Characteristic evaluation method of brown-coal tar using the principal component analysis

Hee-Joon Kim[1*], Yoko Nunome[2], Bayartsaikhan Tsendee[3], Zoltuya Khashbaatar[3] and Naoki Kano[4]

[1] *Department of Environmental Chemistry and Chemical Engineering, School of Advanced, Engineering, Kogakuin University, Tokyo, Japan*
[2] *Faculty of Pharmacy, Department of Pharmacy, Yasuda Women's University, Japan*
[3] *Department of Chemical Engineering, School of Applied Sciences, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia*
[4] *Department of Chemistry and Chemical Engineering, Faculty of Engineering, Niigata University, Niigata, Japan*

**Correspondence author. Email: kim6908@yahoo.com.jp*

ABSTRACT
This study aims to characterize brown-coal tar, a pyrolysis product, using three types of Mongolian brown coals: Baganuur, Shivee-Ovoo, and Khuut. The coal tar was analyzed by gas chromatography/mass spectrometry (GC/MS) in a horizontal fixed-bed reactor at temperatures ranging from 400 to 900℃. Chemometric analysis, specifically principal component analysis (PCA), was employed to reveal differences among coal samples at various temperatures.
The coal tar primarily contained long-chain aliphatic compounds, such as n-alkanes, n-alkenes, and aliphatic ketones, along with polycyclic aromatic hydrocarbons (PAHs). The peak areas of aliphatic compounds increased with temperature up to approximately 600℃, then sharply decreased above 700℃. In contrast, the total PAHs concentration in the tar exponentially increased above 700℃, except for Baganuur coal.
The total PAHs concentrations in the tar at 900℃ were 57.1 mg/g for Shivee-Ovoo and 34.7 mg/g for Khuut, whereas Baganuur coal tar had the lowest value of 8.85 mg/g. This discrepancy is likely due to the low O/C ratio of Baganuur coal, which hindered the progress of thermal decomposition. Furthermore, GC/MS chromatograms combined with PCA successfully classified the coal samples by production area, based on the first (PC1) and second (PC2) principal components.

Keywords: *pyrolysis, Mongolian brown coals, coal tar, principal component analysis, polycyclic aromatic hydrocarbons*

Production of hydroxyapatite adsorbent from sewage sludge ash

Zoltuya Khashbaatar[1*], Bat-Erdene Erdenetsogt[1], Enkhtuul Mendsaikhan[1,2], Naoki Kano[2] and Hee Joon Kim[3]

[1] *Department of Chemical Engineering, School of Applied Sciences, Mongolian University of Sciences and Technology, Ulaanbaatar, Mongolia*
[2]*Department of Chemistry and Chemical Engineering, Faculty of Engineering, Niigata University, Niigata, Japan*
[3]*Department of Environmental Chemistry and Chemical Engineering, School of Advanced Engineering, Kogakuin University, Tokyo, Japan*

**Correspondence author. Email: kh.zoltuya@must.edu.mn, ORCID: 0000-0001-5643-7752*

ABSTRACT
Recently, the world's water resources have been severely impacted by human activities such as rapid industrialization and economic growth. This has consistently resulted in certain subsequent, unacceptable issues, like heavy metal contamination and waste disposal, fertilizers, and pesticides.. For the management of heavy metal contamination in water, strict controls on emissions and recycling are also essential. These days, researchers are interested in studies of dolomite-based adsorbent material for removing heavy metals due to its abundant and low-cost material. Furthermore, synthetic hydroxyapatite, or Hap ($Ca_5(PO_4)OH$), adsorbent could be manufactured from naturally available minerals for the precursors of calcium synthesized with phosphate, which could become a low-cost adsorbent. The key aims of this study are (1) to synthesize and characterize the SSA-derived hydroxyapatite adsorbent, (2) to investigate the influence of aqueous medium pH, dosage, initial concentration, contact time, and temperature on the recovery of phosphorus, and (3) to evaluate the characteristics of the novel adsorbent based on data from XRD, SEM, and XRF apparatuses. Our findings indicate that, in the absence of an external calcium source, a phosphorus product with elevated P content in sewage sludge ash (SSA) can be synthesized directly from calcium liquid and phosphorus liquid at a 1.5Ca/P molar ratio.

Keywords: *SSA, precipitation, calcium and phosphorus recovery, hydroxyapatite adsorbent*

REFERENCES

[1] F. Younas, N.K, Niazi, I. Bibi, Constructed Wetlands as a Sustainable Technology for Wastewater Treatment with Emphasis on Chromium-Rich Tannery Wastewater, J Hazard Mater, 422, (2022). http://dx.doi.org/10.1016/j.jhazmat.2021.126926

[2] Z. Khashbaatar, S. Akama, N. Kano, H.J. Kim, Development of a New Dolomite-Based Adsorbent with Phosphorus and the Adsorption Characteristics of Arsenic (III) in an Aqueous Solution, Water (Switzerland), 14, (2022). http://dx.doi.org/10.3390/w14071102

The study to determine the possibility of *Acidithiobacillus ferrooxidans(OR512156.1)* leaching of low-grade copper ore

Bujinlkham Tuvd[1], Badamgarav Chimed-Ochir[1], Garamjav Munkhbat[1], Ariunzaya Tsolmonbaatar[2], Chinzorig Radnaabazar[1] and Erdenechimeg Dolgor[1*]

[1] *School of Engineering and Technology, National University of Mongolia, Ulaanbaatar, Mongolia*
[2] *Gobi-Altai Medical School, Mongolian National University of Medical Sciences, Gobi-Altai, Mongolia*

**Corresponding author: E-mail: erdenechimeg_d@num.edu.mn, ORCID: 0000-0002-8344-4760*

ABSTRACT

The mesophilic and acidophilic iron oxidizing bacterial strain TF1 was isolated from acidic mine drainage of mining operations. This bacterial isolate is a motile, Gram-negative coccobacillus with dimensions of 3.97 by 5.11 µm exhibiting optimal growth at 30°C and pH of 2.0. Strain TF1 grows autotrophically by utilizing ferrous iron and sulfate as its energy sources. Bacterial biomass was prepared for bioleaching in Silverman and Lundgren's 9K media. The Strain TF1 was identified as *Acidithiobacillus ferrooxidans* (OR512156.1.) through confirmation by various analytical methods including morphological, biochemical, and physiological analyses, alongside 16S rRNA gene sequencing, revealing over 97% sequence similarity.

Geochemical and mineralogical analysis of the low-grade copper ore revealed that chalcopyrite is associated with titanite and has been partially replaced by chalcocite, covellite, and hydrogoethite. X-ray fluorescence analysis indicated that the sample contains 0.164% Cu, 1.92% Fe, and 1.32% S. Mineral phase analysis identified oxidized copper at 95.94 mg/kg, secondary copper at 557 mg/kg, and primary copper at 729 mg/kg.

Temperature-dependent bioleaching experiments were conducted in shake flasks using locally isolated iron-oxidizing bacterial strains. Key parameters, including pH, oxidation-reduction potential (ORP), copper concentration, total iron, and ferrous iron (Fe^{2+}) were monitored every three days. The highest copper recovery rate of 55.74% was achieved at 30°C using iron-oxidizing bacteria. In comparison, bioleaching with raffinate under the same temperature conditions resulted in a 44.66% copper recovery over 30 days.

***Keywords**: Acidithiobacillus ferooxidans, Bioleaching, ·pure culture isolation, 16S rRNA, low-grade copper ore.*

Hydrothermal flowthrough pretreatment of rice husk and pyrolysis characteristics of residual solid

Tianlong Liu [1*]

[1] *Jiangsu Province Engineering Research Center of Fine Utilization of Carbon Resources, China University of Mining & Technology, Xuzhou, Jiangsu, China*

**Correspondence author. Email: tianlong.liu@cumt.edu.cn, ORCID: 0000-0002-7679-7592*

ABSTRACT

The sophisticated multi-components and cross-link chemical structures of lignocellulosic biomass are important bottlenecks restricting its value-added utilization. Cleanly and efficiently pre-fractionating lignocellulose is of great significance for the fractional conversion of biomass. In this study, rice husk (RH) was subjected to hydrothermal pretreatment with a continuous flow reactor and the reaction process and kinetics were studied. Effects of the pretreatment temperature and flowrate on the chemical compositions of RH were investigated and the pyrolysis characteristics of residual solid and the distributions of its pyrolytic products were analysed by thermogravimetric analysis and curie-point pyrolysis gas chromatography/mass spectrometry, respectively. The results show that the solid-liquid reactions conform well to the unreacted shrinking core model with phase boundary reactions rate-controlling. The reactions occurred in the pretreatment are mainly the hydrolysis of hemicellulose, the removal of ash and the decomposition of lignin. The hydrothermal flowthrough pretreatment is superior to the batch mode towards selectively retaining cellulose of RH and improving the specific surface area (216 m^2/g) and SiO_2 purity (99.70%) of RH ash. Levoglucosan produced from the pyrolysis of residual solid at a curie-point temperature of 445 oC achieved a relative content of 52.3%, which is 6.0 times higher than that from RH.

Keywords: *Rice husk, hydrothermal treatment, levoglucosan, pyrolysis.*

REFERENCES

[1] T. Liu, A. Mori, R. Arai, S. Asano, S. Kudo, J.I. Hayashi, Selective production of phenolic monomers and biochar by pyrolysis of lignin with internal recycling of heavy oil, Energy Fuels 34 (2020), pp. 7183−7189. https://dx.doi.org/10.1021/acs.energyfuels.0c01164.

[2] T. Liu, F. Ning, Q. Li, Z. Li, X. Feng, X. Zhao. Post-synthesis of HZSM-5 by aluminum fluoride in an acidic fluoride solution for enhanced reforming of lignite pyrolytic volatiles into light aromatics, Energy Fuels, 37 (2023), pp. 10929−10938. https://doi.org/10.1021/acs.energyfuels.3c01494.

[3] T. Liu, Z. Li, S. Kudo, X. Gao, J.-i. Hayashi, Leaching char with acidic aqueous phase from biomass pyrolysis: Valorization of the leachate via catalytic hydrothermal gasification, Fuel 373 (2024), pp. 132264. https://doi.org/10.1016/j.fuel.2024.132264.

A study on the attenuation of acidic solution from the Zoovch-Ovoo uranium ore processing plant

Khulan Byambasuren[1], Ulziibadrakh Erdenebat[1], Alen Silam[1], Altansukh Batnasan[1], Burmaa Gunchin[1] and Nyamdelger Shirchinnamjil[1*]

[1]*Institute of Chemistry and Chemical Technology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia*

**Correspondence author. Email: nyamdelger_sh @mas.ac.mn, ORCID: 0000-0003-1242-7776*

ABSTRACT

A series of laboratory experiments were conducted to study the cation exchange interactions in neutralizing the remaining acidic solution after uranium extraction via acid-in situ recovery. We subjected a sample from the Zoovch-Ovoo uranium ore processing plant, referred to as the sand-clay sample. It was treated with a sulfuric acid solution with a pH of 2.2, or a concentration of $6.3 \cdot 10^{-3}$ M, and the pH became stable at 3.4. The resulting solution contained Ca^{2+}, Na^{+}, K^{+}, Al^{3+}, Fe^{2+}, Mg^{2+}, and other microelements (Zn, Pb, Co, Ni, P, Cu, Cr, Ba, Sr), which confirms the cation exchange process. Subsequently, a clay-type sample, which was prepared by handpicking the clustered parts from the sand-clay sample, was desorbed using NaCl and NaCl+$MgCl_2$ solutions over 24 hours with 1-hour intervals. For 30 mmol/L NaCl solution, the pH stabilized at 4.83, while in 30 mM NaCl + 100 mM $MgCl_2$ solution, the pH stabilized at 4.45. From these results, the mineral composition of the clay sample appears to be a key factor. Moreover, it was observed that NaCl is more effective in neutralizing the acidic solution absorbed by natural clays. Overall, ion exchange methods can be used to neutralize the acidic clay and solution formed during uranium extraction. While the experiment is able to determine the time length of complete neutralization to occur under natural conditions, NaCl and NaCl + $MgCl_2$ solutions can be used for facilitated attenuation.

Keywords: *cationic exchange process, in situ recovery, natural and facilitated attenuation*

REFERENCES

[1] M. S. Pelizza and C. S. Bartels, Introduction to uranium in situ recovery technology, Uranium for Nuclear Power, (2016) pp. 157-213, https://doi.org/10.1016/B978-0-08-100307-7.00007-7

[2] world-nuclear.org,16 05 2024. [Online]. Available: https://world-nuclear.org/information-library/nuclear-fuel-cycle/mining-of-uranium/in-situ-leach-mining-of-uranium.

[3] E. Ts., N. Yasuda, Q. M. R. Nizam, K. E., N. Chimedzogzol and E. Ch., Radioactive background in some uranium deposits of Mongolia, The International Journal of Engineering and Science, (2023), pp. 29-38, doi:10.9790/1813-12122839

Simultaneous removal of Pb(II), Cu(II), Cd(II) and Zn(II) from aqueous solution using modified *Urtica Dioica* leaves

Naoki Kano[1*], Enkhtuul Mendsaikhan[2,3], Munkhpurev Bat-Amgalan[3], Naoto Miyamoto[1], Ganchimeg Yunden[3] and Hee-Joon Kim[1,4]

[1] *Department of Chemistry and Chemical Engineering, Faculty of Engineering, Niigata University, Niigata, Japan.*
[2] *Graduate School of Science and Technology, Niigata University, Niigata, Japan.*
[3] *Department of Chemical Engineering, School of Applied Sciences, Mongolian University of Sciences and Technology, Ulaanbaatar, Mongolia.*
[4] *Department of Environmental Chemistry and Chemical Engineering, School of Advanced Engineering, Kogakuin University, Tokyo, Japan.*

**Correspondence author. Email: kano@eng.niigata-u.ac.jp ORCID: 0000-0002-5590-2875*

ABSTRCT

This article discusses the simultaneous removal of Pb(II), Cu(II), Cd(II), and Zn(II) from aqueous solutions using *Urtica dioica* leaves (UDLs) modified with sulfuric acid, followed by heat treatment to enhance adsorptive properties. The modified UDLs were characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), scanning electron microscope-energy dispersive X-ray spectroscopy (SEM-EDS 。), and nitrogen adsorption/desorption experiments (N_2- Brunauer–Emmet–Teller (BET)). The effects of adsorbent dosage, temperature, the pH of the aqueous solution, and contact time on the adsorption of heavy metals by these materials were studied. Typical adsorption isotherms (Langmuir and Freundlich) were determined for the adsorption process, and maximal removal efficiencies of Pb(II), Cu(II), Cd(II), and Zn(II) were determined as 99.2%, 96.4%, 88.7%, and 83.6%, respectively. The adsorption kinetics results were consistent with the pseudo-second-order equation, indicating that the adsorption process was mainly chemical adsorption. Moreover, thermodynamic analysis indicated that the adsorption processes are spontaneous and endothermic in nature. The influence of competing ions on the adsorption of multiple heavy metals was also investigated. The results suggest that sulfuric acid and heat treated *Urtica dioica* leaves can be a promising, inexpensive, and eco-friendly adsorbent for removing heavy metal ions from contaminated water.

Keywords: *Urtica dioica leaves (UDL), heavy metals, low-cost adsorbent, wastewater treatment*

Studying the effect of K addition on the synthesis of C_{2+} hydrocarbons by hydrogenation of carbon dioxide

Ermuun Gan-Erdene[1,*], Manlaibaatar Purevsuren[1], Tsogbadrakh Namsrai[2], and Enkhsaruul Byambajav[1]

[1] *Department of Chemistry, National University of Mongolia, Ulaanbaatar, Mongolia*
[2] *Department of Physics, National University of Mongolia, Ulaanbaatar, Mongolia*

**Correspondence author. Email: grn.rmugen@gmail.com*

ABSTRACT

This study investigates the effect of potassium (K) addition on the catalytic performance of cobalt oxide (CoO) in the hydrogenation of carbon dioxide (CO_2) to hydrocarbons. Employing a synergy of experimental and computational approaches, we demonstrate that K doping markedly enhances the adsorption of CO_2 and hydrogen (H_2) on the CoO catalyst surface. X-ray diffraction (XRD) analysis confirmed the presence of the CoO phase with a lattice constant of 4.237 Å, aligning closely with experimental data. Density functional theory (DFT) calculations revealed a substantial decrease in adsorption energies, with CO_2 adsorption rising by 77% and H_2 adsorption by 46% on the K doped CoO surface compared to the undoped counterpart. Temperature-programmed desorption (TPD) analysis further validated these findings, showing a 36.89% increase in CO_2 adsorption on the K-added catalyst, suggesting a shift to a more basic surface that favors the uptake of acidic gases like CO_2. Projected density of states (PDOS) calculations provided deeper insight, indicating that K addition stabilizes electron. These results highlight the pivotal role of surface adsorption in driving selective hydrocarbon synthesis and offer valuable guidance for designing efficient, cost-effective catalysts for CO_2 hydrogenation.

Keywords: *Catalyst, promoter, hydrogenation of carbon dioxide, adsorption energy*

REFERENCES

[1] Li, K., Li, X., Li, L. et al, Nature of catalytic behavior of cobalt oxides for CO_2 hydrogenation. JACS Au, 3(2), (2023), 508–515. https://doi.org/10.1021/jacsau.2c00632

[2] P. Manlaibaatar, Hydrogenation of CO_2 to light hydrocarbons ($C_2 - C_4$) using additional metal promoters (Ba, La, Ce) and a combined support Co−K catalyst, Chemistry-2024 Conference, (2024), Ulaanbaatar, Mongolia.

[3] P. Giannozzi, et al., J. Chem. Phys. 152, (2020), 154105 https://doi:10.1063/5.0005082

[4] I.C.T. Have, J.J.C. Kromwijk, M. Monai, et al, Uncovering the reaction mechanism behind *CoO* as active phase for *CO_2* hydrogenation. Nature Communications, 13, (2022). 324. https://doi.org/10.1038/s41467-022-27981-x

Research on using synthetic polymers as fuel

Battsetseg Tsog[1], Bat-Erdene Erdenetsogt[1,*] and Zoltuya Khashbaatar[1]

[1] *Department of Chemical Engineering, School of Applied Sciences, Mongolian University of Sciences and Technology, Ulaanbaatar, Mongolia*

**Correspondence author. Email: et_baterdene@must.edu.mn, ORCID: 0000-0003-2051-1134*

ABSTRACT

With a potential annual capacity of 1.5 million tons, our country's second oil refinery is expected to provide half of its fuel and lubricant demands. Construction is now underway to fully operate it in 2027. Due to the current economic recovery in the mining sector, the demand for fuels and lubricants has been rising annually, and the rest of the market will probably remain dependent on imports. Since the world's oil supplies are predicted to deplete within 30 years, scientists investigated and effectively tested viable fuels and lubricants that could be produced using alternative fuels to substitute oil.

Hence, we studied the prospects of producing high-quality, affordable motor fuel via chemical processing of the most commonly used waste polymers. A Hitachi TG/DTA thermogravimeter and a fixed-bed reactor were employed to thermally degrade the waste polymers—PP, HDPE, and LDPE—used in the study. The characteristics of the decomposition products were evaluated using standard techniques. The FLASH™ 2000 Organic Elemental Analyzer was used to determine each raw material's elemental composition.

Testing for thermal degradation of the waste polymers in the study revealed a direct correlation between the heating rate and fluid production. In our research, the PP had the highest concentration of carbon (85%) but the lowest concentration of hydrogen (15%) atoms, which made up the majority of the elemental composition of the raw materials under investigation. Thermal degradation of waste polymers results in a decline in the yield of liquid products in the following order: PP→HDPE→LDPE (74.99%, 72.25%, 70.66%) respectively.

It has been concluded that producing high-quality fuel by thermally treating waste polymers is feasible because most of the physicochemical properties of each fraction meet fuel standards.

Keywords: *Waste polymer, Thermal decomposition, Pyrolysis resin, Motor fuel*

REFERENCES

[1] M. Niu et al., Kinetic Model for Low-Temperature Coal Tar Hydrorefining, Energy & Fuels, vol. 31, no. 5, (2017) pp. 5441–5447, doi: 10.1021/acs.energyfuels.6b03109.

[2] L. Brennan and P. Owende, Biofuels from microalgae—A review of technologies for production, processing, and extractions of biofuels and co-products, Renewable and Sustainable Energy Reviews, vol. 14, no. 2, (2010), pp. 557–577, doi: 10.1016/j.rser.2009.10.009.

Modelling and optimization hydrogen production through steam methane reforming

Lkhagvajav Purevdorj [1,2] and Tamiraa Ganbold[2*]

[1] *Geological Center for Research and Analysis, Ulaanbaatar, Mongolia*
[2]*Department of Chemical and Biological Engineering, School of Engineering and Technology, National University of Mongolia, Ulaanbaatar, Mongolia*

**Correspondence author. Email: tamiraa@num.edu.mn ORCID: 0000-0001-9965-9208*

ABSTRACT

Hydrogen production from methane is more necessary for sustainable chemical manufacturing than cleaner energy sources. It is crucial in various industries, namely refining, ammonia production, and methanol synthesis. This process goes into two reactors; th e first reactor facilitates the SMR reaction, while the next reactors carry out the Water-Gas Shift, Plug Flow (WGS) reaction at different temperatures. The SMR reaction occurs under endothermic conditions at temperatures between from 800 K to 1300 K, whereas at pressures at higher pressure, also convertingmethane and steam into hydrogenand carbon monoxide by catalysed by nickel (Ni). By modelling the SMR reaction using a PFR, parameters such as reaction rate, raw material conversion rate, system heat load, and product composition were calculated. The reaction kinetic were considered as heterogeneous catalyst reaction. The optimal operating conditions for the SMR reactor—considering methane conversion rate, hydrogen content, which were determined to be a temperature of 1000 K and a pressure of 2.66 bar. The WGS reaction is exothermic; hence, at higher temperatures (1300 K), the methane conversion reaches up to 72%. However, as temperature rises, the heat load on the reactor also increases. Under these conditions of 1000K and 2.66 bar, the hydrogen content increased from 36.2% to 72.5%, and the heat load on the reactor was 3900 kW. This research offers important insights for designing and operating hydrogen production systems in industrial applications.

Keywords: *Steam Methane Reforming, Water-Gas Shift, Plug Flow Reactor, Methane, Hydrogen, Conversion rate.*

REFERENCES

[1] C. Ratnasamy, J. P. Wagner, Water Gas Shift Catalysis, Catalysis Reviews, (2009). https://doi.org/10.1080/01614940903048661

[2] Yongtaek Choi, Harvey G. Stenger, Water gas shift reaction kinetics and reactor modeling, Department of Chemical Engineering, Lehigh University, Bethlehem: с.н., (2003). https://doi.org/10.1016/S0378-7753(03)00614-1

Study of the effect of electron acceptors in catholyte of two-chamber microbial fuel cell using cation exchange membrane

Khishigshinen Dorlig[1], Tugskhuslen Terenchimed[1], Chinzorig Radnaabazar[1], Munkhjargal Sharav[2] and Erdenechimeg Dolgor1[*]

[1] *School of Engineering and Technology of National University of Mongolia, Ulaanbaatar, Mongolia*
[2] *School of Science of National University of Mongolia, Ulaanbaatar, Mongolia*

**Corresponding author: E-mail: erdenechimeg_d@num.edu.mn ORCID: 0000-0002-8344-4760*

ABSTRACT
Water pollution is a global issue that has drastically increased in recent years due to rapid industrial development. Different technologies have been designed for the removal of pollutants from wastewater. However, most of these techniques are expensive, generate new waste, and focus solely on metal removal instead of metal recovery. In this study, novel facultative exoelectrogenic strains designated *Bacillus paramycoides* sp. AX-29 and *Advenella incenata* sp.YX-1 were isolated from municipal and industrial wastewater, respectively. These isolates were utilized as pure and mixed culture inoculums in a bioelectrochemical two-chamber system (BES) to produce bioelectricity and treat simulated industrial wastewater. The performance of the cathodic electron acceptors (CEA) used in the two-chambered microbial fuel cell (MFC) was in the following order: potassium dichromate, K2Cr2O7 (0.5 V; 19.2-75.9 mW/m2) > potassium ferricyanide (0.38 V; 41.6-106.9 mW/m2). Different operational parameters were considered to find out the performance of the MFC, like initial pH in aqueous solutions, concentrations of the electron acceptors, and phosphate buffer. The solution of the cathode electrolyte has a definite effect on the voltage and output factor of the MFC, indicating that this is directly related to the oxidation potential of the acceptors in the cathode

Keywords: *Bacillus paramycoides, Advenella incenata, bioelectrochemical two-chamber system, microbial fuel cell*

Synthesis of maghemite nanoparticles from iron phosphate using alkaline solution and evaluation of its battery characteristics

Hirokazu Okawa[1*], Shun Ikeda[1], Mitsuki Ota[1], Takahiro Kato[1], Turtogtokh Enkhtuya[2] and Tsermaa Galya[2]

[1] *Graduate School of Engineering Science, Akita University, Akita, Japan*
[2] *Department of Physics, School of Applied Science, Mongolian University of Sciences and Technology, Ulaanbaatar, Mongolia*

Correspondence author. Email: okawa@mine.akita-u.ac.jp

ABSTRACT
Maghemite (γ-Fe_2O_3) has been attracted as a cathode material for lithium-ion batteries because it has high theoretical capacity among the iron oxide materials. However, the structural change from spinel to rock-salt phase by the insertion of lithium ions into maghemite at discharge makes it difficult to deintercalate lithium ions from the rock-salt phase at charge. Therefore, maghemite is difficult to use as the cathode material of lithium-ion secondary battery without solving this issue. Recently, it was found that nanosized particles of maghemite can work as the cathode material of lithium-ion battery. We reported a new method to synthesize maghemite nanoparticles through the alkaline solution treatment of crystalline scorodite. The advantage of this method is the avoidance of particle growth, and the synthesized nanoparticles are approximately 4 nm. In this study, we synthesized maghemite nanoparticles from iron phosphate using alkaline solution. Finally, we investigated the relationship between the primary and secondary particle sizes and the battery performance.

Keywords: *Maghemite, lithium-ion battery, Cathode, alkaline treatment, nanoparticles*

Thermal dissolution of coal from the Khoot deposit

Batbileg Sanjaa[1*], Namkhainorov Jargalsaikhan[1], Shiirav Gandandorj[1], and Purevsuren Barnasan[1]

[1]*Institute of Chemistry and Chemical Technology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia*

**Correspondence author. Email: bilegsanjaa@gmail/com ORCID: 0000-0001-8633-1553*

ABSTRACT

This study presents the results of research on the thermal dissolution of coal from the Khoot deposit located in the Bayanjargalan soum of Dundgovi Province. Pyrolysis experiments were conducted in a laboratory setting using a retort device to determine the yields of the resulting products. Tar necessary for thermal dissolution was prepared, and thermal dissolution experiments were carried out in an autoclave device using coal, coal pyrolysis tar, and the middle fraction of tar distillate. Hydrogenated creosote oil was used as the solvent, with a selected ratio of coal, tar, middle fraction, and solvent at 1:1.8. The yields of liquid products were determined as follows: 19.92% for coal, 51.94% for tar, and 74.36% for the middle fraction of tar distillate. Elemental analysis revealed that the H/C atomic ratio was 0.85% in the original coal, while it increased to 0.94% in the liquid products from coal, 1.15% in tar, and 1.12% in the middle fraction of distillate. Prior to the thermal dissolution experiments, an experiment was conducted to swell the original coal, aiming to enhance the yield of liquid products. Among the solvents used, the sample swollen with a [dimethylformamide:triethylamine =1:1] solvent achieved a liquid product yield of 48%, which is approximately 2.5 times higher than the liquid product yield from the thermal dissolution of the original coal (19.92%). The amount of soluble matter in the swollen coal was found to increase by approximately 6.5% compared to the initial sample.

***Keywords**: tar, middle fraction, solvent, swelling*

REFERENCES

[1] P. N. Kuznetsov, B. Avid, Fan Xing, N.V Perminov, L.I. Kuznetsova, I.V. Korolkova, Thermal Dissolution of Bituminous Coal in Heavy Coal Semicoking Tar and in Binary Blends with the Anthracene Oil, Journal of Siberian Federal University, Engineering & Technologies Vol. 13, (2020) 1018–1027. DOI: 10.17516/1999-494X-028211

[2] S. Batbileg, Investigation on pyrolysis and thermal dissolution of some coals from Mongolian deposits, Dissertation for Doctor (Ph.D) degree, (2016) Ulaanbaatar

[3] B. Purevsurenan, D. Batkhishig, S. Batbileg, Investigation on Characterization and Pyrolysis of Some Coals from Mongolia, Atlantis Press International B.V, (2021). http://creativecommons.org/licenses/by-nc/4.0/.

[4] P.N. Kuznetsov, N.V. Perminov, L.I. Kuznetsova, F.A. Buryukin, S.M. Kolesnikova, E.S. Kamenskii, N.I. Pavlenko, Thermal dissolution of different-ranked coals in tetralin and the anthracene fraction of coking tar, Solid Fuel Chemistry,Vol. 54, (2020) 61–68.

Polymer synthesis and recycling

Vladimír Sedlařík *

Center of Polymer Systems, Tomas Bata University in Zlin, Czech Republic

**Correspondence author. Email: sedlarik@utb.cz, ORCID: 0000-0002-7843-0719*

ABSTRACT

This research centers on the interdisciplinary fields of polymer science, biodegradation, nanomaterials, agrochemistry, and waste management. A primary focus is the investigation of biodegradable polymers such as poly(lactic acid) (PLA), poly(vinyl alcohol) (PVA), and polyurethanes, emphasizing their structural properties and degradation behaviors in various environmental conditions. The work also explores the synthesis and functionalization of nanomaterials, particularly silver nanoparticles, for use in antibacterial films and advanced functional composites. In the agricultural context, research examines the environmental impact of intensive farming, degradation of fertilizers, and valorization of lignocellulosic biomass by-products through steam explosion processes. Additionally, the study addresses challenges in waste management, including the recycling of gypsum board and issues related to biomass combustion. Advanced analytical techniques such as X-ray photoelectron spectroscopy (XPS) and fluorimetry are employed to characterize material properties. Collectively, this work aims to develop sustainable, value-added solutions by understanding the interaction between materials, their environments, and potential applications.

Carbon dioxide separation using zeolite membranes investigated by molecular simulation

Hiromitsu Takaba [1]*

[1]*School of Advanced Engineering, Kogakuin University, Tokyo, Japan*

**Correspondence author. E-mail: takaba@cc.kogakuin.ac.jp ORCID: 0000-0003-1622-5485*

ABSTRACT

Zeolite membranes with 8-membered ring pore sizes, such as CHA and DDR, are known for their high performance in separating CO_2/CH_4 mixtures. Their application in natural gas refining plants, where high durability is required, is currently under study. However, there is concern about a decrease in separation performance under high-pressure conditions. The non-equilibrium molecular dynamics (NEMD) method is recognized as an effective theoretical approach for predicting the separation characteristics of gas mixtures using zeolite membranes. As a direct modeling method, NEMD simulations can easily predict permeability and selectivity while accounting for the membrane's microstructure. In this study, we evaluated the separation characteristics of zeolite membranes by comparing them with a defect-free membrane model using the NEMD method for a CO_2/CH_4 mixture. Additionally, we explored strategies to enhance the separation factor, particularly at high pressure. Our NEMD simulation results indicate that controlling the grain boundary size is an effective approach to increasing the CO_2 separation factor.

Keywords: *zeolite membranes, simulation, gas mixture.*

REFERENCES

[1] F. Hirosawa, K. Watanabe, M. Miyagawa, H. Takaba, Direct evaluation of void effect on gas permeation in mixed matrix membrane by non-equilibrium molecular dynamics, J. Membranes Science, 677, (2023) 121594. https://doi.org/10.1016/j.memsci.2023.121594

[2] F. Hirosawa, M. Miyagawa, H. Takaba, High Efficient CO_2 Separation at High Pressure by Grain-Boundary-Controlled CHA Zeolite Membrane Investigated by Non-Equilibrium Molecular Dynamics, Membranes, 13(3), (2023) 278, https://doi.org/10.3390/membranes13030278

[3] F. Hirosawa, M. Miyagawa, H. Takaba, Selectivity enhancement by the presence of grain boundary in chabazite zeolite membranes investigated by non-equilibrium molecular dynamics, J. Membrane Science, 632, (2021) 119348. https://doi.org/10.1016/j.memsci.2021.119348

Experimental study of bioleaching using bacteria cultured from PLS solution of the copper plants

Garamjav Munkhbat[1], Delgerjargal Altantsetseg[2] and Erdenechimeg Dolgor[2*]

[1] *Chemical laboratory, Achit Ikh LLC, Orkhon province, Mongolia*
[2] *Department of Chemical and Biological engineering, School of Engineering and Applied Sciences, National University of Mongolia, Ulaanbaatar, Mongolia*

**Corresponding author: E-mail: erdenechimeg_d@num.edu.mn ORCID: 0000-0002-8344-4760*

ABSTRACT

Samples were taken from the PLS solution of the L-SX-EW copper cathode plants and the activities of iron and sulfur oxidizing bacteria were determined, cultured, separated, and identified in 9K medium. The bacteria isolated from the solution were used singly and in consortium in shaking flask tests on low-grade copper sulfide ore to determine the copper metal recovery. In order to determine the presence of bacterial activity, a leaching test without bacteria was conducted and the results of the test with bacteria were compared and concluded. The feed ore used in the shaking flask test had a copper content of 0.18% and oxidized copper was 7.01%, secondary *40.79*%, and primary sulfide 46.53%. The solutions for the testwork were plant raffinate and synthetic solution.

The bacteria isolated and cultured from the PLS solution were identified as *Acidithiobacillus caldus, Leptospirillum ferriphilum, Acidiphilium cryptum,* and *Ferroplasma acidarmanus* by the Magigene Microbiology Laboratory in China.

Total 35 shaking flask experiments were conducted for 7 days under the conditions of 10, 20, and 35 °C, ore particle size $P_{60/70/80}$=75μm, and solution 1.0, 1.5, 1.8 and 2.0. The copper recovery in the bioleaching experiment ranged from 8 to 35%. The experimental results showed that the best effect on copper recovery was at 35 °C, while the lowest copper recovery was at 10 °C. This indicates that temperature has a strong effect on bacterial activity. The results of the experiments on the effects of solution pH and ore particle size showed very little difference in results. This indicates that only bacterial activity has a strong influence on the copper recovery rate in this experimental study. The copper leaching rate increased from 25% to 35% in the bioleaching process using bacteria.

Keywords: *Low-grade copper sulfide ore, Iron and sulfur oxidizing bacteria, PLS, Raffinate and synthetic solution, Shaking flask bioleaching test, Copper recovery, Iron recovery*

Adsorptive removal of bromide ions by Ag-modified ceramic membrane synthesized from kaolin and dolomite

Munkhpurev Bat-Amgalan[1*], Enkhtuul Mendsaikhan[1, 2], Naoki Kano[3], Naoto Miyamoto[3], Hee-Joon Kim[4] and Ganchimeg Yunden[1]

[1] *Department of Chemical Engineering, School of Applied Sciences, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia*
[2] *Graduate School of Science and Technology, Niigata University, Niigata, Japan*
[3] *Department of Chemistry and Chemical Engineering, Faculty of Engineering, Niigata University, Niigata, Japan*
[4] *Department of Environmental Chemistry and Chemical Engineering, School of Advanced Engineering, Kogakuin University, Tokyo, Japan*

**Correspondence author. Email: munkhpurev@must.edu.mn ORCID: 0000-0002-6905-1952*

ABSTRACT

In the process of disinfecting drinking water, bromide produces hazardous brominated disinfection by-products, particularly bromate (BrO_3^-). It is highly desirable to find an energy-efficient and cost-effective way to remove bromide ions prior to disinfection. Herein, a novel and inexpensive adsorptive ceramic membrane was fabricated from kaolin and dolomite by dry compaction method and developed with silver for the removal of bromide. The influence of sintering temperature on the kaolin and dolomite based support, and calcination temperature, feed pH on the developed membrane are systematically explored. The obtained developed membrane (KD20-1150) exhibits a high removal rate of bromide (94.7%) with a water permeation of 215.8 L/h·m^2 under optimal condition (pH 7). The XPS and EDS analysis revealed that the bromide anions (Br^-) adsorption occurred on the surface and in the pore wall sides of membrane, with the silver cations (Ag^+) reacting by strong chemical interaction. This work provides insightful perspectives into the mechanisms and performance of silver-loaded ceramic membranes, illustrating their potential for use in environmental protection in the future.

Keywords: *Adsorptive removal, Bromide ion, Silver-loaded ceramic membrane.*

REFERENCES

[1] Cohen, B.Shapira, E. Avraham, A. Soffer, D. Aurbach, Bromide Ions Specific Removal and Recovery by Electrochemical Desalination, Environmental Science & Technology 52 (11), (2018), 6275-6281. https://doi.org/10.1021/acs.est.8b00282.

Investigation influence factor oxidation of copper concentrate under atmospheric conditions

Gereltuya Ganbaatar[1], Gerelsaikhan Bereevenjav[1], Maralmaa Byambaa[2], Ochirkhuyag Bayanjargal[2] and Erdenechimeg Dolgor[2*]

[1]*The Geological Center for Research and Analysis, Ulaanbaatar, Mongolia*
[2] *Department of Chemistry and Biological Engineering, School of Engineering and Technology of National University of Mongolia, Ulaanbaatar, Mongolia*

**Corresponding author: E-mail: erdenechimeg_d@num.edu.mn ORCID: 0000-0002-8344-4760*

ABSTRACT

This study investigates the atmospheric oxidation behavior and mineral phase transformations in two copper concentrate samples (10240-N and 10241-N) exposed to natural sunlight over four months. Key environmental parameters—temperature, relative humidity, and pH—were continuously monitored and shown to significantly influence oxidation dynamics. Analytical techniques including X-ray diffraction (XRD) and linear sweep voltammetry (LSV) using Tafel plots were employed to assess mineralogical changes and electrochemical activity. Results revealed that the sample with higher pyrite content (10241-N) exhibited greater oxidative transformation, marked by increased corrosion current density (Icorr), emergence of secondary phases such as Cu_2S and FeOOH, and progressive depletion of chalcopyrite. Pourbaix diagrams were used to explain the redox stability of copper sulfide minerals, demonstrating that chalcopyrite is stable under mildly acidic and reducing conditions (pH 2–4, Eh < 0.4 V) but becomes reactive at lower pH and higher Eh. These findings confirm the synergistic influence of environmental factors and mineralogical composition on oxidation pathways. The results provide critical insights into the atmospheric stability, storage behavior, and hydrometallurgical processing of copper sulfide concentrates under natural weathering conditions.

Keywords: *Copper concentrate, Chalcopyrite oxidation, Pyrite, Atmospheric oxidation, Galvanic interaction*

REFERENCES

[1] E. Dolgor, Chemical technology non-ferrous and precious metals /in Mongolian/, 1st ed. Press of National University of Mongolia, 2018.

[2] X. Xiong et al., Oxidation mechanism of chalcopyrite revealed by X-ray photoelectron spectroscopy and first principles studies, Appl Surf Sci, vol. 427, (2018) pp. 233–241. doi: 10.1016/j.apsusc.2017.08.047.

Reduction of water hardness by natural zeolite via batch process

Oyundari Dandarbaatar[1], Enkhzul Erdenezul[1], Tamiraa Ganbold[1], Ochirkhuyag Bayanjargal[1] and Amgalan Bor[1*]

[1]*Department of Chemical and Biological Engineering, School of Engineering and Technology, National University of Mongolia, Ulaanbaatar, Mongolia*

**Correspondence author. Email: amgalan.b@num.edu.mn ORCID: 0009-0005-5008-7233*

ABSTRACT

In 2023, a water quality study found that 86% of groundwater sources in Mongolia's Gobi region failed to meet safety standards, mainly due to high water hardness and heavy metal contamination. While a lot of research has focused on removing heavy metals, much less attention has been given to reducing water hardness. This research explores natural clinoptilolite zeolite (1–2 mm) for water hardness reduced. Zeolite was activated using a planetary ball mill, with optimal conditions (150 rpm, 5 minutes, 3 mm balls). Under these conditions, batch adsorption showed effective Ca^{2+} and Mg^{2+} removal, with synthetic hardness water (28.5 mg-eq/L, 18 mg-eq/L) and the groundwater (11 mg-eq/L, 2.5 mg-eq/L) samples reaching regulatory standards in 780 minutes and 30 minutes. Batch adsorption experiments using synthetic hard water and both activated and natural zeolite reduction in total hardness by 50–70 %, with calcium ion removal by 70–86 % and magnesium ion by 26–39 %. Results demonstrate that natural zeolite is an effective, low-cost, and environmentally friendly material for softening hard water.

Keywords: *Natural zeolite, hardness water, batch adsorption process*

REFERENCES

[1] Institute of Geography and Geoecology, Information released at the 2023 meeting of the Standing Committee on Security and Foreign Policy of the Mongolian Parliament, Ulaanbaatar, Mongolian Academy of Sciences. (2023), Ulaanbaatar, Mongolia

[2] Gobi sub-region urban development sector research final report, Institute of Economics – National University of Mongolia, (2019), Ulaanbaatar, Mongolia

[3] D. Dorj, "Environmental Chemical Analysis", (2005), Ulaanbaatar, Mongolia.

[4] N.I.A. Aziz, N. Othman, W.A.H. Altowayti, Z.M. Yunus, N. Fitriani, M.F.M. Din, and F.M. Fikri, Hardness removal of groundwater through sand, zeolite and rice husk activated carbon, Malays. J. Anal. Sci, 25, (2021), pp.605-621.

Copper adsorption in natural and composite zeolite materials

Unur-Odontuya Sundev[1,2] Undarmaa Altangerel[1], Enkhjin Bat-Yalalt[2], Amgalan Bor[2], Ochirkhuyag Bayanjargal[2], and Tamiraa Ganbold[1*]

[1] *Geological Center for Research and Analysis, Ulaanbaatar, Mongolia*
[2] *Department of Chemical and Biological Engineering, School of Engineering and Technology, National University of Mongolia, Ulaanbaatar, Mongolia*

**Correspondence author. Email: tamiraa@num.edu.mn ORCID: 0000-0001-9965-9208*

ABSTRACT
Contamination of the environment with heavy metals, particularly copper (Cu) presents significant risks to both ecosystems and human health. Due to its abundance in Mongolia, natural zeolite is a promising water purification material, offering economic and environmental advantages. This study explores the adsorption of Cu on both natural and composite zeolite materials through batch and column experiments. The adsorption capacities of the natural zeolite and the composite zeolite were estimated in both batch and column processes. Additionally, column adsorption experiments were analysed using Thomas model. Composite zeolite materials demonstrated superior adsorption efficiency due to their enhanced functional groups and increased surface area, as observed in batch experiments. Under initial conditions of 50 mg/l concentration, a flow rate of 10 ml/min, and a column volume of 2.35 cm^3, the breakthrough was observed at a total solution volume of 8000 ml. The adsorption capacity in the lead column was found to be 18 mg/g for natural zeolite, whereas the adsorption capacity was 17.99 mg/g for composite zeolite using the Thomas model. However, the mass of the composite zeolite almost two times less than the natural zeolite. Compared to previous research, the production of composite zeolite materials is more cost-effective, while exhibiting improved adsorption capacity.

Keywords: *copper, adsorption, natural zeolite, zeolite composite*

REFERENCES

[1] X. Li, C.S. Poon, P.S. Liu, Heavy metal contamination of urban soils and street dusts in Hong Kong. Appl, Geochem, 16, (2001) 1361–1368, https://doi.org/10.1016/S0883-2927(01)00045-2

[2] H. Malassa, M. Hadidoun, M. Al-Khatib, F. Al-Rimawi, M. Al-Qutob, Assessment of Groundwater Pollution with Heavy Metals in North West Bank/Palestine by ICP-MS, J. Environ. Prot, 5, (2014), 54–59. 10.4236/jep.2014.51007

Removal of Pt (IV) using wheat based biosorbent

Nyamjargal Lkhamtogmid[1*], GanchimegYunden[1], BurmaaGunchin[2] and Sukhbat Sukhbaatar[3]

[1] *Department of Chemical Engineering, School of Applied Science, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia*
[2] *Institute of Chemistry and Chemical Technology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia*
[3] *Ministry of Industry and Mineral Resources, Ulaanbaatar, Mongolia*

**Correspondence author. Email: nyamjargal@must.edu.mn ORCID: 0009-0000-8306-8767*

ABSTRACT

This research focuses on the effective use of agricultural waste for the recovery of Pt(IV) from aqueous solutions. We investigated the effects of various sorption experimental parameters, including the concentration of the acid solution, contact time, and initial metal concentration, in detail. To enhance the adsorption capacity for Pt(IV), wheat husk and stalk were treated with concentrated sulfuric acid, creating new coordinating sites for adsorption. The modified biosorbents used for Pt(IV) recovery from aqueous solutions were characterized using FTIR, spectrophotometry, SEM-EDS, and XRD techniques. The adsorption capacities of the biosorbents were determined to be 13.28 mg Pt/g for the wheat husk biosorbent (WHA) and 14.44 mg Pt/g for the wheat stalk biosorbent (WSA), achieving a removal efficiency of 77% and 72%, respectively. The optimum conditions for Pt(IV) adsorption were identified as a pH of 1 and a reaction time of 4 hours. The results indicate that low-cost adsorbents can be effectively used for the recovery of Pt(IV) from aqueous media.

Keywords: *Straw, Husk, Biosorption, Cost effective sorbent*

REFERENCES

[1] U. Farooq, J. Kozinski and M.A.Khan, Biosorption of heavy metal ions using wheat based biosorbents– A review of the recent literature, Bioresource technology, 101 (2010), pp. 5043-5053. https://doi.org/10.1016/j.biotech.2010.02.030

[2] A.Ghomi, N.Asasian-Kolur, S.Sharifian, Biosorption for sustainable recovery of precious metals from waste water, Journal of environmental chemical engineering., 8 (2020), pp. 1793–1820. https://doi.org/10.1016/j.jece.2020.103996

[3] P. Ha Neul, Ch. Han Ah, W. Sung Wook, Fibrous polyethylenimine/polyvinyl chloride crosslinked adsorbent for the recovery of Pt(IV) from acidic solution: Adsorption, desorption and reuse performances, Journal of Cleaner Production., 176 (2018), pp. 360-369. https://doi.org/10.1016/j.jclepro.2017.12.160

Factors affecting the inosine-5'-monophosphate (5'-imp) content in muscles of Mongolian sheep

Erkigul Bukyei[1*], Borjigin Gerelt[2], Buyanchimeg Baasanjargal[1] and Enkhbat Tumurbaatar[1]

[1]*School of Engineer and Technology, Mongolian University of Life Science, Ulaanbaatar, Mongolia*
[2]*College of Food Science and Engineering, Inner Mongolia Agricultural University, Hohhot, China*

[*]*Correspondence author. Email: erkigul@muls.edu.mn ORCID: 0000-0003-0262-5090*

ABSTRACT
Meat flavor, one of the most important eating quality parameters, is primarily composed of taste and aroma. IMP is a flavor enhancer that is 50 times more potent than monosodium glutamate. In this research, the effects of season, breeds, and deference feed factors on IMP content of muscles biceps femoris, longissimus dorsi, and triceps brachii from Mongolian sheep. The different areas grazing Mongolian (Mongolia) and Ujumqin (Inner Mongolia, China) sheep depending on the time of the year were investigated as the research group while grain-fed Ujumqin sheep with the same season as the control group. In the winter and summer seasons grazing Mongolian, Ujumqin sheep, and grain-fed Ujumqin sheep were explored and the changes in IMP (Inosine-5'- monophosphate) content in three parts of skeletal muscles (biceps femoris, longissimus dorsi, and triceps brachii) with the between seasons. The methods employed in this survey were a combination of High-performance liquid chromatography (HPLC) methods. The result showed content of IMP in muscles of winter and summer grazing Mongolian and Ujumqin sheep were greater significantly ($P<0.05$) than those of the same seasons grain-fed Ujumqin sheep. Moreover, the Longissimus dorsi IMP content had higher than order skeletal muscles, but no observed significant differences ($P>0.05$) between muscles. Under natural grazing conditions, the sheep are upright and the pasture grows. It can provide better feeding conditions for the sheep, so the intramuscular IMP content is relatively higher.

Keywords: *Mongolian sheep; Ujumqin sheep; Skeletal muscles; inosine monophosphate*

REFERENCES

[1] G. Chdaraabal, Sixty years revive led by sheep studies, 2nd edition. MGL, (2013) 71-72, Ulaanbaatar city.

[2] 梁富武. 乌珠穆沁羊的选育攻关[J]. 中国牧业通讯, (17), (2010), 38-39.

[3] Chen, G. H., Li, H. F., Wu, X. S., Li, B. C., Xie, K. Z., Dai, G. J., Chen,K. W., Zhang, X. Y., & Wang, K. H, Factors affecting the inosine monophosphate content of muscles in Taihe silkies chickens [J], Asian-Australian Journal of Animal Science, 15(9), (2002), 1359-1363.

Modeling the impact of recirculating water on molybdenum flotation

Tseelei Suren[1], Odontuya Gombosuren[2], Uyanga Dashnamjil[2], Khureldavaa Otgonbayar[2], Ichinnorov Amarjargal[2], Sarangerel Davaasambuu[3] and Oyuntsetseg Dolgorjav[2*]

[1]*Erdenet Institute of Technology, Branch of Mongolian University of Science and Technology, Mongolia*
[2]*Institute of Chemistry and Chemical Technology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia*
[3]*Department of Chemistry, School of Arts and Sciences, National University of Mongolia, Mongolia*

[*]*Correspondence author. Email: oyuntsetsegd@mas.ac.mn ORCID: 0000-0001-5278-1580*

ABSTRACT
The primary objective of this research is to analyze the seasonal variations in the composition and properties of recirculating process water in copper and molybdenum concentration plants. Additionally, this study aims to assess the impact of these changes on the molybdenum flotation concentration process through modeling. The analysis of the recirculating process water regime used in the flotation process of the concentration plant shows that there are no significant structural or dynamic changes. However, there is a slight variation in the quantitative values of anions and cations over time. Based on the chemical composition data, the recirculating process water can be classified as a sulfate-calcium type water. The results of the study showed that the molybdenum content in the recirculating process water remained stable and close to its original levels, indicating it is in a soluble form, and therefore undergoes minimal changes. When calculating the effect of the chemical composition of the recirculating process water, along with other factors, on molybdenum metal recovery using Principal Component Analysis (PCA) we found that six out of the 29 selected parameters were significantly correlated. PCA analysis showed that the main factors (Ca^{2+}, Mg^{2+}, mineralization, Mn) in recirculating water whose composition changes with seasonal fluctuations negatively affect the molybdenum flotation concentration process. Particularly in winter, when the tailing pond is iced and the inflow of both underground and surface water is significantly reduced, mineralization and composition of Ca^{2+} and Mg^{2+} ions increase. These ions adsorb on the surface of molybdenite, increasing its hydrophilicity, which results in a decrease in the molybdenum recovery.

Keywords: *flotation, molybdenum, waterquality, principal component analysis*

REFERENCES

[1] S. R. Rao and J. A. Finch, A review of water re-use in flotation, Miner Eng, vol. 2, no. 1, (1989) pp. 65–85, https://doi.org/10.1016/0892-6875(89)90066-6

Study on the adsorption activity of composite materials for heavy metal ions

Ulziidelger Byambasuren[1*], Enkhtuya Majigsuren[1], Munkhpurev Bat-Amgalan[1], Ganchimeg Yunden[1] and Naoki Kano[2]

[1]*Department of Chemical Engineering, School of Applied Sciences, Mongolian University of Sciences and Technology, Ulaanbaatar, Mongolia*
[2]*Department of Chemistry and Chemical Engineering, Faculty of Engineering, Niigata University, Niigata, Japan*

**Correspondence author. Email: bulziidelger@must.edu.mn ORCID: 0009-0009-8121-5989*

ABSTRACT

Three types of mesoporous silica with different particle sizes were synthesized using TEOS and various surfactants. The synthesized silicas exhibited pore sizes of approximately 3.38, 6.75, and 5.16 nm, with surface areas of 855.12 m²/g for SBA-12, 606.62 m²/g for SBA-15, and 745.10 m²/g for SBA-16, respectively. An adsorbent bead was developed to remove heavy metals from aqueous solutions by combining chitosan with SBA-12, SBA-15, and SBA-16 in a mass ratio of 8:2. The adsorption capacity of the adsorbent beads was systematically evaluated concerning heavy metal ions, considering various parameters including solution pH, contact time, temperature, initial concentration of heavy metal ion solutions, and the quantity of adsorbent material utilized.

Keywords: *mesoporous silica, chitosan, heavy metals ion*

REFERENCES

[1] M.Enkhtuya, B.Ulziidelger, Yu.Ganchimeg, Adsorption of Chromium (III) and Chromium (VI) Ions from Aqueous Solution Using Chitosan–Clay Composite Materials, Polymers. 16 (2024) 1399. https://doi.org/10.3390/polym16101399

[2] A. Basem, D.J.Jasim, H.Sh.Majdi, R.M. Mohammed, M. Ahmed, A.H.Al-Rubaye, E. Kianfar, Adsorption of heavy metals from wastewater by chitosan: A review, Results in Engineering. 23 (2024) 102404. https://doi.org/10.1016/j.rineng.2024.102404

Study of raw materials for thermal insulation materials

Bayarjargal Sandagdorj[1], Dolgorjav Rentsendavaa[1]* and Saran Galdansambuu[1]

[1]*Department of Chemical Engineering, School of Applied Sciences, Mongolian University of Sciences and Technology, Ulaanbaatar, Mongolia*

**Correspondence author. Email: dolgorjav@must.edu.mn ORCID: 0009-0009-9446-7480*

ABSTRACT

In the context of Mongolia's severe continental climate, the heating season typically spans approximately two-thirds of the year. This prolonged demand for indoor thermal regulation has led to an increasing need for effective thermal insulation materials in the construction and development of buildings and utility networks. Accordingly, the development and application of innovative composite insulation materials have become imperative to reduce heat loss and improve energy efficiency. In this study, natural clay and limestone were used as raw materials, and their chemical composition as well as physical and mechanical properties were investigated. The chemical analysis of the primary clay revealed that it predominantly consists of 70.50% SiO_2 and 23.47% Al_2O_3, while the limestone sample contained 87.57% CaO, 7.30% SiO_2, and 1.15% MgO. Mineralogical analysis of the clay showed that it is composed of approximately 47.4% kaolinite, 28.1% SiO_2, along with other associated minerals.

Keywords: *thermal insulation, clay, limestone.*

REFERENCES

[1] B. Ulziiburen, Research on producing thermal insulation materials from Mongolian clay-rich opoka, (2003), Ulaanbaatar.

[2] G. Saran, and H. Seifert, Hydrothermal erzeugte Leichtzuschläge, Silikattechnik, (1996).

[3] G. Saran, Research on fire-resistant thermal insulation materials, (2011), Ulaanbaatar.

[4] G. Khatanbaatar, Research on high-strength autoclaved aerated concrete, (2011), Ulaanbaatar.

[5] B. Namjildorj, Research, testing, and processing of Mongolian clay-based raw materials, (2018), ISBN 978-99978-3-706-6.

[6] M. Garcia-Valles, P. Alfonso, S. Martínez, and N. Roca, Mineralogical and thermal characterization of kaolinitic clays from Terra Alta (Catalonia, Spain),) Minerals, 10(2), 142. (2020), https://doi.org/10.3390/min10020142

[7] A. E. Souza, S. R. Teixeira, G. T. A. Santos, and E. Longo, Addition of sedimentary rock to kaolinitic clays: Influence on sintering process, Cerâmica, 59, (2013). 147–155.

Modeling and simulation of methanol production from Syngas

Ilchgerel Dash[1*], Ulziidelger Byambasuren[1], Jargaldelger Batdelger[2] and Nyam-Osor Surenkhorloo[3]

[1]*Department of Chemical Engineering, School of Applied Sciences, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia*
[2]*City Police Department, Ulaanbaatar, Mongolia*
[3]*Erdenes Tavantolgoi LC, Ulaanbaatar, Mongolia*

**Correspondence author. Email: ilchgerel@must.edu.mn ORCID: 0009-0008-1475-9495*

ABSTRACT
Mongolia has an enormous amount of brown and coking coal resources. However, the usage of brown coal is limited to electricity production and a small amount of coking coal has been exported to China. This is not favorable for the Mongolian economy. Therefore, the coal needs to be processed and converted into high valuable products. There are many ways to process coal, and one of the most promising technology is the production of synthesis gas. This is because synthesis gas can be utilized to produce a variety of different kind of chemicals, including methanol.
We modeled and simulated methanol industry from synthesis gas using Aspen plus software. We assumed that the inlet gas mixture, with a flow rate of 1000 kmol/h, contained 10% of carbon dioxide, 30% of carbon monoxide, and 60% of hydrogen. Furthermore, we selected RCSTR as the reactor type and Soave-Redlich-Kwong as the property method.
The sensitivity analysis shows that the optimal reactor temperature and pressure are 200ºC and 50 bar, respectively. The simulation results indicate that the conversions of carbon monoxide and hydrogen are approximately 45% and 87%, respectively, and the methanol production rate is approximately 232 kmol/h with a purity of 99.6%.
The best composition of the inlet stream for the highest methanol production was found to be 20% of carbon monoxide, 10% of carbon dioxide, and 70% of hydrogen when the feed gas mixture composition was varied.

Keywords: *coal, Aspen plus, kinetics, SRK, CSTR.*

Investigation on the removal of organic pollutants from aqueous solution

Sergelen Erdenebaatar[1], Siqin Zhao[2], Ilchgerel Dash[1], Sukhbat Sukhbaatar[3] and Ganchimeg Yunden[1*]

[1]*Department of Chemical Engineering, School of Applied Sciences, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia*
[2] *Chemistry and Environmental Science College, Inner Mongolia Normal University, China*
[3]*Department of Heavy Industry Policy, Ministry of Mineral Resources and Industry, Ulaanbaatar, Mongolia*

**Correspondence author. Email: ganchimeg.yu@must.edu.mn ORCID: 0000-0003-4740-2018*

ABSTRACT
Organic pigments, particularly azo compounds, are commonly used in various industries, including printing inks, plastics, and textiles. Unfortunately, wastewater produced by these industries poses a significant risk to the environment, contaminating soil and drinking water sources. This study investigates the adsorption activity of zeolite from the Tsagaan Tsav deposit in Mongolia for removing the dyes methylene blue, methyl orange, congo red, and rhodamine B. The zeolite samples were characterized using various instrumental analyses, such as X-ray diffraction (XRD), scanning electron microscopy with energy dispersive spectroscopy (SEM/EDS), and Fourier-transform infrared spectroscopy (FT-IR). The experiment result confirmed that zeolite is more effective for methylene blue and rhodamine B. The results indicate that the interaction between zeolite and organic pollutants is best described by a second-order kinetic model, with adsorption following the Langmuir isotherm model.

Keywords: *Adsorption kinetics, Adsorption isotherm, Organic pigment*

Hydrochemical characteristics and utilization of hot springs in Arkhangai province

Ichinnorov Amarjargal[1], Odontuya Gombosuren[1], Oyuntsetseg Dolgorjav[1] and Bolormaa Oyuntsetseg[2]

[1] *Laboratory of Ecological Chemistry, Institute of Chemistry and Chemical Technology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia*
[2] *Department of Chemistry, National University of Mongolia, Ulaanbaatar, Mongolia*

**Correspondence author. Email: oyuntsetsegd@mas.ac.mn ORCID: 0000-0001-5278-1580*

ABSTRACT

In this study, chemical characteristics, the identified water classification, and utilization of water samples from 4 hot springs located in the Arkhangai province in Central Mongolia were used for interpretation. The Giggenbach's ternary diagrams, silica (chalcedony and quartz), and cation (Na-K-Ca, K-Mg) geothermometers were used to characterize the waters and estimate the subsurface temperature. The four hot springs have surface temperatures of 38-88 ℃ with moderately alkaline pH (8.33-9.05) with low dissolved solute content of 161-267 mg/L. The sodium ion is the predominant cation with the trend Na > K ≈ Ca > Li > Mg, and the anionic trend is HCO_3+CO_3 > SO_4 > F > Cl. The results show that waters are in partial equilibrium with the rock, with reservoir temperatures lying between 80-150℃. The hot waters are bicarbonate-sodium type, primarily originating due to global silicate weathering and carbonate mineral dissolution, with reservoir temperatures as estimated from chalcedony and quartz geothermometers lying between 78-109℃ and 109-137℃, respectively.

The study has identified the scope for utilization of hot waters for direct-use purposes like space heating, meat drying, greenhouse cultivation, and milk pasteurization. In a nutshell, the Arkhangai province is a promising low-temperature geothermal site in the country, featuring numerous low to moderately warm springs that can be utilized for both electricity generation by binary cycles for societal benefits.

Keywords: *hot spring, geothermometer, chalcedony, utilization.*

REFERENCES

[1] A. H. Truesdell and R. O. Fournier, Procedure for estimating the temperature of a hot-water component in a mixed water by using a plot of dissolved silica versus enthalpy, U.S. Geol. Survey J. Res, 5(1) (1977), pp. 49-52.

[2] A. J. Ellis, Chemical and isotopic techniques in geothermal investigations, Geothermics, 5(1-4) (1977), pp. 3-12