The First International Conference on Biochar Research and Application

第一届生物炭研究与应用国际研讨会

September 20-23, 2019
Shenyang Liaoning China

ABSTRACT

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Abstract

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Toxicity/bioavailability assessment of pesticide contaminated sediments amended with carbonized sugar beet pulp and miscanthus

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Abstract

Aquatic sediment represents a sink for toxic and persistent chemicals such as hexachlorobenzene (HCB) and lindane (γ-HCH). This paper investigates the possibility of reducing the environmental risks associated with the presence of these pollutants in sediments by amending the sediment with carbonized waste biomass to sequester the contaminants and render them biologically unavailable. Sugar beet pulp (SB) and miscanthus (M) waste biomass were converted by thermochemical methods: (1) hydrochar (HTC) – hydrothermal carbonation at three temperatures (180°C, 200°C, 220°C) and (2) biochar (BC) – slow pyrolysis up to 400°C. The effects of the dose and contact time between the sediment and the carbon-rich amendments on the effectiveness of the imobilization are estimated. Three doses of carbonized biomass (1%, 5% and 10%), and three equilibration contact times (14, 90 and 180 days) were investigated. Results have shown that the bioavailable fraction of γ-HCH and HCB decreased significantly in comparison to the unamended sediment (from 66.4% for γ-HCH, and 74.6% for HCB, to <2% for both compounds). The sequestration potential of amended sediment increases in the sequence HTC_SB <HTC_M <BC_SB <BC_M. Additionally, the increase in the HTC preparation temperature further increases sequestration potential and reduction of bioavailable fractions both compounds in sediment. The increase in the applied dose and the aging time of the prepared mixtures further reduce the bioavailable fraction, compared to the untreated sediment. Toxicity of amended sediment assessed by *Vibrio fishery* luminescence inhibition test and by measuring *Zea mays* germination and biomass yield was significantly reduced in the BC amended sediment and increased in the HTC amended sediment. γ-HCH and HCB accumulation in the *Zea mays* biomass in the unamended sediment were significantly higher than in the all HTC and BC amended sediment. The obtained results showed that the remediation potential of the produced biochars and hydrochars significantly depends on (1) the feedstock characteristics, (2) the process conditions for the conversion of biomass, and (3) the physicochemical properties of the pollutants.

Keywords: Remediation; Hydrochar; Biochar; Sediment; Hexachlorobenzene; Lindane

Acknowledgement: The authors acknowledge the financial support of the Ministry of Education, Science and Technological Development of the Republic of Serbia, in the frame of projects: TR37004 and III43005.