

CHEMICAL TECHNOLOGY & ENGINEERING

Fabrication of ceramic membrane developed with cross-linked chitosan for removing Cr(VI)

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ABSTRACT


Water pollution has emerged as a major issue in the world. It is especially harmful for humans and ecosystems when heavy metals are present in water bodies. Membrane filtration technologies for heavy metal removal have received a lot of attention. In this study, ceramic membranes were fabricated from low-cost raw material (ultrafine) and were developed with a chitosan top layer. The ceramic membranes were sintered at different temperatures between 950 °C and 1150 °C for 1 and 3 hours. The characterizations of membrane were examined by pure water flux, water absorption, compressive strength, XRF, XRD, TG-DTA, N₂-BET and SEM-EDS. Moreover, cross-linked chitosan is fabricated as an adsorptive layer for the removal of chromium(VI). The prepared composite membrane possessed effective removal and separation properties for heavy metals in a single step process with good flux, uniform structure, excellent reusability, chemical and mechanical durability. Additionally, the composite membrane has the potential to be an effective, environmentally friendly, and broad application for heavy metals and wastewater purification.

Keywords: Ultrafine raw materials, chitosan top layer, composite membrane, chromium(VI) removal.

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Investigation on characterization of different type of coals and preparation of coal derived activated carbon on their bases

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ABSTRACT

Mongolia has great resources of coal (173 billion ton) including high rank bituminous coals (6 billion ton), subbituminous coals and brown lignite coals, unfortunately had not developed yet coal based chemical industry such as gasification and liquefaction industries and polymer chemical industry. Also can be developed factory to produce activated carbons from coal and other carbon containing (carbonaceous) organic materials by comparatively easier technology. Activated carbon consumption is continuously being increased because they are using in important areas such as waste, drinkable water treatments, atmospheric pollution control, hazardous gas separation, chinning of solvents, etc. All carbonaceous material can be converted into activated carbon. Because of its availability and cheapness, a great portion of activated carbon production is derived from natural coal. Mongolia has imported 700-800 ton activated carbons per year with price 700-900 USD/ton. We have been chosen 3 different coals including 1 high rank bituminous coal of Tavantolgoi deposit, 1 stone subbituminous coal of Shariin gol and 1 brown lignite coal of Baganuur deposit and enriched by heavy liquid such as zincium chlorade ($ZnCl_2$) solution and processed by semi coking (carbonization) to produce the main raw material for coal derived active carbon. On the bases of these carbonized coals have been obtained coal derived activated carbon by activation with preheated water steam for 120 min. Most important technical properties of initial coal samples and activated carbons and their microporous properties such as iodine number- %, methylene blue adsorption- mg/g and surface area (BET)- m^2/g determined and characterized. Also have been suggested a technological scheme for production of coal derived activated carbon.

Keywords: *High rank coal, bituminous coal, stone subbituminous coal, brown coal, activated carbon, surface area.*

Study of roasting process of copper sulfide concentrate with potassium chloride

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ABSTRACT


This study aims to determine the optimal conditions for the combustion and dissolution of chalcopyrite. Copper sulfide concentrate combustion with potassium chloride is one of the ecologically friendly methods that does not emit sulfurous gases. The experiment to determine the optimal combustion time and the temperature was carried out at a temperature range of 450-550°C with 50°C intervals for 1, 2, 3, and 4 hours respectively when the concentrate/KCl weight ratio was at 1/0.7. Dissolution was carried out for 1-4 hours with 1-hour intervals, when the solid-liquid ratio was taken at 1:9. As a result of the experiment, the highest copper recovery was 94.7% for the following condition; combustion temperature and time 500°C and 3 hours, dissolution time sulfuric acid 2 hours. Experiment results to determine the appropriate ratio of concentrate and potassium chloride were fired at 500, 550°C in ratios of 1:0.6, 1:0.7, 1:0.8, and 1:0.9 for 3 hours each. Also, the experiment for choosing an optimal concentration of sulfuric acid was carried out in the range of 20-80 g/l with 20 g/l intervals and informed that the concentration of sulfuric acid of 40 g/l was considerable. Experiments for studying the optimal ratio of solid-liquid were carried out with ratios of 1:6, 1:9, 1:12, 1:15, and 1:20, and they confirmed that the ratio of 1:9 is most suitable. The solid residue was characterized by XRD and SEM-EDX analysis. ICP-OES equipment was used to determine the copper amount in the solution. As a result of the above investigation, the highest recovery of copper was 97.7%.

Keywords: *Roasting temperature, Chalcopyrite, Leaching, Copper recovery.*

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Properties of woolen woven coated with melanin of yak hair

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ABSTRACT

The melanin of yak hair is a biomaterial with unique features and functions. We investigated the properties of woolen woven when coated with yak hair melanin. Natural melanin was extracted from yak hair by the method of acid hydrolysis. The woolen woven was coated with 5%-10% owt melanin, 0.8 g/l sodium hydroxide (NaOH), and pH=4 acetic acid (CH₃COOH), at a liquor ratio of 1:40 at 96°C for 30 min. Melanin, extracted from yak hair, has the potential to become a natural dye. But converting it into leuco form with the help of a reducing agent makes it dyeing ability. From the UV/Vis spectrophotometer, SEM, and EDS analysis results, it can be seen that the melanin is completely absorbed into the wool fibers. Also, woolen woven is coated with melanin, the good 3/5-4/5 color fastness, the tensile strength of the fabric has improved by warp 53.53 %, weft 45.87 % but the elongation has reduced by warp 10.79 %, weft 18.3 %, and the thermal properties of woolen textiles are improved by 23 %. This research is important for the development of future clothing materials, treatments, and cosmetic products to protect against environmental stress caused by climate change.

Keywords: *Natural pigment, functional textile, dyeing ability, color fastness, tensile strength, thermal resistance.*

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Research study on possibility of recovery of Au and Ag by processing of tailings of gold and silver ore processing plant

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ABSTRACT

Gold and silver are recovered from the ore by gravity concentration, cyanidation or flotation methods. The choice of those methods depends on the mineralogical characteristics as well as gold and silver contents of the ore. According to the results of the analysis conducted using D8 ENDEAVOR X-ray diffractometer (XRD) and TIMA automatic mineral analyser of the Research Institute of the SOE "Erdenet Mining Corporation", native silver, silver-containing minerals such as arganite, argentoyarosite, iodirite and other minerals such as galena, sphalerite, plumbogarsite, pyrite, magnetite, goethite, siderite, quartz, feldspar, and muscovite were determined in the samples. The grain sizes of silver-containing minerals in galena, pyrite, goethite, siderite, and quartz ranged from 0.99 to 81.2 μm .


In this study, tailings samples from the gold and silver processing plant with the 0.1-0.115 g/t Au and 50-55 g/t Ag content and P80 particle size of 170-190 μm were reprocessed by gravity concentration and flotation methods to maximize recovery of gold and silver.

According to the results of the gravity concentration test, the reprocessing of the tailings has insignificant importance from the economical point of view. However, it was obtained experimentally that the suitable P80 size for processing by flotation is 100-110 μm .

By the research of the effect of several collector reagents, as observed by flotation tests a mixture of Na₂S (30g/ton) and Aero-34-18 (6-8 g/ton) reagents showed the best results with the concentrates containing 1700-1900 g/ton Ag.

Keywords: Erdenet Mining Corporation, flotation methods, gold, silver, Au and Ag.

Synthesis of hydroxyapatite nanoparticles using dolomite powder

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ABSTRACT


This study has been developed for the synthesis of hydroxyapatite using low-cost dolomite material. We assessed the influence of calcination temperature and input gases on the decomposition of raw dolomite, and the relation between the calcination temperature and the phosphorus affinity. Also, the influence of calcination temperature on the porosity of the novel synthesized adsorbent was investigated. By using TG-DTA, thermal analysis of raw dolomite and synthesized adsorbent was performed in the condition of continuous heating from room temperature to 1000°C at a heating rate of 20°C/min, under air atmosphere, and TG and DTA curves were obtained. The chemical compositions of raw dolomite, calcined dolomites, and synthesized adsorbents were determined by XRD analysis. The specific surface areas and pore volumes of synthesized adsorbents were measured using a surface area and pore size analyser. We developed a new hydroxyapatite adsorbent using low-cost dolomite for heavy metal removal in an aqueous solution. The following could be drawn. The composition of calcined dolomite is controlled by calcination reaction time and input gas. Phosphate was adsorbed by precipitation of hydroxyapatite onto the surface of calcined dolomite in the alkalic medium. Synthesized adsorbent consists of Hydroxyapatite and Magnesium oxide, which has high porosity and is good at the ion exchange process for the removal of cations in wastewater.

Keywords: Dolomite, Synthesis, Phosphorus, Hydroxyapatite, Nanoparticle.

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Effect of decalin as a hydrogen donor in cracking of atmospheric residue from Tamsagbulag oil, Mongolia

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ABSTRACT

In this work, we studied the thermal cracking of atmospheric residue from Tamsagbulag crude oil in the presence of hydrogen donor-decalin. The oil is highly paraffinic and has high a viscosity and low yield of distillate fraction. Therefore, deep processing is necessary to increase the yield of distillate fractions. The cracking experiments were carried out using decalin at two different concentrations (5% and 10 wt.% of feed) under a hydrogen pressure of 5 MPa. Additionally, a control experiment was conducted without the use of decalin under a nitrogen pressure of 0.4 MPa. The experimental temperature was 450°C and the duration varied from 60 to 180 minutes. The cracking process resulted in the formation of gaseous, liquid products, and coke from the atmospheric residue. The yield of liquid products was found to be two times less without decalin (49.0%) compared to decalin at 5% (82.42 wt.%) and 10% (86.67 wt.%) for 120 minutes. From these results, we have concluded that the optimal condition of the cracking process to obtain higher fuel fraction and lower gaseous and coke is the cracking process with 10% decalin for 120 min under a hydrogen pressure of 5 Mpa at 450°C.

Keywords: *atmospheric residue, cracking, hydrogen donor, fraction, decalin.*

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Computing the relative abundance of atmospheric pre-nucleation clusters from *ab initio* thermochemical calculations

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ABSTRACT

The first step in the formation of cloud condensation nuclei is the formation of pre-nucleation clusters from common atmospheric trace gases and water. This step defines the nucleation rate of aerosol particles and ultimately determines the extent of cloud formation and scattering of solar radiation by the atmosphere. Experimental studies of pre-nucleation clusters are limited to relatively large cluster sizes, only approaching diameters of 1 nm recently. Furthermore, characterization techniques limit the experiments to low pressure dry environments where the effects of atmospherically-relevant water concentrations are excluded. Here, we present a computational approach for determining the stabilities and relative abundances of pre-nucleation clusters using realistic trace gas and water concentrations under atmospheric conditions. Our methodology couples extensive conformational and configurational sampling of cluster geometries with *ab initio* thermochemical corrections and high-quality electronic energies to yield the Gibbs free energies of formation. Then Hess' Law of chemical equilibria is used to compute relative concentrations of each cluster.

Keywords: *Atmospheric aerosols, quantum chemistry, density-functional theory, computational chemistry.*

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Technological calculation of the refinery industry of the Tamsagbulag deposit

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ABSTRACT

We worked under the settled goal to make a model using Aspen Plus software and then made the initial technologic estimation for a refinery that produces 1 million tons of petroleum per annum. The test results show that the yield of the gasoline fraction is 14%, the kerosene fraction is 9%, the diesel fraction is 22%, the density of these fractions is 757-861 kg/m³, and kinematic viscosity determined to be 1.15-2.901mm²/sec. According to the technological calculation of the oil refinery with a capacity of 1.000.000 tons/year, the diameter of the column is 2.4m, the distance between the trays is 0.4-0.55m, and there are 34 trays in total. Actual steam velocity in the column is 0.3-0.47m/sec, the relatively active area of the tray is 0.782-0.788mm², the surface gravity coefficient is 1.015-1.13, allowable column velocity is 0.63-0.8247mm², the heat loss of 1st section is 8162162.6 kJ/h, the heat loss of 2nd section is 24893462.2 kJ/kg, and the heat loss of 3rd section is 16762905kJ/hour. Aspen Plus program allows 102901 kg of oil per hour to set the preheater through the furnace at 94°C and 0.4MPa pressure with 202°C and 0.4MPa pressure with 2.270kg/h steam at 75°C, 2564kg/h light compound at 0.4MPa pressure, 2120kg/h water, 13897 kg/h of naphtha and 86592 kg/h of heavy residue at 198°C and 0.3 MPa were determined.

Keywords: *Aspen Plus, petroleum, gasoline, distillation.*

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A study on chemical purification of graphite concentrate from Zulegt ore, Mongolia

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ABSTRACT

Removal of silicate minerals from graphite concentrate is one of important problems to achieve high purity graphite product. Alkali roasting pre-treatment and acid leaching process were used to prepare high-purity graphite from a graphite concentrate. The results showed that the alkali roasting pre-treatment and acid leaching process could enhance the fixed carbon of graphite concentrate to a higher level. Under the optimum conditions selected, a graphite product with fixed carbon content of 97.0% was obtained from graphite concentrate with carbon content of 87%. According to XRD and SEM-EDS analysis, impurities mainly composed of Fe, Si, and Al were decomposed to water soluble or acid soluble components during alkali-roasting pre-treatment and acid leaching process. The crystal structure and surface topography of graphite are not changed during above mentioned processes.

Keywords: *Graphite, Concentrate, Carbon, Iron.*

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Determination of chemical elements and heavy metal content in livestock animal meat in Mongolia by atomic absorption spectrometer (AAS)

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ABSTRACT

Meat is a great source of complete protein and is a valuable raw material. It contains necessary proteins, fats, minerals and vitamins that human body needs. This study was carried out to analyse calcium, iron, zinc, copper content in livestock animal meat and raw materials of livestock animal, such as liver, kidney, heart, tripe, lung, omasum, reticulum, tongue, ums, kite and head by atomic absorption spectrometer. Also, heavy metals such as lead and cadmium content was determined as a food safety indicator. The study materials beef, mutton, goat meat, camel meat, horse meat and raw materials were bought in a meat local market. Methods from Mongolian Standards (MNS) were used for the study. The study results showed that the highest calcium content of 38 mg% was in sheep tripe. Therefore, it is possible to produce a health food from this raw material. In livestock offals, zinc content varied from 1-2.5 mg%, and in skeletal muscle it varied from 1.5-38 mg%. This study shows that livestock animal organ meats can be used as an additional nutrition source in a human diet and in safety for utilization.

Keywords: *Skeletal muscle, organ meat, minerals, spectral analysis.*

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Ceramic membrane for environmental application: Recent developments and prospect

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ABSTRACT

Ceramic membranes have limited applications until now owing to their high processing cost, despite their excellent properties such as long-term durability, high strength, and incredible thermal / chemical resistance compared with polymeric membranes. The filtration efficiency and permeability of ceramic membranes have rapidly increased, and manufacturing costs have continuously decreased due to continuous research. Nowadays, ceramics membrane market starts to open for field of withstanding harsh conditions such as oil, textile and semiconductor/electronic industry.

In this conference, we will present the recent developments and prospect of ceramic membranes for wastewater. Also, the research results of the multi-channel ceramic membrane developed by the extrusion process in KIMS were reported, and in particular, the results of improving the properties of the alumina and silicon carbide membrane were summarized. That is, in the case of alumina membranes, water permeability could be improved through the sol-gel process and surface modification. For silicon carbide membrane, by developing an oxidation bonded SiC membrane, an original excellent membrane could be developed.

Keywords: *Ceramic membrane, extrusion, alumina, SiC, clay.*

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Future depletion of heavy oil/bitumen reserves: improvement of efficiency and reduction of GHG emission

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ABSTRACT

Steam injection and cold production methods are commonly used in heavy-oil recovery. The former has limitations due to high cost and environmental problems while the latter is more environmentally friendly but less efficient. Therefore, the future depletion of heavy-oil reserves requires more efficient and ecofriendly (low greenhouse gas (GHG) emission) methods. The objective of this paper is to discuss new generation methods to decrease GHG emission and water/natural gas consumption, while sustaining heavy-oil production. To achieve these goals, two topics will be addressed: (1) Improving the efficiency of thermal in-situ heavy-oil/bitumen recovery methods with additives (nano based smart materials, chemicals, and solvents, and (2) testing zero GHG emission production methods. New generation in-situ techniques for heavy oil/bitumen recovery including water (cold production) or steam-based applications with additives such as nano-based smart materials, surface active agents (IFT and wettability changers such as surfactants, alkalis, amines, alcohols, ethers etc.) along with solvent and electromagnetic heating are outlined. Flow and phase behavior of reservoir fluids during the aforementioned in-situ recovery processes at microscale and bench-scale is investigated and theoretical models of enhanced in-situ bitumen recovery technique are presented accordingly using laboratory and field-scale numerical simulation methods.

Keywords: *Heavy-oil recovery efficiency, GHG emission reduction, steam injection, nanomaterials, solvents.*

Strategic tendency for the development of coal preparation and processing technology

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ABSTRACT


There is a real change in the balance of energy sources depending on the program adopted at the international summit and the measures taken against global warming. It is important to understand this change based on practical research concerning new sources of consumption. Along with this, there has already commenced a need to consider many alternatives in terms of technical and technological solutions for coal deposit exploitation, as well as methods and methodology for calculating the efficiency of investors' projects. Therefore, based on international and domestic data of experience, this report was written by reviewing the historical role of the coal industry, which has contributed to the socio-economic development of the country, and the trends of technological development.

Keywords: Market demand, standards, export income.

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Synthesis of chitason based new material for recovery of Pt (IV)

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ABSTRACT

In this study a new type of adsorbent bead material was obtained using chitosan and pretreated clay. The pretreated clay was produced from the clay of the "Tsogt-Ovoo" deposit in the Umnogovi province of Mongolia. It was produced by acid and heat treatment to remove its mechanical impurities. The mixtures of chitosan and pretreated clay were taken with various ratios (8:1, 8:2, and 8:3) for chemical processing to obtain a chitosan-based adsorbent bead for recovery of Pt(IV) from aqueous solution. It was determined that the adsorption capacity of the adsorbent bead when the chitosan and pretreated clay mass ratio 8:2 was the highest for platinum ion (Pt(IV)). The adsorption properties of Pt(IV) were studied depending on the pH of the solution, time, temperature, initial concentration of platinum ion solution, and mass of adsorbent material. The adsorption efficiency was the highest (93.29%) when the initial concentration of the platinum ion was 50 mg/l at the following condition; pH=3, temperature 25 OC, time 4 hours, and the mass of the adsorbent material 0.1 g. It shows that the chitosan-based adsorbent bead can be used for the recovery of platinum (Pt(IV)) from aqueous solution.

Keywords: Adsorption kinetics, adsorption thermodynamics, platinum recovery.

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Dispersion and orientation of montmorillonite in Nylon-6

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ABSTRACT

Incorporation of high aspect ratio nanoparticles can significantly increase mechanical properties such as elastic modulus and tensile strength, and the functionality of the obtained nanocomposites. In this work, organically modified montmorillonite (Cloisite 30B) is dispersed and simultaneously oriented in Nylon-6 matrix using a high shear thin film machine. Organically modified montmorillonite was loaded into Nylon-6 with percentage range of 1-5. Produced Nylon-6/montmorillonite nanocomposite material's properties were analyzed using TEM, XRD, and DSC apparatuses, MTS 810 machine as well as their gas permeability is tested. The characterization results showed that high degree of dispersion and orientation, tensile modulus was increased by approximately 66% compared to the pure Nylon-6, high degree of crystallinity; gas permeability was decreased by approximately 3.5 times than neat nylon-6. Additionally, we have recovered new $\alpha 2$ crystal form in the nanocomposite materials with high degree of dispersed and oriented oMMT.

Keywords: Nylon-6, montmorillonite, dispersion, orientation, crystal.

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Design, preparation, and application of thermally conductive polymer composites

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ABSTRACT

As demand for new generation of intelligent electronic devices with high-performance, multi-functionality, and small-volume are growing, heat accumulation in devices has become a serious problem, which highly shortens the service life of modern high-performance devices, and even causes fire hazards. Thermally conductive polymer composites have been successfully used as thermal management materials (TMMs) to dissipate that excess heat for their great flexibility, light weight, easy preparation, and low cost. To endow the polymer composites outstanding thermal conductivity, there are two effective methods: 1) Constructing aligned filler networks as directed thermal pathways via force-field induced filler orientation; 2) Surface modification of fillers to decrease the thermal interface resistance in polymer composites. Further, the underlying heat conduction mechanism of polymer composites were explored by multiscale simulations, and a new influence factor, shape factor, was proposed and further proved. Our works not only provide a series methods to fabricate polymer composites with high thermal conductivity, but also paved the way for rationally designing and preparing high performance TMMs.

Keywords: *Thermal management materials (TMMs), polymer composites.*

Investigation on pyrolysis tar and its chemical composition of Booroljuut coal from Mongolia

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ABSTRACT


The products formed during coal heating under airless conditions are hard residues, condensed liquids, and uncondensed gases. The condensed liquid or tar is one of the most important pyrolysis products. Therefore, a detailed investigation of the pyrolysis of lignite and its tar provides basic theoretical knowledge for further thermal processing and application of coal. The main technical characteristics and elemental composition of the analytical sample of Booroljuut coal have been determined. The first time that the pyrolysis experiments of Booroljuut coal is being conducted. The pyrolysis experiments were performed at different heating temperatures (550-600 °C) and the yields of pyrolysis products were determined. The optimum heating temperature of pyrolysis of Booroljuut coal was chosen at 600°C, at which the tar yield was higher (32%). Purified (completely removed from the pyrolysis water) tar was subjected to IR analysis. Also, the tar organic bases and organic acids are separated from the tar, and residual neutral fractions of pyrolysis tar is the most important product of coal pyrolysis. Therefore, this tar was divided into several fractions including aliphatic, aromatic, and polar. These fractions were analyzed by GC/MS analysis, and the determined most important organic substances are derivatives of benzene, naphthalene, phenols, and alcohols. In total, 21 organic compounds soluble in hexane, 7 compounds soluble in toluene, and 6 compounds soluble in dichloromethane were identified.

Keywords: *Coal pyrolysis, tar, neutral oil.*

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Research on obtaining zeolite from the ash of Erdenet thermal power station

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ABSTRACT

This research work completed the study of obtaining zeolite by hydrothermal method using the ash of Erdenet Thermal Power Plant. According to the results of the study, the ratio of macroelements of ash in the ash pond of Erdenet Thermal Power Plant is less than 1, so it belongs to acid ash. Also, based on the content of oxides, it was determined that the ash of Erdenet Thermal Power Plant is a siliceous type of ash due to the high content of silicon and aluminium oxides, and the low content of iron and calcium oxides. According to the results of the XRD analysis of natural zeolite, it contains $\text{Ca}(\text{Si}_7\text{Al}_2)\text{O}186\cdot\text{H}_2\text{O}$ -86.94% and SiO_2 -13.06%. However, based on the results of XRD analysis of zeolite subjected to heat treatment, $\text{Ca}(\text{Si}_7\text{Al}_2)\text{O}186\cdot\text{H}_2\text{O}$ - 47.3%, SiO_2 -27.48%, $\text{Al}_2\text{Si}_2\text{O}_8$ - 20.64% were formed. Depending on the results of the XRD analysis of the synthesized zeolite, Sodalite ($\text{Na}_4\text{Cl}(\text{Al}_3\text{Si}_3\text{O}_{12})$)-83.72% at 200°C. Optimal reaction conditions for extracting zeolite from ash by hydrothermal method Ash: NaOH ratio 1:6, reaction temperature 80°C, stirring speed 200 rpm, reaction time 3 hours, hydrothermal temperature 200°C, time 4 hours, zeolite yield 83.72% $\text{Na}_4\text{Cl}(\text{Al}_3\text{Si}_3\text{O}_{12})$ was determined.

Keywords: Zeolite, sodium hydroxide, radiation, hydrothermal.

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A study on identification of the complications of molybdenum flotation

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ABSTRACT

In a condition where ore processing volumes at the SOE "Erdenet Mining Corporation" are increasing and ore characteristics are changing, there is a need to study the difficulties in molybdenum flotation and improvement of the characteristics of molybdenum recovery. It has been established by practical observations and conducted research experiments that the flow of the flotation process of Mineral Processing Department varies seasonally. Out of 3 factors (ore, water, and reagent) a study was conducted to determine the negative effects of water used in flotation process. In the technological process, 3 types of water are used: circulating, technical, and open pit drainage water/leachate. Slurry was sampled from the molybdenum flotation feed, from the sampling point № 94. To keep the primary sample uniform for the experiment, the slurry was divided into several 1-liter (L:S=70:30) parts and stored in cold conditions. The primary sample contained α Cu-22.16%, α Mo-1.022%, α Fe-26.36%, α I -89.35, α II-10.24 and α oxide-0.41. At present, the use of water from the treatment plant of Orkhon Province in the technological process has been temporarily stopped. Water is under the influence of nature and climate and is affected to some extent by air (oxygen) and temperature. Air and water may oxidize the surface of iron (pyrites, iron oxides) and copper minerals, which may negatively affect the flotation conditions. The 3 types of water used in the experiment were mixed in a certain proportion and the experiment was performed by mechanical oxygenation. As a result of the experiment, when the ratio of water was mixed and oxygenated, copper recovery increased by 7%, iron recovery increased by 6%, whereas the molybdenum recovery tended to decrease. An experiment was carried out to suppress chalcopyrite and pyrite in molybdenum flotation using starch (C₆H₁₀O₅). As a result of the experiment, when the consumption of starch is low, the copper recovery tends to decrease by 3.7% and the iron recovery by 3.3%, while the molybdenum recovery did not change very much. When a mixed reagent of kerosene and methylnaphthalene (C₁₁H₁₀) was tested as a molybdenum collector instead of diesel fuel, molybdenum recovery decreased by 2%, and copper and iron recovery decreased by 1.5%. Hydrogen peroxide (H₂O₂) is used as an oxidizing agent in molybdenum flotation. In this study, ferrous sulfate (FeSO₄) was used to increase the oxidation activity of H₂O₂ and currently experiments and research work are ongoing.

Keywords: Erdenet Mining Corporation, Mineral Processing Department, molybdenum flotation.

Kinetic study of thermal decomposition of Shivee-Ovoo and Tavantolgoi coals

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ABSTRACT


The present research work deals with the behavior of the thermal decomposition of the coals from Shivee-Ovoo and Tavantolgoi deposits and the determination of the kinetic parameters of their thermal decomposition. Thermal decomposition experiments were performed at five different heating temperature rates (10, 20, 30, 40, 50°C/min) for two typical rank coal such as bituminite and lignite samples in an argon atmosphere temperature range from 25°C to 1000°C. The experimental results of thermogravimetric analysis of both Shivee-Ovoo and Tavantolgoi coal samples show that the heating rate increases weight loss was decreased as well as the maximum decomposition rate was slightly increased. First-time kinetic parameters such as activation energy and pre-exponential factor were calculated using model-free methods like Kissinger, Friedman and KAS for the Shivee-Ovoo and Tavantolgoi coal samples. The arithmetic average of activation energies calculated by the Kissinger, Friedman and KAS methods were 157.9, 188.6, and 203.6 kJ/mol for Shivee-Ovoo and 227.05, 129.2, and 131.1 kJ/mol for Tavantolgoi coal, respectively.

Keywords: Coal, coal pyrolysis, kinetic, thermal, decomposition.

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Sulfation roasting of copper technogenic concentrate; a DFT calculation

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ABSTRACT

Sulfation roasting is one of the most prominent methods to recover copper from its sulfides. While water-soluble copper sulfate is produced with this method, an insoluble iron oxide derives as well. Therefore, supervision of iron oxidation at the desired level is of utmost importance to assure the quality of final products while the level of negative environmental impact will be controlled by decreasing the release of SO₂. During leaching with an alkaline-sulfide mixture, metal elements such as Bi, Sb, and As contained in tetrahedrite (Cu₁₂Sb₄S₁₃) concentrate result in a solid residue called technogenic (conformation) concentrate with copper sulfides (chalcopyrite, covellin, chalcocite and pyrite). Herewith, we introduce the recent findings about optimization of sulfation roasting with saturated oxygen injection on improvement of concentrate solubility. Such a technogenic copper concentrate consists of each 33.45 % of Cu, 14.14 % of Fe, 0.73 % of Ag, and 23.87 % of S. The results revealed that the optimal conditions for leaching temperature for the sulfation-roasting is 400 °C, with a duration of 3 hours, and an oxygen injection rate of 20ml/min result in 93.12 % of copper recovery. A combination of XRD and SEM-EDS analysis of sulfation roasted samples revealed a desired amount of copper sulfate together with goethite, maghemite, ferric sulfate, albite, anorthite while an elemental analysis with ICP-OES and other chemical analysis showed us each 28.34 % of Cu, 11.28 % of Fe, 0.65 % of Ag, and 14.37 % of S. A density functional theory (DFT) method based on the Vienna ab-initio simulation package (VASP) was evolved to reveal the process of sulfation (CuSO₄) of copper sulfide. The reaction pathway calculation assumed that the sulfation of copper sulfide molecules begins due to the direct interaction of SO₂ and O₂ with absorption energy of E_{ads} = -3.62 eV or with the initial formation of SO₃, and formation of sulfate with calculated absorption energy of E_{ads} = -1.78 eV each. Our results suggest that both of the above sulfation reactions of CuS are thermodynamically viable.

Keywords: *Copper sulfide, sulfation, covelline.*

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Preparation of glass-ceramic composites by one stage heat treatment from waste glass and fly ash

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ABSTRACT

Glass-ceramics are produced from aluminosilicate by a combination of a melting process and one or two stage heat treatment for crystallization, nucleation and crystal growth. Coal fly ash and waste glass containing a large amount of SiO₂, and Al₂O₃ can be good raw materials for structural high tech materials such as glass ceramics. The mixtures of waste glass, fly ash and fluorite were wet ball milled for 4-8 hours, dried and one-stage heat treatment that sintered at 800, 900 and 1000 °C for 60-240 minutes. The properties of the material were determined by the methods of X-ray fluorescence (XRF), differential thermal analysis-thermogravimetry (DTA/TG), X-ray diffractometer (XRD), and the parameters of mechanical properties were analyzed. The glass-ceramic materials had a hardness of 38-94.66 HB containing the major minerals such as diopside (CaMgSi₂O₆), albite (NaAlSi₃O₈) and wollastonite (CaSi₃O₈). These materials used as cladding in the building industry.

Keywords: Glass-ceramics, fly ash, ball mill, diopside, hardness.

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The study of recovery of precious metals and rare earth elements from the e-waste and NiMH battery waste

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ABSTRACT

The hydrometallurgical process is more suitable for recycling the various metal mixtures which are found in waste electronics and waste batteries due to its cost-effectiveness, ease of operation, and eco-friendly. Especially, using modern technology of hydrometallurgy, metallization is transferred to the solution state by leaching. Therefore, understanding the etching process parameters is crucial for achieving high metal recovery. In this process, selective precipitation of dissolved metals in the solution separated the target products. In this study, we carried out the metal leaching process in a laboratory environment. As a result of the experiment, pure cathode copper (95.52 %) was obtained by recycling electronic waste. Moreover, composite parts and metal-containing parts are processed and the metals in the solid parts are dissolved in an acid solution at a temperature of 60-80 °C under the influence of oxygen. When the dissolved metal is transferred to the solution and its content is calculated by analytical method. For instance, 1 kg of electronic waste contains 20 % metal, and the remaining 80 % were glass, plastic, and ceramics. But 1 kg of waste battery consists of 23 % metal and the remaining 77 % plastic and insulation. This study provides an important way for the investigation of metal recoveries from electronic wastes.

Keywords: *Economic, cost-effectiveness, recycling, pyrometallurgy, leaching, hydrometallurgy.*

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Study on gasification of coal from Shivee-ovoo deposit of Mongolia

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ABSTRACT


In our study, we determined the elemental-technical characteristics and mineral-chemical composition of brown coal in the first and second seams of the Shivee-Ovoo deposit, and gasification was carried out with water vapor in a stationary state. According to the results of the research, it can be seen that the sample of the first seam has low moisture and ash content, the yield of volatile substances is high, and the coal moisture and ash of the second seam are high, determined that the yield of volatile substances is relatively low. Therefore, from the results of coal gasification of the first layer, when the reaction temperature is 720 °C, H₂ - 7.04 %, CO₂ - 1.98 %, and CO - 0.39 % at 850 °C, and CH₄ - 0.14% at 520 °C, which was the maximum yield. According to the results of coal gasification of the second layer, at 730 °C, H₂-6.17 %, CO₂-1.74 %; and CO-0.52 % at 850 °C; and at 690 °C, the yield of CH₄ was maximum which was 0.11 %. Regarding the results, it can be seen that the yield of H₂, CH₄, and CO₂ in coal gasification of the first layer is higher than that of the second layer, while the output of CO is relatively high in the second layer [1-4].

Keywords: Gasification, stationary state, Shivee-Ovoo, synthetic gas, hydrochloric acid

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Mechanochemical modification study of natural zeolite to improve the adsorption

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ABSTRACT

Mechanochemical activation was carried out to improve the adsorption capacity of natural zeolite. Characterisation of mechanochemically activated Urgun zeolite has been performed. Zeolites can be activated differently depending on their particle size, and the averaged samples from 0.45 mm sieve were selected. For zeolite activation, the ratio of sample to corundum balls was 1:1, 1:2, 1:3, and 1:4 and was activated at 180 rpm for 45 minutes. According to the results, the most suitable ratio for mechanochemical activation was found to be 1:3, or the maximum specific surface area of the sample was 6355.44 cm²/g. After the activation of zeolite, the ratio of 0.45 mm particle size samples and balls was taken as 1:1, 1:2, and 1:3 and activated for 30, 60, 90, and 120 minutes at 180 rpm, respectively. Samples with 0.30 mm grain size were activated at 180 rpm for 30, 60, 90, and 120 min at a ratio of 1:2 for comparison. According to the results of the activation time experiments, a 1:3 ratio of sample to beads was suitable for activation for 60 min. When the absorption capacity of the mechanically activated sample was determined by absorbing acetic acid, the absorption capacity increased by 25%. Structural characterisation was performed with XRD, SEM and DCS/TG.

Keywords: “adsorption capacity”, “planetary mill”, “zeolite”.

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The fuel consumption mathematical modelling of a public transport bus in urban traffics

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ABSTRACT

When studying the statistical data obtained from the results of measuring the consumption of dual fuel mode diesel fuel and liquefied petroleum gas (LPG) when the bus is running on a diesel-LPG mixture, the fuel consumption values are different for different routes. The regularity of the fuel consumption during operation of the bus with diesel-LPG dual fuel was established depending on the operational and technical speed and the hall filling factor. It is considered appropriate to calculate the influence of operating speed and passenger density on diesel-LPG dual fuel consumption. A multiple regression mathematical models of diesel fuel consumption in the diesel-LPG dual fuel of buses depending on the operating speed and passenger density was derived.

Keywords: *Operating speed, passenger density, consumption of diesel-LPG dual fuel, multiple regression mathematical models.*

Naturally crosslinked hydrogels for wound dressings

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ABSTRACT

This work was focused on the preparation and characterization of naturally crosslinked sodium alginate/ gelatine (SA/G) hydrogels with various concentrations of SA and G. In an attempt to overcome the cytotoxicity problem of the chemically crosslinked hydrogels, genipin (GP) was used to obtain a biocompatible wound dressing material. The effects of SA/ G ratio (20/80 to 80/20) on the morphology and chemical structure were examined via Scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR), respectively. Swelling properties were determined gravimetrically.

FTIR spectra of SA/G-GP hydrogels revealed an increase in amide I and II absorbencies indicating the formation of heterocyclic compound of GP linked to the G and also the formation of the secondary amide group as a result of the reaction between G and GP. With increasing GP concentration, the swelling degree markedly reduced and the thermal stability enhanced. Since GP shows low toxicity, crosslinked hydrogels could be a promising candidate for biomedical applications, such as wound dressings.

Keywords: *Sodium alginate, gelatine, hydrogels, crosslinking, swelling behaviour.*

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