

**BEHAVIOR OF GASES AND VAPOURS IN MICROPOROUS PHASE OF TISSUE
SYSTEMS OF NATURAL MATERIALS, ADSORPTION AND DISSOLUTION
PROCESSES AND THEIR KINETICS**

Grant project of the Grant Agency of the Academy of Sciences of the Czech Republic

No. A2046101

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Abstract

Natural organic substances are characterized by presence of microporous phase formed by solid phase and aggregate of cavities of molecular size. The ability of the microporous systems to sorb selected gases (hydrogen, helium, methane, oxygen, carbon dioxide, and water vapor) has been studied depending on their physical properties with the aim to distinguish the type of mutual interaction. To identify individual processes, gravimetric sorption analysis was used employing the equilibration time at each point of the isotherm as a variable parameter of the sorption process significant for diffusion as a function of time. An equation has been derived to calculate the sorption isotherm corrected for absorption for any sorbent-sorbate system at given thermodynamic conditions. The range of the effect of absorption on textural parameters derived for micropores from Dubinin's equation was determined, and based on analysis of the sorption isotherm, both sorption processes were discerned. Part of methane absorbed in the macromolecular coal matrix represents another, from the practical standpoint very important mode of binding. Rate constants were used for exact differentiation of the dominant process.

KEYWORDS: microporous systems, physical adsorption, absorption identification, sorption kinetics

STRUCTURE OF HARD COALS AND ITS INFLUENCE ON COAL CONVERSION PROCESSES

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Abstract

On the basis of structural parameters determinations the models of liptinite, vitrinite and inertinite at coals with medium coalification were suggested. Aromatic-cyclanic clusters form coal polymers with molecular weight of about 1300–1600, several polymers are associated by non-covalent interactions to an aggregate with molecular weight of about 7700–9700 which contains both planar formations of 1.1–1.2 nm in length and cylinder like formations of about 1 nm in the inner diameter. The suggested chemical models correspond with the physical models obtained on the basis of transmission electron microscopy and X-ray diffraction analyses. A very low content in the molecular (mobile) phase led to one-phase models of the structure of investigated coals. It was found that association of polymers and content of cyclanic parts of clusters are the main factors influencing the inner surface and reactivity of coal, respectively. On this basis the influence of the chemical and physical structure of maceral groups and/or maceral fractions on the behavior of bituminous coal in conversion processes (co-pyrolysis, co-coking and co-gasification) was expressed.

KEYWORDS: coal structure, aggregate, reactivity, inner surface, maceral fractions

COUPLED MODELLING OF UNDERGROUND STRUCTURES USING INTERNAL PARAMETERS

*Grant Project of the Grant Agency of the Academy of Sciences of the Czech Republic
No. A2119001*

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Abstract

In the grant project a new procedure for assessment of geotechnical structures was proposed, starting with evaluating of internal parameters of the mathematical physically nonlinear model (Transformation Field Analysis) using partial results of the physical models from equivalent materials. The internal parameters may stand for plastic, viscoplastic or further non-linearising effects. In numerical models Desai's Distinct State Concept was combined with the TFA. The procedure may be considered as a special case of an inverse analysis. The results will be used as the arguments for increasing the bearing capacity of the structure and economic optimization.

KEYWORDS: physical and numerical modelling, stability, tunnel, slopes

CHANGES OF PHYSICAL AND MECHANICAL PROPERTIES OF ROCKS IN FUNCTION OF DEPTH

Grant project of the Grant Agency of the Czech Republic

No. 205/01/1299

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Abstract

Laboratory tests of physical and mechanical properties of the Proterozoic metabasalts and Archean amphibolites from the various depths of the Kola Superdeep Borehole (SG-3) and their analogues from the surface were performed. The density and grain density, porosity, simple and triaxial strengths, deformational characteristics (deformation modulus, Young's modulus and Poisson's ratio) and velocities of ultrasonic waves were found and mutual comparison of the results was carried out.

KEYWORDS: Kola Superdeep Borehole, rock mechanics, physical properties, mechanical properties, core samples, surface analogues samples

STUDY OF THE UPPER CRUSTAL STRUCTURE ON THE TERRITORY OF BOHEMIA USING SEISMIC WAVES FROM QUARRY BLASTS

Grant project of the Grant Agency of the Czech Republic

No 205010481

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Abstract

The territory of the Czech Republic is covered with a relatively dense network of quarries using blasts for rock disintegration. The main task of the project was the measurement and interpretation of seismic waves generated by these blasts with the help of mobile seismic stations. At first, the measurements concentrated to the region of coal mines in North and West Bohemia, where large charges are blasted and the monitoring of seismic activity is performed using permanent local networks. The frequency range of measurements apparatuses was 0.03 to 50 Hz with accurate time synchronization derived from GPS. The basic characteristics of body and surface seismic waves, such as travel times, anisotropy and dispersion were studied. The measured seismograms were used for structural studies. Travel-time curves of P waves enabled to study the upper part of the Earth's crust down to approximately 5 km. Shallow structure, was studied by means of the dispersion of short-period surface waves. The principal axes of the anisotropy of seismic waves were compared with the directions of regional geological structures. For this purpose, some theoretical approaches were developed, e.g. joint inversion using both body and surface waves.

KEYWORDS: quarry blasts, broadband seismograms, list of quarries

3-D INVESTIGATION OF ROCK FABRICS BY DEFORMATION MEASUREMENT, ULTRASONIC SOUNDING, NEUTRON DIFFRACTION AND PETROGRAPHIC IMAGE ANALYSIS

Grant project of the Grant Agency of the Czech Republic

No. 205/01/1430

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Abstract

Investigation within the framework of the grant project was carried out in three levels.

Construction of a new high-pressure equipment and measuring of new samples. Measuring and processing of former measured parameters of selected rocks. Systematic collection of rock samples in areas significant from the geological point of view.

KEYWORDS: ultrasonic sounding, neutron diffraction, petrographic analysis

REDUCTION OF HEAVY METAL EMISSIONS FROM FLUIDIZED BED COMBUSTION USING SORBENTS

Grant project of the Grant Agency of the Czech Republic

No 104/00/1297

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Abstract

The project was focused on the study of trace toxic elements at fluidized bed combustion of coal using mineral additives. Influence of CaCO₃, Ca(OH)₂, Al₂O₃, SiO₂, TiO₂, and diatomite on reduction of sulfur in combustion residue and distribution of trace elements (As, Be, Cd, Cr, Hg, Mn, Ni, Pb, Sb, Se, V and Zn) among individual emission fluxes (ash from the fireplace, coarse fractions and sub-micron fractions of fly ash, and combustion gases) was studied. At the theoretical section, the experimentally determined distribution of trace elements in the emission fluxes was compared with a theoretical prediction based on thermodynamic calculation consisting in minimization of the total Gibbs energy of the system for a group of points, which satisfied the mass balance conditions.

KEYWORDS: fluidized bed combustion, lignite, synthetic fuel, emissions, trace elements, additives, combustion model

GEODYNAMICAL INTERDISCIPLINARY STUDIES INTO SLOPE FAILURES IN LOCALITIES OF ARCHAEOLOGICAL SIGNIFICANCE

Project of Czech Rep. Grant Agency

No 205/01/0743

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Abstract

The nature and dynamics of recent slope deformations in two selected localities – Mužský Hill near the town of Turnov and Obří Hrad (Giant Castle) near the town of Kašperské Hory were studied on the basis of detailed engineering geological and geomorphologic analyses and interpretations of data of field monitoring.

KEYWORDS: slope failures activity, field monitoring

COPYROLYSIS AND COLIQUFACTION OF COAL WITH ORGANIC WASTES

Grant project of the Grant Agency of the Czech Republic

No 105/01/0332

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Abstract

Co-pyrolysis of the mixtures of organic wastes with coal, the yield in solid, liquid and gaseous products and the effect of the process conditions were investigated by using a model pyrolytic unit. A mixture of coal with waste tyres was co-pyrolyzed in an rotary kiln on a macro-laboratory scale with an entirely prevailing yield in a fine-grained carbonizate which is suitable for the subsequent preparations of carbon sorbents. A pressure apparatus for the investigation of deoxidation and desulfuration of lignites at medium temperatures was constructed and tested. The pyrolysis of a mixture of PVC with metal oxides aiming at the separation of chlorine from the organic substances and at the separation of non-ferrous metals from metallurgical wastes was investigated by means of laboratory model.

KEYWORDS: co-pyrolysis coal/organic wastes, coal precursors of sorbents, deoxidation of coal

**FUNDAMENTAL MOBILITY TRENDS IN THE NORTHERN PART OF THE
MORAVO-SILESIA ZONE (THE BOHEMIAN MASSIF) – A COMPLEX
GEODYNAMIC ANALYSIS**

Grant project of the Grant Agency of the Czech Republic

No. 205/01/0480

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Abstract

The geodynamic joint Czech-Polish GPS network East Sudeten was established in 1997. Since 1997 seven epoch GPS measurements have been realised. GPS satellite signals were monitored by the Ashtech receivers and antennas that were situated practically whenever at the same network sites and obtained GPS data were processed with the software Bernese 4.2. RMS values in the horizontal movement velocities determination have not exceeded 1 millimetres and in the vertical movements 2-3 millimetres. Seven epoch measurements already realized allowed annual movement trends to be determined and geodynamical terranes to be identified in the northern part of the Moravo-Silesian region. Monitoring of regional seismic activity alternately even by four seismic stations delineated several seismogenic zones in the area under study. The stations registered local seismic events and mining induced seismic events up to ML ≈ 0 . In the Moravo-Silesian region nine local earthquakes were recorded in the 2001-2003 period. Geological structure-tectonic mapping of brittle deformations was correlated with data of the digital elevation model. Paleostress analyses of the Moravo-Silesian area display the NNW-SSE compression and strike-slip regime the ENE-WSW. The systems of Lusatian (WNW-ESE) and Sudetic (NW-SE) faults are in a pseudo-conjunction with the Moravo-Silesian (NNE-SSW) and Orlice (NNW-SSE) faults.

KEYWORDS: geodynamics, GPS measurements, monitoring of local earthquakes, brittle tectonics, the Sudeten, the Bohemian Massif

INORGANIC CEMENTS BASED ON SILOXO-SIALATE STRUCTURE

*Internal Start Project of the Grant Agency of the Academy of Sciences of the Czech Republic
No I013/ No Z3046308*

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Abstract

The report on the Start project results brings a summary of an investigation carried out as a part of the author's doctoral study. The work dealt with the application of geopolymers, inorganic cements based on alkali-activated aluminosilicates. Their application has been divided into two parts based on one principle, namely sticking and cementing rocks with geopolymer cement.

KEYWORDS: geopolymer, sol-gel, inorganic polymer cement, adhesive, binder, restoration of monuments, hazardous rock mass