

BIOGAS PRODUCTION FROM POULTRY MANURE WASTEWATER
USING SOIL MIXED CULTURE

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ABSTRACT

The resource limitation of fossil fuels and the problems arising from their combustion has led to widespread research on renewable energy resources. Currently, biogas has a great potential as renewable energy in Malaysia due to abundantly available resources. According to Malaysia Department of Veterinary Services, poultry industry in Malaysia was growing annually which contributed in the rising amount of poultry manure wastewater (PMW). Biogas resources from wastewater have potential energy of 7800 TJ/y. Thus, utilizing the increasing amount of PMW, into biogas production was suggested in this study. The design of experiment (DOE) of this study utilized Response Surface Method (RSM) by Design Expert Software. Firstly, biological treatment using soil water was conducted because according to few researchers, more than 1000 mg/L of ammoniacal nitrogen (AN) present in PMW will cause inhibition. The initial AN concentration of PMW used in this study was up to 1490 mg/L. The best suggested condition for PMW treatment from the software was agitation (0 rpm), reaction time (5 hours), type of soil water (SSW), soil to water ratio (1:6) and PMW: soil water (1:4). Utilization of this conditions resulted in 81.90% of AN removal. Next, factorial analysis was conducted to analyze factors affecting biogas production. From the result, agitation gave the highest contribution to biogas production by 24.09%. This showed that agitation was the most affecting factor in this study. Agitation ensures efficient transfer of organic material for the active microbial biomass, to release gas bubbles trapped in the medium and to prevent sedimentation of denser particulate matter. The best suggested condition for factorial analysis of PMW by the software was agitation (120 rpm), reaction time (3 days), substrate to inoculum ratio (4:1), process system (batch), and type of substrate (treated PMW). After factorial analysis, process optimization was conducted. The suggested optimum conditions by the software were validated at agitation (120 rpm) and reaction time (3.3 days). Under this condition, 0.00397 L/g COD of biogas yield was obtained with 30% of methane content. This counts for 5.82% error from predicted value. The result from this study showed that utilization of PMW was a suitable method in biogas production. Along with the process, biological treatment was proved to be applicable as treatment method for AN removal to avoid inhibition.

ABSTRAK

Had sumber bahan api fosil dan masalah yang timbul dari pembakarannya membawa kepada penyelidikan meluas kepada sumber tenaga boleh diperbaharui. Kini, biogas mempunyai potensi besar sebagai tenaga boleh diperbaharui di Malaysia kerana sumbernya banyak didapati. Menurut Jabatan Perkhidmatan Veterinar Malaysia, industri ternakan di Malaysia semakin meningkat setiap tahun yang menyumbang kepada peningkatan jumlah air sisa ayam (PMW). Sumber biogas daripada air sisa mempunyai potensi tenaga 7800 TJ/y. Maka, penggunaan PMW yang semakin meningkat untuk pengeluaran biogas telah dicadangkan dalam kajian ini. Reka bentuk eksperimen (DOE) kajian ini menggunakan kaedah permukaan bermuka (RSM) oleh perisian Design Expert. Sebagai permulaan, rawatan biologi menggunakan air tanah telah dijalankan kerana menurut beberapa penyelidik, lebih 1000 mg/L nitrogen ammonia (AN) dalam PMW akan menyebabkan perencatan. Kepekatan awal AN PMW yang digunakan dalam kajian ini adalah sehingga 1490 mg/L. Rawatan PMW yang dicadangkan dari perisian itu adalah pergolakan (0 rpm), masa tindak balas (5 jam), jenis air tanah (SSW), nisbah tanah kepada air (1:6) dan nisbah PMW kepada tanah air (1:4). Seterusnya, analisis faktorial telah dijalankan untuk menganalisis faktor yang mempengaruhi pengeluaran biogas. Dari keputusan, pergolakan penyumbang tertinggi bagi pengeluaran biogas sebanyak 24.09%. Ini menunjukkan bahawa pergolakan adalah faktor yang paling mempengaruhi dalam kajian ini. Pergolakan memastikan pemindahan cekap bahan organik untuk mikrob aktif biojisim, melepaskan gelembung gas terperangkap dan mencegah pemendapan bahan lebih padat. Keadaan dicadangkan untuk analisis faktorial PMW oleh perisian adalah pergolakan (120 rpm), masa tindak balas (3 hari), nisbah substrat kepada inokulum (4:1), sistem proses (kelompok), dan jenis substrat (PMW terawat). Selepas analisis faktorial, proses pengoptimuman telah dijalankan. Keadaan optimum yang dicadangkan oleh perisian telah disahkan pada pergolakan (120 rpm) dan masa tindak balas (3.3 hari). Dalam keadaan ini, 0.00397 L/g COD hasil biogas telah diperolehi dengan 30% kandungan metana. Ralatnya adalah 5.82% daripada nilai yang diramalkan. Hasil daripada kajian ini menunjukkan bahawa penggunaan PMW adalah kaedah yang sesuai dalam pengeluaran biogas. Bersama-sama dengan proses ini, rawatan biologi telah terbukti boleh diguna pakai sebagai kaedah rawatan untuk penyingkiran AN untuk mengelakkan perencatan.