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（博士課程）
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論 文 要 旨

THESIS SUMMARY

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学籍番号： Student ID Number		指導教員（主）： Academic Advisor(main)	吉川　邦夫
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要旨（和文 2000 字程度）
Thesis Summary（approx.2000 Japanese Characters ）

The large volumes of lignocellulosic residues which could have been converted into organic fertilizers are burnt in field or regarded as waste each season everywhere in the world. However, it is the nature of lignocellulose to degrade slowly, because microbial access to cellulose, a major biodegradable component of lignocellulose, is inhibited by hemicellulose-lignin association during the composting process. Overall aim of this research was to investigate the hydrothermal treatment (HTT) technology as a pretreatment step in enhancing biodegradability of lignocellulosic residues for organic fertilizer production.

Because many lignocellulose components (e.g. cellulose and lignin) act as carbon sources as well as air-flow supporting materials during composting process, pretreatment which results in total solubilization or collapse of lignocellulose cell wall structure should be avoided. Therefore, initially, the effects of HTT on physicochemical properties and subsequent aerobic degradation of lignocellulose was study. The results showed that 180 °C was the most effective HTT temperature for subsequent aerobic biodegradation by solubilizing the largest portion of hemicellulose (86.5%) within the cell wall, which had two consequences: 1) it supplied additional readily bioavailable form of carbon, which in turn promoted rapid microbial activities in the early stage of decomposition; and 2) it created pores and cavities within the cell wall, which permitted rapid bacterial penetration and cellulose degradation. As a consequence, biodegradation of the residue treated under this reaction temperature proceeded rapidly and stability was reached within 21 days, compared to 63 days of continued degradation for the untreated residue.

Composting of lignocellulosic materials can be associated with high rate of NH_3 loss into atmosphere, i.e. loss of essential nutrient. A simple solution that could prevent NH_3 loss effectively is to add simpler sugars, e.g., the forms of carbon that is readily available for rapid microbial immobilization of nitrogen. Previously, HTT with mild reaction temperature (180°C and 1.0 MPa) was found very effective in solubilization of hemicellulose polysaccharides into simpler sugars (i.e. xyloses and glucose). Thus, attention was directed to examine the effectiveness of HTT (180° C, 1.0 MPa, 30 min) on reducing NH_3 loss during bench-scale composting of lignocellulosic residue. As results, the HTT was very effective for reducing NH_3 loss by solubilizing the largest portion of hemicellulose, which supported microbial immobilization to suppress NH_3 loss in earlier stage of composting, and improved susceptibility of cellulose particles to microbial attack, which supported immobilization to suppress NH_3 loss in later stages of composting. Effect of HTT was also expressed by high nitrogen content: 3.4% in treated residue compared to 2.3% in untreated residue.

The stability and maturity of the final compost product is very important for successful agricultural application. Unstable and immature compost can cause soil nitrogen rubbing, induce oxygen deficiency for plant roots /seeds, create toxicity due to high concentrations of ammonia or various organic acids and promote growth of certain soil pathogens and diseases. In order to allow comprehensive approach for assessing maturity, bin-scale composting of rice straw as a model of lignocellulosic residues was performed following the pilot-scale of HTT. The results showed that the rice straw compost product with HTT after 6 weeks of composting was adequate to be considered a stable and mature, as expressed by C/N ratio of 12.5, microbial stability of < 8.05 mg CO_2 g^{-1} OM d^{-1}, NH_4-N content of 93.8 mg kg^{-1} OM, pH-8.4, EC-2.9 mS cm^{-1} and finally by germination index of >83%. As for rice straw compost product without HTT, the high microbial activity (> 12 mg CO_2 g^{-1} OM d^{-1}) even after 14 weeks of composting suggests that the residue has not stabilized yet and is far away from maturation phase.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 2 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 2 copies of 800 Words (English)