Water & Environmental Engineering Laboratory-WEEL Research Output-2021

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Abstract

This report summarizes the research activities and research output of the Water and Environmental Engineering Laboratory (WEEL) in year 2021. Several types of research have been conducted on environmental remediation, environmental protection and bio-renewable energy generation. the research output from WEEL has listed in this report as published scientific journal articles and conference proceedings.

Keywords

Permeable Reactive Barrier (PRB); column experiment; column filter system; lab-scale systems; Microbial Fuel Cells (MFC); electricity generation; nanotechnology; resources recovery; noble nanomaterials; characterization devices; Transmission Electron Microscopy (TEM); Scanning Electron Microscopy (SEM); X-ray diffractometer (XRD); synthesized nanomaterials; BET surface area; particle size analyzers; heavy metals; arsenic; chromium; radioactive elements; cesium and strontium; antibiotics; antimicrobial-resistant geneses; surface water; groundwater; shallow groundwater treatment; deep aquifers; biomaterial; microalgae; nanoplastic; microplastic particles; industrial wastewater; anaerobic digestion system; renewable bioenergy; methane production; biogas production; activated sludge; agricultural byproduct; renewable energy.

1. Introduction

In the Water and Environmental Engineering Laboratory (WEEL), our research team focuses on environmental remediation techniques, environmental protection and renewable energy generation. Hence. We are using the advantages and the benefits of nanotechnology to clean our environment, especially for water treatment and resources recovery from waste.

2. Methodology

We are synthesizing various types of noble nanomaterials which have an extremely small size, high surface area to volume ratio and high surface reactivity compares with bulk materials.
Our lab has accessibility to different characterization devices which used to reveal the physical and chemical properties of our synthesized nanomaterials. For instance, the transmission electron Microscopy (TEM) is used to investigate the morphological structure of nanomaterials.
Also Scanning Electron Microscopy (SEM) is employed to obtain surface topography and composition of our synthesized nanomaterials. Moreover, we use X-ray diffractometer to define crystallinity and detect the chemical composition of the synthesized nanomaterials. BET surface area and particle size analyzers are used to measure the specific surface area and particle size for the synthesized nanomaterials.

We have conducted intensive research to remove the pollutants from water, including Heavy metals such as Arsenic and Chromium, radioactive elements like cesium and strontium and recovery of nutrients from wastewater such as phosphorus and nitrate.
Currently, we are working on new projects; The first one is about the removal of antibiotics from water which their existence in surface and groundwater threats human and aquatic life by motivating the antimicrobial-resistant geneses.
In the second project, we are investigating the performance of microalgae as a promising environmentally friendly biomaterial for the removal of heavy metals from water.
In the third project, we are working on development of new technology to remove the Nano and microplastic particles from water
We have also developed and designed several lab-scale systems to apply the innovative technologies in real life. For instance, the continuous flow treatment system is an efficient technology that has been developed in our lab to remove the contaminants from industrial wastewater. We also developed a column filter system to investigate the design of a permeable reactive barrier which can be used for shallow groundwater treatment. In another scale we designed a new groundwater lab-scale model to simulate the injection of nanomaterials into deep aquifers.
In addition to the previous projects, we are also working on renewable bioenergy development especially methane production by anaerobic digestion system. In this we introduce nanomaterials into an anaerobic digestion system to improve the efficiency of methane production from activated sludge and agricultural byproduct as a source of renewable energy.
In another project, we are utilizing the nanomaterials within Microbial Fuel Cells (MFC) to increase the direct electricity generation by enhancing the microbial activity and electrons transfer inside the MFCs.

3. Conclusions

In WEEL, we believe that a safe and clean environment is essential for maintaining sustainable societies, ecosystems, and economies.
Finally, we would like to welcome all Japanese and International researchers and students to join or visit our laboratory in the future.

4. References

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