

DISTRIBUTION OF SULFUR AND TRACE ELEMENTS IN THE BITUMINOUS COAL AND ANTHRACITE

Grant project of the Grant Agency of the Academy of Sciences CR

No A 3111103

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Abstract

The study is supported by the technical aspects and utilization of coal in the Clean Coal Technology Program. The project proposal are connected to distribution of elements, namely sulfur, trace elements and ash content in bituminous coal and anthracite of the world average coal seam (model distribution).

KEYWORDS: Paleozoic coal deposits, sulfur, trace elements, Czech Republic, world basins

ELECTROMAGNETIC AND ACOUSTIC EMISSION FROM SOLID BODY

Grant project of the Grant Agency of the Czech Republic

No. 103/01/1058

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Abstract

The purpose of the project was further improvement of the model including generation of electromagnetic signals during formation of cracks in solid substances and further determination of AE (acoustic emission) and EME (electromagnetic emission) signal correlation. Based on the principle of formation of the electromagnetic field excited by the oscillating electrical charge on crack walls.

KEYWORDS: acoustic emission, electromagnetic emission, signal analysis

**THE STUDY OF HIGHER ASH LIGNITE COMPOSITION ON AFFINITY AND
VOLATILITY OF TOXIC ELEMENTS AND SUBSTANCES
FOR ENERGETIC UTILIZATION**

Grant project of the Grant Agency of the Czech Republic

No. 105/020163

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Abstract

The lignites from the ČSA Mine (Most Lignite Basin, Czech Republic) contains a high content of ash (16 %) and sulfur (S_{pyr} 1.5 %; Stotal 3.4 %), therefore it can not be used for combustion or chemical processing and beneficiation is needed. The study of the coal fractions (prepared by sink-float technique) shows that there is a very good correlation between ash content, pyrite sulfur and the majority of heavy elements (e.g. As, Se, Hg, Cu, Sb, Pb, Zn, Cd). The use of the mathematical model for calculation of the elements affinity between inorganic and organic parts of coal verified the dominant affinity of heavy elements to the pyrite (e.g. 95% As, 83% Hg, 60% Se). The laboratory density fractionation sorting of the lignite with size fractions from 0.5 to 1.0 mm and/or from 0 to 0.5 mm showed a possibility of gravity sorting of extraneous ash and sulfur, which are above all cumulated into the fraction with density of above $1.8 \text{ kg}\cdot\text{dm}^{-3}$. Further, use of magnetic separation of ash and selected elements from lignite was also studied and good results were obtained. Both separation methods (gravity and magnetic separation) showed the suitability of their including into the process of the powder lignite pre-treatment before the combustion process. A special task which arose from separation efforts was a finding of new aluminium complexes.

KEYWORDS: lignite, toxic elements, magnetic separation, element affinity

**DEVELOPMENT AND OPTIMIZATION OF MANUFACTURE PROCESS
FOR HEAT RESISTANT
FIBRE REINFORCED CERAMIC MATRIX COMPOSITES**

Grant project of the Grant Agency of the Czech Republic

No. 106/02/0177

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Abstract

Basic parameters of the curing process of 8 commercially available polysiloxane resins from 3 suppliers as well as their weight losses during pyrolysis in nitrogen to 1200°C were established. These properties are vital for employing the resins as matrix precursors in heat resistant fibrous composites made by pyrolysis of polymer matrix composites. A device was developed which enables to study the resin sample as a dielectric in a measuring capacitor and conditions were found for monitoring the curing process by measuring the loss impedance. Specimens of composites reinforced unidirectionally with R-glass, SiC (Nicalon NL202) or alumina + mullite (Nextel720) fibres and with a matrix derived by pyrolysis from selected methylsiloxane or methylphenylsiloxane resins were manufactured in lab. Their mechanical properties (e.g., Young's modulus and flexural strength) and resistance to oxidation are positively influenced by increasing the pyrolysis temperature. The temperature dependence of modulus falls remarkably above 600°C or 1100°C for the composites reinforced with R-glass or Nextel/Nicalon fibres, respectively. During oxidation in hot air (900 and 1200°C) the better endurance of methylsiloxane resin is revealed by a lower weight loss of the composite as well as by a lower deterioration of the shear modulus, which monitors intensity of fibre/matrix bonding.

KEYWORDS: polysiloxane resin, pyrolysis, ceramic matrix composite, mechanical properties, resistance to oxidation

THE STUDY OF REINFORCEMENT AND MATRIX STRUCTURE ON ELASTIC PROPERTIES OF COMPOSITE MATERIALS BY MEANS OF STATIC AND DYNAMIC MEASURING METHODS

Grant project of the Grant Agency of the Czech Republic

No. 106/02/p025

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Abstract

Grantový projekt 106/02/p025 byl zaměřen na vývoj měřících metod vyhodnocujících elastickou anizotropii kompozitních materiálů, obzvláště pak pro potřeby měření při teplotách do 1300°C. Pro potřeby měření elasticity při zvýšených teplotách byla modifikována zkouška čtyřbodovým ohybem. Dále byla provedena rozsáhlejší studie elasticity kompozitních materiálů s keramickými vlákny do teploty 1300 °C s ohledem na detekované reologické jevy. Pro měření elastické anizotropie při pokojových teplotách byly modifikovány příp. nově vyvinuty testy založené na metodě rezonančních frekvencí.

KEYWORDS: measurement, elasticity, resonant frequency, anisotropy, orthotropy, plate, cylindrical shell

**THE INFLUENCE OF DEEP MINING DAMPING ON THE PROCESSES IN
LITHOSPHERE AND ENVIRONMENT
PŘÍBRAM URANIUM DEPOSIT AFTER TERMINATION OF MINING
*Project of the Program for the Support of the Target Research and Development,
Academy of Sciences of the Czech Republic***

No. S 3086005

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Abstract

In spite of its exceptional extent, the deep mining in the Příbram area had but little effects on the landscape, which were practically insignificant, e.g., in comparison with the impact of the deep mining in Ostrava region. Although the mining operations in the area of the local uranium – poly-metallic deposit was terminated more than twelve years ago, one has to take into account that its after-effects will have to be monitored and, if necessary, dealt with during several future decades. Areas of subsidence may be included among topical or only potential hazards to the environment and inhabitants in connection with the uranium industry in the Příbram area.

If the underground exploitation operations have been conducted so that the loosening processes, accompanied by gradual or sudden caving in of empty cavities due to the destruction of the surrounding rock massif, may reach the surface, the surface is in danger of subsidence. Such area is designated as a subsidence area and all building, forestry or agricultural activities are prohibited there. In the area of the Příbram deposit, a total of 9 subsidence areas have been designed, and their monitoring is the subject of this paper.

KEYWORDS: uranium industry, underground exploitation

GEOPHYSICAL OBSERVATIONS AND PREDICTION OF GEOPHYSICAL FIELDS FOR USERS

*Project of the Program for the Support of the Target Research and Development,
Academy of Sciences of the Czech Republic*

No. S3012007

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Abstract

Daily and weekly predictions of geomagnetic activity were produced and transmitted regularly to the News Desk of Czech Television and the headquarters of the International Space Environmental Service (ISES). More detailed predictions of geomagnetic activity were used in airborne prospecting by the firm IMPULS. It was explained to the company MERO why voltage and currents are induced in oil pipelines during geomagnetic storms. The accuracy of predictions of geomagnetic activity was analysed. The Internet page of ISES RWC Prague was currently updated in co-operation with the ISES headquarters in Boulder, USA. The project helped to realise not only the ionospheric service and the creation of regular ionospheric predictions in the IAP, AS CR but also supported the activity of the ISES RWC Prague. Ionospheric predictions were regularly directed to the Czech Army. Real-time ionograms were transmitted to the data and prediction centre of the RAL in Great Britain to contribute to a solution of short-term predictions. Effects of geomagnetic storms, planetary and gravity waves on processes in the ionosphere were studied in detail. The standard maps of earthquake hazard in the terms of macroseismic intensity and effective peak acceleration for the territory of the Czech Republic, Poland and Slovakia were calculated. The map of seismic zones of the Czech Republic in terms of the reference peak ground acceleration was prepared for the national application document Eurocode-8. The long-term effects of geodynamic processes on the Earth's surface were studied. Long-term displacement trends, responsible for local deformations, were determined from GPS data. General procedures of a geodynamic hazard assessment were suggested and exemplarily were applied to a wider region of the Červená hora Saddle, where the motorway will be constructed. The GI virtual seismic network, providing rapid and quality localisations and estimates of the magnitudes of regional earthquakes in Central Europe, was established to be prepared to inform government and Civil Protection authorities, the media and the public. Up-dated catalogues of regional seismic events are published on the WWW site of the GI AS CR.

KEYWORDS: prediction, geomagnetism, ionosphere, seismic network, seismic zones, GPS, earthquake hazard, geodynamic hazard, Czech Republic

USE OF CAUSTOBIOLITHS FOR PREPARATION OF CARBON MATERIALS AND WASTE TREATMENT

The targeted project of the Academy of Sciences of the Czech Republic

No. S3046004

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Abstract

The processing conditions for the treatment of organic wastes while using caustobiolites (in particular coal) and the preparation of selected carbonaceous materials related to it were determined. A part of the project was also to solve the questions of the preparation of raw materials before their processing. On the basis of studies of physical and chemical properties of coal the new definition of macerals, their composition and behavior during utilization was presented. The processing of organic wastes (paper, wood, cellulose, rubber, plastics, mixed communal waste) was observed as thermal, with coal, and as cool processing, with a geopolymer base. The results were presented and discussed. Further, carbonaceous sorbents conditioned with ferrous and ferric salt were prepared for the cleaning of mine water containing heavy and toxic metals and with high arsenic content. Further it was discovered that a sol-gel reaction makes the alkaline-activated clay component polymerize in a cool way so that it is able to encapsulate all ash or fly-ash elements into a geopolymer net. Hardening over time, the formed material is compact and solid, its solidity further increases with time, is non-flammable, resistant to acids and lye, does not contract and perfectly imitates a form. It does not release any emissions in heat, they are not destroyed at temperatures above 500°C and if the proper proportion of the filler is used, it is resistant to temperatures above 800°C. It is significant that the geopolymer net also encapsulates radioactive elements. Si,Al-geopolymers are good at binding with coal and can strengthen mineshafts. Finally, it was found that magnetic filtration with NdFeB magnets enables efficient purification of raw materials, with equipment small in size and easy to carry, which is relatively cheap. The constructed filters can be immediately used in industrial conditions.

KEYWORDS: coal, macerals, geopolymers, magnetic filters

**SEISMIC VELOCITY MODEL IN THE VICINITY OF EGER RIFT
FROM DISPERSION OF SURFACE WAVES**
*Internal Start Project of the Grant Agency of the Academy of Sciences of the Czech
Republic*

No. I039 / No. Z3046908

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Abstract

We have studied the uppermost crust seismic velocities in the western Bohemia region. Surface wave records were analyzed, dispersion curves were estimated and compared with the theoretical curves computed for average regional models. We made an inversion of the estimated dispersions for 1D velocity models for several tens of surface wave paths. The lateral heterogeneity of the region was discussed and more data were analyzed to prepare surface wave tomography inversion. Several computer programs were developed and joined in the SVAL program package. It can be used in other regions to provide the surface wave analysis and inversion.

KEYWORDS: surface waves, frequency-time analysis, group velocity, dispersion, isometric method, Western Bohemia