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Effects of Calcium Silicate-Containing Civil Construction Waste on Soil N_2O Emissions

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Abstract

Currently, there is a trend to utilize calcium silicate ($CaSiO_3$) containing civil construction waste as a soil amendment or conditioner in Japan as well as in European countries. Autoclaved lightweight Aerated Concrete (AAC) is a $CaSiO_3$ containing porous material made from industrial waste of civil construction. AAC is utilized as a soil amendment that can influence terrestrial carbon dioxide (CO_2) emissions. Still, no evidence exists regarding its impact on the emission of nitrous oxide (N_2O), which has a higher global warming potential than CO_2. This study investigated the impact of AAC (Inenica, Clion Co., Ltd, Japan) on N_2O emissions from paddy soil under both compacted and non-compacted conditions, at 60% and 100% Water-Holding Capacity (WHC). Samples (24) were incubated in glass vials (25°C) for 21 days. During the incubation, the vials were covered with a polyethylene film (0.02 mm thickness) to ensure minimal evaporation while maintaining air exchange. Emissions of N_2O were measured at 0 (incubation starting day), 1,3,7,14 and, 21 days using gas chromatography during the incubation period. All measurements were performed in triplicate. In addition, a separate set of samples was incubated under the same conditions for NH_4^+-N, and NO_3^--N measurements. Results revealed that AAC significantly (p<0.05) lowered N_2O emission during the whole period of incubation. The cumulative N_2O emissions of samples with AAC were approximately 43% and 51% lower, respectively, in compacted and non-compacted soils, compared with samples without AAC at 60% WHC. At 100% WHC, the cumulative N_2O emissions of samples with AAC in compacted and non-compacted soils respectively, showed 52% and 67% decline (significant at p<0.05), compared with samples without AAC. When compacted, the N_2O was significantly high, showing the influence of soil physical conditions, and N_2O emissions were significantly lower at higher WHC (100%). AAC suppressed N_2O emissions from soil under both compaction and WHC levels. Results confirm that AAC supports suppressing terrestrial N_2O emission, indicating its potential as a sustainable soil amendment that enhances climate change resilience.

Keywords: *Autoclaved lightweight aerated concrete, Calcium silicate, Greenhouse gases, Nitrous oxide*