Rice Straw Phytolith to enhance CO2 capture: Ideas for sustainable management of rice straw and reduction of greenhouse gases from paddy soils

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Silicate weathering processes have immobilized CO2, contributing to the regulation of greenhouse gas effects. Due to the similarity between composition of silicate and phytolith (an amorphous silica defined as Si precipitated in plant), it is hypothesized that phytolith is also able to sequester CO2 in form of HCO3-/CO32-. In this work, rice straw phytolith (RSP), a common residue from on-site burning of rice straw after harvesting, was examined in terms of CO2 capture via batch adsorption experiments with a CO2 aeration system. Captured amount of CO2 was calculated by monitoring CO2 release from aeration system which was adsorbed in NaOH solution with phenolphthalein as an indicator. pH, solution chemistry, and surface charge of RSP were monitored to provide relevant data on the interaction between CO2 and phytolith. A comparison in discolorations of NaOH solutions was utilized to assess RSP's ability to capture CO2. Presence of RSP resulted in a pH increase from 7.0 to 9.9 while in CO2 aeration, the pH increased from 5.2 to 5.7. This suggested for a release of alkaline metals accompanying with dissolution of phytolith structure, which motivated CO2 sequestration. The presence of CO2 decreased phytolith dissolution from 31.9 to 18.8 mgSi /L and increased surface charge from -1001 to -605 mV, suggesting that H+ or alkaline ions neutralized phytolith surface charge, whereas the concentration of H+ might sequester more CO2. It is suggested that as an enhancer of CO2 capture, RSP may reduce CO2 emission in paddy areas and contribute to the sustainable management of rice straw. The role of phytolith in reducing CO2 on a global scale should be investigated and will be included in our further studies.

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