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Computational Optimization of Solid-state Anaerobic Reactor Blends

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Abstract

Solid-state anaerobic digestion (SS-AD) is a promising technology for recovering bioenergy from organic waste with high total solids content (over 15%), thus contributing to climate change mitigation. Nevertheless, SS-AD units face process challenges including poor biogas yields, low reaction rates, and process instability, as well as logistics challenges such as feedstock seasonality and transportation costs. Here we propose a user-friendly model that produces optimal SS-AD feedstock mixtures. For each ingredient, model inputs include (a) monthly availability, (b) mixture ratio range constrains, (c) and characteristic property ranges. The model generates uniform random combinations of ingredients from a hyper-rectangle that are subject to a total volume constraint, and ranks resulting mixtures according to user-defined priorities. Initial parametrization is based on biowaste characteristics of agro-industrial waste characteristic of the Mediterranean which the user can modify. Feed mixture outputs can drive appropriate actions to boost biogas production, such as minimizing the organic overloading and excess ammonia. Model applicability is demonstrated with two 12-month scenarios where the desired mixture (a) has minimum moisture and maximum VS content, and (b) includes 50% pig manure. Preliminary results show that model output is reliable and can be useful to SS-AD facility managers for optimizing mixtures.

Keywords: olid anaerobic digestion; biogas, Mediterranean organic waste, mixture, moisture calculator

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