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Unlocking economic value and sustainable furniture manufacturing through recycling and reuse of sawdust

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Abstract

The various stages in the manufacture of furniture, from cutting through processing to polishing, produces a lot of sawdust of varying grades. The extraction and disposal of such waste in a developing country such as Zimbabwe, with no established or sustainable ways to handle waste, is a growing concern, often posing environmental challenges. Research was carried out at a leading furniture manufacturing company in Zimbabwe to establish the quantum of sawdust produced periodically while carrying out experiments to determine parameters such as compressive strength and density for the viable production of briquettes that can either be disposed of economically or used for the company's fuel requirements. An affordable briquetting machine was designed based on existing briquetting technologies to handle the waste in a sustainable and economic way. The challenges encountered in the disposal of the waste were turned into opportunities. The company will not only enjoy modest income from the waste but will also save on their current waste management costs and easily pay back for the briquetting machine.

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Keywords: Briquetting; economic value; sawdust; sustainable manufacturing; waste extraction and disposal

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1. Introduction

Timber processing and the manufacture of furniture goes through various stages from ripping thick blocks of raw timber to standard and transportable sizes, cutting to required parts, shaping, mortising and finally polishing and assembly. At each of these stages, a considerable amount of waste, varying in grades from large off-cuts and chips to very fine sawdust, is produced. Research was carried out at a leading furniture manufacturing company in Zimbabwe to assist the company in waste management and disposal of the wood waste in an environmentally friendly and sustainable manner. The company employs conventional machines and manual methods for processing timber and manufacture of furniture, hence the quantum of sawdust produced is generally much higher than in the developed world where precision machinery and modern methods of manufacture are employed [1, 2]. The large amounts of sawdust waste produced, correspondingly require fast and reliable ways to extract and dispose with minimal impact on the environment and the operators while maintaining a safe working domain free of health hazards. Managing industrial waste can be a big challenge especially in view of the fact that most companies thrive and focus to make profit at the minimum possible cost, the extraction and disposal of waste being one of the costs [3]. The conventional methods and machines that the company employs are not only labour intensive and costly but are also unsustainable due to rapid changes in technology, which ultimately affects the company's competitiveness, hence requiring innovative, affordable and sustainable ways of waste management [4].

While the disposal of sawdust in such companies can be a challenge, previous research showed that the different grades of sawdust and timber off-cuts can be used for other purposes such as fuel for heating and other renewable energy purposes, manufacture of chip boards for furniture and mixing with organic manure for fertilizing garden plants [5]. However, in order to use the waste for whatever purpose, may require further processing of the sawdust such as compaction into briquettes, a costly venture hence the reason why companies prefer to simply dispose of the waste [6], hence the need for affordable, sustainable and economic ways of disposal. While there are several ways in which sawdust and timber processed waste can be used, this research focused on how to compact the finer grade of the sawdust into briquettes that can either be used for fuel at the company or sold. Briquettes of different forms have been produced from sawdust from as early as the 1960's using starch or flour to bind the powder together or compressed into blocks before carbonization [7]. Wood conservation can also be used to reduce waste disposal problems by recycling sawdust as a way of reducing the volume of waste to save on storage and haulage costs [8].

The case study company specializes in the manufacture of a wide range of furniture for both commercial and domestic purposes. Global recession and the general decline in the Zimbabwean economy [9] resulted in the company failing to export, let alone compete with local companies. This effectively reduced their annual turnover and profitability. Traditionally, the waste was collected by the city authorities for safe disposal or by merchants who repackaged it for sale. However the economic environment in the country equally affected the local authorities and the merchants, resulting in the increased pile up of the waste at the company, a potential health and environmental hazard. The company established a waste disposal department but this meant an additional cost center, apart from production. The company's desire to maintain their market share and high quality hardwood furniture for local and export purposes motivated them to accommodate this research, aimed at reducing production costs by way of quantifying the amount of sawdust produced periodically, experiment to determine its scientific properties and designing an affordable briquetting machine to compact the sawdust for reuse or retail. The scope of the research was to turn the challenges into opportunities in which the company would not only dispose of the sawdust waste but would also realize income by adding economic value to the waste.

2. Background and literature review

Waste produced when processing timber varies in grades from off-cuts, shavings to course and fine sawdust. The research at the case study company revealed that an average of 367 kg of such waste is produced per month, an amount that the company was increasingly finding difficult to cope with in view of the depressed economic environment. Effectively, almost half of the original timber was processed into waste in the form of shavings or sawdust, partly due to the conventional machines and methods used in production. Due to the failure by city authorities to collect and dispose of the waste, the company embarked on a scheme to dispose of the waste by burning it in-house but this was not environmentally friendly as neighboring companies complained of air pollution. Merchants who used to purchase