Organizing institute

German – Mongolian Institute for Recourses and Technology (GMIT)

Organizing Committee

Conference Chair

Prof. Dr. Battsengel BAATAR (GMIT)

Co-chairs:

Prof. Dr. Thomas HOLLENBERG (GMIT)

Prof. Dr. Altangerel LKHAMSUREN (GMIT)

Conference Secretary

Dr. Narangarav TERBISH (GMIT)

Scientific Committee

Prof. Dr. Ariunbolor PURVEE (GMIT)
Prof. Dr. Avid BUDEEBAZAR (Mongolian Academy of Sciences)
Prof. Dr. Bayanmunkh MYAGMARSUREN (GMIT)
Prof. Dr. Carsten DREBENSTEDT
(TU Bergakademie Freiberg, Germany)
Prof. Dr. Gantuya GANBAT (GMIT)
Prof. Dr. Davaasambuu JAV (Mongolian Academy of Sciences)
Prof. Dr. Domingo Javier CARVAJAL GOMEZ
(University of Hueva, Spain)
Prof. Dr. Manfred J. HAMPE (TU Darmstadt, Germany)
Prof. Dr. Rainer HERD (BTU Cottbus-Senftenberg, Germany)
Prof. Dr. Daniel KARTHE
(United Nations University in Dresden, Germany)
Prof. Dr. Juergen KRETSCHMANN (THGA Bochum, Germany)
Prof. Dr. Oliver LANGEFELD (TU Clausthal, Germany)
Prof. Dr. Frank LEHMKUHL (RWTH Aachen University, Germany)
Prof. Dr. Franz Michael MEYER
(RWTH Aachen University, Germany)
Prof. Dr. Nguyen Thi Hoai NGA (HUMG, Vietnam)
Prof. Dr. Serkan SAYDAM
(Chair of Mining Engineering, UNSW Sydney, Australia)

Local Organizing committee

Ms. Munkhzaya UNDRAKH (GMIT)
Ms. Khuslen CHULUUNBAATAR (GMIT)
Ms. Otgonbayar DOVJUU (GMIT)
Ms. Enkhchimeg ULZII (GMIT)
Ms. Narangarav ERDENEBAT (GMIT)
Mr. Enkhbayar BOLD (GMIT)

Oyu Tolgoi is a world-class mine located in the Umnogov province of Mongolia and is one of the world's leading copper deposits. Oyu Tolgoi LLC is a joint venture between Rio Tinto Group (66 percent) and Erdenes Oyu Tolgoi LLC (34 percent). The shareholder "Erdenes Oyu Tolgoi" LLC is a state-owned company of Mongolia. Since 2010, "Rio Tinto" has been implementing the strategy and operational management of Oyu Tolgoi.

"Oyu Tolgoi" mining complex is located 550 kilometers south of Ulaanbaatar and 80 kilometers north of the Mongolian-Chinese border. As a result of decades of exploration, Oyu Tolgoi deposit was discovered in 2001.

An executive management team specializing in all aspects of the mining business manages Oyu Tolgoi and implements strategic policies. The Board of Directors of "Oyu Tolgoi" company consists of representatives of the shareholders and is responsible for decision-making and monitoring in accordance with the strategic direction of the company. As of the first quarter of 2023, 97 percent of the total workforce of Oyu Tolgoi are Mongolian employees, and 36.5 percent of them are employees of the underground mining project.

"Our way of working" is the code of business ethics of "Oyu Tolgoi" company that we follow when making any business decisions and when every employee performs their work. This code of conduct includes environmental protection, sustainable development, freedom from corruption, employee ethics and rights.

In terms of mine operation, ore is extracted from open pits and a concentrator with a capacity of 100,000 tons of ore per day, along with ancillary facilities and infrastructure, is operating. The copper and gold concentrates produced by "Oyu Tolgoi" company are sold on the international market by establishing spot and long-term contracts.

The construction process of the underground mine is progressing successfully. When the underground mine starts operating at full capacity, Oyu Tolgoi will become one of the largest low-cost copper mines in the world.

Oyu Tolgoi Group is building a 200-kilometer-diameter five-meter mine at a depth of 1,300 meters below the surface, as most of the deposits are located underground.

In March 2023, we witnessed the grand opening of underground mining with the blasting of the 21st ore dump using block mining technology developed by the 150-year-old Rio Tinto Group.

In 2022, Oyu Tolgoi was ranked first in four of the five key indicators that evaluate the "TOP-100 enterprises" that contribute to the social and economic development of Mongolia. Also, 31 of Oyu Tolgoi's supplier companies were selected as Mongolia's TOP 100 Enterpris

Boroo Gold LLC with 25 years of history

Motto: For the development of safe and responsible mining in Mongolia

Vision: Create the conditions for safe production.

Priorities: Boroo Gold will cooperate honestly with its employees, contractors, the Government of Mongolia, and the people. The company respects human dignity, adheres to strict moral standards, and strives to be a good business partner in Mongolia.

We will conduct human-friendly operations in accordance with the international standards of occupational health and safety, environmental and energy management systems, and strive to cultivate a culture of "No-blame" safety operations that treat all employees fairly.

Duties and objectives: In order to achieve our goal, Boroo Gold LLC:

- ✓ Adopt a positive attitude to work without any accidents;
- ✓ Work hard to avoid harm to people, the environment, production, materials, and equipment;
- ✓ Cooperate with the Government and implementing agencies in order to efficiently ensure the social and economic impact of the company's activities;
- ✓ In collaboration with all employees and the Labor Safety, Health, and Environment Council, conduct creative activities on specific environmental, labor health, and safety issues;
- ✓ In line with the company's goals, improve the knowledge and skills of employees, provide necessary resources and provide support;

Boroo Gold is a precursor:

- ✓ Mongolia's first main deposit mine that concentrates and processes gold deposits;
- ✓ A pioneering company that develops a comprehensive understanding of labor safety, hygiene and the environment;
- ✓ The first primary gold deposit plant in Mongolia with CIL/CIP technology to dissolve gold and separate it by absorbing it into activated carbon;
- ✓ The technology of processing low grade gold ore in an environmentally friendly way by crushing and dump leaching was introduced in Mongolia for the first time;
- ✓ Competency-based salary system was first introduced in Mongolia in 2007 by qualification level and creating equal opportunities for everyone;
- ✓ The leading international methods, standards and norms of labor safety were first introduced in the mining sector of Mongolia;
- ✓ Mongolia's first and only gold mine that joined the International Cyanide Management Institute;
- ✓ Environmental Management (ISO 14001:2004), Occupational Health and Safety Management (ISO 18001:2007) and Energy Management (ISO 50001:2018) standards are implemented in its operations;
- ✓ Responsible mining has been developed and environmental rehabilitation has been implemented in parallel with mining. In the years 2003-2022, a total of 562.1 ha of technical and 544.8 ha of biological rehabilitation were carried out;
- ✓ Boroo Gold LLC, which joined the "Billion Trees" National Movement initiated by the President of Mongolia, will plant three million trees. The company has planted 3,000 trees in 2021 and 30,000 trees in 2022 in Boroo and Ulaanbulag mining areas. As part of the "Billion Trees" National Movement, a tree nursery was established on 40.7 hectares;

The company was founded in 1973 as a Mongolian-Soviet joint venture "MONGOLSOVTSVETMET" and it has been operating in the following areas for its 50th year in the mining industry:

Mining and concentration of feldspar,

Mining and concentration of iron ore,

Gold mining and enrichment,

Gravel, gravel, sand production,

Geological exploration research,

Heat production

As a state-owned industrial estate, Mongolrostsvetmet has 1,800 employees and operates in 4 mines including:

- ✓ **Bor Undur Mining** company, has more than 1,500 employees, carries out the mining and processing activities in underground fluorite mine of Bor-Undur, underground fluorite mine of Zuun Tsagaan Del, and iron ore open pit of Bargilt. Bor-Undur underground fluorite mine, located in Bor-Undur Sum, Khentii province, has the capacity to extract 300,000 tons of fluorine ore per year. In the underground fluorspar mine of Zuun Tsagaan Del, located in Ikhet Sum, Dornogovi Province, the main and preliminary excavation work is being carried out from 2021, and fluorspar ore mining will begin from 2023. It has the capacity to extract 200,000 tons of fluorspar ore per year. Bargilt iron ore open pit located in Darkhan sum of Khent province has an annual production capacity of 2.4 million tons of iron ore. Bor Undur Mining company produces FF-95 fluorine concentrate, FC-75 whole fluorine, Fe-65 iron wet concentrate, Fe-52 iron dry concentrate, and Zn-50 zinc concentrate.
- ✓ **Shijir Alt gold mining** company, which operates across Zaamar Sum of Central Province and Buregkhangai Sum of Bulgan Province, has the capacity to process 1.6 million m3 of sand per year and it has more than 200 employees.

AIC
ACHIT IKHT LLC

Achit-Ikht LLC, a member of the London Metal Exchange /LMB/, and a national producer, produces cathode copper by hydrometallurgical method using the derivative deposit of 2nd dump, which is not suitable for the flotation technology of the "Erdenet Mining", has low grade, and is off-balance sheet.

After the operation of the cathode copper plant, the 2nd dump, which had a negative impact on the environment and lost its profitability, was brought into economic circulation, more than 200 new jobs were created in the local area, and cathode copper with a purity of 99.999% grade "A" of the London Metal Exchange has been produced and exported, and a total of 310.9 billion MNT was collected in the national and local budgets.

According to the amendments to the "Minerals" Law, in June 2017, Achit-Ikht LLC became the HOLDER OF THE FIRST PERMIT FOR THE USE OF SOURCE DEPOSITS and became the payer of AMNAT by obtaining the permit No. UN-000001 and paid 25.9 billion MNT as of 2022.

Achit-Ikht LLC will contribute to the society and economy of Mongolia in 2014-2022:

277.9 billion MNT in the state budget

33 billion MNT for the local budget

Usage fee for "Erdenet Mining" is 20.7 billion MNT

Procurement of 418 billion MNT from 1653 domestic suppliers

More than 220 jobs

Technologies and innovations introduced into operation:

Climate control system – 2016

Resource management ERP system – 2018

Automation/Scada/ system – 2018

Comprehensive fire alarm and protection system – 2018

Slurry technology – 2019

LIMS Lab Software – 2021

E-Doc system for archiving and record keeping - 2021

In the field of ensuring labor safety

MNS ISO 45001:2018 standard for occupational safety

ISO 14001:2015 environmental management standard

First prize of "Organization that values healthy and safe workplace" organized by the Ministry of Foreign Affairs - 2019, 2021

Within social responsibility:

The financier of the "Ice House" dream: For the first time in Mongolia, the project of the indoor "Ice House" sports hall with 2,600-3,600 seats that meets the standards of the International Olympic Committee and operates regardless of the season was financed, and it was put into operation in September 2021.

Within the framework of environmental protection:

3.3 ha area was 100% rehabilitated in 2014-2021 in Bayan-Undur sum in Orkhon province.

External and internal monitoring of the environment is carried out for groundwater, pond, air and water samples at 7-day, monthly and seasonal intervals.

Joining the "Billion Trees" National Movement, promising to plant 3 million trees and establishing a tree nursery. - 2022 year

In the framework of supporting education:

Students of MUST in Orkhon province and GMIT were included in the scholarship program and provided with jobs - 2017-2019

Sponsored XXIX State Chemistry Olympiad – 2018

Furnished a complete chemistry cabinet in 4 secondary schools of Orkhon province (Jargalant Sum EBS, Academic House, Schools 14, 20) - 2018-2022

Sponsored XXIX State Chemistry Olympiad - 2018

Furnished a complete chemistry cabinet in 4 secondary schools of Orkhon province (Jargalant Sum EBS, Academic House, Schools 14, 20) - 2018-2022

"Erdenes Silver Resources" LLC was established in May 2019 by Resolution No. 133 of 2014 of the Government of Mongolia and Resolution No. 15 of 2019 of the Board of Directors of "Erdenes Mongolia" LLC.

"Erdenes Silver Resources" LLC is implementing the following functions:

Consulting in the field of mining

Prospecting and prospecting for minerals

Extraction and use of minerals

Drilling by contract

Our company has been granted a special mineral exploration license /XV-2021416/ with an area of 2887.85 ha, named Salhit, located in Gurvansaikhan sum area of Dundgov province according to Minutes No. 26 of the meeting of the Government dated June 12, 2019, and Decision No. 341 of the Minerals and Petroleum Department dated July 5, 2019, within the framework of the government's policy in the field of mineral resources.

Within the framework of this decision, the Ministry of Mining and Heavy Industry, in order to create new sustainable sources of the state budget and to use the resources of the industry appropriately, in the area of Salhit silver-gold deposit exploration license /XV-021416/ in accordance with the law dated October 14, 2019- received a special operating license /MV-021483/ on 2015, and is working to create conditions for bringing the deposit into economic circulation and starting mineral extraction activities in the shortest possible time.

The Government of Mongolia decided to use the above deposits and pay off a certain part of the civil pension mortgage from the income put into economic circulation, and by Decree No. 01 of the Prime Minister of Mongolia dated January 3, 2020, the draft law on the one-time cancellation of loans of citizens with old-age pension loans A working group has been established.

The working group newly approved the law on the one-time payment of loan payments secured by the civil pension, the law on the procedure for compliance with the said law, and made amendments to the law on deposit, settlement and credit operations of banks and authorized legal entities, 2020 of the Parliament The resolution of the National Assembly of Mongolia was formally approved at the meeting on January 10, 2018.

Article 5.1 of the Law on one-time payment of civil pension pledged loans states that "State-owned "Erdenes Mongolia" LLC has pledged civil pensions by pledging the return to the government from the income from the economic circulation of the Salhit silver-gold deposit owned by its subsidiary company. will pay off a portion of the loan." reflected.

Therefore, "Erdenes Silver Resources" LLC is a legal entity responsible for ensuring the implementation of the above approved law.

TRANSWEST MONGOLIA LLC is a Mongolian leading mining and construction equipment distributor with exclusive KOMATSU dealership rights. We are supported by the strength of Sumitomo Corporation, one of the most successful and respected corporations in the world today as well as the operational and technical expertise of SMS Equipment Canada, one of the largest KOMATSU dealers in the world. The exclusive Distribution Agreement authorizes Transwest to represent Komatsu Ltd. on all equipment sales, parts, service, component remanufacture and rebuild offered by Komatsu Ltd. As the only authorized distributor of Komatsu Ltd. in Mongolia, Transwest's support includes providing genuine Komatsu parts and technical expertise fully support by direct factory access along with complete service and technical capabilities, welding and fabrication services, line boring and field service capabilities.

Top Motors is an authorized Toyota dealership of the world leading car manufacturer "Toyota Motor Corporation Inc" and Toyota Center has commenced its operation in September of 2021 as a subsidiary of the MCS group.

Top Motors offers full range of maintenance and repair services, spare parts sales, body & paint and sale of Toyota brand car for Mongolian market with high regards to Toyota's global operation standards.

"Toyota – Top Motors Centre" is equipped with the state-of-the-art diagnostic and maintenance equipment and has a capacity to servicing 20 vehicles at a time. With regards to customer comfort, the Top Motors facility has various amenities for customer convenience and aimed to become one-stop shop for it is customer and visitors.

For customer comfort Top motors provided comfortable customer lounge offering coffee shop with highs speed Wi-Fi interned access and safe play area for kids furnished with cognitive-development toys, and compelling library for family visitors.

We offer the following services to all Toyota users:

- Sales and consulting of Genuine parts
- Periodic and scheduled maintenance plan
- Diagnosis and troubleshooting
- General repair
- Electrical repair
- Wheel alignment
- Headlight adjustment
- Body & paint
- Car wash

Our engineers and technicians are trained and certified by "Toyota Motors Corporation" training program. Beside TMC's training program our technical staff constantly developing their technical skill through in house developed On-Job-Training program.

At Top Motors we endeavor to provide high quality service to all Toyota car owners in Mongolia and will strive to be their lifelong partner and distribute happiness for all.

CONFERENCE AGENDA

Conference date: **19 June, 2023**
Conference location: **Emerald Hall, 2nd floor, Bluesky Hotel, Ulaanbaatar, Mongolia**

Time	Activity / Presentation	Speaker / Chair
08:30 – 09:00	Registration	
09:00 – 09:20	Opening	**Prof. Battsengel Baatar** (Chair of the Conference, Rector of GMIT) **Mr. Batbayar. G.** (State Secretary of the Ministry of Mining and Heavy Industry) **H.E. Joern Rosenberg** (Ambassador of the Federal Republic of Germany)
09:20 – 09:40	Policy reforms in the mineral sector of Mongolia	**Dr. Uyanga Bold** (Ministry of Mining and Heavy Industry)
09:40 – 10:00	German-Mongolian technical cooperation for sustainable mineral resources management in the last decades	**Dr. T. Abel** (Federal Institute for Geosciences and Natural Resources, Germany)
10:00 – 10:20	Coffee break	

Session 1: **Sustainable Use of Natural Resources**		Chairs: **Battsengel Baatar** (GMIT) **Melissa Shanjengange** (Oyu Tolgoi)
10:20 – 10:35	Innovation opportunities through the circular economy in mining – proactive handling of ESG factors and sustainability-oriented regulation	Stefanie Krause, **Jürgen Kretschmann**
10:35 – 10:50	Remediation of mine waters and mine water runoff by use of natural and modified natural materials	John Barbour, Cathleen Webb, **David Dixon**
10:50 – 11:05	Five years of raw material exploration with the ultra-light airborne system D-MTUC in Mongolia – a review	**Rainer Herd**
11:05 – 11:20	Investigation of rare earth elements from coal and coal byproducts	**Bayardulam Jamiyansuren,** Azjargal Burneebaatar, Battsengel Baatar, Bold Khosbayar
11:20 – 11:35	Global trends in mining – correlation between mining methods and technology development for future mines	**Sandra Nowosad,** Oliver Langefeld
11:35 – 11:50	Applications of immersive technology in the mining industry	**Enkhbayar Altantsetseg**

11:50 – 12:05	The potential of microorganisms to leach rare earth elements from monazite	**B.Bayarbayasgalan**, D.Nomin-Erdene, A.Altangerel, D.Sarangerel
12:05 – 12:30	Q&A session	
12:30 – 13:30	Lunch	

Session 2: **Improvement of the Legal Framework for Environmental Protection in Mongolia, China and Germany**		Chairs: **Zaya Lkhagvajav** (GIZ Mongolia) **Marco Haase** (GIZ China)
13:30-13:35	Opening remarks	**Thorsten Giehler,** (Regional Director GIZ East Asia)
13:35 – 13:50	The state and ambience of mining legislation in modern Mongolia – near future" (problems and ways to overcome)	**Khulan Bayar**
13:50 – 14:05	Addressing the environmental impacts of mineral resource extraction	**Carsten Drebenstedt**
14:05 – 14:20	The legal framework for environmental protection in China's mining industry	**Wang Canfa**
14:20 – 14:35	Mining and environmental law in Germany	**Walter Frenz**
14:35 – 14:50	Challenges and prospects of the comprehensive resource utilization system in China	**Zhang Jianwei**
14:50 – 15:05	Implementation and practice of environmental legislation in the minerals sector of Mongolia: current situation and ways to overcome the issues	**Surakhbayar Galsan**
15:05 – 15:35	Q&A session	
15:35 – 15:50	Coffee break	

Session 3a: **Environmental and Economic Challenges in Raw Material Extraction and Processing**		Chairs: **Gantuya Ganbat** (GMIT) **Rainer Herd (BTU)**
15:50 – 16:05	Environmental issues of coal mining in Mongolia	**Martin Knippertz**, Enkhjargal Sodnomdarjaa
16:05 – 16:20	Aviation weather hazard meteorological conditions' role in air pollution at Buyant-Ukhaa aerodrome in Mongolia	**N. Enkhdalai**, E. Munkhtsetseg, B. Tsatsral
16:20 – 16:35	The social license to operate in mining: conceptual evolution and practical implementation in Mongolia	**Enkhzaya Chuluunbaatar,** Sugar Gonchigjantsan, Catherine Macdonald

16:35 – 16:50	Case studies of thermal treatments used for multi/oil-contaminated soil in Korea	Taehoon Koh, Donggeun Lee, Changju Kim, and **Sungchil Lee**
16:50 – 17:05	An overview of water management practices in Namibian mines	**Harmony K. Musiyarira**, Benjamin Mapani, Mallikarjun Pillalamarry
17:05 – 17:20	Reduction of road dust using filters mounted on public buses	**Odbileg Norovrinchin,** Sungchil Lee, Baljinnyam Guntevsuren
17:20 – 17:35	Measurements and 3-dimensional simulations of carbon-monoxide distribution in Mongolian ger	**Byambakhorol Battetseg,** Gantuya Ganbat, Battulga Nasanjargal
17:35 – 17:50	A dust emission model elaborated by dust parameters as soil moisture functions in Mongolia	**Munkhtsetseg, E.,** Shinoda, M., Gillies, J.A., Kimura, R., Nikolich, G., Mikami, M. and Ishizuka, M.
17:50 – 18:00	Q&A session	
19:00	Welcome reception	

Conference date: **20 June, 2023**

Conference location: **Emerald Hall, 2nd floor, Bluesky Hotel, Ulaanbaatar, Mongolia**

Time	Activity / Presentation	Speaker / Chair
Session 3b: **Environmental and Economic Challenges in Raw Material Extraction and Processing + Energy Efficiency**		Chairs: **Sungchil Lee** (GMIT) **Lkhagvaragchaa T. (MCS)**
09:00 – 09:15	Sustainability for All? The challenges of predicting and managing the potential risks of end-of-life electric vehicles and their batteries in the Global South	**Luisa Prates**, Daniel Karthe, Lulu Zhang, Lili Wang, Jack O'Connor, Halim Lee, Christina Dornack
09:15 – 09:30	Sustainable mining and climate protection: exchange between Mongolia and Germany	**Walter Frenz**
09:30 – 09:45	Peak flow frequency analysis for the Orkhon River	**Battsengel Dashdorj**
09:45 – 10:00	Management of end-of-life electric vehicles and lithium-ion batteries in Mongolia	**Uelun Munkhjargal,** Luisa Prates, Daniel Karthe, Gantuya Ganbat
10:00 – 10:15	A comprehensive study on harmonic analysis and behavior in power grids with induction melting furnaces	**Ariunbolor Purvee,** Ankhbayar Vandandorj
10:15 – 10:30	Study of residential house's energy demand	**Enkh-Uchral Erdenebaatar,** Amarbayar Adiyabat
10:30 – 10:45	Capacity building in Mongolian higher education for energy-efficient buildings (CEBEC): A collaborative endeavor	**Myagmarjav Bold,** Ariunbolor Purvee, Altangerel Lkhamsuren, Dorjsundui Gombokhurts, Nyamdulam Renten, Bold Enkhbold

10:45 – 11:00	Passive Solar Greenhouse with soil heat storage	**Tamir Otgonsuren,** Amarbayar Adiyabat
11:00 – 11:15	Q&A session	
11:15 – 11:30	Coffee break	

Session 4a: **Resource-Oriented Engineering Development**		**Chairs:** Carsten Drebenstedt **(TUBAF)** Orgodol Togoo **(Boroo Gold)**
11:30– 11:45	Laser-based wear protection coatings for machine parts in the mineral-processing industry – an overview	**Gunther C. Stehr,** Ariunbolor Purvee, Battsengel Baatar, Khosbayar Nyamjav
11:45 – 12:00	Adsorption equilibria and kinetics of cephalosporin onto surfactant-modified Mongolian zeolite	**Altantogos Myagmar**, Kader Poturcu, Ochirkhuyag Bayanjargal, Ata Akcil, Sarangerel Davaasambuu
12:00 – 12:15	Optimization and continuous improvement of the Oyu Tolgoi comminution circuit	**Ganbold Malkhuuz,** Adrian Zarantonello
12:15 – 12:30	Microbial reduction of nitrous oxide: ecophysiological investigations to development of a viable greenhouse-gas removal biotechnology	**Sukhwan Yoon**
12:30 – 12:45	Q&A session	
12:45 – 13:30	Lunch	

Session 4b: **Resource-Oriented Engineering Development**		**Chairs:** **Manfred Hampe** (TU Darmstadt) **Martin Knippertz (RWTH Aachen)**
13:30 – 13:45	Ore Characterization and Mineralization Effect and Difficulties on Gold Cyanide Leaching	**J. Delgertsetseg,** Ts. Amartuvshin, D. Khatanbaatar
13:45 – 14:00	Selective electrochemical extraction of copper from electronic waste leaching solution with ferric sulphate	**B.Maral**, Z.Tuguldur, B.Sukhbaatar, D.Sarangerel
14:00 – 14:15	The use of numerical calculation methods in geotechnics and mining	Erdenetuya Gantulga, **Lothar te Kamp,** Thomas Hollenberg
14:15 – 14:30	Crud prevention in the solvent extraction stage of a copper production plant	Munkhzaya Batjargal, Bayardulam Jamiyansuren, **Temuujin Tuvshindelger,** Ochirbat Purevjav, Altangerel Lkhamsuren, Manfred Hampe, Battsengel Baatar

14:30 – 14:45	Blast-induced ground vibration impact assessment on the sensitive receptors	**Bataa Dandarmaa**, Baasanbat Tsagaan, Bilegt Batbold, Batzorig Otgonjargal, Uuganbayar Buyantogtokh, Tseesuren Oyun-Erdene, Erdenebayar Naran
14:45 – 15:00	Production of light hydrocarbons (C2-C4) by hydrogenation of CO_2 using Co-K/γ-Al_2O_3 catalysts with additional metal promoters (Ba, La, Ce) and combined supports (Y_2O_3, TiO_2)	**Manlaibaatar Purevsuren**, Enkhsaruul Byambajav
15:00 – 15:15	Kinetic modeling of acid leaching of rare earth elements from the Lugiin Gol deposit	**D.Purevjargal**, A.Altangerel, B.Sukhbaatar, D.Sarangerel
15:15 – 15:30	A study of mechanical properties of wear-resistant chromite alloy coated low carbon steel by semi-automatic welding method	G.Oyunsuren, **B.Purevdorj**
15:30 – 15:45	Electrochemical performance of natural molybdenite (MoS_2) as an anode material in lithium-ion battery	**Bolormaa Gendensuren**, Nyambayar Sugartseren, Min-Jae Kim, Battsengel Baatar, Eun-Suok Oh
15:45 – 16:00	Q&A session	
16:00 – 16:15	Coffee break	

16:00 – 17:00	Mobile OT – Oyu Tolgoi copper mining project information distribution session /at the Bluesky Hotel parking lot/
16:00 – 17:00	**Poster Session**

Presentation	**Speakers**
Metal organic framework electrocatalysts for water splitting	**Ravi Nivetha**, Tran Van Phuc, Huynh Ngoc Diem, Seung Hyun Hur
Neurospora crassa glutamate decarboxylase cell surface display toward the the extracellular Gamma-aminobutyric acid production in recombinant Escherichia coli	**Jae Hoon Jeong**, Ashokkumar Kumaravel, Soon Ho Hong
Computational prediction of dehydrogenation catalysts for perhydro-dibenzyl toluene	**Jingwen Zhou**, Sung Gu Kang
Facile synthesis of two-dimensional $Cu_3Mo_2O_9$/sulfur-doped graphene quantum dots nanocomposites for electrochemical water splitting	**Min Jae Kim**, Tran Van Tam, Won Mook Choi
Influence of metal-support interactions on catalytic performance over highly dispersed xNi/yCZA catalysts for ethanol steam reforming	**Mingyan Wang**, Azam Jamsaz, Pham Ngoc Nhiem, Hoang Thi Van Anh, Eun Woo Shin
Synthesis of spherical suprastructure $NiCu(OH)_2$ for efficient ammonia electrooxidation: mechanistic investigation	**Hoang-Khoi Vu**, Thanh Truong Dang, Pragyan, Jin Suk Chung
Modification and polymerization towards water-based poly-acrylate binder on the performance of electrochemical double-layer capacitors	**Sugartseren Nyambayar**, Gendersuren Bolormaa, Kim Min Jae, Eun-Suok Oh

According to SiO_x content on the electrochemical behavior of SiO_x/C composite anodes of Lithium-ion battery	**Min-Jae Kim**, Ye-ji Yun, Yu-ri Seo, Se-hwa Cheon, Eun-Suok Oh
Internalization of External Costs in the Mining Sector	**Malte Giesenow**
Optimization of CDF: Copper leaching model and sensitivity analysis	**G.Dorjsundui**, B.Sukhbaatar, L.Altangerel
Reprocessing of tailing from Erdenet copper ores: Optimization of the flotation	**Narangarav T**. Battsengel B. Ankhchimeg G. Dugar D.
Soil properties of the permafrost zone in Mongolia and differences between regions	**Purevdorj Ts.**
Testing, Sizing and Optimization of Plant Thickener	**Ts. Amartuvshin**, B. Batsaikhan, S. Handmaa
Natural Rehabilitation Potential in Two Distinct Mining Areas in Mongolia	**Oyun-erdene Tsogtsaikhan**, Gantuya Ganbat, Martin Knippertz

Field trip date: **21 June, 2023**

Field trip itinerary: **Ulaanbaatar -> Baganuur -> GMITcampus in Nalaikh -> Ulaanbaatar**

Time	Activity
8:00	Shuttle bus start from Bluesky Hotel
10:00	Arrive at Baganuur LC
10:05	Greet guests and provide safety instructions in Room No. 209
10:30	Coffee break
10:50	Introduction of Baganuur LC and discussion
11:30	Field trip at the mining site
13:30	Lunch
14:30	Field trip at the department of maintenance and technological machines repair
15:30	Start from Baganuur to Nalaikh
16:00	Arrive at GMIT campus in Nalaikh
16:05	Introduction of GMIT and campus tour
17:00	Head to UB

GERMAN-MONGOLIAN TECHNICAL COOPERATION FOR SUSTAINABLE MINERAL RESOURCES MANAGEMENT IN THE LAST DECADES

Thekla ABEL*, Khulan BERKH, M. Erdmann
Federal Institute for Geosciences and Natural Resources (BGR), Germany
*Email: thekla.abel@bgr.de

ABSTRACT

German-Mongolian cooperation in the geological sector has a long tradition. Since 1962, geology and mining experts from the former Mongolian People's Republic (MRV) and the former German Democratic Republic (GDR) conducted several successful joint exploration and mapping expeditions on the territory of Mongolia. With the political changes in Germany and Mongolia in 1990/1991, the joint expeditions had been ended and activities in the geoscientific sector were mainly moved to development cooperation projects.

In Germany the technical leadership of the cooperation was transferred to the Federal Institute for Geosciences and Natural Resources (BGR), which, as the central geoscientific advisory institution of the Federal Government, performs numerous international tasks and acts as the German implementation organization for technical cooperation with developing nations (TZ) in the geoscientific field. At the same time, socially significant topics such as environmental protection, organizational development and capacity building for service-oriented state institutions in an internationally opening economic area came to the fore in Mongolia. The thematic focus of the cooperation was on the mineral commodity sector. Therefore, within the framework of the German-Mongolian development cooperation, BGR carried out various projects over the last 30 years together with different Mongolian government institutions responsible for the mineral resources sector. To support a transparent and efficient governance of a responsible mining sector, the projects focused mainly on capacity development and elaboration of professional information and data, e.g. studies on gold and rare earths in Mongolia, or an investor's guide for industrial minerals and selected rare metals. In addition, the analytical and economic capacities in the central geological laboratory were strengthened and have been rewarded with three international accreditations. Furthermore, modernizing of mining inspection work and enhancing environmental protection in the mining sector have been supported.

Recently, the focus has been increasingly on supporting digital processes, particularly the further development of the digital mining cadastre and the digital reporting system for exploration and mining companies, as well as enhancing the digital data exchange between institutions. Within the current cooperation, the topics of classification and economic estimation of resources and reserves, reporting standards, and reserve balancing are resumed. In this context, the development of guidelines for the estimation of mineral resources and reserves are being supported.

Important additional aspects, such as the socio-economic impact of mining in Mongolia, are also being worked on. Environmentally responsible mining will continue to be supported again in the coming years. Here, the planned focus will lie on mitigating negative environmental impacts of mining, such as on biodiversity, including by supporting the rehabilitation of mining sites and mine closure planning.

INNOVATION OPPORTUNITIES THROUGH CIRCULAR ECONOMY IN MINING – PROACTIVE HANDLING OF ESG FACTORS AND SUSTAINABILITY-ORIENTED REGULATION

Stefanie KRAUSE, Jürgen KRETSCHMANN*
Technische Hochschule Georg Agricola
*Email: mail@juergen-kretschmann.de

ABSTRACT
Mining companies provide the required materials for the energy transition and green technologies. The question which emissions and waste are generated to produce these technologies attracts growing interest throughout the society. Investors, governments, customers and other stakeholders have recognized that the mining and metals industry is the key to many sustainability issues. One of the greatest challenges for miners - short- to midterm - lies in increasing scrutiny, complex requirements from investors (ESG) and stringent regulation. Consequently, two-third of the world's largest mining companies have defined net-zero or carbon neutrality goals. However, which paths must miners take to achieve these ambitious goals? How can they overcome the reactive phase and integrate sustainability into their core activities? Sustainable business model innovation is considered the prime technique for miners to outperform in this context. Circular business models belong to the most promising approaches beyond them. Based on a literature review, the paper points out potential circular strategies along the mine's life cycle and discusses drivers and barriers towards a circular transition of the sector. It aims to provide a solid information basis and starting point for sustainability strategists in mining.
Key words: Circular economy in mining, circular mining, circular-oriented innovation, sustainable mining, sustainable business model innovation, sustainable business model patterns, ESG, taxonomy regulation, sustainability reporting

REMEDIATION OF MINE WATERS AND MINE WATER RUNOFF BY USE OF NATURAL AND MODIFIED NATURAL MATERIALS.

John BARBOUR[1], Cathleen WEBB[2], David DIXON[1,*]
[1]Karen M Swindler Department of Chemical and Biological Engineering, South Dakota School of Mines and Technology, Rapid City, South Dakota, USA
[2]Chemistry Department and Office of Research Ogden College of Science & Engineering Western Kentucky University, Bowling Green, Kentucky, USA
*Email: david.dixon@sdsmt.edu

ABSTRACT

In many areas when soil is disturbed, especially in areas where mining for valuable minerals and elements occurs, water contamination can become an inadvertent problem. Frequently this contamination includes metals, chemical species, low pH, and elements that can pose a threat to drinking or irrigation water supplies. In some mining operations process water may be stored on site, and through process changes and evaporation of water the concentration of contaminates can increase significantly. There are a number of industrial methods to remediate water, but some of these are expensive and may just transfer the problem to another area, such as using an ion-exchange media. Arsenic is a frequent and naturally occurring contaminant, especially around gold mines and other mining operations. Some treatment methods use anion-exchange media to remove the dissolved arsenic species, however when the exchange media is “spent” or loaded with arsenic, it must be removed and regenerated. Thus, moving the arsenic to another location, and perhaps resulting in a more concentrated solution.

This work began researching the use of a naturally occurring limestone material in the midwest USA, because of its natural affinity for arsenic. It was later modified to increase its capacity for arsenic removal, as well as other chemical species and contaminants. To-date, in addition to removing arsenic (arsenite and arsenate), it has been tested to show removal of fluoride, aluminum, cadmium, copper, lead, zinc, and in more recent work, selenite. Current work is exploring the removal of the more difficult ion of selenium, selenate.

An advantage of using this media and in its modified form, is that arsenic and other contaminants are bound strongly to it. The arsenic laden limestone-based media has been tested as an additive in concrete. The media costs significantly less than other treatment materials, and it (as well as the concrete with media added) has been shown to pass the California TCLP leaching test successfully. Because the media is a naturally occurring material that can be relatively easily modified, if needed, and because disposal is safe without the need for expensive regeneration, it is an attractive cost-effective resource for use in areas where water contamination around mines has occurred

Keywords: Mine water, Runoff, Arsenic, Fluoride, Heavy metals

FIVE YEARS OF RAW MATERIAL EXPLORATION WITH THE ULTRA-LIGHT AIRBORNE SYSTEM D-MTUC IN MONGOLIA – A REVIEW

Rainer HERD
Brandenburg University of Technology (BTU), Cottbus, Germany,
German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
Email: herd@b-tu.de

ABSTRACT

Within the frame of the 'German-Mongolian Raw Material Partnership', the multi-sensor airborne investigation system D-MTUC was transported 2018 to Mongolia for raw material exploration in cooperation with the German-Mongolian Institute for Resources and Technology (GMIT) and the Mineral Resource and Petroleum Authority of Mongolia. The geoscientific instrumentation of the system comprehends a CsI-y-spectrometer of MEDUSA, Netherlands, 2 K-magnetometer of GEM, Canada, a VLF-EM-receiver of RMS, Canada and a data acquisition and control system of GeoDuster, RSA with the option of further sensor installations, for details see Herd and Holst (2015). The sensor configuration enables the system to operate at low speed and low altitude for mineral exploration, geological mapping, detection of freshwater resources and brines and different environmental monitoring missions.

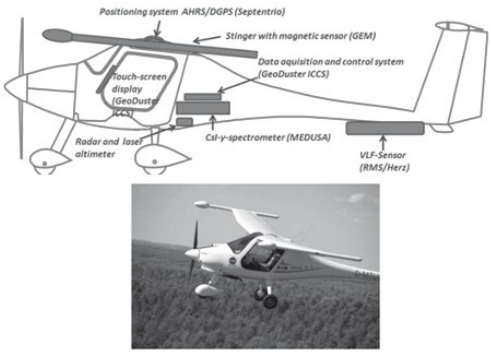

Figure 1. The ultra-light airborne investigation system D-MTUC with actual sensor equipment

During the course of the project, the team was struggling with different administrative, climatic and technical challenges. Before the system could take off administrative difficulties had to be solved with the Mongolian Civil Aviation Authority (MCAA). Harsh weather and climatic conditions (strong winds up to 30 knots and thermic effects) allowed only the time between sunrise at 6 a.m. and 9 a.m. to be used for survey flights. The airfields in Mongolia provide in most cases gravel runways - causing easy propeller damages and have usually no storage facilities like hangars. Fuel with 98 can be found in the capital only. For two years no investigations were possible due to the COVID-19 restriction – just to name a few challenges within the project.

Nevertheless, the team was able to investigate different areas in the Central Gobi Desert, in the Changai mountains and the greater Ulaanbaatar region. In total 4263 line-kilometers with a total areal extent of 662 km² have been investigated. The flight altitude was always 100 m. Different sets of high resolution magnetic and radiometric maps could be produced and handed over to the Mineral Resource and Petroleum Authority of Mongolia. Unknown raw material potentials could be detected. Results and experiences of this unusual project will be presented.

Keywords: Airborne geophysics, raw material exploration, ultra-light aircraft, Mongolia

INVESTIGATION OF RARE EARTH ELEMENTS (REES) FROM COAL AND COAL BYPRODUCTS

Bayardulam JAMIYANSUREN, Azjargal BURNEEBAATAR, Battsengel BAATAR*, Bold KHOSBAYAR
German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
*Email: battsengel@gmit.edu.mn,

ABSTRACT

The rare earth elements (REEs), which are increasing demand because they are essential to the creation of technologically advanced products, have stimulated the development of original processes to recover REEs from secondary sources. The rare earth elements (REEs) from alternative sources, including fly ash from Thermal Power Plant IV, the bottom ash from Baganuur Thermal Plant, Mongolia and its combustion products which are abundant in a number of important elements.

The technical feasibility of physical separation techniques for the enrichment of REE from coal and coal byproducts were investigated such as particle size, gravity, magnetic separation, density separation, flotation and leaching. When recovery rare earth elements from coal ash and coal byproducts, these methods are more effective when used in combination with gravity-flotation, magnetic separation–flotation, flotation-magnetic separation, flotation-leaching, and density separation-leaching rather than separated each of them. In the next step of physical separation, plans are to combine hydrometallurgical experiments on the selected methods.

The TESCAN integrated Mineral Analyzer (TIMA) and X-ray diffractometer (XRD) were used to characterize the mineralogy of coal, fly ash and bottom ashes and further investigation of REE associations and its mineral. The quantity of REEs in the coal sample was determined using the inductively coupled plasm-mass spectrometry (ICP-MS) technique. Quantitative analysis result shows that total REEs content in the coal ash was 414 ppm. Thus, hydrometallurgical leaching is advised to evaluate the possibility of REEs recovery from the secondary sources.

Keywords: Rare Earth Elements, Secondary resource, Fly ash, Coal combustion by-products

GLOBAL TRENDS IN MINING – CORRELATION BETWEEN MINING METHODS AND TECHNOLOGY DEVELOPMENT FOR FUTURE MINES

Sandra NOWOSAD*, Oliver LANGEFELD
Clausthal University of Technology
*Email: sandra.nowosad@tu-clausthal.de

ABSTRACT
As the world pursues a sustainable transformation the demand and production of raw materials is and will be continuing increasing. This, has led to investment increase for opening new mines under new constrains, since the mines of the future are sustainable, digital, autonomous, and energy efficient. However, these are not the only characteristics to take into consideration when designing a new mine, e.g. as economic feasible deposits are found at greater depths, rock temperature and increased weather temperature by the use of battery electric vehicles which makes temperature and ventilations strategies new constrains for future mines. Furthermore, the fundamental design of new mines is based on mining equipment designed more than 30 years ago which have not resulted in major performance improvements and requires optimization and modification of mining methods and mine design for sustainable mines (Darling, 2023). This paper provides a global overview of the current trends in mining (ore mine deposits, battery mineral deposits, automation, digitalization, sustainable strategies, available range of technology, etc) to define the role of underground mining methods, design and selection, and its correlation to technology development considering its inherent new constrains to achieve the sustainable transformation.
Keywords: Virtual reality, Metaverse, Safety training, Interactive training

APPLICATIONS OF IMMERSIVE TECHNOLOGY IN THE MINING INDUSTRY

Enkhbayar ALTANTSETSEG
National University of Mongolia
Email: enkhbayar.a@seas.num.edu.mn

ABSTRACT
In recent years, many industries have applied immersive technologies such as VR, AR, and metaverse. In this paper, we introduce the similar applications of this technology in the mining industry especially mining safety training and introduction to mining courses. Heavy machinery operator training is essential in mining, and therefore we developed a multi-player training platform based on VR technology. The platform consists of three modules: dump truck driving training, excavator operator training, and trainer. The platform's main feature is that trainees conduct training together in the same environment connecting through the network after choosing a virtual training area. Since the platform is based on VR technology, it supports interactive training and provides users with a more realistic and practical experience. Furthermore, we

shifted our platform to the metaverse to involve more users in learning together in a 3D virtual environment. In the metaverse, users can connect to the Internet using computers, smartphones, and even VR devices to interact and conduct training in a virtual environment. Using the metaverse technology, mining students can learn more realistically and effectively about open pit and underground mining concepts and safety practices.

POTENTIAL OF MICROORGANISMS TO LEACH OF RARE EARTH ELEMENTS FROM MONAZITE

Bayarbayasgalan B.[1,2,*], Nomin-Erdene D.[1], Altangerel A.[1], Sarangerel D.[1]
[1]Department of Chemistry, Division of Natural Sciences, School of Arts and Sciences, National University of Mongolia,
[2]New Mongol Institute of Technology
*Email: bayarbayasgalan@nmit.edu.mn

ABSTRACT
Monazite is a phosphate mineral containing rare earth elements (REE) and one of the primary sources of extracting rare earth elements from the ore. Depending on chemical and thermal stability, it is challenging to recover REEs, as it is necessary to extract with sulfuric acid or sodium hydroxide at high temperatures. Environmentally friendly and cost-effective biohydrometallurgical processes have been developed due to equipment corrosion, toxic gas formation, and hazardous waste generation during sulfuric acid treatment. Hence, researchers tend to choose biohydrometallurgical technology for leaching low-grade and scattered ores, which is environmentally friendly and cost-effective. The only problem is separating microorganisms and applying them to leach REEs selectively from the minerals or ores. Herein we aimed to isolate and culture the local strains of bacteria capable of leaching rare earth elements from the ore containing monazite mineral of the Mushgia khudag deposit. We conducted the isolation of culture Burkholderia caribensis and Pseudomonas aeruginosa at 30^0C in the appropriate medium for each from ore containing monazite mineral. The pH and oxidation-reduction potential were monitored, and bacteria cultivation was periodically observed through an optical microscope. Then we conducted the bioleaching experiments of monazite-containing ore under room temperature, solid-liquid ratio 1:16, a particle size of about 1 mm, and 200 rpm. After the bioleaching, the leaching efficiency and phase analysis of the solid residue were carried out and compared to that of the initial ore. The culture bacteria were active and applicable for further leaching the rare earth elements from the monazite-containing ore.
Keywords: Monazide, Rare Earth Element, Microorganism, Mushgia khudag, Bioleaching

THE STATE AND AMBIENCE OF MINING LEGISLATION IN MODERN MONGOLIA - NEAR FUTURE" (PROBLEMS AND WAYS TO OVERCOME)

Khulan BAYAR
Email: khulan@mmhi.gov.mn

ABSTRACT
To analyze the current state of Mongolian mining sector's legislative environment; its impact on the mining industries and the challenges that faced to the mining industries as well as industry's short, medium, and long-term policies. Further discusses the impacts of mining sector to the national economy and the concept of the revision of the mineral law draft.

ADDRESSING THE ENVIRONMENTAL IMPACTS OF MINERAL RESOURCE EXTRACTION

Carsten DREBENSTEDT
TU Bergakademie Freiberg, Germany
Email: carsten.drebenstedt@mabb.tu-freiberg.de

ABSTRACT
The extraction of mineral raw materials takes place through the extraction of substances with specific chemical and physical properties from the earth's crust to enable the needs of society and the economy, such as housing, food, energy, mobility, communication.
Temporary intervention in nature and landscape is indispensable during raw material extraction. Typical interventions can be: land take with loss/impairment of previous land uses and other functions as well as interventions in the water balance. This can lead to permanent chemical and physical changes in the subsoil and the surface, and possibly to geotechnical hazards, for example. In addition, there are typical industrial emissions that change the soil, water, air and climate, such as dust, noise, gases and waste, as well as vibrations and flying rocks during blasting. The consequences can also be health hazards for employees in the company and for the public.
Case studies are used to show how the legal regulations for compliance with environmental and health-relevant limit values are implemented in operations. This is preceded by an intensive investigation of measures to avoid interventions, reduce them and compensate for them in a democratic approval procedure involving specialist authorities and the interests of the public, e.g. with an environmental impact assessment.
Typical measures are, for example, the reduction of land use and of the impact on the water balance as well as a rapid, landscape-typical reclamation of used areas. For example, a recultivation plan agreed with the public is already part of the approval of a mining project, the concrete implementation of which must be demonstrated in operating plans. Financial reserves must be formed for recultivation obligations in the year they arise. In operations under mining supervision, the implementation

is controlled on site. The responsibility of the operator ends only when no more damage can be expected from the areas associated with the extraction.
For emissions, the concept of avoidance of limit value exceedances applies before reduction and compensation. Unavoidable dust and noise at installations can be effectively reduced, e.g. by encapsulating the sources or by operational organisational measures. Protective walls and dams in front of affected objects and/or remediation measures at the objects can further reduce noise and dust immissions. The emission of exhaust gases can be reduced by switching to electric drives.
The avoidance and recycling of waste as well as its proper disposal are another focus of the concept of a responsible mining operation. Careful and safe handling of substances hazardous to water, explosives or other chemical and biological substances must be demonstrated for the mining operation and is the subject of controls and regular training. Research and development ensure that the state of the art is always high.

THE LEGAL FRAMEWORK FOR ENVIRONMENTAL PROTECTION IN CHINA'S MINING INDUSTRY

Wang CANFA[1,2]
[1]China University of Political Science and Law
[2]Beijing-based Center for Legal Assistance to Pollution Victims (CLAPV)

ABSTRACT
China, as a major player in the mining industry, extracted approximately 4.5 billion tons of coal and 970 million tons of iron ore in 2022. Consequently, the solid waste generated during mineral extraction in China is substantial, with an annual emission exceeding 1.5 billion tons and a cumulative tailings storage of approximately 20.7 billion tons. Moreover, various activities such as surface excavation, wastewater discharge, ore transportation, and smelting have significant environmental impacts. Recognizing the importance of environmental protection in mineral development, China has established a comprehensive legal framework comprising the following laws.

1. The Environmental Protection Law of the People's Republic of China: This law specifically addresses environmental protection in mineral resource extraction, emphasizing the need for rational development, biodiversity conservation, ecological security, and the formulation and implementation of ecological protection and restoration plans in compliance with relevant regulations.
2. The Mineral Resources Law of the People's Republic of China: This law stipulates that mining activities must comply with environmental protection laws to prevent pollution.
3. Pollution Prevention and Control Laws: China has enacted specific laws such as the Law on the Prevention and Control of Solid Waste Pollution, the Law on the Prevention and Control of Water Pollution, the Law on the Prevention and Control of

Air Pollution, the Law on the Prevention and Control of Soil Pollution, and the Law on the Prevention and Control of Radioactive Pollution. These laws provide detailed and stringent provisions for preventing atmospheric, water, air, and soil pollution associated with mineral resource extraction.

4. Other Natural Resource Laws:
   Various resource-related laws in China, such as the Grassland Law, Water Law, Land Management Law, and Forest Law, impose restrictions or prohibitions on mining activities that occupy and damage land, grasslands, forests, and ecosystems.
5. Ecological Protection Laws:
   China has also enacted laws such as the Wetland Protection Law, Yangtze River Protection Law, Yellow River Protection Law, Qinghai-Tibet Plateau Ecological Protection Law, and Soil and Water Conservation Law. These laws establish ecological protection thresholds, stipulating requirements for prohibiting or limiting mining activities and constructing tailings reservoirs.

China has established several systems for mineral resource extraction, including the Environmental Impact Assessment System, Pollutant Discharge Permit System, Environmental Protection Tax System, Ecological Compensation System, and Land Reclamation System, under the aforementioned legal framework. Additionally, China's Criminal Law imposes criminal sanctions on illegal mining, while the Civil Code establishes a compensation system for ecological damage caused by mining activities and enables public interest litigation.

By implementing this comprehensive legal framework, China aims to balance the development of mineral resources with environmental protection, fostering sustainable and responsible practices within the mining industry.

MINING AND ENVIRONMENTAL LAW IN GERMANY

Walter FRENZ
Maître en Droit Public, RWTH Aachen University
Email: frenz@bur.rwth-aachen.de

ABSTRACT

Mining must respect the ecological conditions: water protection, environmental protection, habitat protection, environmental impact assessment. These requirements are strict and are not weaker than mining affairs, but stronger. Actually there is a discussion wheter the ecological affairs shall be strengthened further and wheter mining shall be limited quantitatively. But effective climate protection requires raw materials, e.g. for electric cars and lithium batteries. How can access to raw materials be secured? This is especially true for countries with few raw materials, such as Germany. The first starting point is EU Antitrust Law with the access claims to "essential facilities".

To what extent can rules be laid down in international agreements

that secure access to the raw and rare materials necessary for climate protection – and specifically for the benefit of states with a special exemplary function for climate protection?

This is where the climate decision of the Federal Constitutional Court comes into play specifically for Germany. The international dimension of the climate protection requirement under the environmental state goal of Article 20a of the Basic Law obliges the Federal Government in particular to work towards climate protection internationally. To this end, however, it must set an example itself.

In doing so, Germany must also ensure its supply of raw materials necessary for climate protection. Only in this way it can become a model for climate protection. If Germany has strengthened international trust through its ambitious efforts, as postulated by the Federal Constitutional Court, it should find it particularly easy to anchor clauses in international treaties or to reach corresponding bilateral agreements that fulfil the supply of raw materials for climate protection. Germany could contribute a climate of trust also by granting access to its raw materials.

The best way would be to develop a set of rules for raw materials that would grant access to all states and at the same time ensure global compliance with minimum standards for extraction. The German government places particular emphasis on this (Coalition Agreement of SPD, Grünen and FDP of 24/11/2021, p. 34). Efforts could be made to ensure that the availability of raw materials is recognized as a component of climate protection in a follow-up climate agreement and that the signatory states guarantee access.

Against this backdrop, the crucial question is to what extent raw material agreements can be concluded with states if basic environmental and human rights standards are not observed. What then takes precedence – climate protection in this country or human rights or environmental protection in other countries? What mechanisms can be developed and implemented to uphold standards that are not dispensable in other countries?

CHALLENGES AND PROSPECTS OF THE COMPREHENSIVE RESOURCE UTILIZATION SYSTEM IN CHINA

Zhang JIANWEI
Beijing University of Chemical Technology

ABSTRACT

The efficient utilization of mineral resources is of utmost importance for the economic and social development of any nation. Rich in low-grade, compound, and small-scale, but limited in high-grade, single-mineral, and large-scale mines, China is presented with considerable potential for the comprehensive utilization of mineral resources. Over the years, China has demonstrated its commitment to resource conservation and environmental protection by implementing various measures to promote comprehensive resource conservation and efficient utilization.

While notable progress has been achieved, the existing comprehensive utilization system for mineral resources in China still faces challenges, necessitating further improvements within the associated legal framework. Therefore, it is imperative to address these challenges and outline a promising outlook for a sustainable, environmentally friendly, and efficient comprehensive utilization system in China. Such efforts aim to enhance resource utilization efficiency, propel the development of China's ecological civilization and green growth, and align with the United Nations' Sustainable Development Goals by 2030.

IMPLEMENTATION AND PRACTICE OF ENVIRONMENTAL LEGISLATION IN THE MINERALS SECTOR OF MONGOLIA: CURRENT SITUATION AND WAYS TO OVERCOME THE ISSUES

Surakhbayar GALSAN
BlackRock Partners LLC, Ulaanbaatar, Mongolia
Email: surakhbayarg@brp.mn

ABSTRACT

Mongolia has a rich tradition of legislation regarding the use of minerals resources and environmental protection. This research focused on the evaluation of the current situation and implementation of environmental legislation in the mineral resources sector within the framework of the key stakeholders' obligations and duties, and to provide specific recommendations. The research determined that there are several duplications, gaps, and breaches within and between the current laws on Minerals, Environmental Protection, and Environmental Impact Assessment of Mongolia. In other words, the state and local administrative organizations are being only "privileged", exploration and mining license holders are being more "obligated", and local citizens, communities, and non-governmental organizations are being not "obliged" to implement the relevant legislations.

The research also contains a summary of the legislation framework of Mongolia's mineral resources and environmental sectors from the 13th century to the present and a comparative study of developed and developing countries such as Germany, Australia, Canada, and Kazakhstan's environmental legislation in the mineral resources sector.

To strengthen, rationalize and improve the inclusion of the environmental legislation in the minerals resources sector, it is required to bring it into coherence with the 2019 amendments to the Constitution of Mongolia and re-legislate it in the form of codification.

ENVIRONMENTAL ISSUES OF COAL-MINING IN MONGOLIA

Martin KNIPPERTZ[1,2], Enkhjargal SODNOMDARJAA[2,1,*]
[1]Department of Geography, RWTH Aachen University, Templergraben, Aachen, Germany
[2]German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
*Email: enkhjargal@gmit.edu.mn

ABSTRACT

The presentation focuses on the environmental impacts of mining (related) activities in coal mines in Mongolia, with a focus on Baganuur and Nalaikh. Besides the ecological components (including erosion), also the socio-economic conditions are of importance for the derivation of recommendations for a better understanding and management of Mongolia's environment.

The mining industry plays a crucial role in Mongolia's economy; about 50 different minerals are explored in approximately 3.000 deposits, with coal being the country's most important raw material. About 23% of Mongolia's GDP depends on coal exports. The country has coal reserves of about 10 to 15 billion tons. The largest coal mine in Mongolia is Erdenes Tavan Tolgoi with 6.4 billion tons of coal reserves, followed by Shivee Ovoo (646 Mio. t) and Baganuur (600 Mio. t).

Mining activities are associated with environmental issues such as soil contamination, air and water pollution or erosion. In recent years, there has been increasing concern about the impact of mining on the environment and human health in the country. Studying the long-term effects of mining on the soil and environment in Mongolia is one of the country's main concerns.

The aspect of rehabilitation in mining areas is becoming more and more important in Mongolian society. Rehabilitation concepts for the bigger mine sites in Mongolia are available. For the smaller mine sites and especially for the Ninja-mine sites, like Nalaikh, such concepts are not available, even if the necessity is given and commonly accepted.

Opened in 1922, the Nalaikh coal mine was the nation's first industrial mining operation. Nowadays most of the mines are closed, but during the peak season in winter up to 2.000 "Ninja-miners" were working in around 300 mine holes. Nalaikh's coal counted to about 70% of the 1 Mio. t coal burned every year in UB's ger district.

Baganuur Coal mine was established in 1978. Most of the Baganuur coal is used for power and heat generation in the country and mainly in Ulaanbaatar.

Soil analysis in the project areas focuses on heavy metal contents, additional soil features were analyzed. The soil features in both research sites are generally good, heavy metal concentrations are within the guidelines. The Geoaccumulation index and the Surface enrichment factor indicate no major influence of mining activities on the soil quality. In recent years, soil erosion and degradation in Mongolia have increased

due to climatic factors and anthropogenic influences, with mining being one of the main contributors. For example, increased erosion potential has been detected in and around the Baganuur coal mine.
In general, there is little ecological impact of the mining activities on the environment in Baganuur and Nalaikh. Anyway, ecological and especially geotechnical recommendations for the management of Baganuur's and Nalaikh's environment are of importance for the stakeholders.
Keywords: Coal mining, Rehabilitation, Soils, Erosion, Heavy Metals

AVIATION WEATHER HAZARD METEOROLOGICAL CONDITIONS ROLE IN AIR POLLUTION AT BUYANT-UKHAA AERODROME IN MONGOLIA

Enkhdalai N.[1], Munkhtsetseg E.[2]*, Tsatsral B.[3]
[1]Aviation Meteorological Burea, Chinggis Khan International Aerodrome, Mongolia
[2]Meteorology, Hydrology and Permafrost Laboratory, Department of Applied Mathematics, School of Engineering and Applied Science, National University of Mongolia, Mongolia
[3]Ministry of Environment and Tourism, Mongolia
*Email: e.munkhtsetseg@yahoo.com

ABSTRACT
In order to investigate relationship between meteorological parameters and particulate matter in the southwestern Ulaanbaatar, Mongolia, 30-min averaged PM10, PM2.5, PM1.0 (particulate matter with an aerodynamic diameter ≤ 10, 2.5 and 1.0μm, respectively) and meteorological parameters including wind speed and direction, air temperature, atmospheric pressure, and precipitation, and air mass trajectory calculated by HYSPLIT model of the NOAA, USA were analyzed at Nisekh measurement site between April 2009 and June 2011. A clear seasonal variation, winter high and summer low was observed for all particulate matter. During winter season, the 24-h mean concentrations PM10, PM2.5 and PM1.0 were found to be 183.5±71.5 μg m-3, 156.7±63.5 μg m-3 and 149.6±61.4 μg m-3 whereas those were averaged as 54.7±38.3 μg m-3, 14.3±7.2 μg m-3 and 8.1±4.1 μg m-3 during summer time, respectively. In winter season, air mass trajectories were steady during Worst 20% events while variable during Best 20% events, indicating that high air pollution is associated with the atmospheric stable conditions, particularly in the winter. Air mass trajectories were variable during the Worst 20% events whereas steady Best 20% events in spring, showing that unstable weather conditions bring to high air pollution in spring time. During the study period, PM2.5 was constituted 84% of PM10 during winter season whereas 28% during summer, revealing that coarse particulates were dominant in dry summer.
Keywords: PM10, PM2.5, PM1.0, Meteorological parameters.

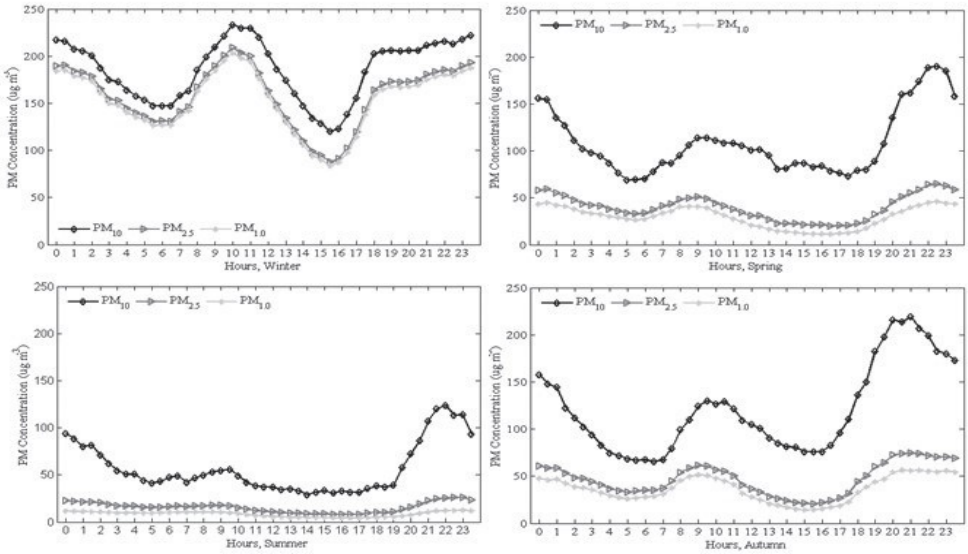

Figure: Diurnal variation of PM10, PM2.5 and PM1.0 for winter and summer

THE SOCIAL LICENCE TO OPERATE IN MINING: CONCEPTUAL EVOLUTION AND PRACTICAL IMPLEMENTATION IN MONGOLIA

Enkhzaya CHULUUNBAATAR*, Sugar GONCHIGJANTSAN, Catherine MACDONALD
German-Mongolian Institute for Resources and Technology (GMIT)
*Email: enkhzaya@gmit.edu.mn

ABSTRACT

Beside the instability of policies, managing the expectations of local communities is seen as the greatest challenge of the extractives sector in Mongolia. Although benefits accrue primarily at the national level, impacts are felt most acutely at the local level, which sometimes leads to disruptions close to the resource. The concept of the Social Licence to Operate (SLO) is that mining operations must support inclusive social and economic growth and build and maintain enduring relationships with communities as well as mitigating the socio-economic and environmental impacts of mining projects. Further, efforts to foster the sustainable development of mining-affected communities need to aim at independence and longevity — thriving post–mine closure — converting non-renewable natural resources into sustainable development and not just the short-term supply of goods and services to the mining project. And industry practices show that robust community engagement plans and activities at early stages of exploration and mining, and aligning the business strategy and milestones with local community development needs and priorities as early as possible can save costly delays and secure SLO.

The paper aims to provide an overview of SLO evolution in Mongolia and define optimal solutions for sustainable local development in local

communities. The role that government, civil society and academia actors can play in supporting this process is also addressed. The paper considers both the conceptual and the practical possibilities for the improved management of extractive resources in order to generate sustainable economic and social outcomes for local communities. The conceptual dimension reviews the key recent literature, and the practical dimension looks at a case study of the community relations and community development program of Oyu Tolgoi, with briefer references to other relevant case studies. There is a focus on community consultation, participation and partnerships — that is, the ability of the intended beneficiaries of programs to influence their design and implementation — and an assessment of whether this is a major success factor in programs that have worked. In order to demonstrate what participation means in practice, the authors draw upon their own experience and observation of community engagement and development. While reflecting on the sustainable development of a resource-rich country, the authors intend to highlight the significance of timely actions and innovative approaches to enhance the participation and engagement of extractive sector stakeholders in order to ensure the sustainable use of natural resources.
Keywords: Sustainable natural resource development, Social license, Extractives industry, Community engagement, participation and development, Mongol

CASE STUDIES OF THERMAL TREATMENTS USED FOR MULTI/OIL-CONTAMINATED SOIL IN KOREA

Taehoon KOH[1], Donggeun LEE[2], Changju KIM[3], Sungchil LEE[4]
[1]Korea Railroad Research Institute (KRRI), 176 Chuldobangmulgwan-ro, Uiwang-si, Gyeonggi-do, 16105, Korea;
[2]US Army Corps of Engineers, Far East District, Camp Humphrey, Korea
[3]PINECO. Co., Ltd., 202 Innovation Building, Konkuk University, 120 Neungdong-ro, Gwangjin-gu, Seoul, 05029, Korea
[4]German Mongolian Institute for Resources and Technology, Ulaanbaatar, Mongolia
*Email: sungchillee@gmit.edu.mn

ABSTRACT
The feasibility of thermal treatment methods such as electrical resistance heating method and microwave thermal desorption method, which have been developed in Korea Railroad Research Institute (KRRI), were presented in this paper for the remediation of multi-contaminated and oil-contaminated soils in terms of environmental and geotechnical aspects. The multi-contaminated soil polluted with heavy oils as well as heavy metals was treated by electrical resistance heating as vitrification technology, which was environmentally as well as geotechnically evaluated with respect to residual concentration, leaching, shear modulus and California Bearing Ratio (CBR). Through the remediation process with a target temperature of 700 , most of heavy metals was

isolated in a crystal form without any harmful leakage, and heavy oil was fully extracted with a form of mist or dust. And it was also geotechnically shown that decontamination process such as removal of heavy metals and oils has an effect on increment of shear modulus and CBR value of treated soil.
The indirect-heated microwave thermal desorption technology was used to remediate oil-contaminated soil. Operating the newly-developed desorption equipment for 3hrs with a target temperature of 600 , more than 99.8% of Total Petroleum Hydrocarbon (TPH) was removed. In the aspect of geotechnical properties, the maximum dry density, internal friction angle and permeability coefficient of the soil were decreased by oil contamination and were finally restored to the almost initial level of the soil after treatment.
In conclusion, it is found that electrical resistance heating and indirect-heated microwave desorption methods are effective, economic and environmental technologies for recovery of clean construction fill material from hazardous contaminated soil.
Keywords: Thermal treatment; Electrical resistance heating; Microwave thermal desorption; Vitrification; Total petroleum hydrocarbon (TPH)

AN OVERVIEW OF WATER MANAGEMENT PRACTICES IN NAMIBIAN MINES

Harmony K. MUSIYARIRA*, Benjamin MAPANI, Mallikarjun PILLALAMARRY
Department of Civil, Mining and Process Engineering, Namibia University of Science and Technology, Windhoek, Namibia
Email: hmusiyarira@nust.na

ABSTRACT
Most parts of Namibia are classified as semi-arid to arid, and Namibia is one of the driest countries in sub-Saharan Africa and one of the most vulnerable in Africa to climate change. This environmental reality dictates the need to improve water-use efficiency across all mining process components and underlies this study's purpose. The dependency and impact on a shared resource create material risk for the mining and metals sector that requires effective management. Many mining areas are located in water-stressed areas and are increasingly facing competition from different users, presenting challenges to the Security of supply. Concerns around access to water are exacerbated by the fact that operations are typically long-lived, needing to secure suitable quality water over 30–50+ years reliably. However, it is widely recognized that a holistic approach to water management is required to achieve resource sustainability and secure future access. In Namibia, ore processing, coupled with anticipated increases in water demand for human consumption and other uses, has significantly stressed the country's limited water resources. Freshwater resources are under pressure from ore processing, industrialization, urbanization, and the demands of a growing population. This is critical in the mining industry

as water is typically the prime environmental medium (besides air) affected by mining activities. Most mining companies operate beside farms, national parks, and fishing areas. Therefore, the future of mining depends on the sustainability of the earth's water resources, which are increasingly under pressure. Water scarcity is consequently a constraint for Namibian development. This Research sought to analyze the mining companies' water management strategies, benchmark these leading practices across the globe, and look at possible remediation and alternative uses of tailings dump. The methodology consisted of comprehensive literature review, field visits to the case study areas, and comparative studies with best practices. The study revealed that water supply and quality are a major threat to operations of mines and the mines have to adopt water stewardship across the life cycle of the mine. The mining sector has felt this constraint acutely, to the point of building the first desalination plant by the Orano mine in the Erongo region. Namibia is one of the countries that could face an especially significant increase in water stress by 2040. This means that businesses, farms, and communities in these countries, in particular, may be more vulnerable to water scarcity than they are today. This study revealed that over a 30-year period, freshwater consumption was reduced by over 55% per ton of milled ore in uranium mines resulting in substantial financial savings as well as the delay in water augmentation through desalination. The strategies employed by the Namibian mining industry involve inclusive stakeholders' engagement and joint water stewardship approaches, recycling and reuse, water monitoring (both ground and surface), as well as the minimization of losses. Namibian mines have implemented various water management practices to address their unique challenges in the semi-arid region. These practices promote sustainable use and conservation of water resources while minimizing the impact of mining activities on the environment and local communities. It is clear that demand management, through the improvement of water-use efficiency across the whole water chain, is vital for future economic sustainability in the sector. The realization that the water challenge cannot be solved by any one party acting alone has been fundamental in ensuring environmental compliance within the mining industry in Namibia. Overall, Namibian mines' water management practices are comparable to the world's best practices for water management. Still, there is always room for improvement and continued innovation in this critical area of mining operations.

REDUCTION OF ROAD DUST USING FILTERS MOUNTED ON PUBLIC BUSES

Odbileg NOROVRINCHEN*, Sungchil LEE, Baljinnyam.
German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
*Email: odbileg@gmit.edu.mn

ABSTRACT
Every day over 450,000 vehicles including 950 public buses run in UB polluting air with their emissions and stirring the dust from roads to the air behind them. The aim of this study is reduction of dust stirred by running buses to the air using additional paper filters attached to them. A bus, Daewoo Bs106, is selected for the test. Air flow around the bus is simulated by the software ANSYS and the engine compartment is selected as the correct location for the filter according to the result of simulation. A special electric dust sucking device is designed and fabricated then the filter is mounted inside of the device. The dust collector of the device is mounted on the back hood of the engine compartment. After 186 hours of running the bus in a certain route, the weight of collected dust is measured and contents are analyzed. During test run 155 g of dust collected by the filter. The result shows that using buses as filter carrier is good alternative to reduce dust in the air for UB due to its mobility, but improvements such as increasing the dust collector sucking area, redesign of the device using air flow around buses but not electric motor, adding more filters near to rear bumper of a bus, increasing number of vehicles installed filters should be done and tested in the near future.
Keywords: Road dust, Paper Filter, Dust Sucking Device

MEASUREMENTS AND 3-DIMENSIONAL SIMULATIONS OF CARBON-MONOXIDE DISTRIBUTION IN MONGOLIAN GER

Byambakhorol BATTETSEG, Gantuya GANBAT, Battulga NASANJARGAL*
German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
*Email: battulga@gmit.edu.mn

ABSTRACT
Ulaanbaatar is one of the most polluted cities in the world, especially in wintertime. During the past two decades, several national and internationally funded projects have been put in place to reduce air pollution. One of the implemented projects is the Government of Mongolia has decided to substitute household raw coal consumption with upgraded briquettes fuels in Ulaanbaatar since 2019 in order to combat air pollution. Concentrations of particulate matter (PM2.5 and PM10) in wintertime from November 2019 to February 2020 were reduced by around 40% compared previous five years, respectively. Unfortunately,

there are some negative impacts, for example, an increased number of carbon monoxide (CO) intoxication incidences along with this coal substitution. High dosage exposure of CO is associated with many illnesses such as allergies, asthma, respiratory infections, and bronchitis and can even lead to death.
Indoor Carbon Monoxide (CO) poisoning causes risks to people living in Mongolian gers and houses. Therefore, in this study, we collected CO concentration in gers and houses during the heating period and performed the CO distribution modelling based on the COMSOL Multiphysics software. The study enables to understand the CO distribution in Mongolian ger. The numerical model result, that in a ger is empty the CO concentration maximum values is around a stove, then from stove to crown wheel, also CO concentration minimum value is near the lattice wall. The study provides recommendations for better indoor air quality in ger based on the obtained results.
Keywords: Carbon monoxide, CO, Indoor distribution, Modelling, COMSOL

A DUST EMISSION MODEL ELABORATED BY DUST PARAMETERS AS SOIL MOISTURE FUNCTIONS IN MONGOLIA

Munkhtsetseg E.[1,*], Shinoda M.[2], Gillies J.A.[3], Kimura R.[5], Nikolich G.[5], Mikami M.[6], Ishizuka M.[7]
[1]National University of Mongolia, Mongolia
[2]Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8601, Nagoya, Japan
[3]Desert Research Institute, 2215 Raggio Parkway, Reno, NV 89512, U.S.A.
[4]Arid Land Research Center, Tottori University, Hamasaka 1390, Tottori 680-0001, Japan
[5]Desert Research Institute, 755 E. Flamingo Road, Las Vegas, NV 89119, U.S.A.
[6]Meteorological Research Institute, Nagamine 1-1, Tsukuba, Ibaraki 305-0052, Japan
[7]Faculty of Engineering, Kagawa University, 2217-20 Hayashi-cho, Takamatsu, Kagawa 761-0396, Japan
*Email: munkhtsetseg.e@seas.num.edu.mn

ABSTRACT
A new dust emission model based on wind and surface wetness is introduced for bare soils in Mongolia. First, we examined dust parameters included the threshold friction velocity and the strength of dust emission in conjunction with surface soil moisture variations. Then the parameterization of dry to wet thresholds as a function of soil moisture was supplied for the dust emission model development. The model is established on dust emission function derived theoretically and verified by portable mini wind tunnel field experiment. The performance of dust emission model was evaluated with observed dust concentration data for the study area.

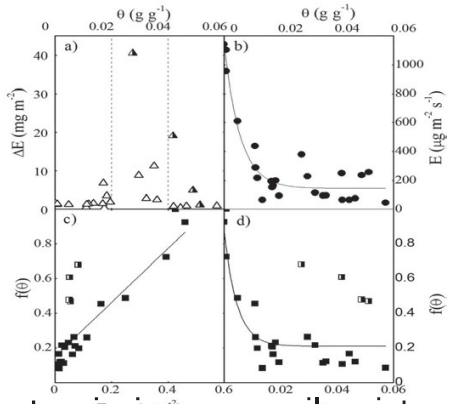

Figure: Dust emissions as a soil moisture function

Keywords: The miniature PI-SWERL portable wind tunnel, Dust emission model, Threshold friction velocity, Erodibility factor, Mongolian grasslands

SUSTAINABILITY FOR ALL? THE CHALLENGES OF PREDICTING AND MANAGING THE POTENTIAL RISKS OF END-OF-LIFE ELECTRIC VEHICLES AND THEIR BATTERIES IN THE GLOBAL SOUTH

Luisa PRATES[1,2]*, Daniel KARTHE[1,2,3], Lulu ZHANG[1,4], Lili WANG[5], Jack O'CONNOR[6], Halim LEE[1], Christina DORNACK[2]

[1]United Nations University - Institute for Integrated Management of Matter Fluxes and of Resources, United Nations University – UNU-FLORES, Dresden, Germany

[2]Technische Universität Dresden, Faculty of Environmental Sciences, Dresden, Germany

[3]Environmental Engineering Section, German-Mongolian Institute for Resources and Technology, Nalaikh District, Ulaanbaatar 12790, Mongolia

[4]Technische Universität Dresden, Chair of Business Administration, esp. Sustainability Management and Environmental Accounting, Dresden, Germany

[5]United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology – UNU-MERIT, Maastricht University, Maastricht, The Netherlands

[6]United Nations University - Institute for Environment and Human Security – UNU-EHS, Bonn, Germany

*Email: luisa.ferolla@unu.edu

ABSTRACT

The transition from fossil-fuel-based internal combustion vehicles to electric vehicles plays a key role to decarbonize road transport and mitigate climate change. Even though this transition is still in its infancy, it is important to consider not only its environmental benefits but also its potential side effects. The current electric vehicle fleet is expected to increase from 2.4 million in 2020 to 81 million in 2050 (Slowik et al. 2020), when more than half of all new cars sold are predicted to be battery-electric vehicles (BEVs). End-of-life (EOL) BEVs and their components (particularly the batteries) are far more challenging to manage than their fossil-fueled predecessors as they contain large amounts of chemical

substances that constitute potential hazards to the environment and human health and safety.
The paper discusses relevant topics for understanding future risks of transition to electric mobility in the Global South countries, which include the international used vehicle fluxes; waste management challenges for EoL BEV and its lithium-ion batteries (LIB); environmental and human health impacts of EoL LIBs disposal and policies and regulations for the e-vehicle life cycle. Recommendations to support the development of science-based policies to close regulation gaps of the used electric vehicle international trade flow, avoid pollution-shifting and guarantee a sustainable transition to e-mobility in the Global South countries are given. As a conclusion, an integrated approach from international and national stakeholders is fundamental to guarantee strong policies and regulations as well as to support the development of a sound management of EoL EV and LIBs in the Global South countries and help pave the way to a global circular economy.
Keywords: E-mobility; Electric vehicles; Waste management; Circular economy; Lithium ion batteries; Used vehicles trade.

SUSTAINABLE MINING AND CLIMATE PROTECTION: EXCHANGE BETWEEN MONGOLIA AND GERMANY

Walter FRENZ
Maître en Droit Public, RWTH Aachen University
Email: frenz@bur.rwth-aachen.de

ABSTRACT
First there is the protection of environment. But above all there is the need of raw materials on the base of all three elements of sustainability:

- Economic growth depends on raw materials, but this growth shall be independent from the need of primary resources (Green Deal). But the use of secondary resources cannot substitute the use of primary resources completely.
- The economic growth shall be based on climate protection: there is only growth in favor of climate protection, but so we need raw materials for climate protection (lithium). Therefore, the need of raw materials is also based on the ecological component of sustainability.
- The social component of sustainability forces also to gain raw materials. Otherwise the prices of products will be higher and higher. Above all this poor people will suffer if there are inflations.
- Result: In the times of climate change it is sustainable to mine raw materials if the environment is protected. An intensive exchange between states with raw materials and without raw materials is necessary – so between Mongolia and Germany.
- This international component is also an expression of the climate decision of the constitutional court in Germany, which requires an international view of climate protection. This view must include raw materials.

Keywords: Sustainable mining, Climate protection, Mongolia, Germany,

PEAK FLOW FREQUENCY ANALYSIS FOR THE ORKHON RIVER, MONGOLIA

Battsengel DASHDORJ
Department of Civil and Environmental Engineering, South Dakota School of Mines & Technology
Email: battsengel@erdenetis.edu.mn

ABSTRACT
At-site peak flow analysis is an important assessment used for estimation of peak flow magnitude in various return periods at a given location. In this paper, peak flow frequency analysis is carried out at Orkhon hydro-station in the Orkhon River of Mongolia based on observed daily flow data between 1945-2014. The analysis evaluates four most commonly used probability distributions namely Lognormal, Gamma, Log Pearson Type III and Gumbel Max for best reflecting historical flow data and estimation of maximum discharges. Kolmogorov-Smirnov and Anderson-Darling goodness of fit tests at 5% significance level were used for selecting best-fitting distribution at this site. Results indicate that Gamma was the best-fitted distribution based on goodness of fit test ranking. Using the Gamma distribution, peak flow magnitudes in 2- to 100-year return periods were estimated and historical peak flow magnitudes was evaluated for the return periods.
Keywords: Peak flow, Best-fitting distributions, Orkhon river

MANAGEMENT OF END-OF-LIFE ELECTRIC VEHICLES AND LITHIUM-ION BATTERIES IN MONGOLIA

Uelun MUNKHJARGAL[1], Luisa PRATES[2], Daniel KARTHE[2], Gantuya GANBAT[1]*
[1]German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
[2]Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), Dresden, Germany
*Email: gantuya@gmit.edu.mn

ABSTRACT
The use of electric and combined engine hybrid cars shows a trend to become more popular in recent years than gasoline cars. These types of vehicles, including plug-in hybrid electric vehicles (PHEVs) and hybrid electric vehicles (HEVs), use lithium-ion batteries (LIBs). However, LIBs have numerous advantages such as energy saving, fast charging, and low maintenance, they can be toxic to the environment and human health if handled inappropriately.
Lately, Mongolia has been the main destination for used hybrid vehicles exported from Japan. The amount of imported hybrid vehicles has tripled from 2012 to 2016. This will lead to an increasing number of end-of-life (EoL) LIB in the short term. Due to the presence of toxic components (e.g cathodes and electrolytes) in EoL LIBs, it is fundamental to find optimal solutions to manage this type of waste.

The main objective of this study is to investigate and evaluate the current situation of the waste management chain in Mongolia, aiming to find the most suitable waste management method that can be implemented within the framework of the law. In this study, methods like literature review, interviews with relevant experts, and field research at factories that recycle this type of hazardous waste were used. As a result of the research, it was found that there is a lack of factories that properly manage this type of waste. Therefore, in order to properly manage this type of hazardous waste, because the cost of exporting these types of hazardous waste is very high, it is necessary to increase the number of waste recycling plants.
Keywords: LIB, EoL EV, Mongolia, Legislation, Waste management chain

COMPREHENSIVE STUDY ON HARMONIC ANALYSIS AND BEHAVIOR IN POWER GRIDS WITH INDUCTION MELTING FURNACES

Ariunbolor PURVEE*, Ankhbayar VANDANDORJ
German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
*Email: ariunbolor@gmit.edu.mn

ABSTRACT
This paper investigates the impact of an 800kW induction furnace on power quality in the connected power grid. We examine how the harmonic distortion of the furnace's voltage affects the power distribution system, with the degree of distortion varying according to the melting load. Our analysis reveals that the heavily distorted current waveform of the furnace causes voltage distortion in the 6/10 kV transmission line and substations. Moreover, the furnace's low power factor, insufficient load, low efficiency, and high system losses result in frequent damage to parallel capacitors and total harmonic distortion. To study the harmonics and behavior, we developed a simulation model of the induction furnace using MATLAB Simulink. Our research contributes to the understanding of power grid harmonics and provides insights into their behavior.
Keywords: Harmonic distortion, Power grid, Induction melting furnace, Simulation model

STUDY OF RESIDENTIAL HOUSE'S ENERGY DEMAND

Enkh-Uchral ERDENEBAATAR, Amarbayar ADIYABAT*
Renewable Energy Laboratory, SEAS, National University of Mongolia
*Email: amarbayar@seas.num.edu.mn

ABSTRACT
In Mongolia, the building sector significantly contributes to the final energy consumption, particularly during harsh cold winters. The purpose of this study is to evaluate the impact of different air tightness levels on energy consumption. A case study was conducted on a residential

house, with a total area of 246 m 2 , using the Passive House Planning Package (PHPP) tool. The house's airtightness was measured twice using the single Blower Door standard measurement system, and a sensitivity analysis was performed to assess the variations in energy demand. The results reveal that improving air tightness from an initial air change rate of n 50 =2.96 to n 50 =1.77 led to a 26% reduction in heating energy demand, from 58.1 kWh/m 2 to 43.2 kWh/m 2 per year. Sensitivity analysis demonstrated that varying air tightness levels had a significant impact on energy demand, with higher air change rates resulting in increased energy consumption. This study highlights the importance of addressing building air tightness in Mongolian climates to optimize energy efficiency and reduce energy consumption in residential houses.
Keywords: Energy balance, Airtightness, Residential house.

CAPACITY BUILDING IN MONGOLIAN HIGHER EDUCATION FOR ENERGY-EFFICIENT BUILDINGS

Myagmarjav BOLD*, Altangerel LKHAMSUREN
German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
*Email: myagmarjav@gmit.edu.mn

ABSTRACT
The rapid urbanization and population influx in Ulaanbaatar, the capital city of Mongolia, have led to severe air pollution issues, primarily driven by the use of fossil fuels for heating purposes in the extremely cold winters. Efforts by the Mongolian government, non-governmental organizations, and international entities to combat air pollution have largely focused on fuel and combustion processes. However, due to poor insulation in buildings, particularly traditional Mongolian gers, these measures have proven inadequate. Enhancing energy efficiency in buildings presents significant potential for mitigating air pollution in Mongolia, but a critical challenge lies in the limited knowledge and skills of professionals, including scientists, engineers, and policy-makers, needed to tackle environmental issues effectively. In this context, universities play a pivotal role.
This paper presents a project aimed at building the capacity of Mongolian higher education institutions in the field of environment and engineering, specifically focusing on energy-efficient buildings. The collaborative project involves five partner universities: German-Mongolian Institute for Resources and Technology (GMIT), Mongolian University of Life Sciences (MULS), Mongolian University of Science and Technology (MUST), Lund University (Sweden), and Tallinn University of Technology (Estonia). The project comprises five main stages, each led by a partner university, with responsibilities ranging from needs analysis to curriculum development, faculty and student exchange programs, establishment of laboratory facilities, and industry training programs.
The specific objectives of the project include developing and revising

higher education programs on Energy Efficient Buildings and Renewable Energy, devising instructional methods and tools, supporting faculty development and fostering cooperation among partner universities, establishing exchange programs for faculty and students, and enhancing laboratory facilities. To demonstrate the project's progress, GMIT, as one of the partner universities, has introduced six new courses and accompanying laboratory equipment related to Energy Efficient Buildings. These courses cover various aspects such as energy economics, indoor comfort, energy management, energy storage, energy systems, and modeling and analysis of energy systems.
By bolstering the capacity of Mongolian higher education institutions through curriculum development, faculty training, and international collaboration, this project seeks to equip professionals with the requisite expertise to address the pressing environmental challenges in Mongolia. By focusing on energy-efficient buildings, the project aims to contribute to the reduction of air pollution in Ulaanbaatar and foster sustainable development in the country.
Keywords: Energy-efficient building, Higher education, Renewable energy

PASSIVE SOLAR GREENHOUSE WITH SOIL HEAT STORAGE

Tamir OTGONSUREN, Amarbayar ADIYABAT*
Renewable Energy Laboratory, SEAS, National University of Mongolia
*Email: amarbayar@seas.num.edu.mn

ABSTRACT
In Mongolia, four seasonal greenhouses are essential for food safety, as one of the main goals of sustainable development. However, operating four seasonal greenhouses in extremely cold weather is not an easy task, which requires additional heating. Our Renewable Energy Laboratory of National University of Mongolia conducted research on passive solar greenhouses with soil heat storage. The greenhouse is built in the Yargait mountain region of Ulaanbaatar with a wide transparent 6mm polycarbonate window and with a soil thermal heat storage. The greenhouse is 6 meters wide and 10 meters long, and the roof is made of 10cm thick EPS foam sandwiched with a 1mm metal sheet and the walls are constructed with a masonry block insulated with 10cm thick EPS foam. The excessive hot air from the greenhouse is sucked through the PVC pipe into the soil heat storage, which is 3 m deep, 6 m wide, and 10 m long and insulated with 10 cm thick EPS foam board. PVC pipes are buried within the soil, for circulating air mass in the soil to exchange heat. The stored heat in the ground is released during the night when there are no sun rays to heat up. Generally, there are two types of seasonal thermal energy storage in the ground, high temperature ground storage 40 ~80 and low temperature ground storage 0 ~40 . Our research object belongs to the low temperature ground storage type. The test has been performed under extreme cold winter condition at -25 ~-35 and the

passive solar greenhouse revealed its capability to heat internal air using only the solar energy during the day and storing excessive heat into the soil. The soil heat storage heated up cold air by around +10 at best, and +5 at worst case. From this research, we conclude that a passive solar greenhouse can heat up only using solar energy during winter the day. On the other hand, the soil can be used as a thermal mass for storing large amounts of heat, recovering heat during the day, and releases at night. But, continuous cloudy days and extremely cold nights under -30 degrees can drain out the stored heat dramatically. Thicker insulation is needed to avoid heat loss dramatically.
Keywords: Solar energy, Greenhouse, Solar energy, Cold climate

LASER-BASED WEAR PROTECTION COATINGS FOR MACHINE PARTS IN THE MINERAL-PROCESSING INDUSTRY – AN OVERVIEW

Gunther C. STEHR[1]*, Ariunbolor Purvee[2], Battsengel BAATAR[2] and Khosbayar NYAMJAV[3]
[1]Dresden University of Applied Sciences (HTW), Faculty of Mechanical Engineering, Dresden, Germany
[2]German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
[3]Erdenet Mining Corporation Soe, Nairamdal Square, Bayan-Undur soum, Orkhon province, Mongolia
*Email: stehr@htw-dresden.de

ABSTRACT
Laser-based additive manufacturing, either using powder bed, powder- or wire-based direct material deposition processes has recently made its way into industrial applications.
In particular wear protection applications, such as in the mineral-processing industry have attracted major attention. The given examples indicate that additive manufacturing using compact high-power laser sources has a great potential to open new horizons outreaching beyond the limits of conventional wear protection.
This paper evaluates the wear resistance of laser-coated machine parts like pump parts in the mineral processing industry to give an overview of several solution approaches. The influence of part and surface preparation as well as the implementation of combined processes using induction preheating will be discussed. Fundamental wear investigations and results of industrial trials are used to determine the best laser coating system to extend the lifetime of specific laser-coated pump parts. Based on these results, the application of laser-based additive manufacturing methods will lead to an extended wear resistance and higher machine efficiency.
Keywords: Laser-based additive manufacturing, Laser coating, Wear protection, Direct metal deposition

ADSORPTION EQUILIBRIA AND KINETICS OF CEPHALOSPORIN ONTO SURFACTANT MODIFIED MONGOLIAN ZEOLITE

Altantogos MYAGMAR[1,2,5], Kader POTURCU[3], Ochirkhuyag BAYANJARGAL[1], Ata AKCIL[2], Sarangerel DAVAASAMBUU[4]*

[1]Department of Chemistry and Biological Engineering, School of Engineering and Applied Sciences, National University of Mongolia

[2]Mineral-Metal Recovery and Recycling (MMR&R) Research Group, Mineral Processing Division, Department of Mining Engineering, Suleyman Demirel University

[3]Department of Chemistry, Arts and Science Faculty, Suleyman Demirel University

[4]Department of Chemistry, School of Arts and Sciences, National University of Mongolia

[5]Department of Medical Chemistry, School of Bio-Medicine, Mongolian National University of Medical Sciences

*Email: sarangerel@num.edu.mn

ABSTRACT

Recently, various porous materials especially zeolites are employed in drug delivery applications that affect the drug loading efficacy and the release rate of drug molecules due to their pore size, size distribution, stable uniform porous structure, surface area, volume, and well-defined surface properties. The polarity of the drug molecules and the nature of the zeolite surface play an important role in the adsorption efficiency. The application of a quaternary ammonium cationic surfactant on minerals such as zeolites causes the change of the clay surface that have an excellent hydrophobicity and great efficiency for adsorption. Zeolite surface charged negatively and when modifying the zeolite surface changes from hydrophilic to hydrophobic and from negatively to positively charged, due to the adsorption of organic molecules onto its external surface and into the interlayer spacing.

In this study we investigated the adsorption isotherm, kinetic and thermodynamic parameters of cephalosporin on cationic surfactant modified zeolite. The characterization of zeolite used for drug adsorption indicates that the natural zeolite used in this study was classified into clinoptilolite that accepted to use in a biomedical field. Adsorption isotherm, kinetic and thermodynamic functions were carried out using batch method as a function of the initial concentration of antibiotic and temperature. The kinetic and isotherm studies of the cephalosporin adsorption were best fitted by the pseudo second order kinetic model (R^2=0.9996) with monolayer adsorption capacity 12.3609 mg/g and Langmuir (R^2=0.9950) isotherm model. The activation energy (E_a) of cephalosporin adsorption onto cationic surfactant modified zeolite indicated that this antibiotic is more strongly adsorbed onto surfactant modified zeolite. Thermodynamic parameters, such as Gibbs free energy, the enthalpy, and the entropy change of adsorption onto cationic surfactant modified Mongolian zeolite have also been evaluated and it has been found that the adsorption process was spontaneous, feasible,

and exothermic. In conclusion, the result of this study suggested that surfactant modified natural zeolite may be an effective and promising adsorbent for cephalosporin from aqueous solution.

Keywords: Adsorption, Mongolian zeolite, Drug loading, Cephalosporin, Cationic surfactant

OPTIMIZATION AND CONTINUOUS IMPROVEMENT OF OYU TOLGOI COMMINUTION CIRCUIT

Ganbold MALKHUUZ[1,*], Adrian ZARANTONELLO[2], Andy SUPRYADI[3], Omar JALDIN[1], Bayasgalan ERDENEBAATAR[1], Munkh-Ulzii GANBOLD[1]

[1]Oyu Tolgoi LLC, Monnis Tower, Chinggis Avenue 15 Sukhbaatar District - 14240, Ulaanbaatar, Mongolia

[2]Senior manager concentrator excellence

[3]Principal Advisor Constraint Utilization, Processing Centre of Excellence

*Email: ganbold.malkhuuz@riotinto.com

ABSTRACT

The Oyu Tolgoi (OT) two lines of SABC circuit has provided and excellent setting for incremental optimizations. Since its commissioning in 2013, several interventions have resulted in marked improvements in milling rate. Improvements include high intensity blasting and reduced crusher gap for reduced fragmentation, opened up discharge grate for increased pebble rate, changed screen size for trommel and vibratory both decks, tightened grinding media quality to reduce breakage, increased ball charge, installed additional magnets to improve metal removal and reduced pebble crusher bypass, changed pebble crusher liner profile for improved size reduction, provisioned flexible feeding arrangement from SAG to BM to improve operation efficiency, upgraded cyclone feed pump and gearbox, increased vortex finder and some others in subsequent processes. In addition to physical changes, expert system is applied to all major units of the OT comminution circuit to optimize the circuit efficiency to its constraint limits. The sequential improvements have resulted in exceeding the design capacity of 96.5ktpd or 36Mt/annual to an average of 115kt/d or ~40Mt per annual. This paper summarizes the improvement project of the OT milling circuit to its current state.

Keywords: Oyu Tolgoi, SAG, Blasting, Crushing, Grinding, Debottlenecking, APC or Expert control, Constraint.

MICROBIAL REDUCTION OF NITROUS OXIDE: ECOPHYSIOLOGICAL INVESTIGATIONS TO DEVELOPMENT OF A VIABLE GREENHOUSE-GAS REMOVAL BIOTECHNOLOGY

Sukhwan YOON
Department of Civil and Environmental Engineering, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea
Email: syoon80@kaist.ac.kr

ABSTRACT
Since the first reports of the genomic and physiological evidence of the novel nosZ clade, now termed nosZ clade II, microbial reduction of nitrous oxide (N_2O) has attracted many in search of environmental technology for mitigation of emission of this potent greenhouse gas. Beginning with the breakthrough discovery revealing that certain subgroups of clade II nosZ-possessing organisms have a distinguished ability to consume submicromolar N_2O for utilization as the electron acceptor, we, the past and present members of Environmental Microbiology Laboratory at KAIST, have made substantial contributions in advancing the physiological and genomic understanding of N_2O reduction, especially pertaining to biological nitrogen removal (BNR) processes in the wastewater sector and nitrogen management of agricultural soils. We have verified, via two disparate avenues of approach, that the clade II nosZ dominate both gene and transcript pools of nosZ in activated sludge microbiomes. In a subsequent study combining culture-based experiments with computational analyses of metagenomes and metatranscriptomes, we have verified that nanomolar N_2O consumption can occur in a sustainable manner in microoxic environments and also that the key players belong to the close relatives of the genera Dechloromonas and Azospira, the organisms presumed to be high-affinity N_2O-reducing organisms. Additionally, we have applied these new scientific insights in developing a self-sustaining N_2O biofiltration system, which can be implemented as a practical addendum to any BNR systems with minimal alterations to the plant designs. The presentation will provide a brief summary of these scientific and technological progresses we have contributed to the field over the past decade, as well as an introduction of the overarching research direction and long-term plans and objectives of our laboratory.
Keywords: Nitrogen cycle, Nitrous oxide, Microbiome, Metagenomics

ORE CHARACTERIZATION AND MINERALIZATION EFFECT AND DIFFICULTIES ON GOLD CYANIDE LEACHING

Delgertsetseg J.*, Amartuvshin Ts., Khatanbaatar D.
“True TRC” LLC, Ulaanbaatar city 16030
*Email: delgertsetseg@truetrc.mn

ABSTRACT
Gold cyanide leaching remains the most commonly used hydrometallurgical process or the extraction of gold from ores and

concentrates. As per reference of metallurgical study and investigation results on various type of gold ore and plant operation practices, there are various types of gold ore that cannot be processed by direct cyanide leaching in terms of process and economic efficiency, and it is required that detail classification of ore type in further.

Keywords: gold ore, cyanide leaching, physic and chemical depressor

SELECTIVE ELECTROCHEMICAL EXTRACTION OF COPPER FROM E-WASTE LEACHING SOLUTION WITH FERRIC SULPHATE

Maral B.[1,2*], Tuguldur Z.[1], Sukhbaatar B.[1], Sarangerel D.[1]
[1]Department of Chemistry, Division of Natural Sciences, School of Arts and Sciences, National University of Mongolia
[2]Khanlab LLC of Mongolia
*Email: maralbbuo7@gmail.com

ABSTRACT

Nowadays, the continuous generation of waste of electrical and electronic equipment with hazardous contents causes severe environmental and human health issues. However, electronic equipment contains many essential components, including nonferrous and precious metals. For this reason, e-waste is considered a secondary raw material for extracting precious and nonferrous metals with the economic benefits of the extraction and reduction the environmental pollution. Copper, a representative of precious and nonferrous metals, generally accounts for 28.41 percent of the total weight of e-waste. Hence, we aimed to obtain powder copper through sequential chemical treatment and electrochemical deposition from the e-waste. The e-waste powder from the printed circuit boards of laptops was initially treated with 0.05 M ferric sulfate in 0.1M sulfuric acid (pH=0.6-1.2) at 300 rpm, solid-liquid ratio 1:10, and room temperature to leach copper.

The leaching efficiency of copper was the highest value at 71.2 percent after 24 hours. The leachate mainly contained copper, zinc, iron, and nickel. Co-existing ions were removed from the pregnant solution by the wet chemical methods. After that, the electrolysis was carried out with copper cathode at 1.35 $A \times cm^{-2}$ of current density and pH=0.6 for 150 minutes. The purity of the obtained powder copper was 98.1 percent (mass). It is evident that copper powder with high purity can be recycled from e-waste with environmentally friendly and efficient sequential processes.

Keywords: Electrochemical extraction, Copper, E-waste, Ferric sulphate, Leaching

THE USE OF NUMERICAL CALCULATION METHODS IN GEOTECHNICS AND MINING - SAFETY, OPTIMIZATION, PROGNOSIS

Erdenetuya GANTULGA[1], Lothar te KAMP[2], Thomas HOLLENBERG[1,*]
[1]German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
[2]ITASCA Consultants GmbH, Gelsenkirchen, Germany
*Email: hollenberg@gmit.edu.mn

ABSTRACT
Geotechnics is a crucial factor in mining, which plays an important role in determining mining method selection. Hence geotechnical investigations based on rock mass properties are critical for improving the design and stability of open pit and underground mines. In recent decades, advances in computer technology and the progress of computing power have become more relevant in an increasing spectrum of research disciplines. For instance, the best assistant in geotechnical research is numerical methods. Numerical modeling software assists in the geotechnical investigation of soil, rock, groundwater, constructs, and ground support. Such analyses include engineering design, optimization of mining methods, a factor of safety prediction, research and testing, and back-analysis of failure. Because geotechnics appreciably affects the economics and safety of mining, if we do it appropriately, we can minimize the risk.
In contrast to the global factor of safety, the probability of failure depends on both mechanics and statistics, is data sensitive (thus opening one potential pathway to digital transformation) and, is relevant for both system and component failures. As a result, geotechnical software that computes the probability of failure/reliability index as one basic output in addition to stresses, strains, forces, and displacements can provide better decision support. This presentation demonstrates how numerical calculation methods are used in geotechnics and mining and shows some applications of research using FLAC3D software.
Keywords: Numerical modeling, Geotechnics, Pillar stability

CRUD PREVENTION IN THE SOLVENT EXTRACTION STAGE OF A COPPER PRODUCTION PLANT.

Munkhzaya BATJARGAL[1]*, Bayardulam JAMIYANSUREN[1], Temuujin TUVSHINDELGER[1,2], Ochirbat PUREVJAV[2], Altangerel LKHAMSUREN[1], Manfred J. HAMPE[1,3], Battsengel BAATAR[1]
[1]German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
[2]Achit-Ikht LLC
[3]The Technical University of Darmstadt
*Email: munkhzaya@gmit.edu.mn

ABSTRACT
In the solvent extraction stage, the formation of crud occurs at the interface

of the aqueous and organic phases. This process is undesirable in copper production. Due to the formation of the crud, the phase separation is lagging in the settler and it affects the throughput through the plant. Furthermore, the most challenging issue is the loss of expensive organic extractants. To prevent the crud formation or reduce the crud in solvent extraction, the chemical characteristics of the pregnant leach solution and crud were investigated as well as factors that influence the formation process of it. Results of the study show aluminum, iron, magnesium, zinc, phosphorus, and calcium to be dominant components in both pregnant leach solution and crud. The pregnant leach solution contains colloidal particles ranging from 537-722 nm in size. Crud contains 29% of the aqueous phase, 30% of the solid phase, and 41% of the organic phase. The solid phase of the crud has sheetlike structures and its particle size ranges from 3-30 μm. Several parameters influence crud formation: total suspended solids, total dissolved solids in the pregnant leach solution, pH of the extraction, etc. When pH is increased iron, magnesium, and aluminum hydroxide complexes are formed in the pregnant leach solution which causes the formation of the crud. However, the extraction process is strongly dependent on the pH, and changing it can effect on recovery of the copper. Decreasing the content of those elements in the pregnant leach solution can reduce the crud in solvent extraction. Iron and aluminum in the pregnant leach solution can be reduced by using an ion exchange resin.
Keywords: Crud, Crud formation, Solvent extraction, Copper Production Plant,

BLAST-INDUCED GROUND VIBRATION IMPACT ASSESSMENT ON THE SENSITIVE RECEPTORS

Bataa DANDARMAA[1*], Baasanbat TSAGAAN[2], Bilegt BATBOLD[1], Batzorig OTGONJARGAl[1], Uuganbayar BUYANTOGTOKH[1], Tseesuren OYUN-ERDENE[1], Erdenebayar NARAN[1]

[1]Oyu Tolgoi LLC, Monnis Tower, Sukhbaatar District, 14240, Ulaanbaatar, Mongolia

[2]Institute of Astronomy and Geophysics, Mongolian Academy of Sciences, Bayanzurkh District, 13343, Ulaanbaatar Mongolia

*Email: bataad@ot.mn

ABSTRACT

In recent years, there has been an increasing need to assess the impact of blasting on sensitive receptors such as cultural heritages and nearby communities. The Oyu Tolgoi open pit mine is one such area where blasting is a common practice. As such, it was essential to evaluate the vibrations generated by blasting and determine their potential impact on the surrounding areas. The study was conducted using seismometers to measure the ground vibrations generated by blasting. These measurements were then compared to established criteria, such as the peak particle velocity (PPV) limits set by regulatory agencies. Additionally,

the sensitivity of the receptors was also taken into account, and the study found that the resulting tremors were assessed as low risk for all the sensitive receptors assessed, including, nearby herder families' homes, open springs, cultural heritages, and mine facilities. The results of this study have significant implications for the Oyu Tolgoi open pit mine, as they can be used to inform decisions regarding blast design, timing, and the location of sensitive receptors relative to blast sites. This information can help to minimize the impact of blasting on the surrounding areas, ensuring the continued safety and well-being of the nearby communities and cultural heritages. Overall, this study provides valuable insights into the potential impact of blasting on sensitive receptors in the Oyu Tolgoi open pit mine and highlights the importance of conducting regular assessments to ensure the continued safety and sustainability of mining activities in the region.

Keywords: Peak particle velocity, Open pit, Sensitive receptor

PRODUCTION OF LIGHT HYDROCARBONS (C2-C4) BY HYDROGENATION OF CO_2 USING Co-K/γ-Al_2O_3 CATALYSTS WITH ADDITIONAL METAL PROMOTERS (BA, LA, CE) AND COMBINED SUPPORTS (Y_2O_3, TIO_2)

Manlaibaatar PUREVSUREN*, Enkhsaruul BYAMBAJAV
Department of Chemistry, School of Arts & Sciences, National University of Mongolia
*Email:Manlaibaatarpurewsuren052@gmail.com

ABSTRACT

In this research work, we obtained C2-C4 hydrocarbons as a product of the Fischer-Tropsch synthesis (FT-CO_2) by converting CO_2 using Co-K/γ-Al_2O_3 catalysts. The catalysts were enhanced with 1% Ba, La, Ce or 0.5-3% Ce promoters, respectively. Moreover, 10% Y_2O_3 or 10%TiO_2 was added to the -Al_2O_3 support, respectively. Effect of the promoter and the support doping on CO_2 conversion and C2-C4 selectivity was investigated in FT-CO_2 synthesis.

The catalysts were prepared using the incipient wetness impregnation method, and characterized by X-ray diffraction analysis, Temperature-programmed hydrogen reduction, and CO_2 desorption measurements. Catalytic activity of the catalysts was evaluated in a fixed-bed reactor at 350°C, 3 atm, and H_2:CO_2=3:1 molar ratio with a total volume rate of 3000 h^{-1}.

At 350ºC, the addition of promoter metals to the catalysts increased catalyst activity. The Ce promoted Co-K/γ-Al_2O_3 catalyst increased the C2-C4 yield by 10.67%. However, the catalyst activity decreased when the Y_2O_3, TiO_2 was added into the -Al_2O_3 support. At 350ºC, the Co-K-1Ce/γ-Al_2O_3 catalyst showed the highest activity in the FT-CO_2 synthesis. With this catalyst, CO_2 conversion, C2-C4 yield and C2-C4 hydrocarbon selectivity were reached 44.90%, 14.91%, and 37.17%, respectively. TPR results of the Co-K-1Ce/γ-Al_2O_3 catalyst showed the

creation of much active sites due to the interaction between metal and support, leading to an increase in selectivity towards light hydrocarbons. Also it was known by CO_2-TPD analysis that the interaction between metal catalysts and support enhanced the CO_2 activation over the Co-K-1Ce/γ -Al_2O_3 by increasing the medium strength basic sites. Furthermore, additional supports such as Y_2O_3 and TiO_2 increased the CO yield by the reverse-water gas shift reaction in FT-CO_2 synthesis.
The addition of Ce as the promoter to the Co catalyst was found to be the most effective way for enhancing the catalytic activity, while the addition of Y_2O_3 and TiO_2 to the ɣ-Al_2O_3 support did not show significant improvement in catalyst performance for the FT-CO_2 synthesis.
Keywords: Hydrogenation, Promoter, Fischer-Tropsch synthesis, Catalyst

KINETIC MODELING OF ACID LEACHING OF RARE EARTH ELEMENTS FROM THE LUGIIN GOL DEPOSIT

Purevjargal D.[1,2*], Altangerel A.[1], Sukhbaatar B.[1], Tuul S.[2], Sarangerel D.[1]
[1]Department of Chemistry, Division of Natural Sciences, School of Arts and Sciences, National University of Mongolia,
[2]Khanlab LLC, Mongolia
*Email: purevjargaldaramjav@yahoo.com

ABSTRACT
Researchers are interested in the treatment of the ores at a low cost because the industrial cost is high due to the origin of rare earth elements (REE), sparse occurrence, and low content. The demand for raw materials, especially REE, is significantly increasing due to the rapid development of technology. The REE, which includes lanthanoids, Sc, and Y, has different technology applications. The demand for REE oxides will reach 210,000 tons in 2025 because of the annual 5-8.6% increment. REE ore can be processed by chemical, biological, and physical-chemical (electrochemical) treatments. The kinetic modeling of these processes becomes the primary situation to consider economic efficiency and to control kinetically.
Herein, this study aims to evaluate the kinetic modeling and mechanism of acid leaching of REE from the Lugiin gol deposit. The elemental composition and mineralization behavior of the solid residue was investigated by ICP-MS and XRD, respectively, before and after the acid leaching. Lanthanum, cerium, and neodymium were associated with calcium in the form of synchysite in the Lugiin gol deposit. Initially, the ore contained 1.46% of La, 2.11% of Ce, 0.18% of Pr, and 0.52% of Nd, where the percentage of total oxide was 5.24% (mass) of TR_2O_3. The recovery of the lanthanum, cerium, praseodymium, and neodymium was 80.17%, and 77.5%, 7.81%, and 27.8% respectively, where the optimal condition was 0.25 mm in size, 1 M of sulfuric acid, and 48 hours. As well as, the mixed control and internal diffusion control models were applied and fitted to the acid-leaching processes. A shrinking-core kinetic model was fitted to

the leaching kinetics of lanthanum. It reveals that the diffusion stage is the rate-determining stage of overall acid leaching. The activation energy is 29.3 kJ mol^{-1}, which is aligned with the diffusion-controlled process.
Keywords: Kinetic modelling, Acid leaching, Rare earth elemenets, Lugiin gol,

STUDY OF MECHANICAL PROPERTIES OF WEAR RESISTANT CHROMIUM ALLOY COATED MILD STEEL BY SEMI-AUTOMATIC WELDING METHOD

Oyunsuren GANBAATAR, Purevdorj BATKHUU*
Erdenet Institute of Technology, Erdenet, Mongolia
*Email: purevdorj@erdenetis.edu.mn

ABSTRACT
In the study the changes of mechanical property of low carbon steel which widely used in production of metal structure after coating by Wear Resistant High-chromium White Cast Iron were studied. The coating process were carried out by semi-automatic welding method and used 0.7, 0.6 and 0.5 mm grain size coating materials. Before the cladding the coating material was fixed on the surface of steel with a thickness of 0.3, 1.0 and 1.5 mm. The electrical current for welding was selected under three modes: 80, 100 and 120 Amper. Changes in mechanical properties after coating were evaluated by surface hardness and abrasive wear testing. Also measuring the chemical composition of the bead in relation of the surface hardness. The hardest and most wear resistant layer is formed when the chromium content was around 2.4-2.6%.
Keywords: Hardness, Low carbon steel, Material, Wear, Mechanical property, Abrasive wear

ELECTROCHEMICAL PERFORMANCE OF NATURAL MOLYBDENITE (MOS_2) AS AN ANODE MATERIAL IN LITHIUM-ION BATTERY

Bolormaa GENDENSUREN[1], Nyambayar SUGARTSEREN[1], Min-Jae KIM[1], Battsengel BAATAR[2], and Eun-Suok OH[1*]
[1]School of Chemical Engineering, University of Ulsan, 93 Daehak-ro, Nam-Gu, Ulsan 44610, Republic of Korea
[2]German-Mongolia Institute for Resources and Technology, Ulaanbaatar, Mongolia
*E-mail: esoh1@ulsan.ac.kr

ABSTRACT
Our human beings are paying more attention on the development of chemo-synthetic anode electrode with high capacity and good electrochemical stabile for next generation lithium-ion batteries (LIBs), but it has been faced the environmental population. At present, a natural ore molybdenite (MoS_2), as inexpensive and natural abundant materials, can be directly utilized as eco-friendly anode in advanced LIBs technology instead of pure molybdenum disulfide which are almost prepared by a

chemical synthesis progress. In additive, the choice conductive additive and binder play important role in the electrochemical performance of all MoS_2-based electrode.
In this study, we firstly investigated an electrode fabrication process of the natural molybdenite which is sourced from Mongolian mineral. The molybdenite electrodes have been prepared by varying a conductive additive and binders, and are characterized by morphology, peeling strength, and impedance analyzer. The molybdenite electrode provide a better electrochemical performance and stability when both of carbon nanotubes (CNT) and water-based latex blend binder (SBR/CMC) used instead of the usual carbon black and PVDF, respectively. To optimize the electrode slurry fabrication, the molybdenite electrode investigated difference electrochemical analysis such as a cyclic voltammetry, impedance and galvanostatic cycling performance. The work is briefly thwarted to light side on Mongolian's natural mineral as high-capacity anode materials in energy storage field.
Keywords: Natural molybdenite, Lithium-ion battery, Anode, Eco-friendly, Mongolian mineral

METAL ORGANIC FRAMEWORK ELECTROCATALYSTS FOR WATER SPLITTING

Ravi NIVETHA, Tran Van PHUC, Huynh Ngoc DIEM, Seung Hyun HUR
Department of Chemical Engineering, University of Ulsan, Daehak-ro 93, Nam-gu, Ulsan 44610, South Korea
Email: sgkang@mail.ulsan.ac.kr

ABSTRACT
The increasing energy shortage and environmental crises caused by greenhouses gases have attracted considerable research attention. Hence, benign renewable energy sources are needed to solve these issues. Unfortunately, renewable sources, such as wind, geothermal and solar energy, do not satisfy the energy consumption of human society. Hydrogen, with high energy density and zero carbon emission, is considered the most promising renewable energy source to replace fossil fuels.
At present, noble metal compounds, such as Pt, IrO_2/RuO_2, and carbon-based materials, are ideal catalysts for water splitting application. However, their high cost and low abundance limit their applicability. Therefore, tremendous efforts are taken to explore efficient materials to overcome these issues. Transitions of metal carbides, metal nitrides, metal oxides, and chalcogenides phosphides are investigated for their electrochemical energy conversion and storage applications. Nevertheless, these alternative catalysts are still not on par with conventional precious metals despite their innovative structures with high activity and stability.
Multifunctional candidates are prepared by cost-effective and simple techniques, possess unique electronic configurations, and have high electroactivity, which makes them a viable choice for alternative ideal

catalyst and electrode materials. Metal-organic frameworks (MOFs) are a fascinating class of porous crystalline materials formed by metal nodes or clusters and organic ligands. Similar to graphene, 2D MOFs are gaining interest for their electrochemical performance owing to their unique structure, surface exposure to more metal atoms, the tunable oxidation state of metal nodes, enhanced electrical conductivity, high porosity, and ultra-thin thickness. These features aid the rapid mass transport of reactants and products during the electrochemical process. Especially, 2D bimetallic MOFs exhibit high activity for electrocatalytic reactions than their monometallic counterparts because of their unique metal active sites, high charge carrier mobility, optimized electrocatalytic kinetics, and electronic conductivity. However, these bimetallic are limited in the multifunctional actives for water electrolysis and supercapacitor applications.

Herein, we report bifunctional water-splitting electrocatalysts synthesized by the pyrolysis of bimetallic MOFs and 2D bimetallic Fe/M-BDC (M-Ni, Zn, Co and Cu), BDC:1,4 benzene dicarboxylic acid) MOFs prepared by solvothermal and exfoliation, which all exhibit excellent water splitting performances.

NEUROSPORA CRASSA GLUTAMATE DECARBOXYLASE CELL SURFACE DISPLAY TOWARD THE THE EXTRACELLULAR GAMMA-AMINOBUTYRIC ACID PRODUCTION IN RECOMBINANT *ESCHERICHIA COLI*

Jae Hoon JEONG, Ashokkumar KUMARAVEL, Soon Ho HONG*
Department of Chemical Engineering, University of Ulsan 93 Daekakro, Nam-gu, Ulsan 44610, Korea
*Email: sgkang@mail.ulsan.ac.kr

ABSTRACT

The production of Gamma-Aminobutyric Acid (GABA) involves the decarboxylation of glutamate by the glutamate decarboxylase enzyme (GadB). In efforts to improve GABA productivity, various heterologous GadB enzymes have been identified and introduced into Escherichia coli. In this study, a cell surface display strategy was employed by displaying the Neurospora crassa glutamate decarboxylase (GadB) on the surface of Escherichia coli using OmpC as an anchoring motif. To construct the display system, GadB was fused to the truncated C-terminus of OmpC and expressed in E. coli.

The recombinant E. coli displaying GadB produced 3.03 g/L of GABA from 10 g/L glutamate within 12 hours of culture. Moreover, when the GadB display system was cultured at high cell density, it achieved 100% GABA yield from 50 g/L of glutamate. These results suggest that GadB expression on the E. coli surface is stable and effective for GABA production. This surface display strategy has potential for use in the industry for bulk chemical production, and could also be applied to other potential enzyme candidates.

COMPUTATIONAL PREDICTION OF DEHYDROGENATION CATALYSTS FOR PERHYDRO-DIBENZYLTOLUENE

Jingwen ZHOU, Sung Gu KANG*
School of Chemical Engineering, University of Ulsan, 93 Daehakro, Nam-Gu, Ulsan 44610, South Korea
*E-mail: sgkang@mail.ulsan.ac.kr

ABSTRACT
With the purpose of identifying highly efficient catalysts for dehydrogenation of liquid organic hydrogen carriers, this study focused on Pt/M_1/Pt(111) (M_1 = Ni, Cu, or Pd) and $Pt_{33\%}/M_2$ and $Pt_{67\%}/M_2$ (M_2 = Fe(100), Ni(111), and Cu(111)) alloys as catalysts for promoting the dehydrogenation of perhydro-dibenzyltoluene (H18-DBT). The three different approaches to improve the catalytic performance were investigated. The influence of applied strain, solute concentration, and electric fields on the dehydrogenation of H18-DBT on the catalysts was systematically revealed. In addition, the dehydrogenation mechanism was clearly elucidated. Most importantly, the valid descriptor for screening the potential catalysts will be discussed in this presentation.

FACILE SYNTHESIS OF TWO-DIMENSIONAL $Cu_3Mo_2O_9$/SULFUR-DOPED GRAPHENE QUANTUM DOTS NANOCOMPOSITES FOR ELECTROCHEMICAL WATER SPLITTING

Min Jae KIM, Tran Van TAM, Won Mook CHOi*
School of Chemical Engineering, University of Ulsan, Republic of Korea
*Email: sgkang@mail.ulsan.ac.kr

ABSTRACT
Recently, the hydrogen energy has received considerable attention due to its high energy density and sustainability. The water splitting has recently been studied as one of the most environmentally friendly methods to produce hydrogen. In this study, two-dimensional $Cu_3Mo_2O_9$ nanostructure decorated with sulfur-doped graphene quantum dots (SGQDs) on Ni foam is synthesized for binder-free electrode for the electrochemical H_2 production. This SGQD/$Cu_3Mo_2O_9$ nanocomposite on Ni foam is characterized by XRD, XPS, and FE-SEM, which reveals their porous 2D nanosheets structure and a successful formation of composite. This composite has a larger surface area than existing $Cu_3Mo_2O_9$ which promotes not only electrolyte access but also hydrogen bubble release. In 1.0 M KOH, the SGQD/ $Cu_3Mo_2O_9$ nanocomposite can perform superior electrocatalytic activities toward HER and OER. The obtained catalyst can possess a low potential of -0.3 V vs RHE to achieve a current density of 10 mA/cm^2 for HER and a potential of 1.7 V vs RHE for OER. These excellent electrocatalytic performance can be attributed to the modulated electronic configuration of SGQDs between Cu and Mo, resulting in the electron delocalization and polarization, and optimizing adsorption/desorption energy.

Key Word: $Cu_3Mo_2O_9$ nanosheets, Graphene quantum dots, Sulfuric doping, Overall water splitting

INFLUENCE OF METAL-SUPPORT INTERACTIONS ON CATALYTIC PERFORMANCE OVER HIGHLY DISPERSED XNI/YCZA CATALYSTS FOR ETHANOL STEAM REFORMING

Mingyan WANG, Azam JAMSAZ, Pham Ngoc NHIEM, Hoang Thi Van ANH, Eun Woo SHIN*
School of Chemical engineering, University of Ulsan, Ulsan, South Korea
*E-mail: ewshin@ulsan.ac.kr

Abstract

Ethanol steam reforming (ESR) is one of the potential and efficient processes to convert ethanol to hydrogen. Ethanol that has high hydrogen content is considered a renewable energy source to produce hydrogen and can be an alternative to fossil fuels to alleviate the greenhouse gas effect. In this study, xNi/yCeZrO – Al_2O_3 catalysts for ethanol steam reforming were successfully prepared with different loading amounts of Ni and CeZrO. Within the optimal ratios among the Ni/CZ/Al components, nickel could possess excellent physical properties and maintain the 4-7nm particle size and large specific surface areas even at high Ni loading, resulting in effectively increasing Ni dispersion and enhancing metal-support interaction. Strong CZ crystalline structure (40CZA) is found to influence the size of nickel particles and accelerate the migration of Ni into the $CeZrO_2$ lattice via the strong metal-support interaction, as estimated by various techniques. Also, the concentration of oxygen vacancies increased, and the acidity of the catalyst decreased, once the incorporation of well-dispersed Ni occurs. Consequently, xNi/40CZA shows superior ESR activity in terms of higher ethanol conversion and H_2 production rate with respect to the xNi/20CZA. Irrespective of the reaction temperatures, 10Ni/20CZA exhibited the highest H_2 production rate among the xNi/20CZA catalysts whereas the H_2 production rate for xNi/40CZA were proportional to the Ni contents. This result was strongly connected with the fact that Ni was still highly dispersed over 40CZA even at excessive Ni loading whereas additional isolated Ni metallic sites were formed over 20CZA at excessive Ni loading (15Ni and 20Ni). Finally, a strong interaction between Ni and CZA or Ni incorporation into CZA support makes ceria more reducible, which helps to produce mobile oxygen during the reforming reaction and dissociative adsorb water, resulting in the suppression of carbon deposition and enhancement of ESR stability. Based on the results above, a possible xNi/yCeZrO – Al_2O_3 catalyzed reaction pathway was formulated as well.

SYNTHESIS OF SPHERICAL SUPRASTRUCTURE NICU(OH)2 FOR EFFICIENT AMMONIA ELECTROOXIDATION: MECHANISTIC INVESTIGATION

Hoang-Khoi VU[1], Thanh Truong DANG[1], Pragyan[1], Jin Suk CHUNG[1]*
School of Chemical Engineering, University of Ulsan, Ulsan 44610, Republic of Korea
*E-mail: jschung@ulsan.ac.kr

Abstract
Electro-oxidation of ammonia has recently attracted much attention not only for environmental remediation but also for the anode reaction in direct ammonia fuel cells and for hydrogen fuel production. However, the electrochemical ammonia oxidation reaction (AOR) is kinetically sluggish and therefore suffers from a large overpotential. As such, the design and fabrication of efficient electrocatalysts are crucial for environmental remediation and energy conversion technologies. Compared to Pt-containing catalysts, there have been limited studies on noble-metal-free electrocatalysts for the AOR. Ni is known to be an effective and inexpensive catalyst for reactions of various small molecules. Kapałka et al. in 2010 discovered that ammonia could be catalytically oxidized on $Ni(OH)_2$. Very recently, binary and ternary alloys and hydroxides containing Ni and Cu have gained attention as catalysts for the AOR. Herein, we synthesized self-assembled superstructures of NiCu-based electrocatalysts (a combination of $Ni(OH)_2$ and Cu_2O) using dodecylamine as the reducing and shape controller agent in hexane, (NiCu-D). The as-prepared spherical superstructures of NiCu-D exhibited an outstanding reactivity toward ammonia electrooxidation with a current density of 44.9mA/cm^2 (at 0.6V vs Hg/HgO). Also, it showed high selectivity towards N_2 production up to 78% and was stable for 9 hours of electrocatalytic reaction.

MODIFICATION AND POLYMERIZATION TOWARDS WATER-BASED POLY-ACRYLATE BINDER ON THE PERFORMACE OF ELECTROCHEMICAL DOUBLE-LAYER CAPACITORS

Sugartseren NYAMBAYAR, Gendersuren BOLORMAA, Min Jae KIM, Eun-Suok OH*
School of Chemical Engineering, University of Ulsan, 93 Daehak-ro, Nam-Gu, Ulsan 44610
*Email: esoh1@ulsan.ac.kr

ABSTRACT
Electrochemical double-layer capacitor (EDLCs) are considered promising electrochemical energy storage systems due to their fast charge-discharge character, high-power densities, long life expectancy and their low maintenance. In general, mostly researcher have been focusing on intenving or modifying the active materials, although other researchers are lately focusing on conductive agent and the binder of EDLCs. The conductive agent helps to form continuous electron

pathways in electrodes for high-power EDLC, however binder has crucial role which yet made up of small amount of whole electrode contents and doing the role of uniting electrode materials with current collector during charge-discharge process. EDLC's traditional binder which is Polyvinylidene fluoride (PVdF) dissolved in non-environmental friendly solvent of n-methyl pyrrolidone, water based binder styrene-butadiene rubber (SBR) are mainly used in electrode manufacturing process. According to this consequence, we have been focusing on to investigate new water-based polymer latex binder to displace PVdF. Polymer latex binder produced by in-situ emulsion polymerization [2] is an aqueous dispersion of polymer particles stabilized by a general surfactant. As the main polymer latex, core part is produced by Styrene monomer, core-shell structured polystyrene-poly(acrylonitrile-co-butyl acrylate) (PS-HNB3) is used, and adding additive monomer AA(acrylic acid) to the core and shell part to improve adhesive characteristic. This new latex is applied to capacitors and graphite anodes. In our preliminary test, additive AA into only the core part and used in both core-shell parts of the binder increases adhesion strength between composite layer and the current collector and decreases interfacial resistance when compared to our reference binder. A variety of characterization techniques will be adopted to show the performance of the synthesized binder of PS-HNB3 with AA.

ACCORDING TO SIO_X CONTENT ON THE ELECTROCHEMICAL BEHAVIOR OF SIOX/C COMPOSITE ANODES OF LITHIUM-ION BATTERY

Min-Jae KIM, Ye-ji YUN, Yu-ri SEO, Se-hwa CHEON, Eun-Suok OH*
School of Chemical Engineering, University of Ulsan, 93 Daehak-ro, Nam-gu, Ulsan, 44610
*E-mail: esoh1@ulsan.ac.kr

ABSTRACT

Lithium-ion batteries have been employed a pivotal role in our life thanks to their excellent rechargeability and outstanding energy density. Among them, the anode is one of the main components of a lithium-ion battery that plays an important role in cycle and electrochemical performance of a lithium-ion battery, and so depending types of the active material exhibited different capacity yield on the battery performance. Recently, Si monoxide and its suboxides (SiO_x) has been promising as an anode material for lithium-ion batteries. SiO_x has a better cyclability compared to huge volume expansion silicon anode during lithiation/delithiation while delivering higher capacity than that of graphite. As the result SiO_x is an adequate material for the development of lithium-ion batteries behaving higher energy densities. Nevertheless, some inherent disadvantages of SiO_x such as the volume variation, poor electronic conductivity and solid electrolyte interphase formation has been still resulted in damage to the electrode performance. To overcome these problems, the modified properties of SiOx and the use of carbon materials as composites of SiOx

are being studied as an effective strategy.
In this study, SiO_x (5-30 wt.%) content plays a key role in electrochemical behavior of SiOx and Graphite (SiO_x/C) composite anode. The composite electrode was fabricated of SiO_x/C composite, a conductive additive, and a latex binder by mixing with water to form a slurry and coating on copper foil. Compared to lowest SiOx content with most stability specific capacity, increasing of SiO_x content in SiO_x/C resulted in higher initials specific capacity, but also faster fading on electrochemical performance. Herein, various experiment in mechanical properties and electrochemical behavior for optimized composition investigated by texture analyzer, sheet-resistance test, and rheometer of slurry solution. In addition, electrochemical analysis also conducted such as cycle tests, C-rate, Cyclic voltammetry, and EIS.

INTERNALIZATION OF EXTERNAL COSTS IN THE MINING SECTOR

Malte GIESENOW
Department of Geography, RWTH Aachen, Aachen, Germany
Email: malte.giesenow@geo.rwth-aachen.de

ABSTRACT
External costs arise when an activity, such as the production or consumption of goods and services, has negative impacts on the environment, society, or health that are not fully borne by those who benefit from the activity. In the mining sector, these costs relate to environmental damage, social impacts, and other harm caused by mining and extraction of raw materials. The internalization of these external costs is an important instrument to improve the sustainability of the mining sector and ensure that the costs of these activities are borne by the polluters. Examples of instruments that can be used for the internalization of external costs in the mining sector include environmental taxes, certificates for emission trading, environmental assessments, and compensation payments to affected communities.
Mongolia is a country rich in natural resources, particularly in the mining sector. However, the exploitation of these resources has external costs, such as environmental pollution, soil degradation, and social conflicts. The internalization of these external costs is an important step towards improving the sustainability and competitiveness of the mining sector.
This poster examines the current developments and challenges in the internalization of external costs in the mining sector, with a focus on Mongolia. It investigates the policy framework, legal instruments, and implementation of the internalization of external costs in practice. The findings of this study can contribute to improving the understanding of the internalization of external costs in the mining sector of Mongolia and provide recommendations for policy, businesses, and civil society to promote the sustainability and competitiveness of the sector.

OPTIMIZATION OF CDF: COPPER LEACHING MODEL AND SENSITIVITY ANALYSIS

Dorjsundui GOMBOKHURTS[1*], Sukhbaatar BATNASAN[2],
Altangerel LKHAMSUREN[1]
[1]German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
[2]Budapest University of technology and Economics, Budapest, Hungary
Email: dorjsundui@gmit.edu.mn

ABSTRACT
In order to forecast saturated liquid flow and project viability, the leaching process often uses some kind of modeling and forecasting technique. Therefore, it is necessary to construct a dynamic model to replicate leaching operations from ore handling to the end product. On the other hand, it's critical to offer advice on how to optimize the key leaching process variables. In this study, a thorough hydrodynamic computational fluid dynamics model is presented and applied to a copper ore body. The model is parameterized using experimental data from column leaching, and it is validated using multiple types of leach tests conducted under different acid flow rate conditions.
Keywords: Copper leaching, Fluid dynamics model, Sensitivity analysis,

REPROCESSING OF TAILING FROM ERDENET COPPER ORES: OPTIMIZATION OF THE FLOTATION

Narangarav TERBISH, Battsengel BAATAR*, Ankhchimeg GANZORIG, Dugar DAVAAJARGAL
German-Mongolian Institute for Resources and Technology (GMIT), Ulaanbaatar, Mongolia
*Email: battsengel@gmit.edu.mn

ABSTRACT
For modern society, raw resources are an important factor to function in the long term. Due to natural resources are depleting, waste materials can be used as a source. One source of the largest quantities of mineral resources is tailing pond of the Erdenet mine, operating for 44 years. There are many suggestable ways to process tailings and big historical data also available on the whole history of copper production of this mining. The aim is to define the most suitable way to process copper tailings among other possible methods with theoretically and educated conclusion. Based on physical and chemical characteristics, in this research, flotation tests with different reagents including were carried out to optimize the conditions. Two of frother and for of collectors are tested with different dosage in different pH condition. Copper recovery in optimized conditions through froth flotation test was reached to 32.27% with copper grade of 1.4%. The chemistry of vat leaching with several leaching solutions would be considered in order to compare with flotation result on this tailing samples.
Keywords: Recovery, Flotation. Copper, Tailing, Erdenet mining

TESTING, SIZING AND OPTIMIZATION OF PLANT THICKENER

Amartuvshin Ts*., Batsaikhan B., Khandmaa S.
"True TRC" LLC, Ulaanbaatar, 16030, Mongolia
*Email: amartuvshin.ts@truetrc.mn

ABSTRACT
Selection of plant thickener, critical, based on test work results assists in preventing from a number of risks. It is fact that as the diameter and wall height of the thickener increases, the cost of the new plant project and the operating costs (water, electricity, reagents, etc.) increase. In order to properly size and optimize the plant thickener dimension and the plant operation it is important to conduct laboratory and semi-plant continuous sedimentation tests, reflecting specific characters of processing minerals and materials. These test works are the main definers of modeling. In other words, by simulating and testing the thickening process of the concentrator in laboratory and semi-industrial conditions with continuous operation, there are many advantages of obtaining numerical data of the thickener technology in advance and modeling the thickener based on the test results.
Keywords: Thickener wall height, Settlement test, Thickener test, Thickener diameter calculation

NATURAL REHABILITATION POTENTIAL IN TWO DISTINCT MINING AREAS IN MONGOLIA

Oyun-erdene TSOGTSAIKHAN[1], Gantuya GANBAT[1], Martin KNIPPERTZ[2*]
[1]German-Mongolian Institute for Resources and Technology, Ulaanbaatar, Mongolia
[2]RWTH Aachen University, Aachen, Germany
*Email: martin.knippertz@geo.rwth-aachen.de

ABSTRACT
Soil erosion in Mongolia has intensified, and the general level of soil fertility has decreased. The effects of global warming, and human activities such as grazing pastureland, mining operation, intensification of agriculture, urbanization, and road damage are the main causes of soil cover degradation. Due to the ecosystem characteristics of the geographical landlocked location within continental harsh, arid climatic conditions, there is clearly a different identification requirement in rehabilitation potential of mining areas. So, it is necessary to dig in to differentiate the possible rehabilitation characteristics on the most suitable ecosystems. And discrimination of the potentiality by the ecosystem and location makes how to achieve optimized mining rehabilitation results.
In this work, the main focus is to concentrate on the natural healing process and weigh into potentiality using pyramid concept (1). Study area and soil characteristics are considered on 2 distinct mining areas located in 2 different ecozones of Mongolian, one is in sub northern area,

Ecozone III, which covers both sandy kastanozem soil and gravelly sandy kastanozem soil. The other comparison study area is Ecozone VI, which within the desert zone the soil specially forms in gravelly and sandy features, and the vegetation becomes scarce with its both species and biomass due to its hot, dry characteristics. Kastanozem soil has more fertile components and thicker humus layer than the desert gravelly and sandy features. Natural features consist of climatological features (precipitation, temperature, wind), soil types and vegetation index data were collected and analyzed using ArcGIS software. These mining areas followed up with verification areas weighted in Khuvsgul and Southgobi areas appointed 180 and 120 points respectively. However, the potential scores on rehabilitation expenses in respective regions explains that the chance of adjustable value on those planned rehabilitation budget, where sustaining the soil rehabilitation stick into long term natural healing process.

These concludes that the pyramid concept should be applied to the other areas of Mongolian mining sites to enable natural rehabilitation potentiality into long term, sustainable mining rehabilitation plan.

Keywords: Natural rehabilitation, Rehabilitation potential, Mining potentiality, Sustainable mining

SOIL PROPERTIES OF THE PERMAFROST ZONE IN MONGOLIA AND DIFFERENCES BETWEEN REGIONS

Purevdorj TSERENGUNSEN
Soil science division Institute of Geography and Geoecology, Mongolian Academy of Sciences.
Email: purevdorjts@mas.ac.mn

ABSTRACT

The distribution of permafrost in Mongolia is sporadic and discontinuous, varying based on location, landscape, and temperature. Additionally, the patterns and characteristics of the soil cover in these areas differ greatly. In this study, we aimed to identify these variations and differences by examining the soil cover found in permafrost regions.

To do this, we divided the permafrost regions into four distinct areas: Mongolian-Altai, Gobi-Altai, Khangai, and Khuvsgul. We then collected soil samples from 164 fixed depths (0-5 cm, 5-15 cm, 15-30 cm, and 30-60 cm) in 41 soil profiles surrounding permafrost monitoring boreholes.

This study provides valuable information about the characteristics of soil cover in the permafrost regions of Mongolia. The findings suggest that the soil cover in Mongolia is diverse and is influenced by factors such as the region's location, climate, and temperature. The results show that the dominant soils in the studied regions are Kastanozems and Chernozems, while Aridic Kastanozems soils are more prevalent in Mongolian-Altai and Gobi-Altai. The study also highlights the differences in soil pH, carbonate content, organic matter, available phosphorus, and potassium among the regions. Additionally, the study found that the soil texture is distributed

evenly across the regions, while the content of gravel varies depending on the region.

Our results showed that Kastanozems and Chernozems soils dominated the Khuvsgol and Khangai regions, while Aridic Kastanozems soils were more prevalent in Mongolian-Altai and Gobi-Altai. Soil pH was neutral to slightly alkaline, and the carbonate content was low to moderate. The soil organic matter, available phosphorus, and potassium all decreased with increasing depth. Soil texture was evenly distributed, and the content of gravel was highest in Gobi-Altai and lowest in Khuvsgul. The total soil organic carbon content, at 0-60 cm, was 4.2 kg m^{-2} in Mongolian-Altai, 3.0 kg m^{-2} in Gobi-Altai, 6.8 kg m^{-2} in Khangai, and 7.5 kg m^{-2} in Khuvsgol. Overall, the results of this study provide useful information for those who are interested in understanding the soil cover in Mongolia and its distribution across different regions. The information can be used for various purposes such as agriculture, ecology, and environmental studies.