Improving biochar stability against natural abiotic aging in the environment

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Biochar is considered as carbon sequestration due to its relatively stable carbon structure, but the undergoes weathering in a subsurface environment depending on various surrounding conditions. In other words, the physicochemical properties of biochar vary significantly with consecutive aging, making it completely different from fresh biochar's those introduced initially (Xu, 2018). These aging processes reduce the stability of the biochar, leading to unnecessary changes in the behaviours of heavy metals in the environment where biochar is applied. To this end, it is required to control the stability of biochar against the natural aging process. Most previous studies have reported that the pyrolysis temperature is a dominant parameter determining the stability of biochar. However, the result is too simple and inaccurate (Leng, 2019). Although biomass type and biochemical composition are decisive factors affecting the stability of biochar, it has received only minimal attention. Generally, plant biomass contains biopolymers consisting of cellulose, hemicellulose, and lignin. These biopolymers in the biomass are decomposed of by the biotic aging process including various physical stresses (e.g. water, oxygen, etc.), resulting in changes in the bioavailability and environmental risks of heavy metals after amended to metals-contaminated soil. However, among the biopolymer, lignin has most stable structure unlike (hemi) cellulose composed of aliphatic C chains, thus lignin is relatively resistant to oxidation (Kim, 2020). That is, the lignin content in the biomass is closely related to the stability of the biochar against aging. Therefore, in this study, accelerated aging tests employing wet-dry (WD), freeze-thaw (FT) cycling, and simple incubation with constant moisture have been conducted to predict the long-term stability of biochar depending on the lignin content in the biomass. To verify the hypothesis, sawdust of fir, oak, and pine wood adjusted the amounts of lignin were pyrolyzed at 400 ℃. The characteristics of biochar (DOM leaching, functional group, pH, etc.) with/without aging and the mobility of Pb, Cu, Zn, and As in the biochar-amended soil were evaluated.

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