

THE EDUCATION UNIVERSITY OF HONG KONG
FACULTY OF LIBERAL ARTS AND SOCIAL SCIENCES

Research Impact Prize for the Dean's Research Fund 2018-19

Brief Introduction of Awardee's

Research/KT Publication/Study/Output and Future Research/KT Development

Awardee (Dept): Dr. Li Wai Chin, Assistant Professor (SES)
Publication Title/KT project: Biochar and fate of heavy metal in soil & heavy metal in rice grain

- A. *Briefly introduce your research/KT publication/study/output for which you have received the prize.*

Several remediation strategies for heavy metal contaminated soils have been developed, including physical treatment, chemical treatment, electro kinetics remediation, biological remediation and phytoremediation. At present, an in situ stabilization technology with exterior amendments is considered to be environmentally safe, low-cost and highly efficient to alleviate toxicity and reduce the bioavailability of heavy metal in contaminated soils. There are many fixing amendments in organic, inorganic, combined organic and inorganic materials such as zeolite, biochar, crop residues etc. Biochar is an abundant source of organic compound by pyrolysis of biomass wastes, which contain wood chips and crop straw under a limited oxygen environment. Many studies have shown that biochar has potential to the remediation of heavy metals in contaminated soils. As a soil amendment, biochar has many positive properties, such as a large specific surface area, microporous structure, active functional groups which could immobilization heavy metals.

Our team has evaluated the cadmium (Cd) immobilization effects of sulfur or sulfur-iron modified biochar and its related microbial community changes in Cd-contaminated soils. Sulfur-modified biochar and sulfur-iron modified biochar addition increased pH value and the content of soil organic matter, and also decreased DTPA extractable Cd. There is a negative significant correlation between organic matter content and the available Cd in soil. The improvement of soil fertility and the reduction of Cd bioavailability are more important mechanisms for higher bacterial abundances. In short, the study has the potential for developing the remediation method of Cd-contaminated soils.

Arsenic (As) is a highly toxic and carcinogenic metalloid, which has received increased attention as the result of reported As contamination. Many anthropogenic activities have led to As contamination of soil, including the use of pesticides, herbicides, phosphate fertilizers, and wood preservatives, as well as the semiconductor industry, glass industry, mining, and smelting. Arsenic is easily ingested through the consumption of rice, and thus, it has a detrimental effect on human health through the food chain. Continuous As exposure can cause skin, lung, and bladder cancer and can lead to breathing and neurological problems as well as cardiovascular diseases. Our team has investigated the effects of biochar modified with Fe-oxyhydroxy sulfate (Biochar-FeOS), FeCl₃ (Biochar-FeCl₃), and

zero-valent iron (Biochar-Fe) on the pH, NaHCO₃-extractable As concentrations, and the As fractions in soils. Addition of Biochar-FeOS, Biochar-FeCl₃, and Biochar-Fe had no significant effects on the soil pH but significantly decreased the contents of NaHCO₃-extractable As in soils. Biochar-FeOS, Biochar-FeCl₃, and Biochar-Fe treatments decreased the concentrations of non-specifically sorbed and specifically sorbed As fractions in soils, and increased the amorphous and poorly crystalline, hydrated Fe, Al oxide-bound, and residual As fractions. Compared with the other iron-modified biochars, biochar-FeOS showed the most effective immobilization and has the potential for the remediation of As-contaminated paddy soils.

These studies highlight the potential mechanisms for the remediation of contaminated paddy soils and contribute to the understanding of biogeochemical dynamics of pollutants in soil.

B. How you used/will use your prize and perhaps its usefulness to your research/KT development?

Based on the existing background information, the long-term effect of the modified biochar on pollutants immobilization in contaminated soil and the effects of the biochar on microorganisms, shall be further systematically investigated.

C. Expected research/KT outcomes/outputs/impacts arising from this prize.

The data generated will assist the preparation of a GRF proposal.