

## **NANOCOMPOSITE ORGANOMINERAL HYBRID MATERIALS**

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### **ABSTRACT**

**This paper presents a few methods of sol-gel synthesis: alkoxide, non-hydrolytic and colloidal. Sol-gel technology of nanocomposites based on the use of soluble silicates as precursors is discussed. Availability of nanocomposites based on silica aerogels and analysis of mixing technologies of the nanocomposites preparation are considered. Different types of nano-phase used for producing of the nanocomposites are examined. The authors have studied the various models of packaging of nanoparticles (spherical, fibrous and layered) introduced into the nanocomposite structure during its preparation.**

## **NANOSTRUCTURED LIQUID EBONITE COMPOSITION FOR PROTECTIVE COATINGS**

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### **ABSTRACT**

**Explores the possibility of preparing elastic and hard nanostructured ebonite coatings, utilizing the properties of oligobutadienes without ending functional groups. Examines the vulcanization processes leading to formation of rubberizing ebonite coatings on samples of oligobutadienes. Finds that the most effective bonding materials for non-solution compositions are ebonite coatings. . These covering allow to get rid of the deficiencies intrinsic to conventional rubber shut and liquid rubberizing compounds.**

## **FORMATION OF WOOD BIOPOLYMERIC STRUCTURES AT PRESENCE OF Fe-CONTAINING NANO PARTICLES**

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### **ABSTRACT**

**The molecule relaxation characteristics of natural biopolymeric systems as which used wood of coniferous breeds was investigated by method of the thermomechanical analysis. The interrelation of topological changes of structure of a pine at presence iron nano particles relaxed under loading in conditions of a variation of humidity of system is revealed. It is shown, that at formation of a pseudo-grid of matrix structure, high-temperature amorphous blocks of a pseudo-mesh structure and cluster blocks with units of a branching of a pseudo-grid are consistently shown cluster blocks with molecular weights  $M_{cw}$  240 – 28,000 as is amorphous-structural formations with a matrix of a pseudo-mesh structure. The revealed temperature**

transitions have allowed to establish the influence of drying and introduction ferriferous nano particles on formation of bio structures of wood.

### **DIELS-ALDER ADDUCT ISOMERIZATION STUDIES USING DSC AND PMR METHODS**

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#### **ABSTRACT.**

Model Diels-Alder (D-A) adducts of a different isomeric composition were synthesized using furfuryl acetate (FA) and maleimid (MI). The composition of synthesized isomers was analyzed using the proton-magnetic resonance method (PMR). The D-A adduct isomerization process was studied using the differential scanning calorimetry (DSC) method in the nonisothermal mode.

### **HEAT RESISTANT MODIFIED ASH-SLAG CONCRETE**

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#### **ABSTRACT**

The results of studies of the sodium silicofluoride additive and naphthalene formaldehyde superplasticizer influence on the properties of heat-resistant ash-slag concrete are given in paper. The possibility of a substantial increase in strength at heating, improvement of deformation properties, ultimate extensibility and crack resistance of heat-resistant concrete, containing fly ash as fine mineral additive and ash-slag mix as aggregate, is shown. The changes of strength and open porosity of ash-slag concrete during drying and first heating are studied. The positive effect of complex additive, consisting from superplasticizer and sodium silicofluoride, on the firing shrinkage and heat resistance of the concrete is shown. The expediency and the possibility of producing heat-resistant ash-slag concrete based on dry mixtures at two-stage mixing is demonstrated

### **DESIGN OF BETA-HEMIHYDRATE GYPSUM PLASTER WITH COMPOSITE ADMIXTURE**

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#### **ABSTRACT**

Gypsum binders are low-energy ecologically safe materials. Along with undoubted advantages, related to high sustainability, they have substantial disadvantages, which include low strength, low water resistance, rapid setting and hardening.  $\alpha$ -hemihydrate gypsum binders have significantly higher strength than  $\beta$ -hemihydrate, thus the manufacturing process is more

complicated and more energy consuming. Composite admixtures, consisted of water reducers and setting and hardening regulators, allow either to reduce significantly energy consumption on gypsum items manufacturing due to casting at constant water content or to increase gypsum strength for constant fluidity of gypsum pastes. The article describes the design method of gypsum composition ( $\beta$ -hemihydrate) applying regression analysis. Two-factor experiment was conducted. Regression equations, describing the influence of chemical admixtures on water demand, setting terms, compressive and bending strength The gypsum design method, proposed in this study, allows obtaining the required strength of gypsum composite has been developed to achieve require values of gypsum properties from the cost reduction viewpoint

## **NEW APPLICATIONS OF HIGH-REPETITION-RATE PULSE-PERIODIC LASERS IN THE ARCTIC**

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### **ABSTRACT**

The paper discusses the application of high-power lasers to break the ice cover cover (up to several meters in height) around such engineering structures as oil platforms and icebreakers. The most effective in this case is the joint application of high-power lasers and icebreakers in the cracking of ice covering the ocean. The most dangerous hazards resulting from drifting ice can be easily overcome with the help of high-power lasers. It is obvious today that lasers on offshore oil and gas platforms in the Far North will be in high demand and can greatly facilitate the safety of the personnel of such rigs.

## **UNAMBIGUOUS ENTROPIC EVALUATION OF THE EFFICIENCY OF COMPLICATED TECHNOLOGIES OF COMPLEX PROCESSING OF NATURAL RESOURCES**

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### **ABSTRACT**

A method of unambiguous evaluation of a complicated technological process using complex raw material is developed. It allows an operative analysis of various production stages and modernization of the lagging ones. The proposed method provides the means of an intensification of the total effect at the expense of a targeted allotment of funds for the improvement of sectors possessing available reserves for further growth

## **SENSITIVITY ASSESSMENT IN RISK MANAGEMENT**

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### **ABSTRACT**

This paper considers the issues of improving the quality of risk evaluation and prediction for hazardous industrial facilities. The research focuses on developing the approach to reducing the uncertainty of risk management and solves scientific problems of defining uncertainty range characterizing the range of tolerable risk by means of developing the concept of constructing risk uncertainty range which contributes to more comprehensive uncertainty and sensitivity analysis in risk management. Analysis and selection of models for risk sensitivity prediction is carried out and the model of risk sensitivity assessment and prediction is developed. Analytical expressions are obtained for refining the model of risk uncertainty which allows more accurate simulation of the initial conditions for experimental and probabilistic risk assessment. Ordered sequence of generalized procedures for sensitivity assessment is described which contributes to scientific justification of improving national and international risk management standards.

## **DETOXICATION OF PESTICIDE AND OTHER TOXIC SUBSTANCE REMAINS IN SOIL WITH THE HELP OF NANOMATERIALS**

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### **ABSTRACT**

Intensification of agricultural production involves a large – scale use of fertilizers, plant protection means against pests, diseases and weeds, all those are used within various modern agro-technologies, which leads to soil intoxication with residual amounts of pesticides and agrochemicals. Therefore, a comprehensive approach is necessary for preparing the soil for further sowing. We have carried out the research using activated carbons obtained from agricultural residues.

## **IMPROVEMENT OF INHERENTLY SAFER CHARACTERISTICS OF STIRRED REACTORS BASED ON VisiMix® SIMULATION**

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### **ABSTRACT**

Stirred reactors belong to key process equipment used in many branches of the chemical process industry and characterized by an extremely wide range of process conditions –

temperatures, pressure, heat release or consumption, and, in many cases, significant change of these parameters in the course of a single operation. Such a wide diversity of process applications results in a notable variety of design solutions. Lack of satisfactory compliance of the design solutions to the process requirements creates a risk of accidents. Since stirred reactors operations comprise ~14% of all accidents in the chemical process industry caused by different reasons [1], it is evident that a reliable calculation technique (software) permitting to design a proper reactor for a required chemical process or to evaluate correspondence between the design characteristics and the process requirements must be considered as an ultimate element of the inherent safer design/technology (ISD/IST) tool. The present paper shows that VisiMix® software (being in commercial use since 1996) that combines simulation tools for various mixing-dependent processes with elements of an expert system allows predict dangerous situations and find technical means to mitigate/eliminate the probable risks and hence can become an important part of the ISD/IST concept.

#### THE PHENOMENON OF SUPERFLUIDITY IN WELLS NANOFRAME

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#### ABSTRACT

Based on the classical theory of classic liquid superfluidity in nanocapillars the problem of hydrocarbon liquids superfluidity within micro- and nanometer scale channels is under study. The substantive possibility of the phenomenon of fluid flow superfluidity from the formation into the well through well nanoframe along the capillars with radius corresponding to Maslov superfluidity criterion has been established. Critical superfluidity velocity for well's nanoframe channels with different size radius has been estimated.

#### STUDY ON STRENGTH AND PHYSICAL PROPERTIES OF BITUMINOUS CONCRETE GRADE-1 MIX, WITH E-WASTE CERAMICS AS REPLACEMENT TO AGGREGATES

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#### ABSTRACT

The study proposes effective E-waste management by introducing scientifically modified pavements created by partially replacing the aggregates in Bituminous Concrete Grade-1 mix with E-waste ceramics. From the study it was found that the maximum replacement achievable was 10% as per the MORT&H 4<sup>th</sup> revision specification. The study thereby facilitates safe utilization of 1/10<sup>th</sup> of E-waste ceramics from the 2700 kilotones of E-wastes produced annually in India. If policies are built based on the outcome of this research, then there shall be enhanced levels in safety from the environmental perils of irresponsible recycling and illegal dumping of E-wastes into municipal landfills. The research has also achieved inculcating depreciation in the cost of construction and reduction of pollution load due to anthropogenic activities while producing aggregates.

## DEVELOPMENT OF CHEMICALLY RESISTANT POLYMER CONCRETES

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### ABSTRACT

The way of creation of chemically resistant polymer concretes by use of so-called "positive" corrosion effect is offered. The essence of the proposal is the application of special additives which by interaction with some aggressive medium form insoluble compounds capable to condense and strengthen the structure of this materials. Anticorrosive additives (AAdd) are an innovative approach to creating highly chemical resistant polymer materials. AAdd are specially designed to upgrade the chemical resistance characteristics of base polymer concretes to achieve optimal performance capabilities of the materials operating in aggressive environments. AAdd can be mixed into a wide range of polymer materials offering a significant increase in product life and reducing product permeability. When cured with polymer-based materials, AAdd can dramatically improve the capabilities of poly-based materials by upgrading their chemical resistance properties. The additives are inorganic powders that react with aggressive environments into which they are introduced, forming a new phase of high-strength hydrate complexes. AAdd can be mixed into a wide range of polymer materials such as epoxies, polyurethanes, glues, nylons, polyolephines, synthetic rubbers and PVC offering performance-enhancing attributes that increase the value of the end product.

## MECHANOCHEMICAL SYNTHESIS OF COPPER OXIDES AND SALTS USING THE GAS-LIQUID MEDIUMS

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### ABSTRACT

The mechanochemical synthesis of copper oxide powder from the corresponding metal was investigated. The possibility to obtain the highly dispersed copper oxide in the controlled gas atmospheres was demonstrated. The main kinetic features for the mechanochemical oxidation of copper metal powder at different temperatures and gas phase compositions were established. Particularly, it was shown that the mechanochemical processing of copper powder at 60 °C for 90 min using the water steam-ammonia-oxygen gas mixture (H<sub>2</sub>O-NH<sub>3</sub>-O<sub>2</sub> = 20-15-65%) allows one to oxidize about 92% of copper. An increase in process temperature up to 110 °C resulted in both reaching the 95% oxidation degree and decreasing the process time down to 40 min. The remaining metallic copper can be removed by heat treatment at 400-600 °C. The use of water steam-ammonia-oxygen-carbon dioxide mixture with different gas mixing ratios resulted in the formation of either solid-phase carbon dioxide salts (CuCO<sub>3</sub>·x2NH<sub>3</sub>, CuCO<sub>3</sub>, Cu(OH)<sub>2</sub>) or liquid phase of copper ammonium-carbonate solution. It was found that both copper hydroxycarbonate and copper ammonium-carbonate solution with CO<sub>2</sub>/Cu<sup>2+</sup> ratio more than 0.45 can also be converted into copper oxide.

## **METHODS FOR DETERMINATION OF CHEMICAL COMPOSITION OF PLANT BIOMASS**

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### **ABSTRACT**

Improved methods for the quantitative analysis of polysaccharides and lignin in biomass samples were developed by Designer Energy Ltd (DE). The DE method for determination of polysaccharides in biomass samples is based on the isolation of holocellulose, i.e. total polysaccharides containing both cellulose and hemicelluloses. After acid hydrolysis of holocellulose under mild conditions hemicelluloses were removed, and as a result the content of cellulose can be determined. The content of acid-insoluble lignin was measured by improved method after two-stage acidic hydrolysis of the biomass. In order to prevent loss of the components, a centrifugation technique was used for isolation of final products. The developed methods were used for analysis of chemical composition of crude and pretreated samples of switchgrass and sugarcane bagasse. It has been shown that DE methods provide more reliable results than conventional methods of chemical analysis.

## **TO THE PROBLEM OF METAL CORROSION KINETICS MEASUREMENT**

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### **ABSTRACT**

The paper presents the results of comparative measurements of corrosion rate by Coulometric Detection of Corrosion Products (CDCP method) and voltammetry (VA). The corrosion kinetics was measured in the time interval where the steady potential  $E_{st}$  is established in the "carbon steel – 0.5 M NaCl solution" system as an example. The results of measurements by both methods showed a considerable difference in mass losses in the time interval of specimen surface activation. This fact was explained taking the semiconducting nature of iron oxides into account. Thus, the disagreement may originate from different conductance mechanisms of the metal and its oxides in a strong electric field. The CDCP method was used to determine the conditions required for agreement of the results of potentiodynamic and coulometric measurements.

**IMPACT OF EXTERNAL ACTIONS UPON STRUCTURE OF ALUMINIUM  
ALLOYS AND COMPOSITES**

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**ABSTRACT**

**Presented are research results of impact of low-frequency vibration, ultrasonic, magneto-hydrodynamic (MHD) and plasma treatment of alloys, in liquid state and two-phase condition, upon structure and properties of silumins and silumin-based nanocomposites.**

**BARRIER POLYMERS:  
REVIEW OF MATERIALS, TECHNOLOGIES, AND TRENDS**

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**ABSTRACT**

**Polymers are nowadays one of the most important materials in the world. The article reviews the polymer barrier materials and their applications. Three main groups of them,- low, good (medium), and high (superior) barrier polymers have been described. New generation of barrier materials include new polyesters, liquid crystal polymers, fluorocontaining thermoplastics, nanocomposites, and polymers coated with special materials. Modern trends in research, development and applications of new barrier materials are placing on the front stage blends and alloys, LPCs, multi-layer extruded films, tubes, and containers as well as materials with newly developed coatings such as glass, diamond-like compounds, and nanocomposites.**