Green remediation of cadmium-contaminated soil by cellulose nanocrystals

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Abstract: Cellulose nanocrystals (CNC) were used as a novel, green eluent to remediate Cd-contaminated soil in this study. The influence of washing conditions on the removal of Cd, including CNC concentration, pH value, liquid/solid (L/S) ratio, contact time and temperature were investigated. The effect of CNC remediation of Cd-contaminated soil on soil health and the possible remediation mechanism were also explored. The results showed that CNC concentration, pH value and contact time had a significant effect on the removal efficiency of Cd. CNC rapidly removed heavy metals in soil within 30 min. When the pH value of the eluent was 9.0, the removal efficiency of Cd could reach 86.3%. The eluent mainly removed exchangeable and reducible fractions of Cd, which could effectively reduce the bioavailability of heavy metals. CNC washing had no negative effects on seed growth, species abundance and Shannon index. C-O, $-COO^-$ groups on CNC played an important role in the reaction between CNC and soil Cd, and other oxygen-containing functional groups on CNC could also assist in adsorption, ion exchange and chemical complexation processes. Therefore, cellulose nanocrystals had the potential to remediate heavy metal-contaminated soils in a green and efficient manner.

Keywords: Soil washing; Cellulose nanocrystals; Cadmium-contaminated soil; Soil health; Remediation mechanism