Department of Applied Nuclear Technology

Key words Radiation protection, Safety assessment, waste management, Environmental radioactivity, magnetic separation, Microplastics

Doctor of Engineering/Associate professor

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Education

Division ofSustainable Energy and Environmental Engineering,Engineering,Osaka University.
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Professional Background

Research on treatment method of soil containing radioactive materials and safety assessment of several situations in waste management stream and radiological protection in existing exposure situation

Consultations, Lectures, and Collaborative Research Themes

safety assessment ofradioactive materials / Currentstatus ofreconstruction ofdisaster area after TEPCO Fukushima DaiichiNuclear Power Plant accident/ Radiation transport calculation, safety

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Main research themes and their characteristics

「Behavioral of radioactive Cs in soil in the early stage after environmental release and its application to waste treatment」

To know the interaction between radioactive materials and environmental samples, especially soil. It is one of the basic information that is important for understanding the behavior of radioactive materials in the environment or for safe management of radioactive waste. Previous studies have shown that as time passes after the accident, 137Cs migrates to the strong adsorption sites of clay minerals and becomes difficult to move. In Fukushima, vermiculite (weathered biotite) in soil has strong adsorption sites with high Cs selectivity, and it has been revealed that Cs is concentrated.

In this study, it was used as an adsorbent for Cs by further promoting the concentration of Cs in vermiculite that already exists in the soil. As a result of an experiment using 75 km of soil in Fukushima prefecture containing radioactive substances, Cs existing in relatively large particle size categories such as gravel an silt were transferred to clay minerals of small particle size by using potassium ion as Fig1 _ The shift of the radionuclide to clay minerals by chemical washing an extractant. , It was demonstrated that it is possible to concentrate. A higher volume reduction rate was achieved by combining this chemical transfer treatment with the magnetic separation method. We proposed a waste treatment method to recover vermiculite with high Cs concentration by magnetic separation method, and verified the possibility using the local soil.

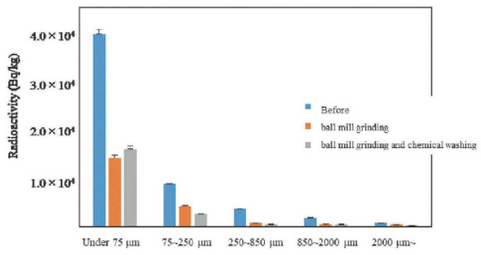

Fig.1 Shift of radiocesium from sand to clay minerals by chemical washing

「Research of Separation Method of Microplastics」

In recent years, marine pollution caused by marine debris, especially microplastics, has become a global problem. In this study, we investigate a separation method of microplastics by electromagnetic Archimedes force under controlled electric and magnetic fields, taking advantage of the fact that plastics are insulators and seawater is an electrolyte. Here, a flow channel with a square cross section is installed in a solenoid-type superconducting magnet, and a pair of electrodes are installed on the side of the flow channel.The right figure shows the results of a simulation of the separation of polyethylene spheres of 0.2 mm diameter from the left end of the channel to the right end of the channel in the region where electric and magnetic fields are applied, while the particles flow in the vertical direction.The right figure shows the trajectory of particles moving to the right in the figure due to the electromagnetic Archimedes force from the left end of the channel to the right end of the channel in the region where the electric and magnetic fields are applied.Since the magnetic Archimedes force is proportional to the magnetic flux density, highly efficient separation is possible under a strong magnetic field.This is the reason why the magnetic Archimedes force is proportional to the magnetic flux density. In addition to this, verification of simulation results by experiment and a new separation method for microplastics using magnetite as an adsorbent for plastics are also being studied.We are also investigating a new separation method for microplastics using magnetite as an adsorbent for plastics.

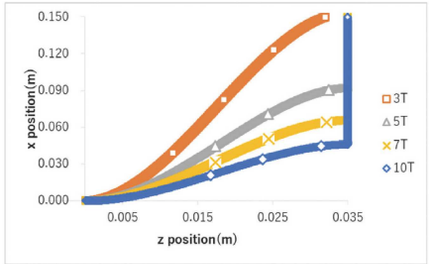

Fig.2 Dependence of the external magnetic field on the trajectory with a particle size of 0.2 mm under conditions of flow velocity 0.2 m / s, current density 0.93 A / cm 2 , and electrode length 120 mm.

Major academic publications

Naoki NOMURA, Kazuki SEKIYA, Fumihito MISHIMA, Yoko AKIYAMA, * and Shigehiro NISHIJIMA,
“Volume Reduction of Contaminated Soil by Physical and Chemical Migration of Radioactive Cesium”, J. Soc. Remed. Radioact. Contam. Environ. Vol.4, No.4, pp.337 - 346, 2016

N.Nomura, F.Mishima, and S.Nishijima,”Separation of micro-plastics from sea water using electromagnetic archimedes force”, Progress in Superconductivity and Cryogenics
Vol.25, No.3, (2023), pp.18~21