic electrical parameters, pH, redox potential, conductivity, permanganate oxidation and concentration of nutrients into the water. From the obtained data it is found that the best electrochemical parameters are achieved in sediment cell planted with *Carex disticha*

**Keywords:** Plant sediment microbial fuel cells, Sediment microbial fuel cells

## **HIGHLY-LUMINESCENT CARBON NANOPARTICLES AS SENSORS FOR MONITORING OF HEAVY METALS**

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**ABSTRACT.** Here we develop highly-luminescent carbon nanoparticles as sensor for monitoring of heavy metals in aqueous solutions in microscopic scale objects. The sensor systems possess selectivity and sensitivity towards the detection of some biologically important metal ions as  $\text{Fe}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Ni}^{2+}$  and etc. To achieve this goal the nanoparticles were synthesized by microwave assisted pyrolysis. Their quantum yield is over 50 % and with blue photoluminescence peak at 450 nm wavelength. The nanoparticles at fixed concentration were tested on various soluble metal ions. For first time the observed chemically induced fluorescence was detected by fluorescence microscope and CCD camera. Thus it is enables to measure the generated signal in microscopic objects by software ImageJ. The results revealed that the surface of carbon nanoparticles exhibit high sensor affinity to pH of sample solution and some dissolved ions.

**Keywords:** carbon nanoparticles, sensor systems, fluorescence imaging

## **APPLICATION OF CARBON QUANTUM DOTS FOR DYE-SENSITIZED SOLAR CELLS**

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**ABSTRACT.** The emergence of quantum dot-sensitized solar cells (QDSSCs) has provided an alternative way to harvest sunlight for energy conversion. Efficiency of a QDSSC depends on the fabrication method of the quantum dots, morphology of the photoanode, type of electrolyte used and the choice of the counter electrode. It is therefore, imperative for engineering of materials and optimization of the fabrication method for the improvement of QDSSCs performance. As a new class of fluorescent carbon nanomaterials, carbon quantum dots (CQDs) possess the attractive properties of high stability, good conductivity, low toxicity, environmental friendliness, simple synthetic routes as well as comparable optical properties to quantum dots. CQDs can be used as photosensitizer in dye-sensitized solar cells and the photoelectric conversion efficiency is significantly enhanced. A novel synergistic photosensitized mechanism is proposed for the obtained hybrid CQDs / $\text{TiO}_2$  energy conversion system. It is based on a design of new generation C-dots with higher corrosion stability, charge transportation and controlled photocatalytic properties for oxygen reduction reaction, especially in terms of band gap energy, chemical composition and surface modification. The advantages of C-dots as a promising alternative of the expensive and unsustainable Ru-complex sensitizers are enhanced power conversion efficiency, good photoinduced electron transfer ability, environmental friendliness and lower cost of fabrication. This is a new direction for improving the efficiency of solar cells.

**Keywords:** quantum dots, carbon nanomaterials, photosensitizer, solar cells.

## **IN SITU BIOREMEDIATION OF A SOIL HEAVILY CONTAMINATED WITH NON-FERROUS METALS AND ARSENIC**

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**ABSTRACT.** Two experimental plots of an acidic soil heavily contaminated with non-ferrous metals (mainly copper, zinc and cadmium) were treated in situ under real field conditions using the activity of the indigenous soil microflora. This activity was enhanced by suitable changes of some essential environmental factors such as pH and water, oxygen and nutrient contents of the soil. The treatment was connected with solubilization and removal of contaminants from the top soil layer (horizon A) due to the joint action of the soil microorganisms (mainly of the acidophilic chemolithotrophic bacteria) and the leach solutions used to irrigate the soil (diluted sulphuric acid). The dissolved contaminants were removed from the soil profile of one of the plots (№ 1) through the drainage effluents. The dissolved contaminants in the plot № 2 were transferred to the deeply located soil subhorizon B<sub>2</sub> where they were precipitated as the relevant insoluble sulphides as a result of the activity of the sulphate-reducing bacteria inhabiting this soil subhorizon. This activity was enhanced by injecting water solutions of dissolved organic compounds (lactate and acetate) and ammonium and phosphate ions through vertical boreholes to this soil subhorizon).

**Keywords:** soil cleaning, heavy metals, arsenic, soil microflora

## MECHANISMS OF BIOLOGICAL OXIDATION OF URANIUM IN NATURAL ECOSYSTEMS

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**ABSTRACT.** The utilization of mesophilic and moderately thermophilic chemolithotrophic bacteria, possessing ferroxidizing activity and producing ferric ions at acidic pH of the medium, is currently applied under industrial scales for extraction of uranium from mineral raw materials (mainly ores and concentrates), as well as for cleaning soils polluted with this element. The studies carried out in some of the developed in the past and, at the present, recultivated to a different stage uranium deposits in Bulgaria revealed that in these biotopes uranium is oxidized and passes in soluble form also by other microorganisms as the extreme thermophilic archaea, heterotrophs producing hydrogen peroxide, nitrifying and denitrifying bacteria producing uranium oxidising nitrogen oxides (NO<sub>2</sub>, NO, N<sub>2</sub>O) as a result of the processes of nitrification and denitrification. The possibilities for biological removal of uranium from polluted waters and soils were tested.

**Keywords:** uranium, microorganisms, biological oxidation

## BIOLEACHING OF METALS FROM A WASTE ORE IN CONNECTION WITH COPPER RECOVERY, ENVIRONMENT PROTECTION AND ELECTRICITY GENERATION

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**ABSTRACT.** A waste ore dump located in central Bulgaria, near Sredna Gora Mountain, after a long period of industrial and then spontaneous bioleaching process, still contained about 0.14 % residual copper and was inhabited by different acidophilic chemolithotrophic bacteria. After rainfall, as a result of spontaneous bacterial activity, acid drainage waters were generated and polluted the environment. To solve this problem, an experimental laboratory installation to treat samples of such waters was constructed. The installation consisted of percolation columns containing samples from the dump, a collector pool for the drainage waters, a cementation unit for copper precipitation and a BACFOX (BACterial Film OXidation) unit for bacterial oxidation of the ferrous ions to the ferric state. The solutions treated in this way were recycled to the ore subjected to leaching. Another portion of the barren solutions from the cementation unit were treated by means of a permeable reactive multibarrier. The effluents from this multibarrier were enriched in biodegradable organic substrates and were characterized with a pH close to the neutral point, absence of dissolved oxygen and low electrochemical potential and were inhabited by anaerobic heterotrophic microorganisms, including some electrochemically active bacteria possessing iron or sulphate anoxic respiration. It was found that these effluents were suitable for generation of electricity in microbial fuel cells. The treatment of the effluents from these cells in the BACFOX unit made these effluents suitable for leaching copper from the waste ore.

**Keywords:** waste ore, metal bioleaching, electricity generation, environmental protection

## ADSORPTION/ DESORPTION OF ARSENATE ON/ FROM GOETHITE AND HEMATITE

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**ABSTRACT.** Arsenic migrates in environment as anions and for that reason its mobility is not strong dependent on pH and redox conditions in the ecosystems. The main aim of this article was to study adsorption/ desorption processes of arsenates on the surface of crystalline ferric iron oxides (goethite and hematite) as the main mechanism to decrease the exposure of aquatic organisms to that pollutant. Adsorption and desorption isotherms as well as the relevant kinetic rate constants, determined by pseudo- first and pseudo-second order equation rate, were the main parameters for the adsorbents evaluation. The results shown that point of zero charge (PZC) of the relevant type iron oxide and the pH of treated waters were the key factors governing arsenate adsorption.

**Keywords:** arsenate, goethite, hematite, adsorption, point of zero charge (PZC), kinetic

## СОСТОЯНИЕ И ПЕРСПЕКТИВЫ РАЗВИТИЯ ПОДЗЕМНОГО ГОРОДСКОГО СТРОИТЕЛЬСТВА КАК СОСТАВНОЙ ЧАСТИ ПРОБЛЕМЫ ОСВОЕНИЯ И СОХРАНЕНИЯ НЕДР ЗЕМЛИ

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