

**2019年5月30日(木)**

[E] Eveningポスター発表 | セッション記号 A (大気水圏科学) : A-GE 地質環境・土壌環境

17:15 ~ 18:30 | ポスター会場 幕張メッセ国際展示場 8ホール\_10

**[A-GE28] 地質媒体における物質移動, 物質循環と環境評価**

コンビーナ:小島 悠揮(岐阜大学工学部)、濱本 昌一郎(東京大学大学院農学生命科学研究科)、斎藤 広隆(東京農工大学大学院農学研究院)、森 也寸志(岡山大学大学院環境生命科学研究科)

**[AGE28-P01] Vegetation pellets development and feasibility evaluation for unmanned-aerial-vehicle seeding on post-landslide sites**\*Hsu Kai-Chi<sup>1</sup>、Song Guo-Zhang<sup>1</sup>、Lin Shin-Hwei<sup>1</sup>、Chang Chi-Hao<sup>2</sup> (1.Department of Soil and Water Conservation, National Chung Hsing University、2.Department of Landscape Architecture, Tunghai University)**[AGE28-P02] フィリピン・コルディリエーラの棚田の保全に関わる土壌環境特性**\*黒住 知代<sup>1</sup>、森 也寸志<sup>2</sup>、宗村 広昭<sup>2</sup>、Milagros How<sup>3</sup> (1.岡山大学環境理工学部、2.岡山大学大学院環境生命科学研究科、3.Universal Harvester Incorporated)**[AGE28-P03] Web-based interactive platform for analysis of regional-scale groundwater resources**\*Chuen-Fa Ni<sup>1</sup>、I-Hsien Lee<sup>1</sup>、Chi-Ping Lin<sup>1</sup>、Wi-Ci Li<sup>1</sup> (1.National Central University)**[AGE28-P04] 地殻流体の流動特性の高精度評価に向けた粘性・透水系数同時測定システムの開発**\*村本 智也<sup>1</sup>、藤田 佳孝<sup>1</sup>、梶川 宏明<sup>1</sup>、飯泉 英昭<sup>1</sup>、井出 一徳<sup>1</sup> (1.国立研究開発法人 産業技術総合研究所, 計量標準総合センター)**[AGE28-P05] Soil hydraulic parameter estimation by evaporation method**窪田 新太郎<sup>1</sup>、\*斎藤 広隆<sup>1</sup> (1.東京農工大学大学院農学府)**[AGE28-P06] Measurement of apparent gas diffusion coefficient in poorly tilled seedbed under windy condition.**\*松本 宜大<sup>1</sup>、吉田 修一郎<sup>1</sup>、関矢 博幸<sup>2</sup>、西田 和弘<sup>1</sup> (1.東京大学大学院農学生命科学研究科、2.農研機構北陸研究センター)**[AGE28-P07] Evaluating improvement techniques for phytosuction separation method to remove heavy metals from contaminated soils**\*小島 悠揮<sup>1</sup>、寺田 隼大<sup>1</sup>、加藤 雅彦<sup>2</sup>、神谷 浩二<sup>1</sup> (1.岐阜大学工学部、2.明治大学農学部)**[AGE28-P08] Transport of Colloidal Particles in Saturated Toyoura Sand: Effects of Flow Rate on Importance of Electrostatic Repulsion**\*杉本 卓也<sup>1</sup>、濱本 昌一郎<sup>1</sup>、西村 拓<sup>1</sup>、足立 泰久<sup>2</sup>、小林 幹佳<sup>2</sup> (1.東京大学大学院農学生命科学研究科、2.筑波大学生命環境系)**[AGE28-P09] Leaching behavior of As, Pb, Cd and Se in subsurface marine and nonmarine sedimentary environment in central Kanto plain, Japan**\*SUSHMITA HOSSAIN<sup>1</sup>、Takashi Ishiyama<sup>2</sup>、Shoichi Hachinohe<sup>2</sup>、Chiaki T. Oguchi<sup>1</sup> (1.Graduate school of Science and Engineering, Saitama University、2.Center for Environmental Science in Saitama)**[AGE28-P10] Colloid transport in a quasi-saturated porous media**\*大古 湧之<sup>1</sup>、杉本 卓也<sup>2</sup>、濱本 昌一郎<sup>2</sup>、西村 拓<sup>2</sup> (1.東京大学農学部、2.東京大学大学院農学生命科学研究科)

[E] Eveningポスター発表 | セッション記号 A (大気水圏科学) : A-GE 地質環境・土壌環境

17:15 ~ 18:30 | ポスター会場 幕張メッセ国際展示場 8ホール\_11

**[A-GE29] エネルギー・環境・水ネクサスと持続的発展**

コッピナー:張 銘(産業技術総合研究所地質調査総合センター地圏資源環境研究部門)、川本 健(埼玉大学大学院理工学研究科)、Jet-Chau Wen(National Yunlin University of Science and Technology)、? 永紅(天津師範大学)

**[AGE29-P01] The role of anthropogenic activities in spring discharge cessation: Jinci Springs China**

Yaru Guo<sup>1</sup>、\*Yonghong Hao<sup>1</sup>、Chun Zhao<sup>1</sup>、Huan Lian<sup>1</sup> (1.Tianjin Normal University)

**[AGE29-P02] Groundwater response to tidal fluctuations in a leaky confined coastal aquifer with finite length**

\*Zhi-Xue Zhao<sup>1</sup>、Tongke Wang<sup>1</sup>、Jun Li<sup>1</sup> (1.Tianjin Normal University, Tianjin, China)

**[AGE29-P03] Relationship between "source and sink" landscape patterns and river nutrient discharge in a peri-urban watershed**

\*Chongwei Li<sup>1</sup> (1.Tianjin Normal University)

**[AGE29-P04] Assessing the Urban Storm-Flood Disaster of Zhengzhou city Based on Fuzzy Methods**

\*Caihong Hu<sup>1</sup>、Xian Du<sup>1</sup>、Ying Zhang<sup>1</sup>、SHAN E HYDER ALIAS TAHIR<sup>1</sup>、Shengqi Jian<sup>1</sup> (1.School of water conservancy and environment, Zhengzhou University, Zhengzhou City, Henan Province, P.R. China, 450001)

**[AGE29-P05] Application of RAMMS Software to Predict the submerged area of Debris Flow: A Case Study of Feng-Chiou torrent in Taiwan**

\*Hsin-Ying Hsieh<sup>1</sup>、Chun-Yi Wu<sup>1</sup> (1.Department of Soil and Water Conservation, National Chung Hsing University)

**[AGE29-P06] Applications of the Cholesteric Liquid Crystal (CLC) Sensor to Rapidly Measure the Volatile Organic Compounds in the Atmosphere Environment**

Ruey-Fang Yu<sup>1</sup>、\*GUAN-BO CHAO<sup>1</sup>、Jian-cheng XU<sup>1</sup>、KUANG-PENG HSIEH<sup>1</sup> (1.Department of Safety, Health and Environmental Engineering, National United University, Taiwan, R. O. C.)

**[AGE29-P07] Solar Ag/P3HT@TiO<sub>2</sub> Photocatalysis of Phenol Wastewater by a Pilot-Scale Fresnel Lens Assisted IPCC Reactor**

\*An-Chi Chen<sup>1</sup>、Ting-Yu Zeng<sup>1</sup>、Wen-Shiuh Kuo<sup>1</sup> (1.National United University,Department of Safety, Health and Environmental Engineering)

**[AGE29-P08] Using fluorescence quenching effect to investigate the electrical neutralization ability for different aromatic organic compounds**

\*Yu-Ting Chen<sup>1</sup>、Wen-Po Cheng<sup>1</sup> (1.National United University,Department of Safety, Health and Environmental Engineering)

**[AGE29-P09] Sustainable recovery of sugarcane biowastes to prepare biochar-derived electrodes for recycling of brackish water**

\*Shou-Heng Liu<sup>1</sup> (1.National Cheng Kung University)

**[AGE29-P10] The National Survey of POPs in Soil: A study of polybrominated diethyl ethers (PBDEs) in Soil in Taiwan**

\*Shyh-Wei Chen<sup>1</sup>、Ming-Yang Syue<sup>2</sup>、I HSIN LEE<sup>3</sup>、Chia Hsin Li<sup>3</sup>、Yihsin Lai<sup>3</sup>、Bo-Wei Power Liang<sup>3</sup> (1.Chung Yuan Christian Univ. Taiwan、2.Soil and Groundwater Pollution Remediation Fund Management Board, EPA, Taiwan、3.Sinotech Engineering Service LTD., Taiwan)

**[AGE29-P11] Remediation of Total Petroleum Hydrocarbons in Soils by Combining Cyclodextrin and Microbubble Ozonation**

\*Kuan-Yi Kuo<sup>1</sup>、Meng-hau Sung<sup>1</sup>、Fu-yin Xie<sup>1</sup> (1.Department of Environmental Science and Engineering,Tunghai University,Taiwan)

**[AGE29-P12] Treatment of organic pollutants in wastewater by ozone microbubbles and cyclodextrins**

\*Fu-Yin XIE<sup>1</sup>、Meng-hau Sung<sup>1</sup> (1.Department of Environmental Science and Engineering,Tunghai University,Taichung City,Taiwan)

---

**[AGE29-P13] High Addition Valued Recycling Technology of Lithium-ion Battery**

\*YI-CHEN TSENG<sup>1</sup>、TIEN-CHIN CHANG<sup>1</sup>、YI-HSIANG HONG<sup>1</sup> (1.Institute of Environmental Engineering and Management, National Taipei University of Technology, No. 1, Sec. 3, Zhongxiao E. Rd., Da'an Dist., Taipei City 106, Taiwan (R.O.C.))

---

**[AGE29-P14] Applying GIS Site Suitability Analysis to Optimize Landfill Selection in Mozambique**

\*Chelsea Adelina Langa<sup>1</sup> (1.Tohoku University, Graduate School of Environmental Studies)

---

**[AGE29-P15] Effectiveness of Solidification/Stabilization of a Heavy Metal-Contaminated Soil Using a Sustainable Binder**

\*Yasong Feng<sup>1,2,3</sup>、Weiyi Xia<sup>1</sup>、Shiji Zhou<sup>1</sup>、Ming Zhang<sup>2</sup>、Yanjun Du<sup>1</sup> (1.Southeast Univ.、2.AIST、3.Tohoku Univ.)

---

**[AGE29-P16] Determining diffusive parameters using out-diffusion experiment with consideration of sampling effect**

\*Ranran Song<sup>1</sup>、Chihiro Inoue<sup>1</sup>、Ming Zhang<sup>2</sup> (1. Tohoku University、2.Geological Survey of Japan, AIST)

---

**[AGE29-P17] Exploring the removal characteristics of heavy metals employing Nanofiltration (NF) technique**

\*Jagdeesh Kumar<sup>1</sup>、Himanshu Joshi<sup>1</sup> (1.INDIAN INSTITUTE OF TECHNOLOGY ROORKEE)

---

**[AGE29-P18] Potential of Potash Recovery Employing Electrodialysis(ED) Technique from Distillery Effluent**

\*SUNIL YADAV<sup>1</sup>、HIMANSHU JOSHI<sup>1</sup> (1.INDIAN INSTITUTE OF TECHNOLOGY ROORKEE)

---

**[AGE29-P19] CHARACTERIZATION OF WATER RETENTION AND MASS TRANSPORT PROPERTIES FOR RECYCLED ROADBED MATERIALS BLENDED WITH AAC FINES**

\*伊藤 良平<sup>1</sup>、加藤 晃<sup>1</sup>、松野 晃大<sup>1</sup>、川本 健<sup>1,2</sup> (1.埼玉大学大学院理工学研究科、2.ベトナム国立土木工学大学)

---

**[AGE29-P20] Characterizing Geotechnical Properties of Drinking Water Sludge Blended with Graded Crushed Clay Brick for Road Subgrade: Effects of Gradation and Mixing Proportion of Crushed Clay Brick on Compaction Property**

\*Tserenlkham Ikhagvasuren<sup>1</sup>、Muhammad Rashid Iqbal<sup>1</sup>、Ken Kawamoto<sup>1</sup> (1.Graduate school of science and engineering Saitama University, Japan)

---

**[AGE29-P21] CHARACTERIZING PHYSICAL AND CHEMICAL PROPERTIES OF RESIDUES GENERATED FROM CONSTRUCTION AND DEMOLITION WASTE**

\*カク ネイネイ<sup>1</sup>、川本 健<sup>1</sup>、松野 晃大<sup>1</sup> (1.埼玉大学)

---

**[AGE29-P22] CHARACTERIZATION OF PORE-STRUCTURE PARAMETERS FOR UNDISTURBED AND REPACKED SAMPLES AT FIELD WATER CONTENTS**

\*Arjun Baniya<sup>1</sup>、Akihiro Matsuno<sup>1</sup>、Ken Kawamoto<sup>1</sup> (1.Saitama University , Graduate school of Science and Engineering)

---

**[AGE29-P23] CHECK SHEET SURVEY FOR ESTIMATING CDW GENERATION AND CASH FLOW AT BUILDING DEMOLISHING SITES IN HANOI, VIETNAM**

\*Cuong Viet Tran<sup>1</sup>、Kawamoto Ken<sup>1</sup> (1.Graduate School of Science and Engineering, Saitama University)

---

**[AGE29-P24] APPLICATION OF CRUSHED GRAINS OF LATERITE AND AUTOCLAVED AERATED CONCRETE FOR HEAVY METAL REMOVAL FROM WASTEWATER**

\*Buddhika Priyadarshani Bandara Arachchillage<sup>1</sup>、Yuki Yoshida<sup>1</sup>、Pradeep Kumara Gajanayake Mudalige<sup>1</sup>、Akihiro Matsuno<sup>1</sup>、Ken Kawamoto<sup>1</sup> (1.Graduate School of Science and Engineering, Saitama University)

---

**[AGE29-P25] 使用済カルシウム系ヒ素吸着材の環境安定性に及ぼすケイ酸の影響**

\*杉田 創<sup>1</sup>、小熊 輝美<sup>1</sup>、張 銘<sup>1</sup>、原 淳子<sup>1</sup>、川辺 能成<sup>1</sup> (1.国立研究開発法人 産業技術総合研究所)

---

**[AGE29-P26] The Fate of Chloroethene in Geo-environment**

\*張 銘<sup>1</sup>、吉川 美穂<sup>1</sup> (1.産業技術総合研究所地質調査総合センター地圏資源環境研究部門)

[E] Eveningポスター発表 | セッション記号 A (大気水圏科学) : A-GE 地質環境・土壌環境

■ 2019年5月30日(木) 17:15 ~ 18:30 | 皿 ポスター会場 幕張メッセ国際展示場 8ホール\_10

### [A-GE28] 地質媒体における物質移動, 物質循環と環境評価

コンビーナ:小島 悠揮(岐阜大学工学部)、濱本 昌一郎(東京大学大学院農学生命科学研究科)、斎藤 広隆(東京農工大学大学院農学研究院)、森 也寸志(岡山大学大学院環境生命科学研究科)

土壌や岩石からなる地質媒体における物質の移動と循環, 並びにエネルギーの輸送について, 室内実験, 現位置試験, フィールド調査, 解析・評価モデル及び関連応用分野への適用など, 広い視点から議論し, 国内外における最新成果の交流を図る。地質汚染, 環境修復, 地層処分, 地中熱利用等未解明部分の多いヴェイドスゾーン (不飽和帯) における物質移動, 熱輸送, 衛星観測等を用いた土壌水分モニタリング及び環境影響評価に関する研究発表を特に歓迎する。

#### [AGE28-P01] Vegetation pellets development and feasibility evaluation for unmanned-aerial-vehicle seeding on post-landslide sites

\*Hsu Kai-Chi<sup>1</sup>、Song Guo-Zhang<sup>1</sup>、Lin Shin-Hwei<sup>1</sup>、Chang Chi-Hao<sup>2</sup> (1.Department of Soil and Water Conservation, National Chung Hsing University、2.Department of Landscape Architecture, Tunghai University)

#### [AGE28-P02] フィリピン・コルディリエーラの棚田の保全に関わる土壌環境特性

\*黒住 知代<sup>1</sup>、森 也寸志<sup>2</sup>、宗村 広昭<sup>2</sup>、Milagros How<sup>3</sup> (1.岡山大学環境理工学部、2.岡山大学大学院環境生命科学研究科、3.Universal Harvester Incorporated)

#### [AGE28-P03] Web-based interactive platform for analysis of regional-scale groundwater resources

\*Chuen-Fa Ni<sup>1</sup>、I-Hsien Lee<sup>1</sup>、Chi-Ping Lin<sup>1</sup>、Wi-Ci Li<sup>1</sup> (1.National Central University)

#### [AGE28-P04] 地殻流体の流動特性の高精度評価に向けた粘性・透水係数同時測定システムの開発

\*村本 智也<sup>1</sup>、藤田 佳孝<sup>1</sup>、梶川 宏明<sup>1</sup>、飯泉 英昭<sup>1</sup>、井出 一徳<sup>1</sup> (1.国立研究開発法人 産業技術総合研究所, 計量標準総合センター)

#### [AGE28-P05] Soil hydraulic parameter estimation by evaporation method

窪田 新太郎<sup>1</sup>、\*斎藤 広隆<sup>1</sup> (1.東京農工大学大学院農学府)

#### [AGE28-P06] Measurement of apparent gas diffusion coefficient in poorly tilled seedbed under windy condition.

\*松本 宜大<sup>1</sup>、吉田 修一郎<sup>1</sup>、関矢 博幸<sup>2</sup>、西田 和弘<sup>1</sup> (1.東京大学大学院農学生命科学研究科、2.農研機構北陸研究センター)

#### [AGE28-P07] Evaluating improvement techniques for phytosuction separation method to remove heavy metals from contaminated soils

\*小島 悠揮<sup>1</sup>、寺田 隼大<sup>1</sup>、加藤 雅彦<sup>2</sup>、神谷 浩二<sup>1</sup> (1.岐阜大学工学部、2.明治大学農学部)

#### [AGE28-P08] Transport of Colloidal Particles in Saturated Toyoura Sand: Effects of Flow Rate on Importance of Electrostatic Repulsion

\*杉本 卓也<sup>1</sup>、濱本 昌一郎<sup>1</sup>、西村 拓<sup>1</sup>、足立 泰久<sup>2</sup>、小林 幹佳<sup>2</sup> (1.東京大学大学院農学生命科学研究科、2.筑波大学生命環境系)

#### [AGE28-P09] Leaching behavior of As, Pb, Cd and Se in subsurface marine and nonmarine sedimentary environment in central Kanto plain, Japan

\*SUSHMITA HOSSAIN<sup>1</sup>、Takashi Ishiyama<sup>2</sup>、Shoichi Hachinohe<sup>2</sup>、Chiaki T. Oguchi<sup>1</sup> (1.Graduate school of Science and Engineering, Saitama University、2.Center for Environmental Science in Saitama)

#### [AGE28-P10] Colloid transport in a quasi-saturated porous media

\*大古 湧之<sup>1</sup>、杉本 卓也<sup>2</sup>、濱本 昌一郎<sup>2</sup>、西村 拓<sup>2</sup> (1.東京大学農学部、2.東京大学大学院農学生命科学研究科)

## Vegetation pellets development and feasibility evaluation for unmanned-aerial-vehicle seeding on post-landslide sites

## Vegetation pellets development and feasibility evaluation for unmanned-aerial-vehicle seeding on post-landslide sites

\*Hsu Kai-Chi<sup>1</sup>、 Song Guo-Zhang<sup>1</sup>、 Lin Shin-Hwei<sup>1</sup>、 Chang Chi-Hao<sup>2</sup>

\*Kai-Chi Hsu<sup>1</sup>、 Guo-Zhang M. Song<sup>1</sup>、 Shin-Hwei Lin<sup>1</sup>、 Chi-Hao Chang<sup>2</sup>

1. Department of Soil and Water Conservation, National Chung Hsing University, 2. Department of Landscape Architecture, Tunghai University

1. Department of Soil and Water Conservation, National Chung Hsing University, 2. Department of Landscape Architecture, Tunghai University

Frequent disturbances of typhoons, earthquakes and heavy rains have resulted in many landslides scattering over steep terrains and remote areas of Taiwan. As a result, the general engineering methods may not work well.

In the past, helicopters were used for aerial hydroseeding on such landslides. However, the remediation method with helicopters is complicated. This method takes a lot of manpower and materials. Additionally, the remediation timing is often missed because its preparation is time-consuming.

In recent years, the relevant research and technology of unmanned aerial vehicles (UAVs) are approaching maturity. Compare to helicopters, UAVs have the advantages of mobility and instantaneity. UAVs has many potentials to deliver vegetating materials to landslides.

Traditionally, vegetating materials (liquid or dry powder types) are sprayed to landslide sites through compressors. However, the load of UAVs is limited. They can't carry too much liquid or compressors. In other words, traditional vegetating materials won't work for UAV methods.

This study was to develop several types of agglomerates by mixing vegetating materials. The agglomerates look like a pellet, so it is called "vegetation pellet". To make sure which pellets can be applied to what environmental conditions, the water characteristics, pH value, nutrient content and seed germination rate of pellets with different ingredients were analyzed. In the field experiment, seed germination of pellets was monitored after pellets were applied to three different landslide sites.

Results showed that seed germination of pellets is directly related to the level of environmental moisture. If pellets were applied to landslides where rainfall and soil moisture were high, seed germination rates of pellets could reach 80% within three weeks. There were 1~3 germinating woody plants per square meter. Although germination rates of pellets applied during the dry season were nearly nill, seeds in pellets could germinate vigorously after the first wave of rainfall.

Although this study is still in the initial phase of the pellet development, the preliminary experiments showed that using UAVs to deliver vegetation pellets has considerable potentials for landslide remediation. Further studies can vary the fraction of ingredients and the size of pellets to maximize remediation effects.

キーワード : Aerial hydroseeding, engineering, remediation, UAV, vegetating material  
Keywords: Aerial hydroseeding, engineering, remediation, UAV, vegetating material



# フィリピン・コルディリエーラの棚田の保全に関わる土壌環境特性

## Characterizing Soil Environment in The Rice Terraces of the Philippine Cordilleras

\*黒住 知代<sup>1</sup>、森 也寸志<sup>2</sup>、宗村 広昭<sup>2</sup>、Milagros How<sup>3</sup>

\*Tomoyo Kurozumi<sup>1</sup>, Yasushi Mori<sup>2</sup>, Hiroaki Somura<sup>2</sup>, Milagros Ong How<sup>3</sup>

1. 岡山大学環境理工学部、2. 岡山大学大学院環境生命科学研究科、3. Universal Harvester Incorporated

1. Faculty of Environmental Science and Technology, Okayama University, 2. Graduate School of Environmental and Life Science, Okayama University, 3. Universal Harvested Incorporated

フィリピンのルソン島北部に位置するコルディリエーラの棚田群は、水源涵養や農地という意味から地域の物質循環と食料生産に貢献している。また、世界遺産に指定されており、文化遺産としての保全が望まれているが、崩落の危機にさらされており、自然科学的にそのメカニズムを明らかにし、効率的な保全が新たに望まれている。本研究では、現地調査と土壌の分析を行い、棚田の崩落と保全に関わる因子を抽出することを試みた。仮説として、棚田は物理的な水貯留構造物であり、棚田一枚あたりの深さと重さが不安定性を生み出すと考えた。バナウエー市を中心にViewDeck, Bangaan, Hapaoについて調査したところ、所々において、棚田の田面水に腐敗又は発酵臭があり、耕盤層が深めに計測された。また、現地浸透試験ではガスの発生があり、透水係数が低い又は計測不能になることがあった。有機物の過剰投入によってガスが発生し、土粒子の沈降・圧密が不十分で耕盤が安定せず、貯留水分が大きく崩落のリスクを抱えていると推定された。有機物の投入は肥沃土を高め収量を増やすことに貢献するが、湛水を基本とする水田管理では土壌環境・水質悪化の原因にもなりうるため棚田の保全と稲の収量のバランスの見極めが必要であると考えられた。

キーワード：棚田、耕盤、フィリピン、世界遺産

Keywords: rice terraces, hard pan, Philippines, World Heritage

## Web-based interactive platform for analysis of regional-scale groundwater resources

\*Chuen-Fa Ni<sup>1</sup>, I-Hsien Lee<sup>1</sup>, Chi-Ping Lin<sup>1</sup>, Wi-Ci Li<sup>1</sup>

1. National Central University

With the increasing variability of climate conditions, the sustainable management of groundwater resources has become a challenging task. Accurate assessment of groundwater resources relies on sufficient measurements and efficient analysis tools. The integrated technologies and multidisciplinary knowledge for groundwater have enhance the understanding of dynamics in groundwater systems. Taking advantages of widely developments in computer sciences and web service, the web platform provides an excellent open environment for groundwater investigations. However, most groundwater relevant web platforms are mainly focusing on the data visualization. The data (points, polylines, and polygons) and pre-analysis results (i.e., the figures) overlap a street map to indicate the location of interests and quantify the influenced regions of groundwater hazards. Such one-way interaction framework has significantly limited the implementations of measurement data and groundwater relevant applications. The study aims to develop an online web-based platform for groundwater data visualization, temporal and spatial data analysis, mesh generation and flow modeling. The study integrates multiple program languages such as Java, C, Python, and FORTRAN to bridge the data flow and online visualization. The interactive real-time web environment enables users to screen temporal and spatial measurements on the web map, conduct online data analyses, and develop numerical groundwater models. With well-designed database and numerous modules for data analyses and modeling, the platform allows users to share data and develop collaborative activities. The built-in analysis tools can also improve the efficiency of groundwater management and decision-making processes.

Keywords: groundwater resources, Web-based platform, data visualization, groundwater model

## 地殻流体の流動特性の高精度評価に向けた粘性・透水係数同時測定システムの開発

### Development of simultaneous measurement system of viscosity and permeability for highly accurate evaluation of flow characteristic of Geofluid

\*村本 智也<sup>1</sup>、藤田 佳孝<sup>1</sup>、梶川 宏明<sup>1</sup>、飯泉 英昭<sup>1</sup>、井出 一徳<sup>1</sup>

\*Tomoya Muramoto<sup>1</sup>, Yoshitaka Fujita<sup>1</sup>, Hiroaki Kajikawa<sup>1</sup>, Hideaki Iizumi<sup>1</sup>, Kazunori Ide<sup>1</sup>

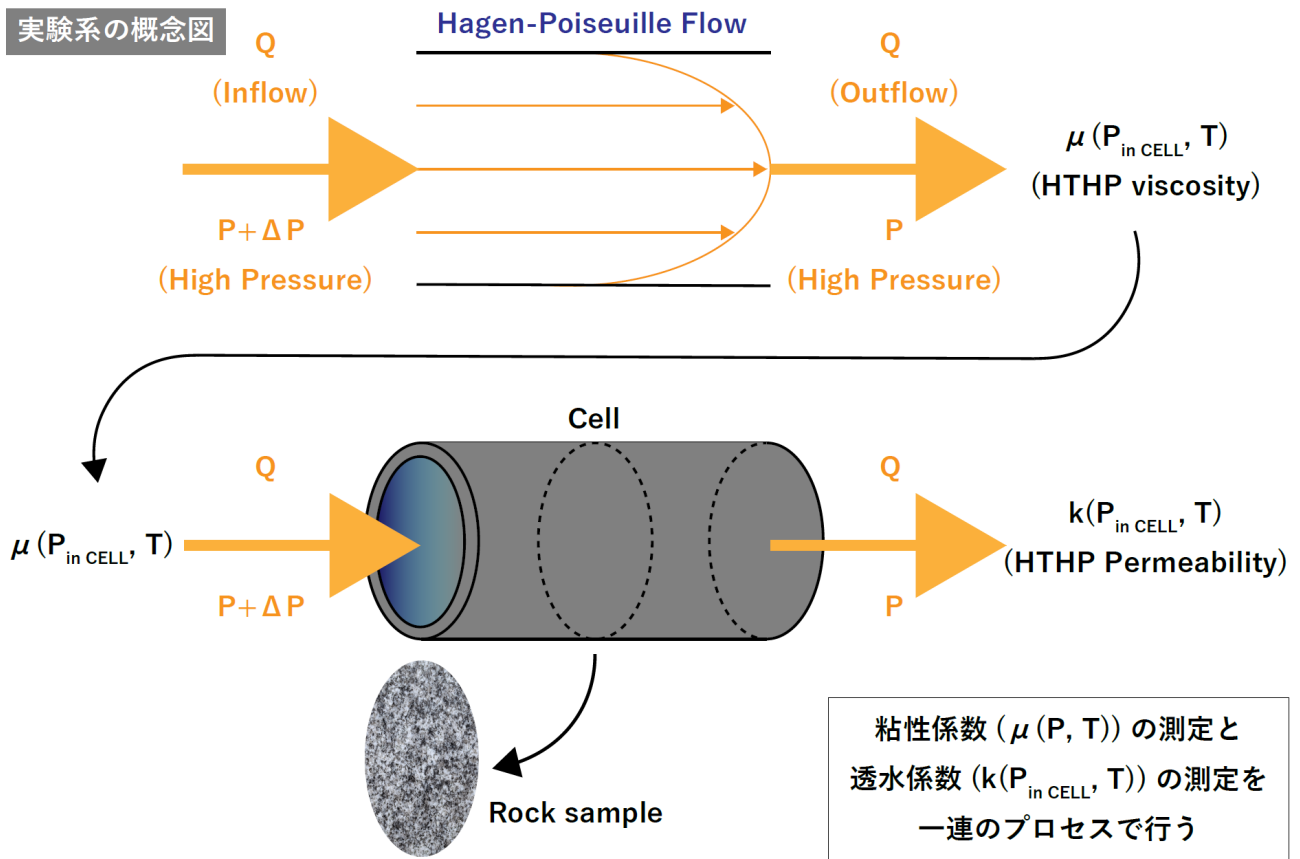
1. 国立研究開発法人 産業技術総合研究所, 計量標準総合センター

1. National Institute of Advanced Industrial Science and Technology, National Metrology Institute of Japan

本研究では、高精度粘性測定技術と高精度液体高圧力発生技術を組み合わせることにより、地殻内における流体の挙動を厳密に評価する為の高精度高温高圧粘性・透水係数同時測定システムを開発することを目的とする。地殻をはじめとした多孔質媒体の特徴の一つに、その内部にある複雑な幾何形状をもつ空隙を経路として流体を透過させることができるという点がある。つまり、多孔質媒体は水理学的性質を有している。近年、高レベル放射性廃棄物地層処分システムの長期安定性を評価する上で、また、流体とテクトニックな岩盤の変形の関係性を明らかにする為、対象となる岩盤の透水・物質輸送特性を詳細に把握する必要性が強調されるようになった。古くより、高圧下にあると考えられる地殻流体の流動特性を把握する為、数多くの研究開発がなされてきたが、地殻流体の粘性の圧力依存性については見落とされがちであり、それに伴う岩石の透水係数の変化を厳密に評価した研究例は数少ない。透水係数の高精度な測定に関する計量学的視点での技術開発は今までに行われてきておらず、また、一般的に用いられているDarcyの法則の適用限界に関する計量学的な検討は行われてきていない。これらに起因して、高圧下における岩石中を流れる流体の流動状態並びに遷移挙動には不明な点が多々ある。本研究では、細管法による高精度な粘性測定で用いられるHagen-Poiseuilleの法則に基づく流れ場の記述と、Darcyの法則に基づく流れ場の記述の類似性に着目して、高温高圧下における粘性・透水係数同時測定システムを開発し、地殻流体の流動特性の本質的な理解に繋げる。

キーワード：Hagen-Poiseuilleの法則、Darcyの法則、透水係数

Keywords: Hagen-Poiseuille law, Darcy's law, Permeability



## Soil hydraulic parameter estimation by evaporation method

窪田 新太郎<sup>1</sup>、\*齋藤 広隆<sup>1</sup>

Shintaro Kubota<sup>1</sup>, \*Hiroataka Saito<sup>1</sup>

1. 東京農工大学大学院農学府

1. Graduate School of Agriculture, Tokyo University of Agriculture and Technology

An evaporation method to estimate soil hydraulic properties, such as soil water retention curve and unsaturated hydraulic conductivity, has been receiving attention because of its simplicity and flexibility. Depending upon experimental setup, there are several approaches available for data analysis. In this study, a so-called simplified method and a more common but more involved inverse method were compared in terms of estimating soil hydraulic parameters. In the simplified method, soil water retention curve and unsaturated hydraulic conductivity were approximated by assuming that soil water pressure heads measured at two locations within the soil sample were linearly distributed. Parameter  $\alpha$  and  $n$  which were used in the van Genuchten (VG) soil water retention model were determined by fitting it to the curve obtained by the simplified method. Unsaturated hydraulic conductivity function was then predicted by the van Genuchten-Maulen model with the obtained  $\alpha$  and  $n$ . For the inverse method, the  $\alpha$  and  $n$  parameters were directly optimized using a numerical analysis by fitting to measured pressure heads. In this study, Toyoura sand, Tottori dune sand, glass beads and silt were used. After soil water retention curves were determined using the simplified method, the VG parameters were estimated to predict unsaturated hydraulic conductivity. With the inverse method, the VG parameters were inversely estimated using HYDRUS-1D program. Results showed that the parameters estimated from both the simplified and inverse methods predicted unsaturated hydraulic conductivity well compared to that determined from the simplified method. On the other hand, those for Toyoura sand, Tottori dune sand and glass beads were not well predicted. In general, the unsaturated hydraulic conductivity in the wet region was overpredicted, while that in the dry region was underestimated when the simplified method was used. Overall, this study shows that the simplified method needs to be carefully used especially for coarse materials, such as sand and glass beads.

キーワード：土壌水理特性

Keywords: Soil hydraulic properties

## Measurement of apparent gas diffusion coefficient in poorly tilled seedbed under windy condition.

\*松本 宜大<sup>1</sup>、吉田 修一郎<sup>1</sup>、関矢 博幸<sup>2</sup>、西田 和弘<sup>1</sup>

\*Yoshihiro Matsumoto<sup>1</sup>, Shuichiro Yoshida<sup>1</sup>, Hiroyuki Sekiya<sup>2</sup>, Kazuhiro Nishida<sup>1</sup>

1. 東京大学大学院農学生命科学研究科、2. 農研機構北陸研究センター

1. Graduate School of Agricultural and Life Sciences, The University of Tokyo, 2. National Agricultural Research Center NARO

In the cultivation of soybean in clayey paddy fields, huge clods with diameters of some centimeters are formed by tillage. In soil, movement of gas is usually assumed to be governed by molecular diffusion. On the other hand, in soil layer with huge clods, movement of gas can be enhanced by wind-induced pressure-pumping through large inter-clod pore space under windy condition. Although pressure-pumping is not a diffusive process, this phenomenon can be represented as a diffusive process by the Fick's law with the apparent gas diffusion coefficient under windy condition ( $D_a$ ). However, little work has been done on  $D_a$  in poorly tilled soil, especially in situ. This study aimed to compare  $D_a$  and molecular gas diffusion coefficient ( $D_m$ ) in poorly tilled seedbed and quantify how many times  $D_a$  is larger than  $D_m$ .

The undisturbed poorly tilled soil was sampled on June 2018 just after tillage from the surface of the clayey field where conversion from flooded rice to soybean was conducted this year using the soil column with a diameter of 15.3 cm and a height of 9.7 cm. The porosity and mean clod diameter of the soil were 0.69 and 2.8 cm, respectively. As a control, Mikawa silica sand was packed into the column with a porosity of 0.49. The empty cap with a height of 2.9 cm were attached to the lower end of the column to conduct gas diffusion experiments. The oxygen concentration sensors were installed to the column and cap at 4.7 and 11.7 cm depth from the top of the column, respectively. The top of the column was closed, and then CO<sub>2</sub> gas was injected from the cap to saturate the column with CO<sub>2</sub>. After opening the top of the column, O<sub>2</sub> concentration was continuously measured. The gas diffusion coefficient ( $D_a$  or  $D_m$ ) was estimated by fitting the measured O<sub>2</sub> concentration at 4.7 cm and 11.7 cm depth to the numerical solution of the diffusion equation. The diffusion tests under the wind for evaluating  $D_a$  was conducted on November 2018 at the field where the soil specimen were taken. Three-dimensional wind velocity at 2 m above the column ( $U_2$ ) was measured by the ultrasonic anemometer. The diffusion tests without the effect of wind for evaluating  $D_m$  was conducted in the laboratory in the same manner.

Under the wind speed  $U_2$  of 1.0 and 1.4 m s<sup>-1</sup>, the apparent diffusion coefficients  $D_a$  for the sand column were both 0.020 cm<sup>2</sup> s<sup>-1</sup>, which was close to the measured  $D_m$  for the column: 0.019 cm<sup>2</sup> s<sup>-1</sup>. Thus, the gas diffusion in the sand column was governed by the molecular diffusion alone. On the other hand, the  $D_a$ s for the poorly tilled soil column under  $U_2$  of 1.5, 2.3, and 4.1 m s<sup>-1</sup> were 0.065, 0.075, and 0.097 cm<sup>2</sup> s<sup>-1</sup>, respectively, while the  $D_m$  for the column was 0.036 cm<sup>2</sup> s<sup>-1</sup>. This result shows the wind induced two to three-fold increase of apparent gas diffusion coefficient through the inter-clod pores of the poorly tilled soil, while the effect does not work on the sand layer.

キーワード：粘土質転換畑、耕耘、土塊、ガス移動、ポンピング

Keywords: clayey rotational paddy field, tillage, clod, movement of gas, pressure-pumping

## Evaluating improvement techniques for phytosuction separation method to remove heavy metals from contaminated soils

\*小島 悠揮<sup>1</sup>、寺田 隼大<sup>1</sup>、加藤 雅彦<sup>2</sup>、神谷 浩二<sup>1</sup>

\*Yuki Kojima<sup>1</sup>, Hayata Terada<sup>1</sup>, Masahiko Katoh<sup>2</sup>, Kohji Kamiya<sup>1</sup>

1. 岐阜大学工学部、2. 明治大学農学部

1. Department of Civil Engineering, Gifu University, 2. School of Agriculture, Meiji University

Soil contamination by heavy metals has been a critical issue because heavy metals are bonded with soil particles tightly and are difficult to remove. Phytoextraction is one of the soil decontamination methods that plants growing at contaminated sites extract contaminants with soil moisture. Although the phytoextraction is environmentally friendly and low in cost, removal rates of contaminants are limited because plants growth is inhibited due to the toxicity of contaminants. Katoh et al. (2016) proposed a new method for heavy metal decontamination, phytosuction separation (PSS), which utilizes plant water uptake and an immobilization material (they used hydroxyapatite). In PSS, a immobilization material for heavy metals was placed on a contaminated soil, and plants grow in non-contaminated soil mounded on the immobilization material. Plant water uptake induces heavy metal transfer from contaminated soil toward the immobilization materials. Since plants are protected from the toxicity of heavy metals in this method, the removal rates of heavy metals are much higher than that with phytoextraction. In this study, we aimed to improve the PSS method by i) using new immobilization materials, ii) inducing soil water cycle between the contaminated and non-contaminated soils, and iii) applying organic fertilizer to enhance plant growth and to increase mobility of heavy metals.

We performed pot experiments to evaluate each improvement techniques with lead contaminated soil collected from a shooting range. As a new immobilization material, we examined iron slag and commercialized adsorption sheet. Water cycle between contaminated and non-contaminated soils are induced by changing position of water supply. Katoh et al. (2016) supplied water from contaminated soil, but we supplied from non-contaminated soils. The water supplied to non-contaminated soil move downward by gravity and reach contaminated soil, and then go back to the non-contaminated soil by plant water uptake. Plant roots produce organic acid and it will be transferred to the contaminated soil with water. Since organic acid increase mobility of lead, the water cycle possibly improve the efficiency of PSS method.

The results showed poor plant growth when slag and commercialized sheet are used as a immobilization material compared with when hydroxyapatite was used. Obviously the plants growth was inhibited by the toxicity of lead. The slag did not have enough ability to immobilize the lead, possibly due to the small soil moisture content in PSS method. The commercialized sheet allowed plant roots penetrate itself and the roots reached contaminated soil. The water cycle increased soluble lead content in contaminated. It means that organic acid produced by roots reached the contaminated soil. Applying organic fertilizer did not increase soluble lead content in the contaminated soil, but it improved plant growth. Therefore, water cycle and organic fertilizer improves the PSS method, but immobilization materials still need to be investigated.

キーワード : phytosuction separation、 heavy metals、 soil water cycle  
Keywords: phytosuction separation, heavy metals, soil water cycle



## Transport of Colloidal Particles in Saturated Toyoura Sand: Effects of Flow Rate on Importance of Electrostatic Repulsion

\*杉本 卓也<sup>1</sup>、濱本 昌一郎<sup>1</sup>、西村 拓<sup>1</sup>、足立 泰久<sup>2</sup>、小林 幹佳<sup>2</sup>

\*Takuya Sugimoto<sup>1</sup>, Shoichiro Hamamoto<sup>1</sup>, Taku Nishimura<sup>1</sup>, Yasuhisa Adachi<sup>2</sup>, Motoyoshi Kobayashi<sup>2</sup>

1. 東京大学大学院農学生命科学研究科、2. 筑波大学生命環境系

1. Graduate School of Agricultural and Life Sciences, The University of Tokyo, 2. Faculty of Life and Environmental Sciences, University of Tsukuba

There are substantial colloidal particles such as clay minerals and metal oxides in soil environments. Such colloidal particles have been considered as a potential carrier of contaminants in vadose zone and aquifer, due to their surface charges and high specific surface area. Therefore, understanding the transport mechanisms of colloidal particles in soils is essential to predict the fate of the contaminants in the environments. In this study, we analyze deposition rate coefficients of polystyrene latex particles with a diameter of 1  $\mu\text{m}$  in a column packed with Toyoura sand with an average diameter of 0.274 mm as a function of NaCl concentration at three different flow rates. The concentration of the colloids in the effluent was quantified using a spectrometer photometer. The experimental results showed that the deposition rate coefficients of the colloids increased with increasing NaCl concentrations and reached a plateau above a certain NaCl concentration, called the critical deposition concentration (CDC). The CDCs shifts to higher salt concentrations with increasing injected flow rates. We show that this experimental trend can be captured by a simplified model including physico-chemical interactions based on the DLVO theory.

キーワード：コロイド粒子、輸送、多孔質媒体、イオン強度、流量

Keywords: Colloidal particles, Transport, Porous media, Ionic strength, Flow rate

## Leaching behavior of As, Pb, Cd and Se in subsurface marine and nonmarine sedimentary environment in central Kanto plain, Japan

\*SUSHMITA HOSSAIN<sup>1</sup>, Takashi Ishiyama<sup>2</sup>, Shoichi Hachinohe<sup>2</sup>, Chiaki T. Oguchi<sup>1</sup>

1. Graduate school of Science and Engineering, Saitama University, 2. Center for Environmental Science in Saitama

Leaching behavior of trace element and heavy metal strongly depends on the physicochemical form termed as chemical speciation in soil and sediment. So that, sediment and soil act as scavenger to transfer naturally or anthropogenically occurring element to subsurface environment with changing environmental conditions. In this research, total 25 boring core sediment samples were investigated at 1 m interval from lowland valley of Yono area, Saitama in Kanto Plain for chemical speciation and potential risk assessment of arsenic (As), lead (Pb), cadmium (Cd) and Selenium (Se) with other metals. Samples were kept in near natural or not oxidized condition applying special preservation technique. A four steps sequential extraction method was adopted to determine chemical speciation. Boring core consist of surface clayey silt, peat, organic rich silt and clay, tuffaceous clay and medium to coarse sand with gravel layer of nonmarine sediment up to 17 m depth, where as from depth of 17 to 20 m transitional sediment are underlain by marine sediment up to 26 m. Total metal concentration, mineral content and chemical speciation concentration were determined by using X-ray Florescence(XRF), X-ray diffractometer (XRD), Inductively coupled plasma mass spectrometer (ICP-MS) and Inductively coupled plasma atomic emission spectrometer (ICP-AES) respectively. Clay minerals distributions were determined specially after application of heat and ethylene glycol treatment and XRD peak analysis. Pore water were collected from each samples and element concentration were measured by ICP-MS and ICP-AES. Under natural condition, pH of the leachate from sediment are not significantly different in nonmarine and marine environment which are ranged from pH 6.55 to 8.04. However, the electrical conductivity (EC) concentration range 53.9 to 72.1  $\mu\text{S}/\text{cm}$  in marine and 77.9 to 104.7  $\mu\text{S}/\text{cm}$  in surface silty clay sediment, that is quite higher than (7.83 to 25.4  $\mu\text{S}/\text{cm}$ ) of nonmarine fluvial, peat and tuffaceous clay. Chemical speciation trend for As in marine and nonmarine sediment is Fe-Mn oxide bound > Carbonate bound > Ion-exchangeable bound > water soluble where more than 95-98 % are consist of residual and organic bound in all samples indicates their occurrence are of natural origin. The potential mobile fractions (Fe-Mn oxide bound + Carbonate bound + Ion-exchangeable bound + water soluble) of Se and Cd are less than 5 % of total concentration whereas for Pb, it is less than 1%. Chemical speciation trend for Se is Fe-Mn oxide bound > Carbonate bound > Ion-exchangeable bound > water soluble in fluvial nonmarine sediment differs from the trend in marine environment which seems more bioavailable. For Cd, the trend is Carbonate bound > Ion exchangeable bound > Fe- Mn oxide bound >> water soluble. The speciation trend of Pb and As is similar. In pore water also, the concentration trend is As > Se > Cd > Pb. However, only As conc. in pore water exceeds several times from environmental standard (10  $\mu\text{g}/\text{l}$ ) of WHO and Japan in leachate and drinking water of both non marine and marine sediment. The highest concentration is 116.42  $\mu\text{g}/\text{l}$  at depth of 17.2-17.4 m, 86.14  $\mu\text{g}/\text{l}$  at 24.2-24.4 m and 63.12  $\mu\text{g}/\text{l}$  at 10.2-10.4 m in transitional, marine and fluvial environment respectively. Pore water concentration of Pb, Cd and Se have not exceeded the environmental standard of leachate and drinking water quality. According to risk assessment, the bioavailable fraction of As, Pb, Se and Cd in both marine and nonmarine sediment is less than 1-5 % of the total concentration indicating low or no risk. However, results suggest that leaching behavior of As differs from Se, Cd and Pb even though according to risk assessment on speciation, they have similar conditions. Pore water as well as groundwater As in fluvial aquifer shows higher concentration which is related to higher potential mobile fractions and enrichment.

Keywords: Trace element, Chemical speciation, Marine sediment, Risk assessment

## Colloid transport in a quasi-saturated porous media

\*大古 湧之<sup>1</sup>、杉本 卓也<sup>2</sup>、濱本 昌一郎<sup>2</sup>、西村 拓<sup>2</sup>

\*Yushi Ooko<sup>1</sup>, Takuya Sugimoto<sup>2</sup>, Shoichiro Hamamoto<sup>2</sup>, Taku Nishimura<sup>2</sup>

1. 東京大学農学部、2. 東京大学大学院農学生命科学研究科

1. The University of Tokyo, 2. Graduate School of Agricultural and Life Sciences, The University of Tokyo

Colloidal particles in soils have been considered as one of the transport carriers for contaminants through groundwater (saturated zone). In natural soil system, repeated wetting-drying cycles often leads to entrapped air in the pores of a water-saturated zone, namely, quasi-saturated condition. However, there are few studies on colloidal transport process in quasi-saturated condition. Therefore, studying the colloidal transport in such quasi-saturated condition is important to understand the phenomenon of colloidal migration in the environments. In this study, we aimed to investigate the effects of entrapped air on colloid transport in porous media based on one-dimensional column experiments. We also characterized entrapped air in the porous media by X-ray CT measurements.

Two different sand columns (1. i.d. 0.9-cm, height 10-cm, 2. i.d. 5-cm, height 10-cm) were prepared for X-ray CT measurements and column transport experiments, respectively. Columns repacked with Toyoura sand were completely water-saturated by applying degassed water to the dry-sand repacked column under vacuum condition. The soil water was drained by applying a suction of 70-cm H<sub>2</sub>O to the column. By hanging water table, the sand columns were then re-saturated by immersing them in water tank, resulting in quasi-saturated sand columns. In the X-ray CT measurements, the sand column was scanned by X-ray CT device (Metrotom 1500, Carl Zeiss) with spatial resolution of 11.3 micron. In the column transport experiments, the suspension of silica particles (SL) with a diameter of 100 nm in diameter was injected to the columns under saturated and quasi-saturated condition at a constant flow rate. Effluents were collected periodically to measure the turbidity, which represents SL concentrations.

X-ray-CT measurements and subsequent CT image analysis showed the decreased fraction of entrapped air in pore volume and the increased fraction of smaller entrapped air at lower part of the column. Pore-network tortuosity analysis based on the CT images revealed that more tortuous liquid-phase network formed in the quasi-saturated condition as compared to the one under water-saturated condition. As a result of column experiments, the colloid transport was facilitated in the presence of entrapped air compared to the fully -saturated condition. It was suggested that the presence of entrapped air would inhibit the deposition of silica particles at the favorable site on the sand particles.

Acknowledgement: This work was supported by Grant-in-Aid for Scientific Research of Japan Society for the Promotion of Science (JSPS) (Leading Initiative for Excellent Young Researchers, and 16H04411)

キーワード：封入不飽和状態、コロイド、多孔質体、輸送

Keywords: quasi-saturated condition, colloid, porous media, transport

[E] Eveningポスター発表 | セッション記号 A (大気水圏科学) : A-GE 地質環境・土壌環境

■ 2019年5月30日(木) 17:15 ~ 18:30 | ㊦ ポスター会場 幕張メッセ国際展示場 8ホール\_11

### [A-GE29] エネルギー・環境・水ネクサスと持続的発展

コンビーナ:張銘(産業技術総合研究所地質調査総合センター地圏資源環境研究部門)、川本 健(埼玉大学大学院理工学研究科)、Jet-Chau Wen(National Yunlin University of Science and Technology)、?永紅(天津師範大学)

このセッションは、社会の持続的発展を目指し、クリーンエネルギー生産、環境修復と保全、廃棄物管理、水循環、水質モニタリング、水資源管理及びエネルギー・環境・水連鎖作用に係る基礎的及び最新研究成果を幅広く発表と議論する場として提供する。また、水・エネルギー及び環境管理に係る市民意識の向上やステークホルダーエンパワーメントと参加の促進並びに政策決定に関連する社会科学的話題の発表も歓迎する。

#### [AGE29-P01] The role of anthropogenic activities in spring discharge cessation: Jinci Springs China

Yaru Guo<sup>1</sup>、\*Yonghong Hao<sup>1</sup>、Chun Zhao<sup>1</sup>、Huan Lian<sup>1</sup> (1.Tianjin Normal University)

#### [AGE29-P02] Groundwater response to tidal fluctuations in a leaky confined coastal aquifer with finite length

\*Zhi-Xue Zhao<sup>1</sup>、Tongke Wang<sup>1</sup>、Jun Li<sup>1</sup> (1.Tianjin Normal University, Tianjin, China)

#### [AGE29-P03] Relationship between "source and sink" landscape patterns and river nutrient discharge in a peri-urban watershed

\*Chongwei Li<sup>1</sup> (1.Tianjin Normal University)

#### [AGE29-P04] Assessing the Urban Storm-Flood Disaster of Zhengzhou city Based on Fuzzy Methods

\*Caihong Hu<sup>1</sup>、Xian Du<sup>1</sup>、Ying Zhang<sup>1</sup>、SHAN E HYDER ALIAS TAHIR<sup>1</sup>、Shengqi Jian<sup>1</sup> (1.School of water conservancy and environment, Zhengzhou University, Zhengzhou City, Henan Province, P.R. China, 450001)

#### [AGE29-P05] Application of RAMMS Software to Predict the submerged area of Debris Flow: A Case Study of Feng-Chiou torrent in Taiwan

\*Hsin-Ying Hsieh<sup>1</sup>、Chun-Yi Wu<sup>1</sup> (1.Department of Soil and Water Conservation, National Chung Hsing University)

#### [AGE29-P06] Applications of the Cholesteric Liquid Crystal (CLC) Sensor to Rapidly Measure the Volatile Organic Compounds in the Atmosphere Environment

Ruey-Fang YU<sup>1</sup>、\*GUAN-BO CHAO<sup>1</sup>、Jian-cheng XU<sup>1</sup>、KUANG-PENG HSIEH<sup>1</sup> (1.Department of Safety, Health and Environmental Engineering, National United University, Taiwan, R. O. C.)

#### [AGE29-P07] Solar Ag/P3HT@TiO<sub>2</sub> Photocatalysis of Phenol Wastewater by a Pilot-Scale Fresnel Lens Assisted IPCC Reactor

\*An-Chi Chen<sup>1</sup>、Ting-Yu Zeng<sup>1</sup>、Wen-Shiuh Kuo<sup>1</sup> (1.National United University, Department of Safety, Health and Environmental Engineering)

#### [AGE29-P08] Using fluorescence quenching effect to investigate the electrical neutralization ability for different aromatic organic compounds

\*Yu-Ting Chen<sup>1</sup>、Wen-Po Cheng<sup>1</sup> (1.National United University, Department of Safety, Health and Environmental Engineering)

#### [AGE29-P09] Sustainable recovery of sugarcane biowastes to prepare biochar-derived electrodes for recycling of brackish water

\*Shou-Heng Liu<sup>1</sup> (1.National Cheng Kung University)

---

[AGE29-P10] The National Survey of POPs in Soil: A study of polybrominated diethyl ethers (PBDEs) in Soil in Taiwan

\*Shyh-Wei Chen<sup>1</sup>、Ming-Yang Syue<sup>2</sup>、I H SIN LEE<sup>3</sup>、Chia Hsin Li<sup>3</sup>、Yihsin Lai<sup>3</sup>、Bo-Wei Power Liang<sup>3</sup>  
(1.Chung Yuan Christian Univ. Taiwan、2.Soil and Groundwater Pollution Remediation Fund Management Board, EPA, Taiwan、3.Sinotech Engineering Service LTD., Taiwan)

---

[AGE29-P11] **Remediation of Total Petroleum Hydrocarbons in Soils by Combining Cyclodextrin and Microbubble Ozonation**

\*Kuan-Yi Kuo<sup>1</sup>、Meng-hau Sung<sup>1</sup>、Fu-yin Xie<sup>1</sup> (1.Department of Environmental Science and Engineering, Tunghai University, Taiwan)

---

[AGE29-P12] **Treatment of organic pollutants in wastewater by ozone microbubbles and cyclodextrins**

\*Fu-Yin XIE<sup>1</sup>、Meng-hau Sung<sup>1</sup> (1.Department of Environmental Science and Engineering, Tunghai University, Taichung City, Taiwan)

---

[AGE29-P13] High Addition Valued Recycling Technology of Lithium-ion Battery

\*YI-CHEN TSENG<sup>1</sup>、TIEN-CHIN CHANG<sup>1</sup>、YI-HSIANG HONG<sup>1</sup> (1.Institute of Environmental Engineering and Management, National Taipei University of Technology, No. 1, Sec. 3, Zhongxiao E. Rd., Da'an Dist., Taipei City 106, Taiwan (R.O.C.))

---

[AGE29-P14] Applying GIS Site Suitability Analysis to Optimize Landfill Selection in Mozambique

\*Chelsea Adelina Langa<sup>1</sup> (1.Tohoku University, Graduate School of Environmental Studies)

---

[AGE29-P15] Effectiveness of Solidification/Stabilization of a Heavy Metal-Contaminated Soil Using a Sustainable Binder

\*Yasong Feng<sup>1,2,3</sup>、Weiyi Xia<sup>1</sup>、Shiji Zhou<sup>1</sup>、Ming Zhang<sup>2</sup>、Yanjun Du<sup>1</sup> (1.Southeast Univ.、2.AIST、3.Tohoku Univ.)

---

[AGE29-P16] **Determining diffusive parameters using out-diffusion experiment with consideration of sampling effect**

\*Ranran Song<sup>1</sup>、Chihiro Inoue<sup>1</sup>、Ming Zhang<sup>2</sup> (1. Tohoku University、2.Geological Survey of Japan, AIST)

---

[AGE29-P17] **Exploring the removal characteristics of heavy metals employing Nanofiltration (NF) technique**

\*Jagdeesh Kumar<sup>1</sup>、Himanshu Joshi<sup>1</sup> (1.INDIAN INSTITUTE OF TECHNOLOGY ROORKEE)

---

[AGE29-P18] **Potential of Potash Recovery Employing Electrodialysis(ED) Technique from Distillery Effluent**

\*SUNIL YADAV<sup>1</sup>、HIMANSHU JOSHI<sup>1</sup> (1.INDIAN INSTITUTE OF TECHNOLOGY ROORKEE)

---

[AGE29-P19] CHARACTERIZATION OF WATER RETENTION AND MASS TRANSPORT PROPERTIES FOR RECYCLED ROADBED MATERIALS BLENDED WITH AAC FINES

\*伊藤 良平<sup>1</sup>、加藤 晃<sup>1</sup>、松野 晃大<sup>1</sup>、川本 健<sup>1,2</sup> (1.埼玉大学大学院理工学研究科、2.ベトナム国立土木工学大学)

---

[AGE29-P20] **Characterizing Geotechnical Properties of Drinking Water Sludge Blended with Graded Crushed Clay Brick for Road Subgrade: Effects of Gradation and Mixing Proportion of Crushed Clay Brick on Compaction Property**

\*Tserenlkham Ikhagvasuren<sup>1</sup>、 Muhammad Rashid Iqbal<sup>1</sup>、 Ken Kawamoto<sup>1</sup> (1. Graduate school of science and engineering Saitama University, Japan)

---

[AGE29-P21] CHARACTERIZING PHYSICAL AND CHEMICAL PROPERTIES OF RESIDUES GENERATED FROM CONSTRUCTION AND DEMOLITION WASTE

\*カク ネイネイ<sup>1</sup>、 川本 健<sup>1</sup>、 松野 晃大<sup>1</sup> (1. 埼玉大学)

---

[AGE29-P22] CHARACTERIZATION OF PORE-STRUCTURE PARAMETERS FOR UNDISTURBED AND REPACKED SAMPLES AT FIELD WATER CONTENTS

\*Arjun Baniya<sup>1</sup>、 Akihiro Matsuno<sup>1</sup>、 Ken Kawamoto<sup>1</sup> (1. Saitama University, Graduate school of Science and Engineering)

---

[AGE29-P23] CHECK SHEET SURVEY FOR ESTIMATING CDW GENERATION AND CASH FLOW AT BUILDING DEMOLISHING SITES IN HANOI, VIETNAM

\*Cuong Viet Tran<sup>1</sup>、 Kawamoto Ken<sup>1</sup> (1. Graduate School of Science and Engineering, Saitama University)

---

[AGE29-P24] APPLICATION OF CRUSHED GRAINS OF LATERITE AND AUTOCLAVED AERATED CONCRETE FOR HEAVY METAL REMOVAL FROM WASTEWATER

\*Buddhika Priyadarshani Bandara Arachchillage<sup>1</sup>、 Yuki Yoshida<sup>1</sup>、 Pradeep Kumara Gajanayake Mudalige<sup>1</sup>、 Akihiro Matsuno<sup>1</sup>、 Ken Kawamoto<sup>1</sup> (1. Graduate School of Science and Engineering, Saitama University)

---

[AGE29-P25] 使用済カルシウム系ヒ素吸着材の環境安定性に及ぼすケイ酸の影響

\*杉田 創<sup>1</sup>、 小熊 輝美<sup>1</sup>、 張 銘<sup>1</sup>、 原 淳子<sup>1</sup>、 川辺 能成<sup>1</sup> (1. 国立研究開発法人 産業技術総合研究所)

---

[AGE29-P26] The Fate of Chloroethene in Geo-environment

\*張 銘<sup>1</sup>、 吉川 美穂<sup>1</sup> (1. 産業技術総合研究所地質調査総合センター地圏資源環境研究部門)

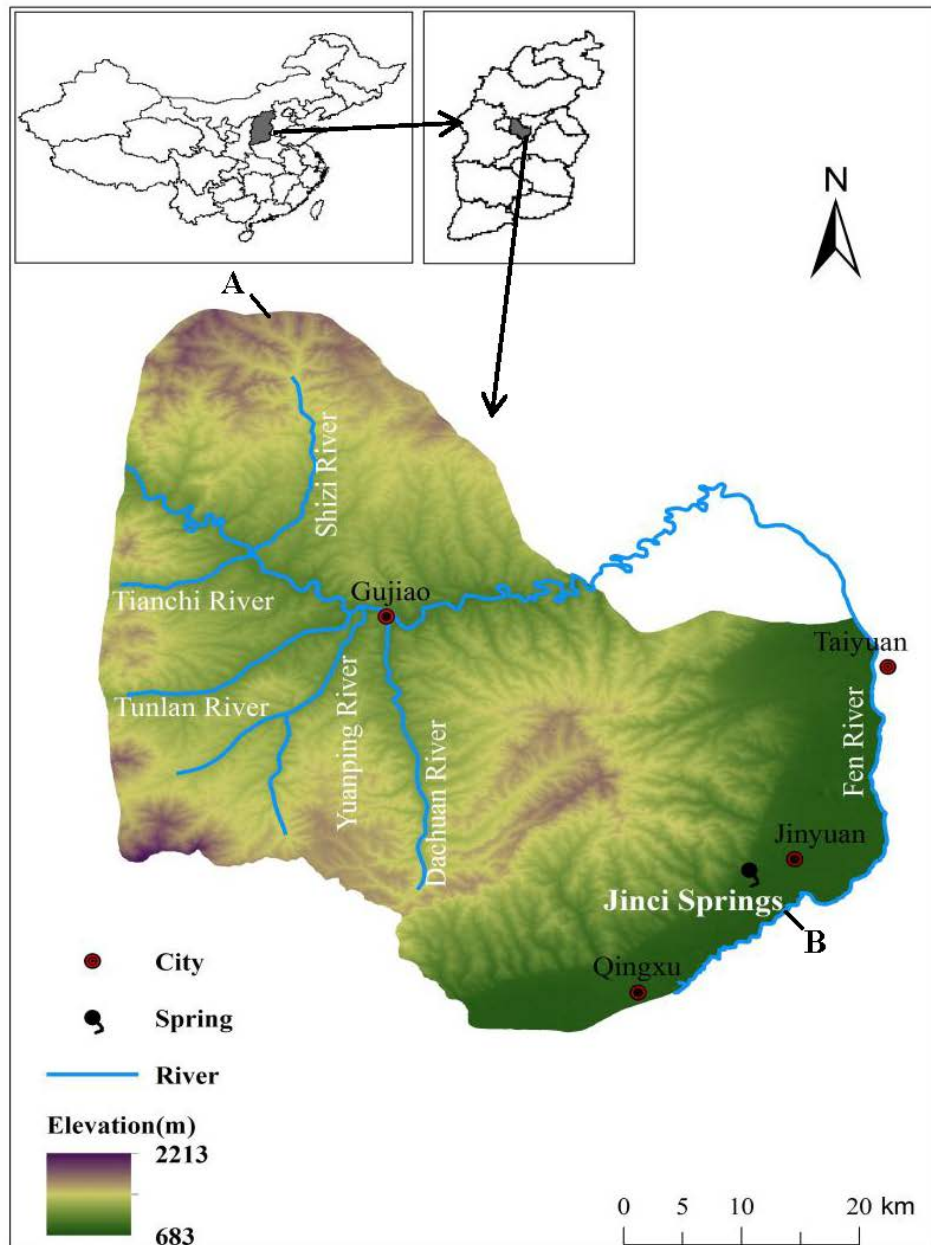
# The role of anthropogenic activities in spring discharge cessation: Jinci Springs China

Yaru Guo<sup>1</sup>, \*Yonghong Hao<sup>1</sup>, Chun Zhao<sup>1</sup>, Huan Lian<sup>1</sup>

1. Tianjin Normal University

Most of the karst spring discharge in northern China has been declining since 1950s. Jinci Springs, as one of the typical karst springs in northern China, has dried up in May 1994. In this study, we proposed grey relational analysis with time lag to calculate the delay between spring discharge and precipitation, and set up GM (1, N) model to simulate the spring discharge. The methods were applied to investigate the drying-up of Jinci Springs. Based on its characteristics of the Jinci Springs discharge, we divided the spring discharge into two stages: in the first stage (1954-1960), the spring discharge only affected by climate variations, and in the second stage (1961-1994), the spring discharge impacted by both climate variations and anthropogenic activities. In the first stage, the Jinci Springs discharge had large grey relational degrees with precipitation ahead of one year and three years. Then the GM (1, 3) model with time lag of one year and three years was set up to simulate the spring discharge of the second stage under sole effect of climate variations. Subtracted the observed spring discharge from the simulated spring discharge, we obtained the contribution of human activities to Jinci Springs cessation. Results showed that the contribution of human activities to the cessation of Jinci Springs was  $1.456\text{m}^3/\text{s}$ , accounting for 70%. The contribution of climate variations was  $0.624\text{m}^3/\text{s}$ , accounting for 30%. The impact of human activities on the spring cessation surpassed climate variations and became the major factor. The contribution of the groundwater exploitation increment was  $0.97\text{m}^3/\text{s}$ , the dewatering from coal mining increment was  $0.60\text{m}^3/\text{s}$ , and the leakage reduction of Fenhe River was  $0.19\text{m}^3/\text{s}$ . The total amount was  $1.76\text{m}^3/\text{s}$ . After the Jinci Springs dried up, human further overexploited groundwater about  $0.304\text{m}^3/\text{s}$ .

Keywords: spring discharge, anthropogenic activities, drying-up, Jinci Springs



**Figure 1** Location and digital elevation model (DEM) of Jinci Springs catchment

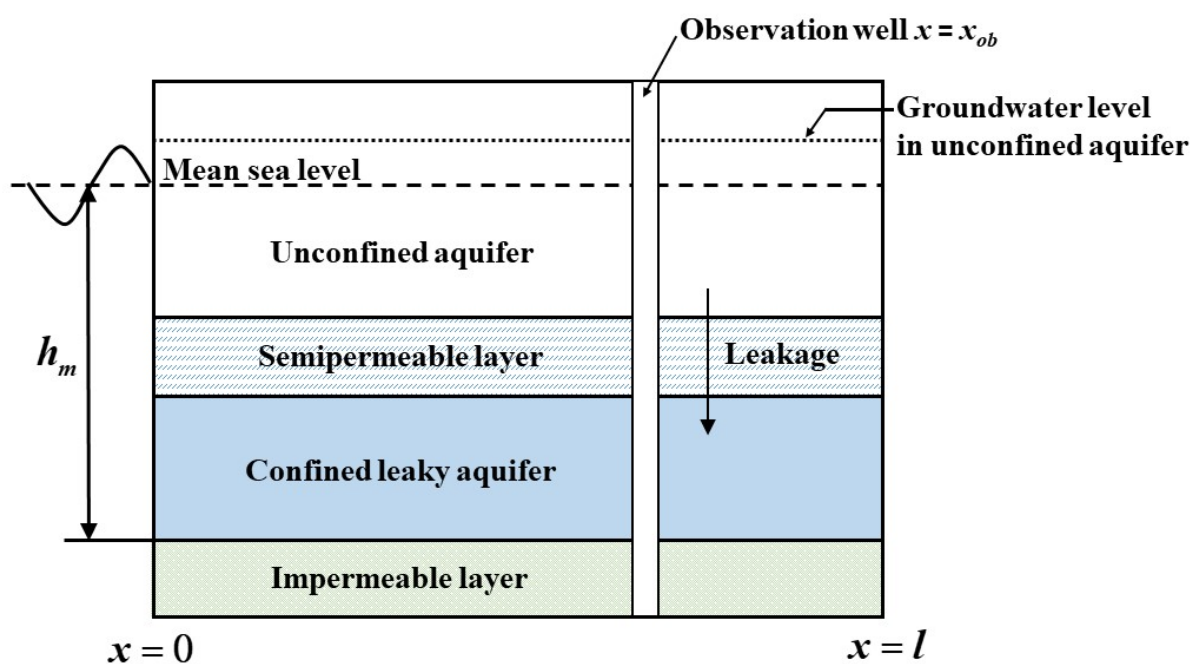
# Groundwater response to tidal fluctuations in a leaky confined coastal aquifer with finite length

\*Zhi-Xue Zhao<sup>1</sup>, Tongke Wang<sup>1</sup>, Jun Li<sup>1</sup>

1. Tianjin Normal University, Tianjin, China

We derive an analytical solution to calculate the groundwater response to tidal fluctuations in a horizontally-finite, leaky, coastal aquifer system. Our solution represents a generalized formulation that encompasses previous results as special cases. Based on the solution, we investigate the joint effects of the leakage and inland aquifer length on the behavior of the groundwater level fluctuation. We show that neglecting the finite-length effect may lead to significant errors in parameter estimations. Moreover, the range where the finite-length effect dominates is quantitatively determined by a characteristic dimensionless parameter. Finally, we demonstrate the usage of the proposed solution in calculating hydraulic properties through an application to a field experiment conducted at the Seine River estuary, France.

Keywords: Coastal aquifer, Analytical solution, Leakage, Tidal effect



**Figure 1** Schematic diagram of the leaky confined aquifer system in coastal areas

# Relationship between "source and sink" landscape patterns and river nutrient discharge in a peri-urban watershed

\*Chongwei Li<sup>1</sup>

1. Tianjin Normal University

Better understanding of landscape pattern affects water quality in the peri-urban watershed are essential for sustainable development and utilization of water resources. A peri-urban watershed refers to a watershed located in the transition or interaction zone, landscape features are subject to rapid modifications induced by human activities. Humans alter land uses and the landscape patterns both temporally and spatially. Land uses in a watershed can be functionally grouped into "source" or "sink" landscapes based on their contribution to the formation of nonpoint-source pollution in the watershed. As a result, the surface runoff and nutrient loading from a watershed are affected not only by the proportion of "source" and "sink" landscapes but also by their spatial arrangement and distribution. The assessment of non-point source pollution in peri-urban and urban watersheds is challenging but crucial for both water resource managers and urban planners.

The Yuqiao Watershed located in northern Tianjin City and southern part of Hebei Province, China, which was chosen as an example of a peri-urban watershed. Based on the "source-sink" landscape characteristic index of the river basin and combined with the water quality data of 33 sub-basins in the river basin of the bridge reservoir in recent years, The relationship between landscape pattern and water quality was analyzed by spatial analysis, correlation analysis and redundancy analysis (RDA) using landscape use and landscape index as explanatory variables and nitrogen and phosphorus load as dependent variables. Results show that Under the influence of urbanization, From 1984 to 2013, the percentage of "sink" landscape (forest and grassland) decreased from 46.5% to 31.9%, entirely the result of the sharp reduction in forested area from 37.5% to 18.9%. In contrast, the percentage of "source" landscape (urban, orchard, and cultivated land) increased from 49.6% to 62.5%. Among them, the urban land increased from 11.6% to 18.1%. The global Moran's I value of landscape spatial load comparison index (LWLI) is 0.637,  $P < 0.01$ , and tends to cluster in space. LWLI was significantly correlated with the spatial distribution of nitrogen and phosphorus in the basin. The complex correlation coefficient  $R^2$  of TN and LWLI in peacetime was 0.811, and that of LWLI and TP in wet season was 0.741. The axial angles among patch density (PD), Shannon Diversity index (SHID) and TN, TP were smaller, indicating that PD and SHID had more influence on the nitrogen and phosphorus in the catchment. Compared with other landscape characteristics indexes, LWLI has the largest impact on nitrogen and phosphorus in rivers, and urban residential land is an important contributor to water pollution in watershed. The results could potentially provide a theoretical support for the optimization of the landscape pattern in watershed.

Keywords: watershed, landscape pattern, nitrogen and phosphorus, spatial analysis, urbanization

## Assessing the Urban Storm-Flood Disaster of Zhengzhou city Based on Fuzzy Methods

\*Caihong Hu<sup>1</sup>, Xian Du<sup>1</sup>, Ying Zhang<sup>1</sup>, SHAN E HYDER ALIAS TAHIR<sup>1</sup>, Shengqi Jian<sup>1</sup>

1. School of water conservancy and environment, Zhengzhou University, Zhengzhou City, Henan Province, P.R. China, 450001

The frequency of urban waterlogging floods increased year by year with the accelerating process of urbanization in China. It is very important for us to study the urban waterlogging warning and emergency management. Four flood evaluation indexes, which are the 3h cumulative rainfall, submergence and waterlogging disaster degree and comprehensive management efficiency, are selected as the accessing indexes based on the DPSIR (Driving forces, Pressure, State, Impact and Responses model) model. Fuzzy comprehensive evaluation method is applied to evaluate the urban disaster degree based on the index weight determined by the analytic hierarchy process (AHP). Zhengzhou city, which located in the middle of China, is taken as an example for our study. Based on the SWMM model, this paper divides the urban area of Zhengzhou into 2200 unit areas. Four grades were divided for disaster degrees. The results show that Zhengzhou city will encounter different grades of waterlogging disasters with different precipitation. 469, 708, 1006 and 1057 units area of the city will encounter the second grades for warning when the rain of half a year, one year, two years and five years return period happen. The results show that the method is scientific and reasonable and can be applied to practical work.

Keywords: waterlogging warning grade, DPSIR model, evaluation index, fuzzy comprehensive evaluation method

# Application of RAMMS Software to Predict the submerged area of Debris Flow: A Case Study of Feng-Chiou torrent in Taiwan

\*Hsin-Ying Hsieh<sup>1</sup>, Chun-Yi Wu<sup>1</sup>

1. Department of Soil and Water Conservation, National Chung Hsing University

Predicting the submerged area of debris flow hazard events can effectively reduce the extent of catastrophe. In this study, we used three-dimensional debris flow runout model, RAMMS (Rapid mass movements simulation), to simulate the debris flow of Feng-Chiou torrent in Feng-Chiou Village, Xinyi Township, Nantou County, Taiwan. The RAMMS is based on the Voellmy-Salm rheology theory and describes the flow development of debris flow in a depth-averaged equation. The RAMMS can be used to simulate the debris flow phenomenon caused by landslide in the study area. We use the well-documented debris-flow event to calibrate the model parameters by back analysis, so that the simulation results are more realistic. Then we used parameters of the total volume (M), flow height (H), dry-Coulomb type friction (coefficient  $\mu$ ) and viscous-turbulent friction (coefficient  $\xi$ ) of the debris flow event for sensitivity analysis and discussed the effect of each parameter on the simulation results. Further, we used the rational formula to estimate the discharges corresponding to the rainfall intensities of different recurrence intervals. We used simply hydrograph method as the initial condition to predict the possible submerged area of debris flow events caused by different recurrence intervals.

Keywords: RAMMS, debris flow, Feng-Chiou torrent, landslide

# Applications of the Cholesteric Liquid Crystal (CLC) Sensor to Rapidly Measure the Volatile Organic Compounds in the Atmosphere Environment

Ruey-Fang YU<sup>1</sup>, \*GUAN-BO CHAO<sup>1</sup>, Jian-cheng XU<sup>1</sup>, KUANG-PENG HSIEH<sup>1</sup>

1. Department of Safety, Health and Environmental Engineering, National United University, Taiwan, R. O. C.

The Volatile Organic Compounds (VOCs) are one of the most important air pollutants emitted from industries. Some of the emitted Volatile Organic Compounds are carcinogenic which are harmful the health of both the human and environments. Typically, the concentrations of the VOCs in the atmosphere environment were measured by a Gas Chromatography (GC). However, these methods are expensive, complex, and difficult to be used for on-line application. According to the literatures, there is a lack of simple and economy detection methods for rapidly measure the VOCs in the atmosphere environment. The purpose of this study was to develop a Cholesterol Liquid Crystal (GLC) sensor for rapidly measure the concentrations of volatile organic compounds (VOCs) in the atmosphere environment.

According to the experimental results of this study, the physical directions of the GLC molecules will be changed when the prepared CLC sensor contact with the VOCs, and resulting the color on the surface of the CLC sensor changed from a Green or Red color to colorless, therefore, the target VOCs can be identified. By using a UV-VIS spectrophotometer or digital image analysis, the color can be identified. Moreover, it was also found that the color change from Green to colorless is rapid when contact with higher concentrations of VOCs. The durations of color change from Green to colorless was also found presented a liner relationship with the concentrations of VOCs, therefore, the concentrations of VOCs in the atmosphere environment can be identified. The CLC sensor was arranged to contact the VOCs by the controlled of different temperatures of  $22 \pm 0.3^{\circ}\text{C}$ ,  $24 \pm 0.3^{\circ}\text{C}$ ,  $27 \pm 0.3^{\circ}\text{C}$  and  $30 \pm 0.3^{\circ}\text{C}$ , respectively. The concentrations of VOCs can be measured from 19,955 ppm to 36,585 ppm with a linear relationship of  $R^2 = 0.97$  at  $22 \pm 0.3^{\circ}\text{C}$ , the concentrations of VOCs from 9,978 ppm to 26,607 ppm ( $R^2 = 0.97$ ) can be measured the GLC sensor at  $24 \pm 0.3^{\circ}\text{C}$ , the concentrations of VOCs from 26,607 ppm to 43,237 ppm ( $R^2 = 0.90$ ) by the GLC sensor at  $27 \pm 0.3^{\circ}\text{C}$ , as well as the concentrations of VOCs from 8,315 ppm to 19,955 ppm ( $R^2 = 0.90$ ) by the GLC sensor at  $30 \pm 0.3^{\circ}\text{C}$ . As a result, the VOCs concentrations can be easy and rapid identified by the prepared CLC sensor using the analysis data from both UV-VIS and image analysis.

Keywords: Cholesteric Liquid Crystal, sensors, Volatile organic compounds(VOCs), Image analysis

# Solar Ag/P3HT@TiO<sub>2</sub> Photocatalysis of Phenol Wastewater by a Pilot-Scale Fresnel Lens Assisted IPCC Reactor

\*An-Chi Chen<sup>1</sup>, Ting-Yu Zeng<sup>1</sup>, Wen-Shiuh Kuo<sup>1</sup>

1. National United University, Department of Safety, Health and Environmental Engineering

One of advanced oxidation processes (AOPs) - solar photocatalysis with novel Ag/P3HT@TiO<sub>2</sub> as catalyst was used to treat phenol wastewater (10 mg/L) in this study. Moreover, a pilot-scale Fresnel lens mounted inclined plate curvature channel (IPCC) reactor was well design, established and evaluated for the treatment of phenol wastewater. 5 Fresnel lens which were made of PMMA with a thickness of 2 mm, a pitch of 0.5 mm, a facet depth of 0.2 mm, and Fresnel circles of 395 were used and mounted on IPCC. Results showed that the degradation efficiency of phenol wastewater could reach 98.35% with a dosage of 0.5 g/L Ag/P3HT@TiO<sub>2</sub> and a reaction time of 3 h under solar light irradiation (average UV<sub>a+b</sub>: 42.90 W/m<sup>2</sup>). In addition, the intensity of solar light was found to be focused with an increase of 1.86 to 3.91 times and the temperature of wastewater could be raised for 3 to 5°C with the assistance of Fresnel lens, leading to that the degradation rate of phenol molecule in Ag/P3HT@TiO<sub>2</sub> photocatalytic process increases 1.66 times as compared to without Fresnel lens system. The molecules of phenol were more efficiently decomposed into low-molecular-weight organic acids which were further mineralized into CO<sub>2</sub> and H<sub>2</sub>O. Accordingly, the Fresnel lens enhanced IPCC reactor showed a synergistic effect on the solar photocatalytic process not only in effectively dealing with a large amount of industrial organic wastewater, but also in the sector of energy conservation in terms of effective utilization of solar energy.

Keywords: Solar Photocatalysis, Ag/P3HT@TiO<sub>2</sub>, IPCC, Phenol, Fresnel lens

# Using fluorescence quenching effect to investigate the electrical neutralization ability for different aromatic organic compounds

\*Yu-Ting Chen<sup>1</sup>, Wen-Po Cheng<sup>1</sup>

1. National United University, Department of Safety, Health and Environmental Engineering

The sources of organic matter in water include natural organic matter and synthetic organic matter. Most part of natural organic matter in water is humic acid which molecular weight is counted for hundreds to hundreds of thousands. The existence of humic acid not only affects the color and smell of water, but also produces toxic disinfection by-products. In addition, in synthetic organic matter, dye is used in the textile industry and the issue of process that produced waste water has been aware of increasingly. Therefore, effectively removing organic matter from water through the chemical coagulation process continues to be considered as a fairly important index of water purification efficiency. When the organic matter contains an aromatic heterocyclic structure and is excited by absorbing a specific radiation, it will eventually release the absorbed energy to the lower electronic energy level. Normally, the energy is released in the form of fluorescence. On the other hand, if the organic matter and metal ions are bonded to each other, the fluorescence intensity will be reduced. This phenomenon is known as the fluorescence quenching effect. In this study, the Stern-Volmer formula  $F_0/F = 1 + K_q[M]$  will be used to evaluate the ability of the  $Al^{3+}$  coagulant complex with organic matter. Where  $F_0$  is the fluorescence intensity in the absence of  $Al^{3+}$  quencher and  $F$  is the fluorescence intensity in the presence of  $Al^{3+}$  quencher,  $[M]$  is the concentration of the quencher, and  $K_q$  is the equilibrium constant or quenching constant. Furthermore, the value of  $K_q$  also represents the electrical neutralization capacity of coagulant under different conditions such as pH, molecular weight, hydrophilicity, functional groups of organic compound and coagulant dosage etc. The results in this study show that (1) under conditions of solution pH=6, the order of  $K_q$  values with different aluminum chloride dosage are Humic acid > Quinic acid > Salicylic Acid. Indicating that the molecular weight of organic matter is an important factor causing the degree of electrical neutralization ability; (2) under different solution pH, Reactive Blue 49 obtains the maximum  $K_q$  values than Direct Red 28 and Disperse Red 60 those often used in textile industry demonstrating the more number of sulfonic groups in the dye molecule, the more intensify electrical neutralization ability. (3) The  $K_q$  value of hydrophilic molecule (Direct Red 28) is higher than hydrophobic molecule (Disperse Red 60). These results indicate that the hydrophilicity of organic matter has a certain influence on the electrical neutralization by aluminum ions. All of results in this study show that the Stern-Volmer formula is a viable and simple method in operation to find the influencing factor of electrical neutralization ability between organic matter and aluminum coagulant and find the optimum coagulation conditions.

Keywords: Aluminum chloride, Coagulation, Aromatic organic compounds, Fluorescence quenching effect, Electrical neutralization

# Sustainable recovery of sugarcane biowastes to prepare biochar-derived electrodes for recycling of brackish water

\*Shou-Heng Liu<sup>1</sup>

1. National Cheng Kung University

Membrane capacitive deionization (MCDI) is an emerging technology for the energy-efficient and cost-effective removal of ions from salt water by electrosorption. To further enhance the capacitive deionization performance, sugarcane bagasse biowastes are used as raw materials to synthesize biochars by microwave-assisted carbonization and activation with potassium hydroxide in the flows of carbon dioxide, which has the advantages of reducing preparation time and saving energy. Experimentally, the effect of microwave power (500-800 W) has been studied on the morphology, the ratios of mesoporosity in the biochars and their corresponding desalination performance of MCDI. Accordingly, the biochars which are activated at 700 W of microwave irradiation under carbon dioxide atmosphere (denoted as SB-CO<sub>2</sub>-700) possess the ratios of mesopores to total pore volume ratio ( $V_{\text{meso}}/V_{\text{total}}$ ) of ca. 64.1% with surface areas of 764 m<sup>2</sup> g<sup>-1</sup>. By using cyclic voltammetry, the specific capacitance of SB-CO<sub>2</sub>-700 is calculated to be ca. 123 F g<sup>-1</sup> at 5 mV s<sup>-1</sup>. From the desalination tests at 1.2 V, the electrosorption capacity of SB-CO<sub>2</sub>-700 samples is estimated to be 15.8 mg g<sup>-1</sup> in 5 mM of NaCl solution. The enhancement in the desalination performance of SB-CO<sub>2</sub>-700 is possibly due to the greater  $V_{\text{meso}}/V_{\text{total}}$  ratio, reasonable surface area and hierarchically porous structure.

Keywords: capacitive deionization, biomass, microwave-assisted CO<sub>2</sub> activation, biochars

## The National Survey of POPs in Soil: A study of polybrominated diethyl ethers (PBDEs) in Soil in Taiwan

\*Shyh-Wei Chen<sup>1</sup>, Ming-Yang Syue<sup>2</sup>, I HSIN LEE<sup>3</sup>, Chia Hsin Li<sup>3</sup>, Yihsin Lai<sup>3</sup>, Bo-Wei Power Liang<sup>3</sup>

1. Chung Yuan Christian Univ. Taiwan, 2. Soil and Groundwater Pollution Remediation Fund Management Board, EPA, Taiwan, 3. Sinotech Engineering Service LTD., Taiwan

The United Nations Environment Programme (UNEP) elaborates the Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention) to protect human health and the environment through a range of measures aimed at reducing and eliminating the production and use of POPs. In order to understand the distribution of POPs in soil, a national soil quality survey has been carried out by Taiwan Environmental Protection Administration (EPA). The survey result can serve as the basis for promoting the management measures and evaluation of management effectiveness. In Taiwan, decabromodiphenyl ether (decaBDE) is still being used as flame retardants that are mostly used in electronic and electrical products. This study discusses the survey result of PBDEs in soil as one of the achievements of soil quality survey.

The strategy of soil quality survey involved investigation for potential pollution sources areas and baseline soil quality areas (Figure 1). Industries handled with a large quantity of decaBDE, large waste treatment facilities for waste electrical and electronic equipments and industrial parks were identified as potential pollution sources which were selected and soils sampled were collected at their surrounding areas. The baseline soil quality survey were undertaken to understand the environmental soil quality without the effect of potential pollution sources. Sixty composite soil samples were collected at surrounding areas of potential pollution sources and 60 composite soil samples were collected at baseline survey areas. Soil samples were analyzed for 24 PBDE congeners by gas chromatography /high resolution mass spectrometer (GC/HRMS).

The survey result shows that PBDEs concentration of all soil samples, collected from surrounding areas of the potential pollution sources and baseline survey areas, are ranged from 0.189  $\mu\text{g}/\text{kg}$  to 656  $\mu\text{g}/\text{kg}$  (the mean concentration is 39.6  $\mu\text{g}/\text{kg}$ ) and 0.268  $\mu\text{g}/\text{kg}$  to 41.9  $\mu\text{g}/\text{kg}$  (the mean concentration is 6.25  $\mu\text{g}/\text{kg}$ ), respectively (Table 1 and Figure 2). The levels of PBDEs in all soil samples are far lower than U.S. EPA's Regional Screening Levels. The study also performed hypothesis test and the result shows that the concentration at surrounding areas of potential pollution sources is significant higher than that at baseline survey areas. It means that the industrials with high polluting potential may have impact on their surrounding environment. In addition, this study compares the spatial distribution of soil surrounding potential pollution sources and baseline survey areas. The higher PBDEs concentrations are detected in soil at surrounding areas of the industrials using decaBDE. It is speculated that decaBDE which is an additive type flame retardant is affected their surrounding soil by emissions during the use of the addition process. The soil concentrations at the surrounding areas of waste treatment facilities for waste electrical and electronic appliances are on an equal level with baseline areas. Furthermore, the PBDE congener pattern is analyzed. The BDE congener pattern is dominated by BDE-209 and account for more than 80% of the total PBDEs concentration. It is speculated that it may be related to the use of decaBDE in recent years in Taiwan and accumulate easier than other BDEs with low bromine number in soil due to their solubility.

To monitoring the condition of the soil quality, assessing the effect of the potential pollution sources on soil quality, a systematic survey and monitoring plan for POPs in the Stockholm Convention was

established by Taiwan EPA. The survey and monitoring works will be conducted in accordance with latest chemical lists of Stockholm Convention. The achievement of soil quality monitoring will help to tracking the influence of potential pollution sources and changes on environmental quality. It also can provide information to assess the effectiveness of control measures, strengthen the soil quality management and ensure the sustainable use of land resources.

Keywords: PBDEs, Soil, Taiwan

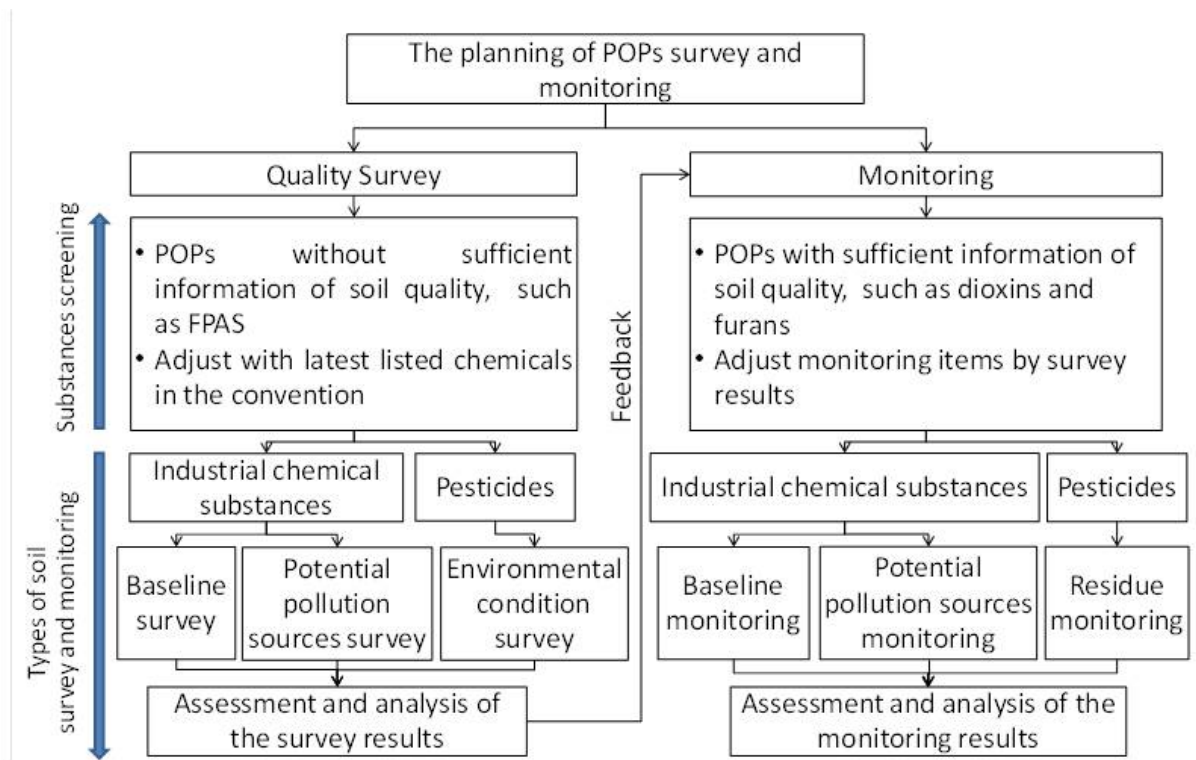


Figure 1 Framework of soil survey and monitoring plan

Table 1 Investigation results of PBDEs in soil in Taiwan

POPs	Type of soil survey	No. of samples	Results ( $\mu\text{g}/\text{kg}$ )	
			Range	Average
PBDEs	Surrounding areas of potential pollution sources	60	0.189~656	39.6
	Baseline survey	60	0.268~41.9	6.25

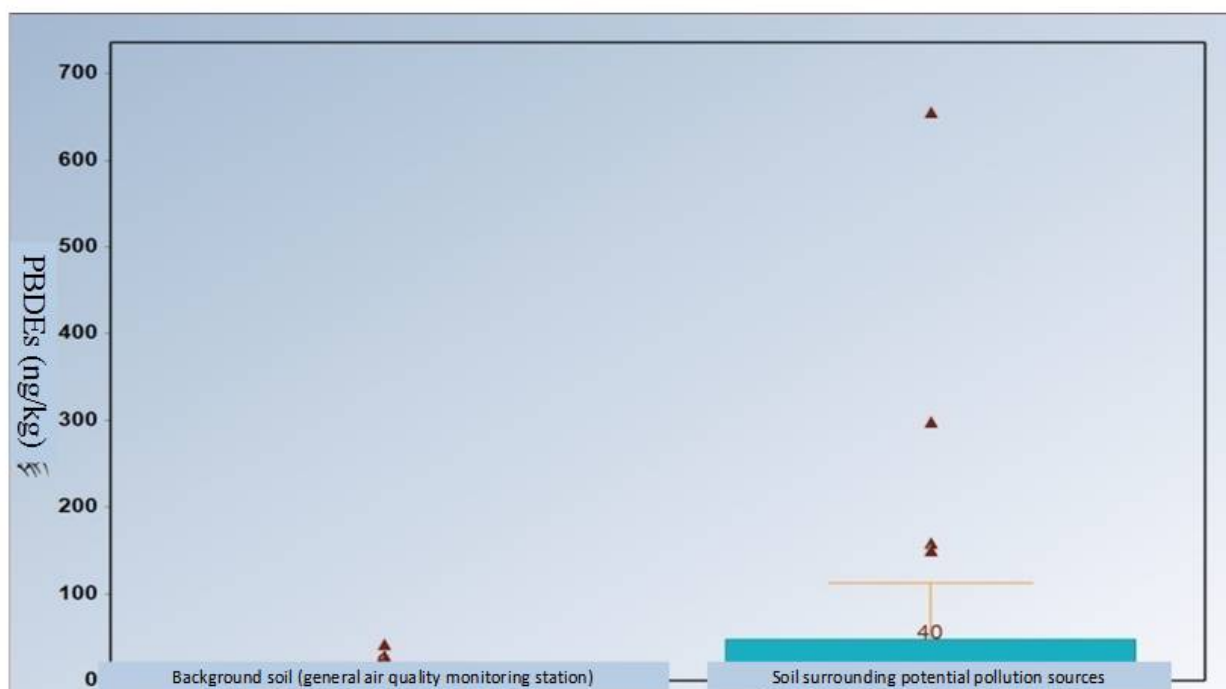


Figure 2 The distribution of PBDEs concentration in soil from potential pollution sources areas and baseline survey areas

# Remediation of Total Petroleum Hydrocarbons in Soils by Combining Cyclodextrin and Microbubble Ozonation

\*Kuan-Yi Kuo<sup>1</sup>, Meng-hau Sung<sup>1</sup>, Fu-yin Xie<sup>1</sup>

1. Department of Environmental Science and Engineering, Tunghai University, Taiwan

In recent years, there have been many studies to increase the solubility of ozone by ozone-binding microbubbles or cyclodextrins, so that ozone has a better treatment effect. At present, no research has been conducted on the treatment of ozone in combination with microbubbles and cyclodextrins. Therefore, this study hopes to use ozone combined with microbubbles and cyclodextrin to treat the total petroleum hydrocarbons (TPH) in soil, and hopes to have better treatment effect than using microbubbles or cyclodextrin alone. This method is also a green remediation method that does not cause secondary pollution to the environment. In this study, ozone was first produced by an ozone generator and passed into a microbubble generator. Micron bubble ozone was then introduced into a water sample containing cyclodextrin, and finally the water sample was passed through a soil contaminated with TPH. In this study, different forms and concentrations of cyclodextrin were tested to examine their pertinent effects, so that the overall treatment efficiency of this method can be optimized. The instruments used in this study include spectrophotometer for the detection of ozone, LC with RID for the detection of cyclodextrin, and GC for the detection of TPH. It is expected that using microbubbles together with cyclodextrins simultaneously will improve the green remediation process.

Keywords: green remediation, soil treatment, total petroleum hydrocarbon, cyclodextrin, ozone microbubbles

## Treatment of organic pollutants in wastewater by ozone microbubbles and cyclodextrins

\*Fu-Yin XIE<sup>1</sup>, Meng-hau Sung<sup>1</sup>

1. Department of Environmental Science and Engineering, Tunghai University, Taichung City, Taiwan

The hydroxyl radicals generated during ozonation can be used to oxidize organic pollutants in water. However, ozone gas is only slightly soluble in water. To increase the treatment efficiency, ozone microbubbles and cyclodextrins can be applied to increase the solubility. Microbubbles have high surface area and long residence time in aqueous solution. If they are combined with ozone gas to form ozone microbubbles, the solubility and half-life of gaseous ozone in water can be significantly improved. In definition, microbubbles refers to bubbles with a diameter between 1 micrometer and 1 millimeter. In addition to oxidative hydroxyl radicals generated, at the moment when the microbubble bursts, the pressure will be released, resulting in a high-speed microjet and ultra-high temperature locally. Under this condition, organic pollutants can also be degraded by pyrolysis. Cyclodextrins are often used in foods and are not harmful to humans. Adding cyclodextrin to the ozone microbubble system can increase the residence time of ozone in water and increase the half-life of ozone in water. Consequently, the combination of microbubbles and cyclodextrins appears to be a promising method for effective degradation of organic pollutants in water. Pesticides are common organic pollutants in water. After application, it may enter the environment via surface runoff, which may directly or indirectly enters water resources such as lakes or reservoirs. It has a certain impact on the environment and ecology, and may enter the groundwater system, which may affect the drinking water quality. The objective of this study is to establish an ozone microbubble system with cyclodextrin to treat organic pollutants in water. A variety of tests are conducted to examine its performance. Parameters considered in the experiments are pH and dosages of ozone microbubbles and cyclodextrin. The best condition for efficient degradation will be determined.

Keywords: wastewater treatment, green remediation, ozone microbubbles, cyclodextrin

## High Addition Valued Recycling Technology of Lithium-ion Battery

\*YI-CHEN TSENG<sup>1</sup>, TIEN-CHIN CHANG<sup>1</sup>, YI-HSIANG HONG<sup>1</sup>

1. Institute of Environmental Engineering and Management, National Taipei University of Technology, No. 1, Sec. 3, Zhongxiao E. Rd., Da'an Dist., Taipei City 106, Taiwan (R.O.C.)

Due to the development of lithium-ion batteries and the advancement of its technology, industrial applications such as that in electric vehicles become its leading application. The demand of lithium-ion battery increases dramatically in respond to the growing market of electric vehicles or other carriers. Under the circumstance that environmental resources are limited, high-value recycling technology is and considerably urgent need to accommodate the trend of the market. Though the differences in recycling technology exist across the countries in terms of efficiency, techniques, and feasibility of commercialization, the extracted noble metals can all be utilized in various products nowadays. No doubt, this technology and noble metals play significant roles in the perspective of industrial development in Taiwan. Other than industrial development, environmental concern due to the toxic waste coming from wasted batteries is of the same importance. Toxicants generated from rubbish lithium-ion batteries can corrode everything on this planet, therefore, policies and regulations to have good control of the waste materials should be developed along with the evolving technology. Due to the development of lithium-ion batteries and the advancement of its technology, industrial applications such as that in electric vehicles become its leading application. The demand of lithium-ion battery increases dramatically in respond to the growing market of electric vehicles or other carriers. Under the circumstance that environmental resources are limited, high-value recycling technology is and considerably urgent need to accommodate the trend of the market. Though the differences in recycling technology exist across the countries in terms of efficiency, techniques, and feasibility of commercialization, the extracted noble metals can all be utilized in various products nowadays. No doubt, this technology and noble metals play significant roles in the perspective of industrial development in Taiwan. Other than industrial development, environmental concern due to the toxic waste coming from wasted batteries is of the same importance. Toxicants generated from rubbish lithium-ion batteries can corrode everything on this planet, therefore, policies and regulations to have good control of the waste materials should be developed along with the evolving technology.

Keywords: Lithium-ion Battery, Circular Economy, Recycling Techonology

# Applying GIS Site Suitability Analysis to Optimize Landfill Selection in Mozambique

\*Chelsea Adelina Langa<sup>1</sup>

1. Tohoku University, Graduate School of Environmental Studies

Proper selection of landfills is a complex task. However, with the application of GIS technology, it is possible to aid in the selection of an optimal site, one that ensures environmental and social standards for potential landfills. In Maputo city, site selection of landfills is difficult due to land restrictions resulting from the land conflicts and groundwater presence. However, in the need of improving waste disposal conditions, a new landfill site has been selected. The goal of this study was to identify potential areas for landfill and evaluate the suitability of the new landfill. Environmental and social criteria were combined to firstly identifying potential disposal sites. By making a cross-reference of criteria map, three types of areas were selected, unsuitable, subjected to special evaluation and suitable areas. It was possible to estimate how the current landfill is in terms of environmental and social safety, based on the AHP ranking process. GIS and its aided tools were proved to be efficient in this process and of great value for the improvement of the municipal solid waste management in Maputo, however, due to the characteristics of the area, on-site studies are still necessary in order to validate landfills.

Keywords: Landfill, Selection, GIS

# Effectiveness of Solidification/Stabilization of a Heavy Metal-Contaminated Soil Using a Sustainable Binder

\*Yasong Feng<sup>1,2,3</sup>, Weiyi Xia<sup>1</sup>, Shiji Zhou<sup>1</sup>, Ming Zhang<sup>2</sup>, Yanjun Du<sup>1</sup>

1. Southeast Univ., 2. AIST, 3. Tohoku Univ.

Cement and lime are currently extensively used in solidifying/stabilizing heavy metals contaminated soils. However, cement and lime production is associated with intensive consumption of energy and nonrenewable resources. Under the drive of environmental friendliness, some by-products-based binders such as ground granulated blast furnace slag, pulverized fuel ash, and cement kiln dust have been successfully used in the remediation of contaminated soil. The authors have recently developed a sustainable binder, basic oxygen furnace slag (BOFS) activated by calcium carbide residue (CCR) and phosphogypsum (PG). The binder has almost no negative environmental impacts, and it can be used as an excellent substitute for cement.

This study presents a preliminary evaluation of the effectiveness of the BOF-based binder to stabilize mixed nickel (Ni) and zinc (Zn) contaminated soil collected from a vacant lot of an electroplating plant. The effects of binder dosage and curing time on soil pH, leachability and strength properties of the stabilized soils were examined. In addition, modified European Communities Bureau of Reference (BCR) sequential extraction procedure (SEP) and mercury intrusion porosimetry (MIP) analyses were performed to investigate the mechanisms that control the variations in heavy metal speciation and soil structure.

The results showed that soil pH and unconfined compressive strength (UCS) increased with increasing binder dosage and curing time. After 90 days of curing, the UCS of stabilized soils was approximately 2.9 - 6.6 times higher compared with those of untreated soil. Leaching concentrations of Ni and Zn were significantly reduced with increases in binder dosage and curing time. With 8% of binder addition and 28 days of curing, the leaching concentrations of both Ni and Zn were well below their corresponding remediation goals. The SEP results indicated that the binder addition significantly reduced the acid-soluble fractions of heavy metals while increased their residual fractions. The MIP test results showed that the soil pore volume reduced notably and soil structure changed remarkably after stabilization, inducing higher UCS compared with the untreated soil.

Keywords: Solidification/Stabilization, Heavy metal, Contaminated soil, Sustainable binder

## Determining diffusive parameters using out-diffusion experiment with consideration of sampling effect

\*Ranran Song<sup>1</sup>, Chihiro Inoue<sup>1</sup>, Ming Zhang<sup>2</sup>

1. Tohoku University, 2. Geological Survey of Japan, AIST

To know the details of diffusive properties of geo-materials is vital in geological disposal engineering projects. Out-diffusion experiment involves the process of heavy metal when diffuses out of geometries. It has simple structure and easy-operational experiment procedure. A theoretical solution considering the adsorption effect and sampling effect was developed. By applying theoretical analyses, we can estimate and decrease the errors induced by sampling. Sensitive analyses were also conducted to estimate a reasonable sampling time range and frequency. With the assist of theoretical analyses, a proper experiment can be designed. In this study, we assumed that heavy metal is linearly adsorpted on the surface of geo-material and linearly desorpted into the porous solution. We tested clay samples to get the effective diffusion-coefficient and capacity factor and examined the effect of sampling. As the linearly adsorption assumption may not be sufficient, especially to describe heavy-metals which easily adsorpted, we also try to discuss the effect of the heavy metal adoption effect to the diffusive process in these experiments.

Keywords: mass transport, diffusion, out-diffusion experiment, contaminants, heavy metal

# Exploring the removal characteristics of heavy metals employing Nanofiltration (NF) technique

\*Jagdeesh Kumar<sup>1</sup>, Himanshu Joshi<sup>1</sup>

## 1. INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Heavy metals are serious environmental concern in recent industrial era, release from different industrial process. These are non-degradable, persistent, highly toxic and tendency of bioaccumulation into body tissues of organism, which causes several health consequences. Various technologies have been reported to develop so far in the removal of these contaminants which primarily include adsorption, chemical precipitation, and phytoremediation. These are conventional techniques of treatment process, which have several disadvantages such as high treatment cost, generation of sludge in bulk and requirement of large amount of adsorbent. From last few decades, usage of nanofiltration membrane (NF) during treatment process has gained significant attention in chemical processing, biotechnology and desalination industries. Recently, nanofiltration technique has been reported to be employed for the treatment of heavy metals in electroplating industries, due to its high efficiency, less energy consumption and minimum generation of toxic sludge. Therefore, a synergistic approach has been explored for the removal of concerned metals in combination with the electrocoagulation technique.

In present study, synthetic waste water was formulated containing different concentration of Zn, Cu and Ni metal ions for the treatment process. A central composite design was explored to study the effect of variable such as pH, concentration, pressure temperature ranges from the value of 4.5-9.5, 10-20 bar, 10-25 ppm and 15-35-degree C, respectively. A set of 30 experimental runs was examined for the removal. Further, the Response Surface Methodology (RSM) was adopted to optimize the removal percentage (maximize) by minimizing the pressure and maximizing the concentration. The experiments were also performed at the optimize conditions which have shown significant co-relation with the predicted values.

The removal percentage (%) of 99.96, 99.82 and 99.93 was observed at temperature of 15 -degree C for Cu, Ni and Zn metal ions, respectively. At low pH, high copper removal was observed as compared to those nickel and zinc ions. The high removal of copper occurred due to the formation of its precipitates at lower pH. The results show that the value of pH and metal concentration are not significantly affected the flux while pressure and temperature increase flux increase. This can be attributed to the fact that increased temperature decreased the viscosity and increase in the diffusion rate of solute through the membrane. The effect of pH and concentration on removal efficiency shows that the removal efficiency increases as pH increases while it decreases with the increased concentration. At desirability 0.993, the maximum removal of Zn, Ni, Cu were observed to be 101.53, 97.81 and 102.48, respectively. The maximum flux 225.88 was achieved at ambient temperature of 25-degree C. A good correlation of 0.9823 was observed for the experimental outcomes among the optimised experimental runs and predicted values.

Keywords: Nanofiltration, Response Surface Methodology (RSM), Electroplating Industry

# Potential of Potash Recovery Employing Electrodialysis(ED) Technique from Distillery Effluent

\*SUNIL YADAV<sup>1</sup>, HIMANSHU JOSHI<sup>1</sup>

## 1. INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Sugarcane is one of the major cash crop of north-western and central part of India. Distillery industry coupled with sugar industry provides an economic and social infrastructure to the rural economy. The byproduct of sugar industry known as Molasses, utilized as raw material for the production of ethanol. The ethanol is a major source of beverages, biofuels and organic solvent production. It generates a large volume (approx. 8-10 L/L) complex, highly colored and concentrated organic stream alongwith high concentration of total dissolved solids as spent wash, which is a great concern as for treatment and disposal. Waste management and resource recovery has become a major task for large volume effluent generating industry to achieve long term sustainable economic development.

The characterization of spent wash shows a high concentration of potassium up to 8-10 g/L. High level of potassium concentration in the spent wash provide a way for economic utilization of the effluent. Several conventional technologies have been reported so far in recovering the potash from spent wash using incineration, ion exchange and chemical precipitation. These are having several disadvantages in respect to high energy consumption, economically nonviable and less environmental significant. Presently, most of the industries depend on membrane processes alongwith anaerobic digestion techniques for the treatment of spent wash. However, the effluent is rich in potassium which can be recovered in the form of potash for its usage in agriculture production, as fertilizer.

In the present study, desalination experiments were carried out for nanofiltration membrane (NF) treated effluent, containing the concentration of potassium upto 6,000 mg L<sup>-1</sup> and electrical conductivity (EC) upto 28 mS cm<sup>-1</sup>. The reject stream after the Nano filtration treatment was passed as feed through the Electrodialysis (ED). The main objective of the study is to separate the feed stream into dilute and concentrate stream with the aim of generating a highly saline effluent. A laboratory scale electrodialysis stack (mega EDR-Z) containing eleven cation exchange membranes and ten anion-exchange membranes of 64 cm<sup>2</sup> effective area was investigated for potassium removal. Two stream generated during the process one is the concentrated brine and the second one is the deionized effluent. The influence of applied voltage (10, 15, and 18 V) on removal efficiency was also examined. From these analyses, the potassium removal up to 92, 96 and 97 % has been observed at operating time of 120, 90 and 75 min, respectively. Similarly, the salinity removal upto 83, 95 and 97 % were observed. A desalinated effluent i.e. the dilute stream with conductivity less than 1mS cm<sup>-1</sup> and potassium level less than 150mg/l was generated. It is concluded that the increases in the voltage led to salt and potassium separation. This is due to the increase in current induces migration movement of all the dissolved ions in the process solutions. So, with the addition of an ED system with NF, a highly concentrated brine stream can be generated that can be further subjected to advance electrochemical process for potassium separation and crystallization.

Keywords: Electrodialysis, Potash Recovery, Spent wash , Ethanol Production

# CHARACTERIZATION OF WATER RETENTION AND MASS TRANSPORT PROPERTIES FOR RECYCLED ROADBED MATERIALS BLENDED WITH AAC FINES

\*伊藤 良平<sup>1</sup>、加藤 晃<sup>1</sup>、松野 晃大<sup>1</sup>、川本 健<sup>1,2</sup>

\*Ryohei ITO<sup>1</sup>, Akira KATO<sup>1</sup>, Akihiro MATSUNO<sup>1</sup>, Ken KAWAMOTO<sup>1,2</sup>

1. 埼玉大学大学院理工学研究科、2. ベトナム国立土木工学大学

1. Graduate School of Science and Engineering, Saitama University, 2. National University of Civil Engineering, Vietnam

Permeable pavement systems (PPS) contribute to reduce surface runoff during heavy rainfall and to mitigate urban heat island effect.

The purpose of this study is to improve water retention capacity for recycled road-base materials utilizing fines (typically under 2 mm) from industrial by-products. Especially, the effects of mixing of fine grains made from autoclave aerated concrete (AAC; 0.106-2 mm) with graded recycled concrete (RC; 0.075-31.5 mm) and steel slag for roadbed construction (SS; 0.075-31.5 mm) were examined. Besides, mass transport parameters such as gas diffusion coefficient, air permeability, thermal conductivity, and heat capacity were measured for tested samples to characterize gas and heat exchange properties and pore structural properties of gas flow. After compacting the samples by Proctor D method, water retention curves were obtained through the drying process from water saturation. The gas and heat transport parameters were also measured at each suction stage and air-dried condition.

As a result, the mixing of AAC fines contributed highly to increase water retention capacities for both graded RC and SS. The mixing of AAC fine grains, on the other hand, did not affect the pore structural properties such as equivalent diameter and tortuosity for gas flow, suggesting the retained water in AAC fine grains would not impede the gas flow in graded roadbed materials mixed with AAC fine grains.

キーワード：再生路盤材、軽量気泡コンクリート、ガス移動

Keywords: Recycled Road-base Materials, Autoclave Aerated Concrete, Gas Transport

# Characterizing Geotechnical Properties of Drinking Water Sludge Blended with Graded Crushed Clay Brick for Road Subgrade: Effects of Gradation and Mixing Proportion of Crushed Clay Brick on Compaction Property

\*Tserenlkham Ikhagvasuren<sup>1</sup>, Muhammad Rashid Iqbal<sup>1</sup>, Ken Kawamoto<sup>1</sup>

1. Graduate school of science and engineering Saitama University, Japan

With rapid construction and renovation works, a huge amount of construction and demolition waste (CDW) is generated in urban areas of developing countries. The CDW is mostly dumped at the landfill sites directly and/or reused for construction works such as ground levelling and backfilling without any quality control of materials. Effective use and recycling of CDW is highly required to establish sustainable urban development. In this study, drinking water sludge (DWS) blended with crushed clay brick (CCB) was tested for the possible application to road subgrade. Especially, the effects of gradation/particle size of CCB and its mixing proportion to DWS on compaction properties have been examined using laboratory tests. A series of the modified Proctor compaction test was conducted using testing samples with three different particles of CCB; the finer (2-10 mm), coarser fraction (10-30 mm), and graded fraction (2-30 mm) and with different mixing proportions to DWS; 20, 40, 60, 80 and 100% on the dry mass basis. The tested results showed that particle breakage of all the above-mentioned fraction was almost the same up to 40% addition of CCB to DWS and was independent of particle size as well. A coarser fraction of CB showed the highest value of particle breakage (45.7%) which was almost double than that of finer (26.9%) and graded fraction breakage (22.8%) respectively. Measured compaction curves of all the mixed samples showed a linear relationship between maximum dry density and mixing proportion of the blended samples. The CCB mixing proportions more than 40% did not show any peak in the compaction curve probably due to a higher quantity of the cohesionless material (i.e., CCB).

Keywords: Drinking water sludge, Crushed clay bricks, Compaction, Particle breakage

# CHARACTERIZING PHYSICAL AND CHEMICAL PROPERTIES OF RESIDUES GENERATED FROM CONSTRUCTION AND DEMOLITION WASTE

\*カク ネイネイ<sup>1</sup>、川本 健<sup>1</sup>、松野 晃大<sup>1</sup>

\*NINGNING HAO<sup>1</sup>, Ken Kawamoto<sup>1</sup>, Akihiro Matsuno<sup>1</sup>

1. 埼玉大学

1. Saitama University

Due to rapid urbanization and population increase, the generation of Construction and Demolition Waste (CDW) is increasing in urban areas and industrial zones in developing countries. In order to promote sustainable development, it is important to have sound CDW management and recycling. Among of generated and dumped CDW, general masonry such as concrete and clay brick can be recycled for road construction and backfilling materials after suitable treatments like crushing and sieving. On the other hand, the reuse of fine residues (typically < 10 mm) faces some difficulties with regards to quality control and potential risk of hazardous materials. Based on the background, this study aims to characterize chemical and physical properties of CDW fines (especially for mortar samples). The testing samples were taken from 3 different demolition sites in Hanoi and Haiphong and a CDW dumping site in Hanoi. For the testing samples, two different fractions, one is bigger than 2mm and the other is grounded and sieved less than 2mm, were used for SEM-EDS analysis. Results showed that the samples with less than 2mm observed by 100 magnification of SEM became more stable (less spatial variability and following normal distribution). The measured Ca/Si values varied widely from 1.36 to 2.60 and became lower than that from a control mortar sample except for one sample from Hanoi demolition site. Further studies are planned to determine the mixing per cents of mortar and clay brick in CDW fines for characterizing the chemical composition and for promoting effective and safe use of recycled fines from CDW.

キーワード：建設廃棄物、粉末廃棄物、走査型電子顕微鏡

Keywords: Construction and Demolition Waste, Fine Residue, SEM-EDS

# CHARACTERIZATION OF PORE-STRUCTURE PARAMETERS FOR UNDISTURBED AND REPACKED SAMPLES AT FIELD WATER CONTENTS

\*Arjun Baniya<sup>1</sup>, Akihiro Matsuno<sup>1</sup>, Ken Kawamoto<sup>1</sup>

1. Saitama University, Graduate school of Science and Engineering

Mass transport in soils occurs through the soil pore network, which is highly influence by pore structure parameters (i.e. pore size distribution, porosity, pore tortuosity and pore coordination number). Micro-focus X-ray computed tomography (CT) has emerged as a powerful non-destructive tool for the direct visualization and better understand soil pore geometry. However, there have been few studies on visualization and quantification of soil pore network and soil pore networks linked to indirect pore parameters for gas flow based on measured gas diffusion coefficient and air permeability. In this study we visualized soil-pore networks for different soils, a sandy loam from Saitama, Japan and silty clay loam from Hawke' s Bay, New Zealand. The study aimed to identify pore structure parameters using a microfocus X-ray computed tomography (MFXCT) system and compare indirect pore parameters such as tortuosity-connectivity parameter and equivalent pore diameter for gas flow. Undisturbed and repacked samples were used for characterizing soil pore networking and structure. For repacked soil samples, particle size ( $d < 2\text{mm}$ ) with field water content were used with different dry bulk densities by hand compaction. Soil samples were scanned by MFXCT system with different scanning resolutions of 12,30 and 50  $\mu\text{m}/\text{voxels}$ . Then, 3-dimensional models were reconstructed with different regions of interest (ROI) of 50, 100, 200 and 300 voxels. Finally, soil pore-structural parameters such as effective pore radius, coordination number, and tortuosity in z direction were analyzed. With increasing ROI, the pore structure parameters of undisturbed and repacked samples showed less variation. The pore connectivity-tortuosity factors derived from MFXCT were well correlated with the indirect connectivity tortuosities from measured soil gas diffusion. However, it was observed that there were some variations between effective pore diameters from MFXCT and equivalent pore diameters for gas flow estimated by gas transport parameters depending on scanning resolutions (ranging from 1:1 to 1:3 for SR = 12  $\mu\text{m}/\text{voxels}$  and 1:1 to 4:1 for SR = 30  $\mu\text{m}/\text{voxels}$ ).

Keywords: Microfocus X-ray Computed Tomography (MFXCT), Gas Transport Parameters, Pore structural parameters

# CHECK SHEET SURVEY FOR ESTIMATING CDW GENERATION AND CASH FLOW AT BUILDING DEMOLISHING SITES IN HANOI, VIETNAM

\*Cuong Viet Tran<sup>1</sup>, Kawamoto Ken<sup>1</sup>

1. Graduate School of Science and Engineering, Saitama University

## Abstract

A number of studies on reuse and recycling of construction demolition waste (CDW) for construction works as well as the properties of building materials using recycled aggregates have been carried out in many developed countries. However, in Vietnam, there are many difficulties to classify and recycle the CDW after demolition construction at site. Because the generation of CDW is increasing in Vietnam due to rapid urbanization and economic growth and CDW was dumped without any quality control of material at disposal site. It is highly demanded to promote the recycling of CDW in a sustainable manner.

In this study, in order to identify the CDW generation and cash flow at actual demolition sites in Vietnam. Firstly, we proposed a check sheet survey to discuss suitable CDW separation and treatment methods. The survey sheet enables to collect data on demolition period, number of labors and equipment, volume of CDW, number of trucks which brought the generated waste from the site, total floor areas, total cost for the demolition work, and so on. Then, using the survey sheet, actual survey works carried out at 3 different building demolishing sites in Hanoi. Finally, utilizing the collected data, we determined waste components and waste generation rates of typical materials such as concrete, brick, valuables (e.g., steel).

Results showed that most CDW generated from demolishing sites was sold to other contractors/buyers for the purpose of construction works (e.g., ground leveling). The generation rates of CDW including valuables varied widely from 0.29 to 1.22 tons/ (m<sup>2</sup> of total ground floor) depending on the building type and scale, and smaller building demolition gave a higher generation rate. As a result of cash flow, the estimated cost for selling valuables and CDW masonry to buyers became much higher than those for the contract cost of demolition work from land owner/client.

Keywords: Construction Demolition Waste (CDW)

# APPLICATION OF CRUSHED GRAINS OF LATERITE AND AUTOCLAVED AERATED CONCRETE FOR HEAVY METAL REMOVAL FROM WASTEWATER

\*Buddhika Priyadarshani Bandara Arachchillage<sup>1</sup>, Yuki Yoshida<sup>1</sup>, Pradeep Kumara Gajanayake Mudalige<sup>1</sup>, Akihiro Matsuno<sup>1</sup>, Ken Kawamoto<sup>1</sup>

1. Graduate School of Science and Engineering, Saitama University

Adverse effects on the environment and human health is highly influence by heavy metal contamination in water is a global significance problem. Among conventional treatment technologies for treating wastewater, a particular attention is given to adsorption process, considering as low-cost and easy technical applicability. In this study, in order to examine the applicability of locally available geo-materials and industrial by-products as cost-effective adsorbents in the treatment technology of heavy metal-contaminated water, laterite made from Vietnam and autoclaved aerated concrete were tested for the removal of arsenic and chromium in wastewater. Zeolite made from Japan was also used as a reference material. The testing samples were first grounded and sieved to be 0.105-2 mm grain size. The standard batch adsorption method by Organization of Economic Cooperation and Development (OECD 2000) was applied to determine adsorption isotherms. The isotherm experiments were evaluated for 1:10 solid liquid ratio at natural pH and 20 °C temperature for solutions with initial concentrations ranging from 100 –2000 mg/L for both metals. The results indicated that Langmuir isotherm described the experimental data the best. Laterite removed arsenic and chromium in solutions up to 8.21 and 1.33 mg/g respectively. It revealed that laterite had higher adsorption capacity for arsenic than autoclaved aerated concrete. The measured removal percentages decreased with increasing in initial ion concentrations. Future, the adsorption mechanism will be suggested by correlating both laterite and autoclaved aerated concrete for heavy metal removal from wastewater.

Keywords: Adsorption , Heavy metals, Industrial by-products, Low-cost adsorbents, Wastewater

## 使用済カルシウム系ヒ素吸着材の環境安定性に及ぼすケイ酸の影響 Effects of Silicic Acid on Environmental Stability of Spent Calcium-based Arsenic Adsorbents

\*杉田 創<sup>1</sup>、小熊 輝美<sup>1</sup>、張 銘<sup>1</sup>、原 淳子<sup>1</sup>、川辺 能成<sup>1</sup>

\*Hajime Sugita<sup>1</sup>, Terumi Oguma<sup>1</sup>, Ming Zhang<sup>1</sup>, Junko Hara<sup>1</sup>, Yoshishige Kawabe<sup>1</sup>

1. 国立研究開発法人 産業技術総合研究所

1. National Institute of Advanced Industrial Science and Technology

In some areas of developing countries, health effects caused by arsenic contained in groundwater used as drinking water have been a serious problem. Calcium compounds show promise for arsenic removal as effective and inexpensive adsorbents. However, the spent adsorbent would contain a great amount of arsenic. When the spent adsorbent is not properly recovered and is discarded near residences, secondary environmental pollution due to arsenic leaching from the spent adsorbent may occur. In our previous studies (leaching tests with soils), it was suggested silicic acid which leached from soils greatly affects leaching behavior of arsenic from the spent adsorbents. In this study, in order to examine the influence of silicic acid on the environmental stability of spent adsorbents in detail, leaching tests with silicic acid solution and 2 kinds of spent calcium-based adsorbent (CaO and Ca(OH)<sub>2</sub>) were carried out. This study revealed that when the initial silicic acid concentration in solution is high, the leaching rate of arsenic decreases. This was inferred that when the silicic acid component in the solution reacted with the calcium component eluted from the spent adsorbents to form the calcium silicate species, the arsenate component leached from the spent adsorbents was taken into the products.

キーワード：ヒ素溶出、使用済吸着材、酸化カルシウム、水酸化カルシウム、ケイ酸

Keywords: Arsenic Leaching, Spent Adsorbent, Calcium Oxide, Calcium Hydroxide, Silicic Acid

## The Fate of Chloroethene in Geo-environment

\*張 銘<sup>1</sup>、吉川 美穂<sup>1</sup>

\*Ming Zhang<sup>1</sup>, Miho Yoshikawa<sup>1</sup>

1. 産業技術総合研究所地質調査総合センター地圏資源環境研究部門

1. Institute for Geo-Resources and Environment, Geological Survey of Japan, AIST

Chloroethene, also has the names of chloroethylene, ethylene monochloride, vinyl chloride monomer (VCM) or vinyl chloride (VC), is an important chemical substance widely used to produce polymer polyvinyl chloride (PVC) in plastic industry. Due to its high volatility, the pollution induced by the use of chloroethene itself is principally limited to air pollution. In geo-environment, such as soils and groundwater, the occurrence of chloroethene is mainly from biodegradation of its parent compound, like *cis*-Dichloroethene (*cis*-DCE), *trans*-DCE or 1,1-DCE, an intermediate product of biodegradation of trichloroethylene (TCE) and/or tetrachloroethylene (PCE). Either TCE or PCE has been widely used as an industrial solvent both in developed and developing countries.

To understand the fate of chloroethene in geo-environment, this presentation overviews the pathways, microorganisms, and degrading rates associated with biodegradation of chloroethene, the pollutant newly specified by the Japanese Soil Contamination Countermeasures Act. In natural environment, biodegradation of chloroethene is very slow and distribution of chloroethene around or downstream a source of pollution is dominantly affected by advection and dispersion. An advection-dispersion equation and sensitive analysis were, therefore, used to examine possible distances of chloroethene which may spread downstream of a source point over long time period. The control of groundwater flow can be an effective countermeasure against further spreading of pollutant plume.

キーワード：クロロエチレン、微生物分解、分解経路、分解微生物、運命  
Keywords: Chloroethene, biodegradation, pathway, microorganism, fate