Combined use of numerical simulation and natural tracer approach to estimate groundwater flow system in a typical arid inland river basin, northwest China

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Groundwater plays a crucial role in arid and semi-arid areas of the world. To obtain a better understanding and quantification of groundwater flow in arid and semi-arid inland river basins, a variably saturated numerical model of a typical arid watershed profile in Qaidam basin was constructed using the code TOUGH2 (Transport of Unsaturated Groundwater and Heat 2). Considering the dramatic change of saturated/unsaturated state near surface in the alluvial-lacustrine plain (midstream and downstream river basin), the mesh near surface is refined compared to the previous studies, and the minimum cell size is 0.1 m in thickness. Natural isotopes (such as radiocarbon and tritium) as well as hydraulic heads were used to calibrate the numerical model. The reliability of the calibrated model was further validated by comparing the results of the numerical simulation and an independent isotopes method. The results indicate that the calibrated model can efficiently reflect the characteristics of groundwater flow system at basin scale. While the natural tracer approaches are more reliable at point scale. According to the travel paths of groundwater simulated by the calibrated model, three groundwater flow systems are distinguished: the local, intermediate and regional groundwater flow system. The circulation depth, groundwater residence time as well as water circulation amount of each groundwater flow system were also calculated with the numerical model. This study demonstrates that combined use of natural tracers and hydraulic data in the numerical model calibration can construct a more reliable model and achieve better understanding and qualification of basin-scale groundwater flow.

Keywords: Numerical simulation, Tracer approach, Variably saturated, Groundwater flow, Arid area, Qaidam basin

Regional groundwater resource evaluation of Golmud River watershed in the south margin of Qaidam Basin, northwest China

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In the arid and semi-arid area, due to scarce of precipitation and strong evaporation, groundwater becomes not only an important source of water supply but also the safeguard water of the vulnerable eco-environment.
Golmud River watershed is located in the south margin of Qaidam Basin. According to the previous researches, the piedmont alluvial fan deposits thick sand and gravel, which is a good groundwater storage site and have abundant groundwater. In the groundwater overflowing belt, groundwater overflow into spring-fed river because of the rise of groundwater level, and the vegetation development; the whole groundwater is basically in the original state. On the basis of thorough analysis of the hydrogeological conditions, we establish groundwater flow numerical simulation model under unsteady flow by using GMS to determine the Qaidam basin groundwater quantity and analyze the influence of groundwater exploitation on the ecological environment of the overflow zone in Golmud River watershed. The results indicate that the amount of the average annual recharge of the Golmud River watershed accounts for $6.4\times10^8m^3/a$. Based on the water use plan, three kinds of groundwater exploitation schemes with quantity of $0.96\times10^8m^3/a$, $2.92\times10^8m^3/a$ and $3.65\times10^8m^3/a$ were provided.With the increasing exploitation of groundwater, river infiltration basically keeps constant, the groundwater level drops to a certain extent, evaporation will reduce and oasis area will shrink back and retreat. The prediction results of different exploitation schemes show that groundwater exploitation mainly comes from spring discharge, the evaporation of phreatic water, and groundwater storage. Compared to the first mining plan, other schemes distribution area of vegetation suitable water level is reduced by 17% and 23% respectively. Compare the results of different exploitation schemes, we decide the exploitable quantity of groundwater, which is $2.92\times10^8m^3/a$. This research can provide a scientific basis for the rational development and utilization of water resources and ecological environment protection.

Keywords: Golmud River watershed, groundwater resource evaluation, numerical simulation

The role of transients in ionic strength in colloid remobilization in saturated porous media

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The deposition and remobilization of soil colloids in groundwater are important with respect to the environmental fate of contaminants and the remediation of subsurface contamination. We conducted a series of column experiments to investigate the effect of solution ionic strength on colloid transport and remobilization. In the experiment, model colloids-Polystyrene latex microspheres with diameter of 1 μm were employed, quartz sand packed column was used as porous medium. During the experiment, ionic strength was changed from 50mM to 10mM, 60mM to 20mM, 70mM to 30mM, then to ultrapure water, or reduced from 50mM, 60mM , 70mM to ultrapure water directly.
We found that colloid remobilization occur under the condition of transients in ionic strength. When ionic strength was 50mM, 3.88% percent of the attached colloid was remobilized after it changed to 10mM. When ionic strength was 60mM, 0.71% percent of the attached colloid was remobilized after it changed to 20mM. When ionic strength was 70mM, 0.07% percent of the attached colloid was remobilized after it changed to 30mM. When ionic strength was reduced from 60mM to 10mM, 20mM, 30mM respectively, the corresponding remobilization rate was 1.75%, 0.71%, 0.09%, the total remobilization rate was 52.12%, 50.86%, 42.73% respectively after injecting to ultrapure water.
We concluded that the amount of colloid remobilization was related to the magnitude of the change in ionic strength.

Keywords: transients in ionic strength, colloid remobilization, saturated steady-state flow

Abnormal drawdown behavior in pumping tests with exponentially decayed rates of abstraction in confined aquifers

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Actual field pumping tests often involve variable pumping rates which cannot be handled by the classical constant-rate or constant-head test models, and often require a convolution process to interpret the test data. In this study, we proposed a semi-analytical model considering an exponentially decreasing pumping rate started at a certain (higher) rate and eventually stabilized at a certain (lower) rate for cases with or without wellbore storage. A striking new feature of the pumping test with an exponentially decayed rate is that the drawdowns will decrease over a certain period of time during intermediate pumping stage, which has never been seen before in constant-rate or constant-head pumping tests. It was found that the drawdown-time curve associated with an exponentially decayed pumping rate function is bounded by two asymptotic curves of the constant-rate tests with rates equaling to the starting and stabilizing rates, respectively. The wellbore storage must be considered for a pumping test without an observation well (single-well test). Based on such characteristics of the time-drawdown curve, we developed a new method to estimate the aquifer parameters by using the genetic algorithm.

Keywords: Analytical solutions, Variable rate, Pumping test, Laplace transform

Leaching recovery of gallium from waste LED chip

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The purpose of this research is to analyze the composition and to study the leaching recovery of gallium (Ga) from waste LED (light-emitting diodes) chip by different leaching reagents. The waste LED chip used in this research is generated during the production of light-emitting diodes chip. The composition analysis result of this research shows that the collected LED chip contains 456 mg/kg of Ga. The water, ash and combustible contents of this collected chip are 0.30%, 82.05% and 17.65%, respectively. In order to recover the valuable Ga contained in the chip, a leaching method is adopted in this research. There are 4 leaching reagents of nitric acid, hydrochloric acid, sulfuric acid and sodium hydroxide are used to study the leaching recovery of Ga from the collected LED chip. The leaching results of aforementioned leaching reagents will be introduced in this research.

Keywords: Leaching, Gallium, Recovery

Leachability, strength and microstructural characteristics of CPC binder stabilized Pb, Zn and Cd contaminated industrial soil

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Synthetic hydroxyapatite is used as an immobilization material to remediate heavy metals in soil and show promising performance of reducing the leachability. However, hydroxyapatite stabilization technology has several drawbacks including the high cost of raw material, difficult in preparation, as well as poor mechanical properties of stabilized matrix. This study presents a new binder, CPC, composed of calcium oxide and single superphosphate. The CPC can effectively solidify and stabilized contaminated soil through acid-base reaction with a final product of hydroxyapatite in the soil. A comprehensive laboratory investigation is carried out with respect to the effect of the CPC content and curing time on the pH, leachability and strength properties of Pb, Zn and Cd contaminated industrial soil stabilized with CPC binder. In addition, microcosmic studies including sequential extraction procedure, X-ray diffraction, scanning electron microscopy, and mercury intrusion porosimetry are undertaken to interpret the mechanisms controlling the changes in leachability, strength properties of the stabilized soils. The results show that the soil pH and unconfined compressive strength increase with an increase in CPC content and curing time. The CPC stabilized soils exhibit an alkaline character regardless of the binder content. After cured for 28 days, the strength of CPC stabilized soils is 2.21 to 5.68 times that of the untreated soils. For all stabilized soils, the leachability of Pb, Zn and Cd is effectively reduced and the corresponding leached concentrations can meet the regulator limit. Moreover, CPC can significantly reduce acid soluble fractions of heavy metals and transfer them to residual fractions in the stabilized soils. The CPC also significantly reduce the pore volume and change the pore-size, which can well explain the measured impact of CPC content on the compressive strength of stabilized soils. It is also found that the formation of heavy metals hydroxyapatite and phosphate-based products are the major immobilization mechanisms for Pb, Zn and Cd in soils.

Keywords: Heavy contaminated soils, Leachability, Strength, Hydroxyapatite, Single superphosphate, Solidification and stabilization

カルシウム酸化物及び水酸化物によるヒ素汚染水からの亜ヒ酸除去
Removal of Arsenite from Arsenic Contaminated Water using Calcium Oxide and Hydroxide

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発展途上国の一部の地域では、ヒ素によって汚染された地下水を飲料水として利用しているため、健康被害をもたらす可能性が高く大きな問題となっている。著者らはこれまでヒ素の中でも5価ヒ素であるヒ酸に着目したヒ素除去試験を中心に研究を実施してきた。本研究では、5価ヒ素よりも毒性が高い3価ヒ素である亜ヒ酸を対象として、酸化カルシウム及び水酸化カルシウムを用いて実施したヒ素除去試験の結果について報告する。

キーワード：亜ヒ酸除去、吸着材、酸化カルシウム、水酸化カルシウム
Keywords: Arsenite Removal, Adsorbent, Calcium Oxide, Calcium Hydroxide

土質材料及びバイオ資材を活用した透過性反応壁材料の検討
Development of permeable reactive barrier system utilizing locally available geo- materials and bio resource in Sri Lanka: Characterizing of heavy metal adsorption and water permeability

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Open dumping is the common method for final waste disposal used in many developing countries. Various kinds of heavy metals often detected in landfill leachate and groundwater surrounded at open dumpsites in Sri Lanka. Thus leachate and groundwater treatment facilities are strongly recommended in order to prevent contamination of natural ecosystem. Permeable Reactive Barrier (PRB) systems might be an effective method to treat contaminated water at open dumpsites, which required low initial cost, maintenance cost and technical support. Therefore, the objectives of this study were to characterize the heavy metal adsorption and permeability performances of low-cost filling materials (soil, biochar, crushed brick, and their mixed samples) locally found in Sri Lanka. Adsorption isotherms of Pb and Cd for tested materials showed that the maximum adsorption capacities and removal percentages of Pb were higher than those for Cd. The brick mixed samples showed less adsorption capacities compared to the non-brick mixed samples because of the low adsorption capacity of brick. On the other hand, the brick mixed samples showed the highest water permeability and exceeded the targeted hydraulic conductivity of 10-3 cm/s, under relatively high compaction degree of 75%. This suggests that the mixing of brick with soil and biochar is effective to satisfy a required water permeability of filling materials for the PRB systems.

キーワード：反応性浸透壁、重金属、吸着特性、透水係数、浸出水
Keywords: Permeable reactive barrier (PRB), Heavy metals, Adsorption, Hydraulic Conductivity, Leachate

Analysis of pore structure for different textured soils by Micro-focus X-ray CT system

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Understanding mass transport properties in soils is important to develop techniques. The mass transport properties can be controlled by soil pore structure. The many analyses by visualization techniques for soil pore structure including a micro-focus X-ray CT system were carried out. However, few reports are available on the examinations of correlations between pore structure parameters and mass transport parameters. In this study, we visualized pore network for different textured soils by using Micro Focus X-ray CT system (inspeXio SMX-90CT, Shimadzu Corporation, Japan) and analyzed pore structure parameters (mean effective pore radius(r_{eff}), pore coordination number(N), and pore tortuosity(T_{zz})). Moreover, we measured gas diffusivity(D_p/D_0) and air permeability(k_a) as mass transport parameters. Different textured soils including sand, loam, and silty clay loam were used. The sand samples with different particle shape were packed at different densities. Similar to sand samples, the loam samples were packed. Undisturbed silty clay loam soils were collected from two different positions of an apple orchard, and two conditions (field water content and air dried after freeze drying) was used.
As a result, gas diffusivity increased with decreasing effective pore radius for the all dry samples. Correlations between effective pore radius and mean particle size have been reported. Thus, this results suggest that gas diffusivity is controlled by mean particle size. On the other hand, the gas diffusivity values of moist silty clay loam taken from alley area in apple orchard are lower than these of dry samples. Blocking by water in soil occurs the degradation of gas diffusion ability.

キーワード：マイクロフォーカスX線CT装置、間隙構造、物質移動係数
Keywords: Micro focus X-ray CT system, pore structure, mass transport confficients

Preliminary environmental magnetic results of pedogenic processes in mine waste during plant growth.

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The historic Kamegai Pb-Zn-Ag deposit at Mt. Hachibuse in Toyama, Japan, was mined between 1567 and 1926, leaving considerable mine waste in the region. This mine waste may generate acidic ground water containing high concentrations of sulphide and metals. Environmental magnetic results are reported here on the changes in magnetic properties of the Kamegai mine’s waste from the growth of the fern, *Athyrium yokoscense*. This fern is known to flourish at sites that are highly polluted with heavy metals such as cadmium, copper, lead and zinc. Six mixtures were prepared from two different soil types, mine waste and synthetic soils of mountain sand, vermiculite and artificial magnetite powder. One mixture of each soil type is a control soil sample without any fern and the other four were planted with *Athyrium yokoscense*. In-field magnetic susceptibility measurements of the soil surfaces were done about once a week for 20 weeks. Overall, the mean magnetic susceptibility of soils with ferns decreased more than the control soils without ferns. However, there is no obvious correlation between the decay rates of susceptibility and plant growth. After 20 weeks the soils were collected for further rock magnetic analyses. Higher mass susceptibilities were observed in soils with the fern, especially near the fern’s roots. More rapid stepwise isothermal remanent magnetization acquisition curves as well as alternating field demagnetization decay curves were observed in the soils with ferns, indicating that more low coercivity magnetic minerals, such as magnetite, were generated in these soils. Therefore, the mass susceptibilities appear to show magnetic enhancement by pedogenic processes. Conversely, the in-field magnetic susceptibility measurements for which the lower magnetic susceptibility were observed in the soils with ferns likely detect the spatial distribution of the fern’s roots.

キーワード：環境磁気、土壌生成、ヘビノネゴザ
Keywords: Environmental magnetism, Pedogenesis, Athyrium yokoscense

Geotechnical properties for waste mixed materials

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Waste disposal sites are essential infrastructure facilities for human and industrial activities. However, it is difficult to construct new disposal facilities due to the lack of land and the public opposition surrounding. Therefore, an effective use of limited space in existing waste disposal sites is highly needed. The control of geotechnical properties such as compaction, consolidation, and shear strength of waste materials is important to reduce disposal space. In this study, geotechnical properties such as basic physical, chemical, and mechanical properties such as compaction, consolidation, and un-drained shear strength were investigated for waste mixed materials of sludge with less than 2.0mm, crushed concrete with the fraction 2.0mm and 9.5mm, and incineration ash with the fraction less than 2.0mm. The materials were mixed with various proportions based on mass ratio. First, mixed materials were compacted by the standard proctor method to achieve 90% degree of compaction. Then, the compacted samples were used for the oedometer test and the Consolidation-Undrained triaxial compression test. The sample size for the consolidation test was 10 cm in diameter and 10 cm in height. The sample size for the triaxial compression test was 10 cm in diameter and 20 cm in height. The triaxial compression test was carried out under three confining stresses of 50, 100, and 150kPa, and the strain rate was maintained as 0.1% per minute. Results show the maximum dry density increased with decreasing the mixing proportion of sludge and the optimum moisture content decreased with decreasing the mixing proportion of sludge. For the mixed materials of sludge and crushed concrete or incineration ash, measured friction angles showed positive linear relations with increasing the mixing proportion of crushed concrete or incineration ash irrespective of different particle size distributions for crushed concrete and incineration ash. Compression index for the mixed materials of sludge and incineration ash linearly decreased with decreasing the mixing proportion of sludge, while for the mixed sample containing crushed concrete, they rapidly decreased with decreasing the mixing proportion of sludge. Therefore, it is highly important to mix the crushed concrete for increasing the strength of waste materials.

キーワード：汚泥、コンクリートがら、焼却灰混合材料の地盤工学的特性の評価
Keywords: Evaluation of Geotechnical Properties for Mixed Materials of Sludge, Crushed Concrete, and Incineration Ash

Experimental study on engineering characteristic of alkali-activated slag - bentonite backfills for vertical slurry cutoff wall

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In this study, alkali-activated slag and bentonite (GMB) are mixed and used to form backfills for vertical slurry cutoff wall. For the purpose of redevelopment and utilization of contaminated site, engineering characteristic of GMB backfill has been research. The slump tests, unconfined compressive strength test, direct shear test and permeability test have been conducted under different content of sand-soil ratio, MgO-activated slag, bentonite and different curing time. The slump test results show that standard slump of GMB backfill is well liner to mini slump. It is found that the values of mini slump are 25.5 to 75.5 mm when the GMB backfill meet the workability of construction. The Unconfined compressive strength test show that, the q_u of GMB specimens are increased with the curing time and content of MgO-activated slag, and the content of bentonite is weakly influence the q_u. The direct shear test show that, the cohesive force of GMB specimens are increasing remarkably when the curing time from 14 d to 28d and the content of MgO-activated slag increased from 5% to 15%. Moreover, the ratio of sand-soil decreased result in cohesive force increasing. The friction of GMB specimens increased with the content of MgO-activated slag and sand-soil ratio, however, it would be decreased slightly with curing time and the content of bentonite. In the last, the permeability result of GMB show that the GMB has a significant effective on cutoff groundwater flow and it can reach the permeability of 1×10^{-7} to 1×10^{-9} m/s.

Keywords: alkali-activatied slag, bentonite, enginering characteristic, cutoff walls

The simulation of the oxygen transport with injection well operation in landfill

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Evaluation of oxygen distribution during aeration in landfill was very important to determine the design parameters of injection well. The coupling model described gas preferential transport in landfill was developed, which linked the effect of advection-diffusion and oxidation reaction and mass exchange between the fracture and matrix system. Combined with the typical cases in field site, the quantitative simulation of the variation of gases distribution during vertical well aeration in short term was presented. The sensitivity of the parameters in the coupling model to gas transport was addressed. The simulation result shown that the oxygen and methane concentration during aeration was represented by using the dual advective-diffusive model (DAD model). The aeration radius achieved by DAD model was closer to the measurement value. It was underestimated by single advective-diffusive model (SAD model). The mass transfer volume between the fracture and matrix system greatly contributes to gas preferential flow effect in landfill. The aeration radius (AR) was obviously influenced by the diffusion coefficient. It will provided evidence for optimum design of gas injection well in aerobic landfill.

キーワード：preferential flow、modeling、oxygen transport、landfill
Keywords: preferential flow, modeling, oxygen transport, landfill

Study on the Compacted Clay Line Shrinkage Crack Characteristics and Crack Soil Representative Elementary Volume

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The shrinkage cracking is a main reason causing of compacted clay liner (CCL) anti-seepage failure in a landfill final cover. In this paper, six soils with different liquid limit (LL) were obtained by combining two natural soils, and the cracking characteristics and representative elementary volume (REV) size were studied by large scale model experiments. The results show that: With 50% liquid limit is bounded, there has a piecewise linear relationship between crack characteristic parameters (i.e. crack rate and crack length) and soil liquid limit, and the slope at LL<50 % is bigger than the slope at LL>50 %. The crack elementary volume (CEV) size of CCLs all accord with normal distribution, which the expectation and the mean square error linearly reduce with the increase LL when LL<50 %, while those change is not obvious when LL<50 %. The REV size decrease linearly with increase soil LL (REV=90.5-1.6LL) for low quid limit soil, while the change of the REV size is non-significant and it is approximately equal to 10 cm for high liquid limit soil.

Soil Water Characteristic Curve and Pore Size Distribution of Life Source Contaminated Clay

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With the diffusion and migration of life source contaminants, the soils experience the variation of moisture state from unsaturation to saturation, and produce complicated physical, chemical and biological reactions, thus transforming the soil properties and structure. Therefore, the investigations on the migration patterns of contaminants in soils, as well as the induced variation in the properties and structure of unsaturated soils at various depths, lay the premise and foundation about the evaluation of environmental effects and engineering geological properties of soils during the migration of contaminants. Based on the physical migration model construction of life source contaminants, life source contaminated clays at various depths were prepared. Subsequently, the soil water characteristic curves of uncontaminated and life source contaminated clay were tested and compared. Furthermore, the pore size distribution of life source contaminated clay was theoretically calculated by means of small incremental method. Meanwhile, the microstructure of life source contaminated clay was observed using scanning electron microscope. The pore size distribution of life source contaminated clay was then quantified and analyzed in order to compare with the theoretical calculation results. Finally, the evolution mechanisms of the clay saturation degree and pore size distribution during the migration of contaminants were revealed. The studies demonstrate that, the life source contaminated clay possesses higher dry density and water content than uncontaminated clay. Meanwhile, with the increase of depth, the life source contaminated clay possesses increasingly low gravimetric water content, wet density and dry density, as well as high saturated gravimetric water content, saturated volumetric water content and saturated permeability coefficient. The soil water characteristic curves (SWCCs) of uncontaminated and life source contaminated clay can be divided into boundary effect region, transition region and residual region. Moreover, the SWCCs of life source contaminated clay intersect with each other, and become steeper and closer to that of uncontaminated clay with the increase of depth. The pore size distribution of life source contaminated clay calculated using small incremental method based on SWCCs is basically consistent with that quantified using MATLAB based on microstructure images. Specifically, with the increase of depth, the life source contaminated clay possesses lager pore size, worse pore uniformity, as well as the pore size distribution transformed from mainly meso- and mini-pores to mostly macro- and meso-pores with the pore size peaks in the range of 5-20 μm. Finally, such effects produce during the migration of life source contaminants in clay as the adsorption of clay particles to organic matters and suspended solids, the complicated chemical reactions between life source contaminants and clay, as well as the formation of biofilms, and induce the reduction of clay porosity and pore size, as well as the increase of clay matric suction, thus inhibiting the migration of life source contaminants gradually.

Keywords: life source contaminated clay, unsaturation, SWCC, pore size distribution

Effects of γ-rays irradiation aging on the mechanical strength and swelling properties of natural GMZ sodium bentonite

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Bentonite was often used as the back filling materials in high-level radioactive waste geological disposal. In order to study the effect of gamma irradiation on the mechanical strength and swelling properties, some experiments was taken on the natural of bentonite sodium Na-bentonite, from Gaomiaozi(GMZ), Inner Mongolia. The bentonite samples were performed at different cumulative doses of electron irradiation aging at room temperature firstly. Then by D8 Advance X- ray diffraction, the mineral composition of bentonite was detected and analyzed. And then triaxial shear test and swelling test were conducted to study the evolution law of the mechanical strength and deformation characteristics before and after irradiation. Results showed that mineral components changed after γ-rays irradiation in bentonite. The microstructure of montmorillonite changed and transformed to the stable silicate and aluminosilicate minerals. After irradiation, with the increase of the irradiation dosage under the same confining pressure, the shear strength of bentonite increased, and the peak shear strength of bentonite had gradually increased, due to the change in the mineral composition. With the increase of confining pressure, the strength increase trend gradually slow, and the effect of irradiation dose on the strength turned to be weaken, which indicates that the confining pressure inhibited the strength growth Bentonite. Due to the decrease of montmorillonite content after different irradiation effects, the expansion force of bentonite was also weakened in logarithmic law. The free expansion and loaded expansion strain decreased in different ratios. The expansion deformation ratio decreased slowly till it reached to a constant.

キーワード：irradiation aging、Na-bentonite、montmorillonite、mechanical strength、swelling property
Keywords: irradiation aging, Na-bentonite, montmorillonite, mechanical strength, swelling property

Availability of natural attenuation of persistent organic compounds in acid sulfate soils distributed in a coastal area

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Coastal acid sulfate soils are naturally generated sediments, mainly containing iron sulfides. When this soil exposure to air, they undergo leaching of sulfuric acid due to the oxidation of iron sulfides. The oxidation has an undesirable influence on plants and ecosystems, and serious damaged sites are artificially remediated. However, iron sulfides also have the potential to degrade toxic VOCs (Volatile Organic Compounds) and persistent organic compounds. These remediation properties have only been observed in laboratory experiments. This study investigated the natural distribution of acid sulfate soils at the mouth of a river, and their remediation ability. These soils are distributed a small scale in southern Japan; Iriomote Island was used as the study site. Coastal acid sulfate soils were found from the surface in the downstream portions and decreased the distribution in the upstream. The surficial acid sulfate soils in upstream areas had already oxidized and leached sulfuric acid. The degradation rate of sampled acid sulfate soils for dieldrin was found to increase with iron sulfide content, and was not affected by organic carbon clearly. The decomposition of dieldrin are controlled by the chemical reactivity of iron sulfides in natural systems, independent of microbial activity.

キーワード：自然減衰、残留性有機化合物、酸性硫酸塩土壌、酸化分解
Keywords: Natural Attenuation, Persistent organic chemicals, acid sulfate soil, oxidative degradation

Characterization of Dioxins in Sewage Sludge

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Dioxins are a group of chemically-related compounds that are highly toxic. They are mainly byproducts of industrial practices and can be produced through a variety of incineration processes such as improper municipal waste incineration and burning of trash. Although technologies are available that allow for controlled waste incineration with low dioxin emissions in recent years, environmental contamination by dioxins remains one of big issues today because they are chemically stable and resistant to degradation in the natural environment. Dioxins are found throughout the world in the environment and they accumulate in the food chain, mainly in the fatty tissue of animals, and may result in high concentrations in sewage sludge.

Characterization of dioxins in sewage sludge is not easy because they have a variety of congeners and have strong adsorption to organic matters. Referring to CEN/TS 16190: 2011, and using the sample provided by Federal Institute for Materials Research and Testing, BAM, this study examined the analytical accuracy of dioxins in sewage sludge by using gas chromatography with high resolution mass selective detection (HR GC-MS). In addition, a comparison between the results obtained by using different columns, specifically, BPX-DXN(SGE) and RH-12ms (Inventx) was made to investigate potential effects from the column being used.

The results demonstrated that both BPX-DXN(SGE) and RH-12ms (Inventx) can be used to analyze dioxins with an acceptable accuracy, i.e., the effects of column are negligible. Comparisons with the results obtained from other laboratories demonstrated that the skillfulness of operators and detailed conditions for extraction could be the major reasons that induce significant analytical errors. Test results were certified by BAM and, therefore, the procedures and approaches used in this study may provide a standard reference for characterizing dioxins contained in sewage sludge.

キーワード：Soil Contamination、Dioxins、Sewage Sludge、Analysis Accuracy、Standardization
Keywords: Soil Contamination, Dioxins, Sewage Sludge, Analysis Accuracy, Standardization

Experimental Setup and Application of High-Precision Fiber Bragg Grating Sensors for Laboratory Core Flooding Monitoring

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The fiber optical sensing (FOS) data from CO_2/brine flooding experiments are of great significance for geophysicists and reservoir engineers to better understand their experimental phenomenon, numerical simulation and field applications in the Carbon Capture, Utilization and Storage (CCUS) projects. The state-of-the-art high-resolution laboratory core flooding apparatus has been designed for CO_2 geological storage and acid gas injection in the Institute of Rock and Soil Mechanics, the Chinese Academy of Sciences, Wuhan, China. This apparatus couples three monitoring techniques of acoustic emission probes, strain gauge and fiber optical sensors into typical sedimentary rocks in core-scale CO_2/brine flooding experiments under simulated in-situ P-T conditions. The main objective of this apparatus is to continuously seize the front of CO_2 plume migration during the coupled process of scCO_2 displacing brine in brine-saturated sedimentary core samples.

In this presentation, firstly we figured out the experimental setup of high-resolution fiber Bragg grating (FBG) Sensors in the laboratory core flooding experimental apparatus. Then, we conducted a series of deionization water and free-CO_2 core flooding experiments on saturated sandstone core specimens under various reservoir conditions. We dynamically monitored the strain responses during the water and CO_2 displacement processes by using three FBG sensor arrays along the axial and radial directions. Finally, we found that the relative strain increased throughout the experiment with the increase in the confining pressure or pore pressure. For the water flooding experiment, the proportions due to the rise of the sequestration pressures were different in each scenario and FBG arrays, and they showed generally positive increases, which can be ascribed to the effective pressure. Meanwhile, the initial arrival time of the precisely characterized strain histories revealed the fronts of the injected water as well as the detailed implications of the CO_2 plume migration during the core-scale flooding processes.

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Keywords: Carbon Capture, Utilization and Storage (CCUS), Core flooding experiment, Fiber optical sensing

Occurrence, Transport Risk and Assessment of *Cryptosporidium*

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Cryptosporidium can infect people when swimming or diving in the recreational water bodies. Here, our work shows findings regarding the transport of *Cryptosporidium* sized-microspheres from soil to the water bodies, which was a potential source of *Cryptosporidium* of water bodies, as well a one-year investigation of the occurrence and distribution of protozoan parasites *Cryptosporidium* in Yunlong Lake, Xuzhou, China. The objective of this work was to investigate the soil chemical characteristic impact on transport of *Cryptosporidium* from the bank soil to surface water bodies, and to evaluate the full-body contact risk of infection of *Cryptosporidium* in the lake. Results show (1) The number of *Cryptosporidium*-sized microspheres transport declined from 25 #/mL to 2 #/mL while the Total Organic Carbon (TOC) in soil increased from 0mg/L to 40mg/L. The number of microspheres washed out reduced sharply with the increased of the content of sodium ion in soil, while the content of sodium ion in soil increased from 0.007mol/L to 0.200mol/L the substitutes washed out reduced from 115 #/mL to 33 #/mL. The transport of microspheres remains stable for the weakly alkaline soil and reduced sharply for the weakly acidic soil, when soil pH rose from 5 to 7, microspheres washed out stabilized at 24 #/mL, but when soil pH rose to 8, microspheres washed out sharply reduced to 10 #/mL. (2) The number of *Cryptosporidium* oocysts were 0-8/10L in water samples and 0-260/g in sediment samples. According to risk assessment, in July, it is the highest risk for swimming or diving (probability of each time infection was 3.66×10^{-3}). Therefore, soil chemical characteristics have an important impact on *Cryptosporidium* transport with runoff. Monitor of *Cryptosporidium* in water bodies is highly recommended after a rain.

Keywords: risk assessment, transport, runoff, Cryptosporidium

Reductive Dechlorination of Carbon Tetrachloride by Microscale Sponge Iron

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Chlorinated hydrocarbons are the most prevalent groundwater pollutants that pose a risk to public health. The degradation of CCl_4 by sponge iron and factors affecting degradation efficiency including acid washing, dosage and initial pH were investigated through batch experiments in this study. Results showed that CCl_4 was effectively degraded by sponge iron and about 75 percent of CCl_4 was transformed into chloroform (CF) by hydrogenolysis process. The rate of CF transformation was slower than that of CCl_4, resulting in the CF accumulation. Surface acid activation showed slight influence on CCl_4 degradation with ZVI. The CCl_4 degradation reactions followed pseudo-first-order kinetics, and the apparent first-order rate constant (k_{obs}) increased linearly with increasing ZVI dosage and the suitable dosage of 20g/L was indicated in terms of surface area-normalized rate constants (k_{SA}). The k_{obs} decreased with the increasing of pH value and the process indicated that the degradation of CCl_4 had a better performance under weak acidic condition.

Keywords: Carbon tetrachloride, Sponge iron, Reductive dechlorination

Study on the conductivity of calcareous sand

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There is an important relationship between the moisture content and conductivity of the salt-containing calcareous sand in the process of groundwater desalination on lime-sand island. The trend of groundwater desalination can be expressed by the conductivity of the salt-containing calcareous sand. But the conductivity of pore water is difficult to measure directly, however, it can be measured indirectly through conductivity and saturation testing of the calcareous sand. An open and bared ground on a lime-sand island is selected to start the conductivity and saturation tests, sensors of temperature, conductivity and water pressure are buried underground at height 0.5, 1.0 and 1.5m to monitor the electrical conductivity and volumetric water content of the calcareous sand. In addition, the chloride ion content and the conductivity of the calcareous sand with different graduation and water contents are measured by laboratory tests. Results shows that the conductivity of pore water is basically linear with the conductivity of calcareous sand, also a linear relationship as between the volumetric water content and conductivity of calcareous sand. The groundwater conductivity in the lime-sand island linear-fitting with the chloride ion content is also illustrated by the local monitoring and laboratory tests, thus the changes of the chloride ion concentration can be reflected by the conductivity of the pore water, then the salinity of calcareous sand and the desalination of groundwater in lime-sand island can be easily evaluated.

キーワード：calcareous sand、conductivity、volumetric water content、linear relationship、chloride ion concentration
Keywords: calcareous sand, conductivity, volumetric water content, linear relationship, chloride ion concentration

Prompt Estimation of Uniaxial Compressive Strength Based on Resistivity and Conductive Alertness of Frozen soil

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Resistivity and conductive alertness is an inherent attribute of frozen soil, and a new method to estimate the frozen soil uniaxial compressive strength quickly is developed based on the resistivity and conductive alertness. The mechanical behavior of the Qinghai-Tibet Railway subgrade filling under load is investigated, indoor frozen soil uniaxial compression tests are conducted with the silt clay of Qinghai-Tibet Railway subgrade filling at different temperatures, resistivity is monitored during the whole test process. In this way, the stress-strain-resistivity curve is obtained, and the influence of temperature on the resistivity and conductive alertness is discussed. Results show that the frozen soil shows the similar properties as a varistor under compressive condition; with the increasing of the compressive stress, the resistivity can be divided into three variation intervals: a reduction zone, a balance zone, and a sharp increasing zone. When the dry density and water content is 1.71g/cm^3 and 17.8% respectively, the original resistivity, maximum resistivity, and the largest tangent modulus of the frozen soil increase simultaneously with the temperature decreasing. The relationship between uniaxial compressive strength(q_u) and original resistivity of the frozen soil satisfies with the equation, a new method of frozen soil strength quickly estimation is proposed and owned wide prospects of engineering application in the future.

キーワード：Frozen soil、uniaxial compressive strength、temperature、resistivity、tangent modulus
Keywords: Frozen soil, uniaxial compressive strength, temperature, resistivity, tangent modulus

Remediating fluoride and boron contaminants from water using envelope of carbon particles and nano fibrous filters.

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Background: Extreme fluoride concentrations have been reported in ground waters of more than 20 developed and developing countries including India, South America and Europe, out of which alone in India, 19 states are facing acute fluorosis problems. Various technologies are being used to remove fluoride from water but still, the problem has not been rooted out. Problems of similar short are stated for Boron too, though not in the same geographical coordinates. The boron contamination is quite an issue for European context. Hence the issue can be applied for remediation irrespective of geographical coordinates. The main problem with an assessment of fluoride contaminants is that they are not needed to be decontaminated fully if done so then it has some adverse health issues are apprehended. So measuring the concentration of fluoride and boron contaminants in water a filtration system is showcased discovered, which is economically viable and can be implemented in both large scale and small scale modules. The main objective of this paper is to showcase the decontamination of fluoride and boron from the water using carbon particles and nanofibrous filter.
Results: In this work, different concentration of carbon nanoparticles were used for decontamination of fluoride and boron contaminants using column separation method and hence its kinetics and stability were measured and fit to be an efficient system of filtration. Since the experimental set up was navigated at different contact times the efficiency of the whole filtration system was found to be 93 % in case of boron contamination and 87% in case of fluoride contamination. Finally, different envelope pouch of filters was tested at different concentration levels to cross check the efficiency of the filtration system.
Conclusion: This major system of filtration is quite cost effective and easy to fit use mechanism using Nanofibrous filters and carbon particles. This filtration system has important applications in terms of groundwater remediation, wastewater treatment even at industrial scale.

Keyword: Nano-Fibrous filters, Fluoride & boron decontamination, Carbon particles, Sorption, Column Filtration,

Keywords: Nano-Fibrous filters, Fluoride & boron decontamination, Carbon particles, Sorption, Column Filtration-water, Water- Sustainability nexus