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A Systematic Study on the Greenhouse Emissions from a Community Composting System Implemented in a Primary School at Universitat Autònoma de Barcelona, Spain

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Abstract

As stated by European regulations, biowaste must be source-separated and collected for its proper treatment and valorisation for resource recovery. In Spain, new legislation requires municipalities to totally separate in origin domestic biowaste by the end of 2023, highlighting the fact that domestic or community composting will be one of the best ways to fulfil these requirements. In this context, different communities are being engaged to perform composting as a way to valorise their own biowastes and contribute to the implementation of circular economy strategies. In this sense, the "Citizen Arenas for improved Resource management and Environmental quality (CARE)" project aims to bring the composting science to children at primary schools to raise their awareness on the different environmental impacts that their own organic waste are responsible for, when not properly managed. To achieve the goals of the CARE project, different formation and information sessions have been imparted to professors and students at a selected school in Bellaterra (Cerdanyola del Vallès, Spain) prior to the installation of a community composting system composed by four different 1 m^3 composting modules. The selected school has a daily average generation of domestic-like biowaste of 50 kg, which is daily introduced in the first composting module together with shredded pruning waste locally supplied. At this moment, 450 kg of biowaste has been treated in a single batch, where typical process parameters such as material temperature, interstitial oxygen, humidity and volatile solids content, as well as material biodegradability and greenhouse gases (GHG) emissions, have been monitored continuously. Temperature and interstitial oxygen were measured 2-3 times per week by means of PT-100 probes and an oxygen probe (Sensotran, Spain). Standard methods for compost materials were applied for material characterization. Gaseous emissions were sampled once a week before and after

mixing the material inside the corresponding composting module by means of a dynamic flux chamber, obtaining two 1 L gas samples in two Tedlar bags (before and after mixing) for each sampling event. Then, methane and nitrous oxide were measured by means of gas chromatography (Agilent Technologies, USA). GHG emission factor in terms of g of CO_2 equivalent was calculated using the IPCC Global Warming Potential (GWP) for methane and nitrous oxide, which are 27 and 273 times the CO_2 GWP, respectively. Thermophilic conditions were reached to ensure sanitization during the first active phase, which also coincided with the maximum gaseous emission rates of methane and nitrous oxide, the most significant GHG from composting. Regarding GHG, an emission factor of 25 g of CO_2 equivalent/kg of dry matter was determined, which accounted for a total of 4.7 kg of CO_2 equivalent emitted throughout the composting process operation. To our knowledge, this is the first study on the GHG emissions from an actual community composting system, and it can be of help for further studies.

Keywords: Community composting; biowaste; compost; greenhouse gases emissions

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