Analisis pengaruh penambahan enzim selulase terhadap penurunan kadar air dan kualitas solid recovered fuel pada proses biodrying sampah organik = The impacts of cellulase enzyme addition on moisture content removal and quality of solid recovered fuel produced in organic waste biodrying

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Abstrak

Komposisi sampah terbesar di Indonesia adalah sampah organik yang dapat dikonversi menjadi sumber energi melalui metode insinerasi. Namun, pembakaran limbah organik secara langsung tidak stabil dan tidak efisien karena kadar airnya yang tinggi. Biodrying adalah teknik penghilangan kadar air dari limbah biomassa dengan bio-heat mikroba dan menghasilkan luaran berupa solid recovered fuel. Permasalahan utama biodrying adalah terbatasnya tingkat penurunan kadar air pada feedstock yang dipengaruhi oleh panas bio-heat dari degradasi senyawa organik oleh mikroba, seperti karbon kompleks, selulosa, hemiselulosa, dan protein di dalam materi biodrying. Penghilangan kadar air pada biodrying dapat ditingkatkan dengan penambahan katalis berupa enzim selulase untuk membantu laju degradasi feedstock organik dan meningkatkan suhu feedstock. Pada penelitian ini, enzim selulase ditambahkan dengan dosis yang berbeda-beda pada reaktor 1, 2, dan 3 sejumlah 0; 0,30; dan 0,45 gram. Feedstock pada reaktor terbuat dari sampah organik dengan kadar air awal sebesar 62 dan C/N rasio 29,50. Biodrying dilakukan dengan reaktor skala laboratorium selama 21 hari dan 5 hari tambahan sebagai usaha untuk menstabilkan feedstock. Parameter fisik, kimia, dan biologis feedstock diamati selama proses biodrying berlangsung, yang menunjukan bahwa kadar enzim selulase pada feedstock memiliki korelasi negatif dengan kadar volatile soild dan rasio C/N feedstock. Pada reaktor yang ditambahkan enzim selulase, terjadi peningkatan profil suhu yang signifikan dan pada reaktor 3 terjadi fase termofilik yang stabil selama 11 hari. Reaktor 2 dan 3 juga menghasilkan penurunan kadar air yang lebih tinggi, yaitu sebesar 26 dibandingkan dengan reaktor 1 sebesar 20 . Penambahan enzim selulase pada biodrying sampah organik juga menunjukan hasil yang positif pada solid recovered fuel yang dihasilkan ditinjau dari nilai kalor SRF reaktor 3 sebesar 3320 kkal/kg dibandingkan dengan reaktor 1 dan 2 sebesar 3174 dan 2838 kkal/kg.
<hr>The largest waste composition in Indonesia is organic waste, which can be converted into alternative energy sources with various method, including incineration. However, direct combustion of organic waste is not efficient in terms of cost and energy due to the high moisture content in organic waste. Biodrying is a technique that optimizes moisture content removal of biomass waste with bio heat produced by microbes rsquo metabolism in feedstock. It also produces solid recovered fuel as an output. One of the main problems on biodrying is the limitation of moisture content removal on feedstock. The moisture content removal process is affected by bio heat that is produced from the degradation of organic compounds such as carbon complex, cellulose, hemi cellulose, and protein by microbes in biodrying material. Moisture content removal on biodrying could be enhanced by adding catalyst, such as cellulase enzyme, to help degrade the feedstock, thus simultaneously enhance the temperature of the feedstock. On this research, cellulase enzyme added with various dosages as much as 0 0,3 and 0,45 gram to the first, second, and third reactor. The feedstock was made from organic waste with moisture content and C N ratio adjsusted to 62 and 29,50. Biodrying was

done in laboratory scaled reactors in 21 days and 5 days addition to stabilize the feedstock. Physical, chemical, and biological parameters were examined during biodrying process. The result showed that cellulase enzyme level during the process has negative correlation with volatile solid and C N ratio on the feedstock. Temperature profile increase was obtained in reactors with enzyme addition. Moreover, the third reactor exhibits more stable and longer thermophilic phase that lasted for 11 days. Enzyme addition also positively influenced moisture content removal, in which the reactors with enzyme addition successfully reached 26 moisture content removal while reactor without enzyme addition only reached 20 . Additionally, cellulase enzyme addition also resulted in higher calorific value of SRF produced from biodrying as shown in SRF produced from the third reactor that reached 3320 kkal kg. Meanwhile, calorific values of SRF from the first and second reactor are 3174 kkal kg and 2838 kkal kg.