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Research paper

Poplar woodchip storage in small and medium piles with different forms, densities and volumes

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ABSTRACT

Wood biomass is one of the main sources of biofuel for bioenergy production worldwide. Generally, the exclusive use of comminuted biomass in automated boilers is preferred because these woodchips consist of homogeneous particles with a specified size. Wood biomass is harvested mainly in autumn and winter, whereas the demand for biomass-fired power stations is continuous throughout the year. Nevertheless, large amounts of woodchips are also produced in the spring and summer from residual materials obtained from the utilisation of conventional poplar plantations.

This study focused on uncovered small and medium woodchip piles. In particular, the influence of form, density, and the size of piles on the biofuel quality during woodchip storage was analysed. The woodchip moisture contents and dry matter losses were considered when evaluating the storage dynamics.

The results suggest that a storage system can be selected to service only the needs of thermal stations because any difference between the form (trapezoidal and cone), volume (35 and 70 m^3), and density of the piles was observed on woodchip quality analysis. In fact, a mean moisture content of 18% and average dry matter losses of 10% were recorded at the end of storage period for all treatments. Notably, the climate conditions and storage periods affected the results of this experiment.

1. Introduction

Wood biomass is one of the main sources of biofuel for bioenergy production worldwide [1]. Generally, the exclusive use of comminuted biomass in automated boilers is preferred because woodchips consist of homogeneous particles with a specified size. Moreover, chipping offers additional benefits in terms of an increased load density and improved handling quality [2].

Chipping may take place during timber harvesting or some months after tree cutting. At present, two different groups of machines can be use in chipping operations: chippers, or machines that use sharp tools (knives) to cut or slice the wood; and grinders, or machines that use blunt tools (hammers) to smash or crush the wood [2]. In particular, grinders are used for contaminated wood, as their blunt tools are less sensitive to the wearing effect of contaminants, but these machines generate a rather coarse product that is unsuitable for use in some plants [3]. In contrast, chippers are exclusively applied to clean wood and offer a finer and better product [1]. In addition, the chippers used to produce woodchips for energy uses can be divided by function based on their knife support: disc and drum [4,5].

Generally, wood biomass is harvested in autumn and winter during tree felling and short rotation coppice harvest. Nevertheless, woodchips can also be produced in spring and summer from residual materials obtained from the utilisation of conventional poplar plantations.

Independent from the harvesting period, the demand of biomass-fired power stations is constant and may contrast the farm's activities [6]. Creating a fuel buffer in the farm to secure the availability of biofuel at all times may solve this problem [7]. Furthermore, biomass storage in the farm is an interesting option for power station because it generates woodchips with a low moisture content.

The woodchip can be stored in different ways in terms of site condition functions [8], and logistical strategies [9]. Nevertheless, many studies have shown that long-term woodchip storage (over three months) can cause significant dry matter losses and a consequent net energy value reduction [10–12]. In fact, these dry matter losses can reach 20% of the initial value for a storage period

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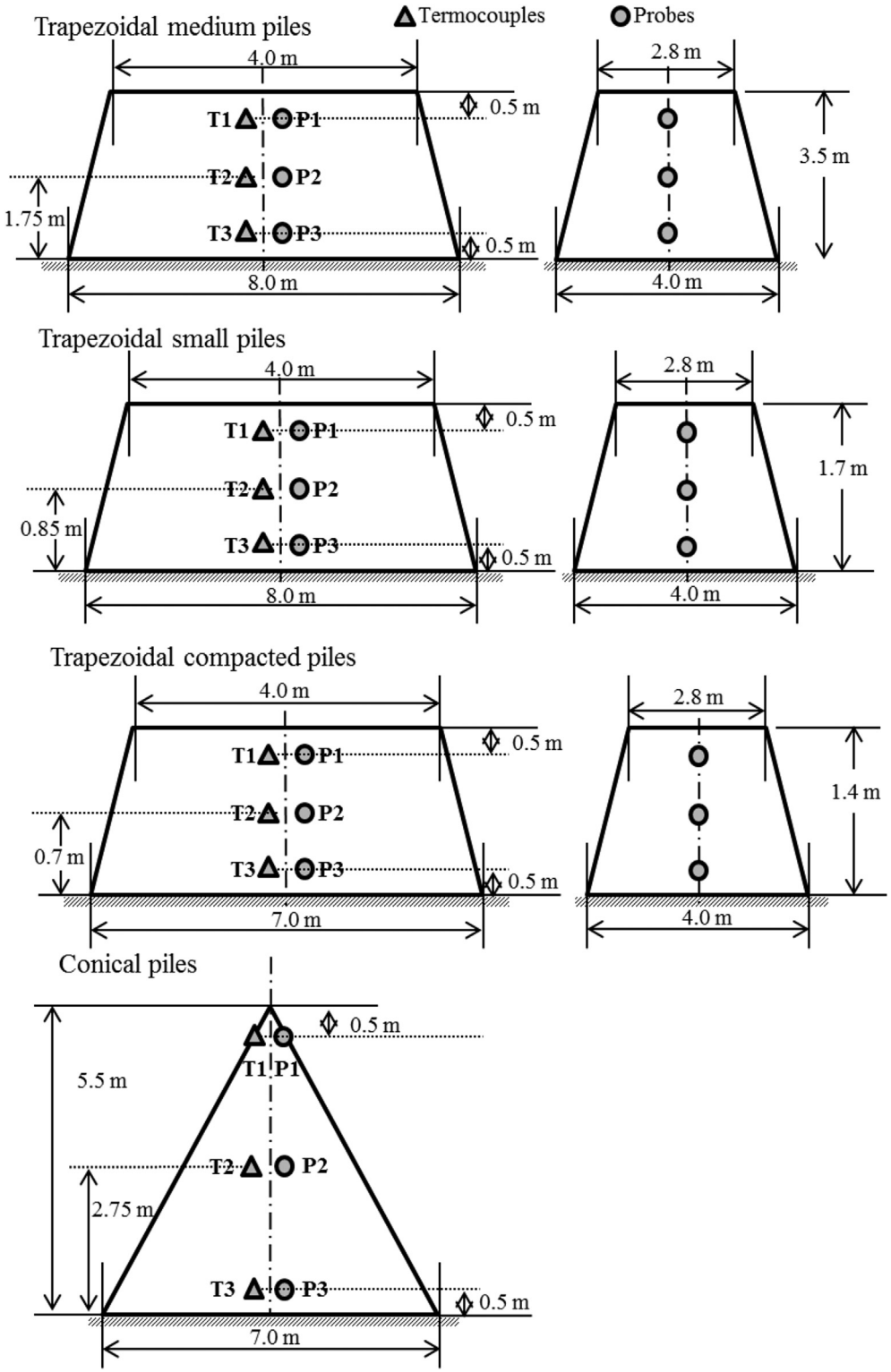

Fig. 1. Pile sizes and position of the probes inside the piles.

of one year [13–15]. Woodchip storage methods and their associated problems have been well documented in the literature [11,12,16–19]. Wood chips stored in small-sized piles can be used in different covering systems in order to guarantee good calorific values and limited energy losses [20]. By contrast, the storage of wood biomass in large piles is only possible outdoors, where the piles are uncovered due to logistical and economic reasons [21]. Nevertheless, previous studies in northwestern Italy have shown that uncovered storage is better than covered storage for small piles as well [20]. Until now no study was focused on pile characteristics (form, density, and volume) used in woodchip storing.

For this reason, the goal of this study was to analyse the