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Life cycle assessment of paper production from treated wood

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Abstract

The potential health and environmental impacts associated with the improper management of chemically treated wood waste demands the adoption of recycling, and disposal practices. Chemically treated wood waste has several physical and chemical properties which makes it usable for the manufacture of another product to multiple use, among which the production of paper and fuel. This paper presents the initial life cycle assessment (LCA) study on wood waste used for paper production. The study boundary is limited with raw materials (raw wood or waste wood) processing and paper production itself, thus corresponds to “gate-to-gate” life cycle with a special focus on life cycle inventory data on waste wood treatment via hydrolysis process. The results of the analysis demonstrate competitiveness of the waste wood use for paper production vs. raw wood in such environmental categories as human health and ecosystem quality.

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1. Introduction

Pulp is a fibrous material resulting from complex manufacturing processes that involve the chemical and mechanical treatment of various types of plant material. Today, wood provides the basis for approximately 90 % of global pulp production, while the remaining 10 % originates from annual plants. Pulp is one of the most abundant raw materials worldwide which are used predominantly as a major component in the manufacture of paper and paperboard, and with increasing importance also in the form of wide variety of cellulose product in the textile, food, and pharmaceutical industries [1]. Pulp obtained by chemical treatment is widely used for many applications: in textile industries, papermaking and packaging industries, in pharmaceutical applications, preparation of innovative materials and in fuel production [2–4]. It's one of the end users of wood from forestry which also supports the development of bioenergy and biomaterials sector.

Global paper and paperboard production reached 376.8 million tons in 2009 [5]. In the period 2007–2009, the Confederation of European Paper Industries countries in the European Union were importing 20 % of their total average wood consumption for the pulp and paper industry predominantly from other European Union countries, Russia, North America and Belarus [6].

The studies on use of pellets made from sawdust and wood waste has been rapidly increasing throughout Europe [7–9], depending on the physicochemical characteristics of these pellets (Table 1).

Table 1. Physicochemical characteristics of pellet wood.

Pellet physical characteristics	
Moisture content, %	9.39
Bulk density, kg/m ³	680.8
Durability, %	98.31
Pellet chemical characteristics	
Calorific value, MJ/kg	20.09
Ash content, %	0.31
Volatile matter, %	63

Wood, by its nature is hygroscopic; moisture content is approximately 9.39 %. It's defined as the ratio of the mass of water it contains on its dry mass. Bulk density is defined as the mass per unit volume of biomass. It is important in terms of transport and storage. It represents a value of 680.8 kg/m³ [10–12].

Life cycle assessment was conducted for two types of paper: Conventional paper made by using the conventional method of cooking and wood waste produced paper made by chemical treatment of wood waste.

2. Materials and methods

Previous studies [13–17] have demonstrated good applicability of life cycle assessment (LCA) method for evaluation of environmental performance of waste derived products and bioresources; thus within the present paper the LCA is selected as assessment tool. The purpose of this LCA is to expand the system boundary from the chemical treatment of waste wood to the utilisation of the final product as a paper. The goal of this analysis is to compare the environmental impacts of conventional paper production with the experimental results obtained from the chemical treatment of wood waste.

In this paper, the study is done on two alternatives, the first which is interested in the production of paper from the final product obtained after chemical treatment of waste wood, and the second alternative is interested to the production of paper from the conventional method

The functional unit is 1 ton of paper production, which will undergo the chemical treatment until we obtain the pulp then the paper manufacture.

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