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# Biodigestion of Mixed Substrates of Cow Manure-Delignified Spent Coffee Ground (DSCG) using Microorganism Enhancer for Biogas Production and Its Kinetic Study

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**Abstract**

Environmentally benign energy strategies have been implemented to cope with the rapidly increased global energy needs. Indonesia's coffee consumption has triggered an increase in the generation of spent coffee ground (SCG) that can be used as a biogas raw material. The novelty that we offer in this research effort is to reduce the premature formation of biogas, so that we can extend the biogas production period during the digestion of spent coffee ground by adjusting the right pH and digestion time. This study aimed to produce biogas from an organic substrate mixture containing cow manure and SCG with a 25:1 C/N ratio by employing effective micro-organisms-4 (EM-4). The process began with delignification of SCG using sodium hydroxide solution to obtain delignified SCG (DSCG). The biodegradation of the substrate was performed in an anaerobic batch digestion (AD) system at ambient temperature by varying pH (5, 7, and 9) and EM-4 concentration (6%, 9%, and 12%). The biogas product and chemical oxygen demand measurements were carried out every two days for 60 days of digestion. The results showed that the increase in EM-4 concentration induced earlier initial biogas production enhanced the volume, and extended the production time. The pH 7 level and 9% EM-4 loading gave the

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**Biodigestion of Mixed Substrates of Cow Manure-Delignified Spent Coffee Ground (DSCG) using Microorganism Enhancer for Biogas Production and Its Kinetic Study**

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# Biodigestion of Mixed Substrates of Cow Manure-Delignified Spent Coffee Ground (DSCG) using Microorganism Enhancer for Biogas Production and Its Kinetic Study

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Environmentally benign energy strategies have been implemented to cope with the rapidly increased global energy needs. Indonesia's coffee consumption has triggered an increase in the generation of spent coffee ground (SCG) that can be used as a biogas raw material. The novelty that we offer in this research effort is to reduce the premature formation of biogas, so that we can extend the biogas production period during the digestion of spent coffee ground by adjusting the right pH and digestion time. This study aimed to produce biogas from an organic substrate mixture containing cow manure and SCG with a 25:1 C/N ratio by employing effective microorganisms-4 (EM-4). The process began with delignification of SCG using sodium hydroxide solution to obtain delignified SCG (DSCG). The biodegradation of the substrate was performed in an anaerobic batch digestion (AD) system at ambient temperature by varying pH (5, 7, and 9) and EM-4 concentration (6%, 9%, and 12%). The biogas product and chemical oxygen demand measurements were carried out every two days for 60 days of digestion. The results showed that the increase in EM-4 concentration induced earlier initial biogas production enhanced the volume, and extended the production time. The pH 7 level and 9% EM-4 loading gave the ideal digestion substrate condition containing cow manure and SCG with a 25:1 C/N ratio to obtain 11.28 mL of biogas/g COD with 100.2% production enhancement. The modified Gompertz equation fitted the experimental data very well as indicated by a high value of the coefficient of determination ( $R^2 > 0.95$ ).

**Keywords:** delignified spent coffee ground, enhancer, biogas, anaerobic digestion, Gompertz equation.

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**A Conceptual Methodology for the Renovation of Multi-apartment Buildings with a Combined Performance and Lifecycle Approach**

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# A Conceptual Methodology for the Renovation of Multi-apartment Buildings with a Combined Performance and Lifecycle Approach

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**Background.** Renovation of existing buildings has become a crucial tool to keep the built environment functional, by which unnecessary waste of resources can be reduced. Although many assessment methods and indicators are set, with the booming “renovation wave”, a question that counters us is how influential and intact these are as a measuring tool. Several debates have emerged in the literature on the integration of different indicators and approaches to have a better way of accessing the buildings.


**Purpose.** The aim of the study was, first, to have a set of integrated indicators for the renovation of residential buildings and, second, to develop an assessment methodology aimed at a comprehensive evaluation of the renovation process throughout its lifecycle stages. A requirement specification and an outline of the tool were developed based on the literature review and the survey.

**Design.** The study has applied a qualitative multi-method research approach, including an online survey with experts, and case studies. The survey was part of renovation needs, barriers and evaluation methods and indicators comprising four sections addressed to experts about building renovation. The aim was, besides collecting general knowledge about the renovation in practice, to identify key indicators and areas where development or modification could have effect during the renovation. The developed methodology was applied in a case scenario of a multi-apartment building in Lithuania.

**Conclusions.** This paper included the development of a combined methodology which applies to the renovation of the existing multi-apartment buildings with a checklist of indicators corresponding to environment, economic, and social aspects.

**Keywords:** renovation, lifecycle, multiapartment, conceptual methodology, existing buildings.



<b>EREM 78/3</b> Journal of Environmental Research, Engineering and Management Vol. 78 / No. 3 / 2022 pp. 73–95 DOI 10.5755/j01.erem.78.3.30948	<b>Biochar and Compost in the Soil: A Bibliometric Analysis of Scientific Research</b>	
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# Biochar and Compost in the Soil: A Bibliometric Analysis of Scientific Research

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Biochar is a carbonized material obtained from the pyrolysis of biomass produced in a limiting environment of zero or very low oxygen. Its interest lies in its versatility for different applications in the water treatment, soil pollution, mitigation of greenhouse gases, etc. The synergy of this product with other amendments such as compost has been studied for different applications in the soil, including environmental remediation, crop yield, etc. The aim of the research is to identify the relevant aspects in the scientific literature of biochar, compost and soil through a bibliometric analysis for which 753 articles were selected from the Scopus database, having as keywords “biochar”, “compost” and “soil”. This research used R software, specifically the package Bibliometrix, to analyze descriptive analysis, author sources, document metrics, citation, co-citation analysis, co-occurrence network, co-word analysis, and collaboration analysis. Results showed that Zhang Z is the author with the greatest number of documents, and with a higher H index. Science of The Total Environment, Bioresource Technology, and Agronomy are the 3 topmost relevant sources. The keywords according to bond strength and most frequent use were biochar (538 occurrences), composting (349 occurrences), compost (436 occurrences), charcoal (295 occurrences), soil (255 occurrences). China is the country with the most collaboration. It is hoped that the bibliometric review will help to identify current research trends and provide information on the application of biochar and compost in the soil.

**Keywords:** biochar, compost, soil, bibliometric analysis, Bibliometrix.