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Suppression of Carbon Dioxide Emissions from Soil Amended with Autoclaved Lightweight Aerated Concrete Under Different Compaction and Moisture Conditions

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Abstract

Carbon dioxide (CO_2) emissions has been highlighted worldwide as a contributor to the greenhouse effect. Soil physical characteristics such as bulk density and moisture content can influence the emissions of greenhouse gasses (GHGs) from soil. Soil conditioners applied to soil can also affect the terrestrial CO_2 emissions. Autoclaved lightweight aerated concrete (ALC) is in use at present as a soil conditioner or calcium silicate fertilizer, it is a type of porous material made from industrial waste. In this study, we determined the effect of ALC (Inenica, Clion Co., Ltd, Japan) on CO_2 emissions from paddy soil with considering soil compaction and moisture content. Laboratory experiments were conducted using soils with and without ALC (0 and 5%), under two levels of compaction (compacted and non-compacted), and two soil moisture contents (60% and 100% water holding capacity: WHC) in 200 mL glass vials. All treatments with triplicates were incubated at 25° C for 21 days under aerobic conditions. Emissions of CO_2 were determined at 0, 1, 3, 7, 14, and 21 days using gas chromatography with the thermal conductivity detector. The addition of ALC significantly decreased CO_2 emissions from soil at the early stages of incubation. Emissions of CO_2 were significantly lower at 100% WHC than at 60% WHC. Non-compacted treatments showed significantly higher emissions of CO_2 than compacted treatments during the incubation time period. This is possibly due to improved soil aeration and porosity, which enhanced the activity of soil microorganisms responsible for the decomposition of organic matter. The interactions between moisture content with ALC addition and compaction on cumulative CO_2 emissions were statistically significant ($p<0.05$). The effect of ALC addition on CO_2 suppression was more effective at compacted and 100% WHC (51% reduction compared with control). Our study suggested that precise dosage of ALC application (5%) can effectively reduce CO_2 emissions from soil, under 100% WHC and compaction conditions than 60% WHC and non-compaction conditions.

Keywords: Aerobic, Autoclaved lightweight aerated concrete, Carbon dioxide, Compaction, Moisture content