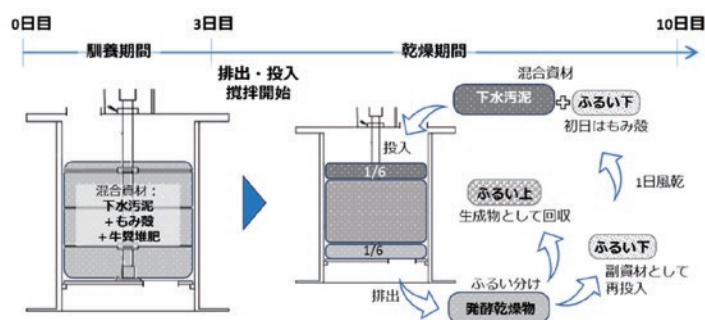


発酵熱を用いた 効率的なバイオマス乾燥方法の検討

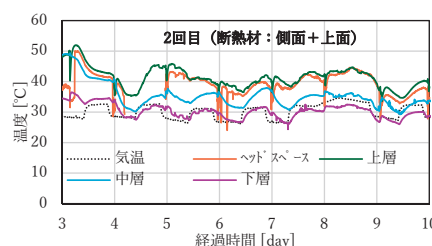
Study on an Efficient Biomass Drying Method Using Fermentation Heat

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連続式発酵試験のフロー



連続式発酵試験における
発酵槽内温度の経時変化

概要

本研究では、下水污泥の固形燃料化に向けた低炭素・低エネルギーな前処理技術として、縦型密閉発酵方式を模擬したバッチ式および連続式発酵試験を実施し、乾燥に適した通気量と断熱条件を検討した。

バッチ式発酵試験では、0.6、1.0 vvmの通気条件で発酵熱により最高53℃まで昇温し、6日後に含水率が大きく低下した一方、1.7 vvmでは発熱・乾燥効果とも限定的で、過剰通気が発酵や保温を阻害する可能性が示された。

連続式発酵試験では0.8 vvmで安定した発酵熱が得られ、ヘッドスペースの保温により温度上昇と含水率低減が促進された。また、排気側温度と通気量が乾燥効率を左右する重要因子であることが示唆された。適切な通気制御と断熱性能の向上により、下水污泥の含水率を約6日で最低43%まで低減でき、さらなる乾燥促進の可能性も確認された。

In this study, with the aim of developing low-carbon pretreatment technologies for converting sewage sludge into solid fuel, we investigated the applicability of a drying acceleration technology that utilizes fermentation heat. We conducted batch and continuous tests modeled after a vertical closed-fermentation system to determine the appropriate aeration rate and insulation method.

The results of the batch tests showed that, at aeration rates of 0.6 and 1.0 vvm, the temperature rose to a maximum of 43–53°C due to fermentation heat, and the moisture content had decreased significantly after 6 days. In contrast, no heat generation was observed at the 1.7 vvm aeration rate, and the reduction in moisture content was limited; this suggests that excessive aeration inhibits either or both fermentation and heat retention.

In the continuous test, stable heat generation from fermentation was confirmed under an aeration rate of 0.8 vvm; it was also found that maintaining the temperature in the headspace effectively increased the temperatures in both the headspace and the upper layer, thereby effectively reducing the moisture content. Furthermore, since the weight loss due to fermentation could be estimated from the saturated vapor pressure in the headspace and the upper layer temperature, it was suggested that the temperature on the exhaust side and the aeration rate are important for reducing the moisture content of the fermented dried material.

Based on the above, it was demonstrated that Bio drying can reduce the moisture content of sewage sludge to at least 43% within 6 days through appropriate control of the aeration rate and improvement of the fermentation tank's thermal insulation performance; furthermore, it was shown that drying could be further accelerated by maintaining the temperatures in the headspace and upper layer while increasing the aeration rate.