was to investigate U (VI) reduction by indigenous bacteria in uranium-bearing black shale sediment and to determine whether microbially-precipitated uranium has long-term stability in subsurface. Through this study, fundamental information on the effects of microorganisms on the fate of redox-sensitive elements in natural settings will be provided. Soil and sediment samples were collected from uranium-bearing black shale in the Dukpyung area in Korea. Microbial inoculum was prepared from soil and sediment slurry supernatant. The reactors were purged with $N_2 : CO_2$ gas (80 : 20) to maintain anaerobic condition. Glucose, acetate or lactate was added as an electron donor at a final concentration of 5 mM. The reactors were incubated for 40 days at 30°C and concentrations of U, Fe and anions were monitored at set time interval. Uranium was removed from microbial solutions faster than controls. Since dissolved form of U is considered to be U (VI), the result indicated that indigenous bacteria initiated the reduction of U (VI) through either biological or chemical reaction and thus precipitation of uraninite. The observed decrease in dissolved U implied that microbial *in-situ* stabilization of uranium in deep subsurface can be expected. The activity of indigenous bacteria also led to the formation of black precipitates, which were proved to be mackinawite (FeS 0.9) after XRD and SEM-EDS analyses. It seemed that indigenous bacteria reduced Fe^{3+} and SO_4^{2-} into Fe^{2+} and HS^- , respectively, and these two combined to form mackinawite. It is important to consider the risk of uraninite reoxidation after *in-situ* reduction and precipitation in aquifer. However, the biogenic mineral mackinawite may prevent uranium from being re-oxidized even though unexpected change in subsurface environment happens. Indigenous bacteria were observed to be capable of immobilizing uranium in anaerobic sediment with various organic materials supplied. The indigenous bacteria reduced Fe^{3+} and SO_4^{2-} , leading to the formation of mackinawite which can enhance the stability of precipitated uranium. The present results suggest that *in-situ* stabilization of uranium is possible and it may be effectively used in remediation of uranium in contaminated subsurface.

Key words uranium; indigenous bacteria; reduction; black shale; *in-situ* stabilization

The simulation of airborne disease virus transmission in group buildings

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With the densification of population and the deterioration of urban ecological cycle, the airborne disease virus is becoming a new crisis for human. It is well known that airborne disease virus such as smallpox, hives, mumps and SARS can cause respiratory disease by the aerosol of sneezes or cough of infected person. The pathogens release virus aerosol to the environment. If the virus can live some time in the air, it can go with air flowing far away. The aim of the present research is to simulate the transportation of airborne disease virus in a group of buildings by taking into account the time-dependent virus aerosol source. A commonly used virus-host dynamical model is introduced to simulate the time-dependent development of virus aerosol releasing process. The wind velocity field is described by the continuity equation, momentum equation and turbulence model to enclose the Reynolds stress in the momentum equation. The RNG model is used in all simulations. The aerosol of microbial pollutant is assumed flowing at the same velocity as the air. The computation time is one life cycle of virus T. We assume that the pathogens release virus aerosol at the upper wall of building A. The conclusions are: (1) The microbial pollutant begins to be discharged after its delitescence $1/12$ T. As the virus goes into logarithmic growth period, the concentration of virus and the pathogenic area increase very fast. After entering the virus decay period ($1/3$ T), the pathogenic area decreases. It should be noticed that no secondary infection is considered in present simulation. Generally, as the virus concentration is above the pathogenic concentration, new pathogens will be infected and release virus aerosol to the environment. With the increase of new pathogens, the pathogenic area would increase very fast and finally result in the outbreak of infection. The coming paper will consider the secondary infection case. (2) For the above arrangement of buildings and the pathogens releasing virus from the upper wall of building A, the virus can threaten two sides of building A and building B and one side of building C. The other two buildings suffer few effects. Numerical results show that the effects of virus are possible to be reduced by proper arranging the position of buildings according to the wind speed and direction.

Key words numerical simulation; airborne disease virus; virus transmission; group building

Chemical reduction of nitrate by nanoscale Fe/Ni bimetallic particles

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Nitrate (NO_3^-) is a common contaminant of groundwater due to the intensive agricultural activities and special overfertilization. Nitrate itself is relatively nontoxic, but it can be reduced to nitrite (NO_2^-) which may cause cancer and methemoglobinemia. So application of treatment technologies to remediate nitrate contamination is necessary. In recent years, significant numbers of studies have focused on the denitrification by chemical reduction. Extensive research has reported that reduction of nitrate can be coupled to the oxidation of zero-valent iron (FeO), and nanosized zero-valent iron has more reactivity than microscale FeO due to its special physical and chemical properties. However, most investigations have shown that during the denitrification process with FeO, the main end-product is ammonium (NH_4^+). Catalytic reduction system has been demonstrated that it may enhance the production of benign product N_2 . In order to improve the selectivity to N_2 of FeO, we discussed the denitrification of nitrate using nanosized Fe/Ni bimetallic particles. Fe/Ni bimetallic nanoparticles were prepared by synchronized liquid phase-synthesize method. The particles were characterized by transmission electron microscope (TEM) and the results showed that the particle sizes were in the range of 30–50 nm. Freshly prepared nanoparticles with various loading (1.0%, 5.0%, 10% and 20%, w/w) of Ni were used to remove nitrate immediately with the concentration $80 \text{ mg NO}_3\text{-N} \cdot \text{L}^{-1}$ at neutral pH condition. Compared to nanoscale FeO, Fe/Ni nanoparticles increased the reaction rate obviously and the loading 5% of Ni has the most reactivity, in which Fe acts as the reductant and the second metal, Ni acts as a catalyst and the pH of the solution increased to 9 at the end. The effects of various initial NO_3^- concentrations on the denitrification and the removal of NO_2^- with nano-Fe/Ni were also investigated. The kinetics of chemical reduction of nitrate was discussed. The results showed that nitrate reduction by Fe/Ni nanoparticles undergo two steps: Firstly, NO_3^- was adsorbed onto the particle surface and reduced to NO_2^- ; Then NO_2^- was reduced to NH_4^+ and desorbed from nanoparticle surface to solution. NH_4^+ also was the main end-product, and NO_2^- was the interim-product and no NO_2^- existed in solution at last.

Key words zero-valent iron; nanoscale; bimetallic particle; denitrification; nitrate

Associations and mobility of uranium in soils near a depleted uranium (DU) weapons testing site, SW Scotland

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Natural uranium has three isotopes, ^{238}U , ^{235}U and ^{234}U , with natural abundances of 99.27 atom %, 0.72% and 0.0055%, respectively. Only ^{235}U is fissile and the production of nuclear fuel and nuclear weapons involves enrichment of uranium in ^{235}U . This process also results in separation of ^{234}U from ^{238}U , leaving depleted uranium (DU), with typical $^{234}\text{U}/^{238}\text{U}$ and $^{235}\text{U}/^{238}\text{U}$ activity ratios of about 0.19 and 0.013, respectively, as a waste product. The high density, high melting and boiling points and chemical stability of uranium and the availability of DU in relatively pure form mean that DU has many uses, including armour-piercing munitions. Such munitions have been developed in the UK since the 1960s and testing has been carried out by the Ministry of Defence (MoD) at firing ranges such as Dundrennan, SW Scotland and Eskmeals, NW England. The firing of DU munitions can result in the dispersion of DU and its combustion products (oxides) as aerosols or as larger fragments, with the potential for human exposure either directly at the site of detonation or via post-depositional migration in the environment. The aim of this work was to investigate the potential environmental mobility of DU by characterizing the associations of U in soil porewaters with increasing distance from a firing site. To this end, several soil cores located down-wind of the firing site at Dundrennan, near Kirkcudbright, SW Scotland, were collected in May 2006. These were sectioned on-site into 1- or 2-cm depth intervals and porewaters were isolated by centrifugation (10 minutes; 8873 g) on return to the laboratory. Following filtration through 0.2-micron cellulose nitrate filters, the porewaters were analyzed by ICP-QMS (U concentration) and ICP-OES (Fe, Al, Ca, Mg, Mn concentrations). Sub-samples were also subjected to centrifugal ultrafiltration (100, 30, and 3 kD) and to gel electrophoretic fractionation (agarose; 0.045 M Tris-borate; 20 mA, 30 minutes). Results showed that U was present at up to $4 \mu\text{g/L}$ in the soil porewater and that the associations of U varied with sample location and soil depth. In particular, ultrafiltration and gel electrophoresis in combination with UV/vis spectroscopy and ICP-OES and ICP-MS analyses enabled isolation and characterization of the U associations with colloids of different sizes and compositions. The findings of this study therefore have important implications for the mobility of uranium in soils and its possible transfer to receiving waters.

Key words depleted uranium; colloid; organic matter; gel electrophoresis; ultrafiltration