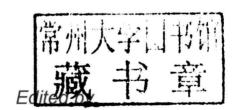
Environmental and Safety Aspects of Renewable Materials and Energy Sources

Edited by Juraj Ladomerský, Karol Balog, Jozef Martinka, Emília Hroncová and Janka Dibdiaková

Environmental and Safety Aspects of Renewable Materials and Energy Sources

Special topic volume with invited peer reviewed papers only.



Juraj Ladomerský, Karol Balog, Jozef Martinka, Emília Hroncová and Janka Dibdiaková



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Preface

This issue of Advanced Materials Research is focusing on the Environmental and Safety Aspects of Renewable Materials and Energy Sources. The issue is published as a special topic volume. It brings the original and most recent results of renewable sources research in the selected areas. The publication is divided into four chapters:

- 1. Environmental and Renewable Materials and Technologies, Safety Aspects of Energy Systems
- 2. Fire Safety Aspects and Heat Research
- 3. Occupational Safety and Health Research
- 4. Safety Aspects of Management and Applied Research

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This issue of the Advanced Materials Research published only the original scientific studies and the original scientific papers. Each of the original scientific studies had been reviewed by three reviewers and approved by the Guest Editors Board. Each of the original scientific papers had been reviewed by two reviewers and approved by the Guest Editors Board.

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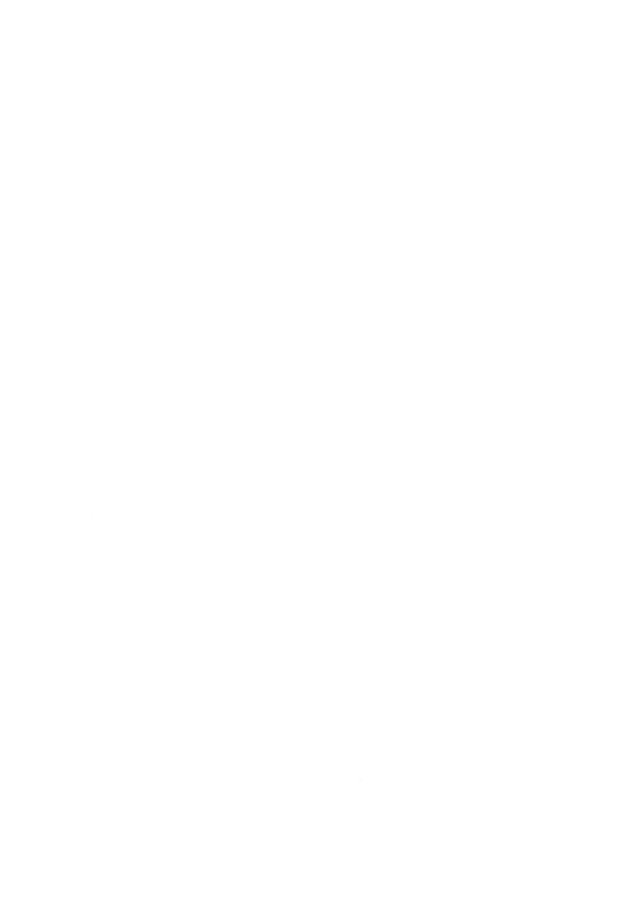
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CHAPTER 1:

Environmental and Renewable Materials and Technologies, Safety Aspects of Energy Systems

Aspects of Ecodesign when designing a retort with decreased emissions in the production of biochar

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Key words: LCA, ecodesign, production, biochar, environmental impact

Abstract

The paper pinpoints the important aspects of ecodesign when designing a retort with decreased emissions in the production of biochar. When designing changes in the construction of equipment for the production of biochar, the requirements for minimum material and energy demands and the need to reduce emissions to the environment were taken into account.

In the pyrolysis processes for the production of biochar, we mainly monitored the following inputs and outputs from/to the environment using life cycle analysis and ecodesign. When the decreasing emissions aspect was not included in an ecodesign, the measurements showed standard damage to the atmosphere characteristic for the production of biochar. The results of measuring emissions from the production of biochar in a retort with decreased emissions showed a significant decrease in emissions. Designs take into consideration the need to minimise the local materials available for the production of equipment for the production of biochar and the availability of raw materials for biochar (mainly accessible and suitable waste).

The overall environmental profile (assessment) of biochar is improving based on this construction and conceptual design. Using such a strategic approach, other applications for ecodesign, inventory analysis and assessment of the life cycle of biochar are possible.

1. Introduction

The conversion of biomass using pyrolytic methods is nowadays mainly investigated in terms of the permanent sustainability of the energy consumption of renewable resources.

Decreasing the consumption of fossil fuels in the energy sector is a significant step forwards towards the sustainable production of energy [1]. Therefore, the products of pyrolysis are increasingly attracting our attention. To date, there have been several studies and environmental assessments, comparisons of the impact of the production and consumption of biofuel [2-6], or investigations into the pyrolytic conversion of various cultivated plants and waste from such plants [7-12] which indicate that one of these raw materials is biochar.

The term 'biochar' is general; however, the environmental aspects of the production and consumption of biochar make it more specific.

Charcoal is the term for coal produced from biomass and it is used in households (usually for obtaining energy for food preparation).

Biochar or charcoal (pyrolysis coke from biomass, main component carbon) for various uses (Household, Industrial, Agricultural) is produced and consumed by techniques and technologies which are environmentally friendly.

Such biochar or charcoal then find their application in developed and developing countries, mainly as fuel (charcoal), and in applications for fertilising soil (biochar), etc. [13-20].

Biochar is therefore interesting during production and consumption, i.e. throughout its entire life cycle.

Attention is mainly paid to the sustainability of biochar production and consumption using the raw materials available for its production, with the lowest possible emissions into the environment during its production and consumption.

An important phase of biochar's life cycle is its production. During the unit process of biochar production, the emission of pollutants to the atmosphere is mainly from pyrolysis processes (then gradually to all components of the environment) and, therefore, to significant contamination of the environment.

For example, Ladomerský et al. (2013) state that for charcoal or biochar burial in soil to have a positive effect on climate change requires environmentally modern and suitable pyrolysis technology with minimisation of CH₄ emission [21].

The creation and amount of emissions to the environment during the production and consumption of biochar appears to be an important environmental aspect when assessing the life cycle of biochar. [21-27].

A life cycle assessment is a powerful tool in system analysis, serving to evaluate the impact of human activity upon the environment [28, 29].

Ecodesign is labelled as a suitable tool for preventing pollution [30, 31].

The assessment takes place in selected waste categories, resulting in a design for measures to increase the effectiveness of the relationship between the impact of the evaluated products and the impact upon the environment.

All these aspects, as well as other facts, are taken into consideration when including the important environmental aspects in the ecodesign of retorts for the production of biochar with reduced emissions. A suitable approach is therefore analysis of the life cycle of biochar and the use of ecodesign for its production equipment (a retort).

This paper focuses upon showing the significance of the individual environmental aspects important in ecodesign, and an assessment of the life cycle for a retort with reduced emissions for the production of biochar.

Since an LCA as well as an ecodesign are multi-criteria analyses, setting the correct balance between the assessed factors and environmental aspects is important.

Using thorough LCI (life cycle inventories), we achieve detailed knowledge of the development and needs of the studied pyrolysis of biochar (optimisation of material and energy flows in inputs and outputs, optimisation of heating, reducing emissions, the final required quality of biochar, etc.) and subsequent systems in other studied phases of the life cycle.

The aim of the ecodesign of a retort is to design a retort construction which would produce a significantly reduced amount of emissions than those emitted in the comparable traditional production of charcoal. At the same time, material and energy saving in the construction of a retort is achieved.

In traditional furnaces for the production of charcoal, wood slowly converts to charcoal under the limited access of oxygen. Firstly, wet wood is dried and waste gases from the furnace consist of a mixture of water vapour and products from incomplete incineration of wood (mainly carbohydrates, including methane).

This Ecodesign is a concept which attempts to create a small retort which minimises the impact upon the environment in the life cycle phase of raw materials, production and use. Using this method, it is possible to improve the environmental profile of biochar and its production in local conditions.

This paper may serve as a basis for further analysis and environmental assessment of biochar in the whole life cycle.