Enhancement of Micro-sized Furniture by using Wooden Wastes

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Abstract— The number of small-scale businesses within most national economies is generally high, especially developing countries. Waste wood can be a potentially valuable resource for the manufacture of various materials and products. The type and volume of wastes generated during the manufacture of forest products have changed over time depending on various factors. Often these businesses have a weak economic status and limited environmental awareness. This study investigated the types of waste generated and the recycling methods adopted in micro-sized enterprises engaged in the manufacture of furniture. An assessment was also made of whether the characteristics of the enterprise had any effect on the waste recycling methods that were practised. It was found that medium-density fibreboard, and to a lesser extent, chipboard, were used in the manufacture of furniture, and two major types of waste in the form of fine dust and small fragments of board are generated during the cutting of these boards. Enterprises were found to have adopted other methods to utilise their wastes in addition to using them as fuel. Such enterprises include those operating from a basement or first floor of a building in the cities, those continuing production throughout the year, those in need for capital and those enterprises not operating a dust-collection system. a building in the cities, those continuing production throughout the year, those in need for capital and those enterprises not operating a dust-collection system. The percentage of the workforce that has received vocational training in furniture manufacturing is low, which is an obstacle to the utilisation of waste materials in a variety of ways.

Key words: MDF, Waste wood, SPSS

I. INTRODUCTION

Waste wood can be a potentially valuable resource for the manufacture of various materials and products. The type and volume of wastes generated during the manufacture of forest products have changed over time depending on various factors. One of these factors is the reduction in the amount of wood resources available. One example is the change in the past and present utilisation of bark, a by-product of the forest-products industry.

The economic value of bark is much lower than that of wood, both quantitatively and qualitatively. Therefore, it has been considered a worthless by-product of the forest-products industry, and has mostly been given away or sold at a low price. Today, bark can be used as a medium-layer material in board production and as a raw material in insulation board production reported that small and medium-sized enterprises in Finland, which is rich in forest resources, have shown less effort in reducing material losses compared to the country's metal industry. One of the factors affecting the utilisation of industrial wood waste is the environmental pollution caused by fossil fuel and the regulations imposed to control such emissions. At a time when fossil fuels were much cheaper than wood, wood waste was destroyed by burning. The increase in fossil fuel prices and the environmental pollution caused by their use has resulted in the use of wood for generating energy.

The effects of legal regulations on wood waste management can be seen in the management of medium density fibreboard MDF waste. In Tennessee, where it is a legal requirement for MDF residues to be disposed of in a landfill, the number of landfill sites has diminished and burial costs have subsequently risen, resulting in efforts to demonstrate that these wastes can be utilised to improve soil reported that in the forest-products industry, in which biomass is generated as a by-product, it was prohibited to burn wood wastes in boilers for heat production and it is only relatively recent that fossil-fuel boilers have been converted into renewable biomass-burning boilers.

Recycling of all industrial wood waste is theoretically possible, but in practise there are factors that limit recycling practises. These include waste collection and transportation, the scale of the business, the industrial sector in which the company operates, the amount and type of waste produced environmental regulations and the level of development within a particular country.

A. The forest-products industry and its waste materials

The forest-products industry uses wood as a raw material. This industry includes lumber, furniture, paper and paper products, pulp, and other wood industries. It is usually divided into two distinct industrial sectors. The first is the primary wood-products industry, which covers a wide range of operations from lumber production to the manufacture of finished products that are mostly or completely made of wood or composite wood materials. The second is the value-added or secondary forest-products industry, which manufactures products by processing raw materials or semi-processed materials, and generally includes the production of pallets, light furniture, cabinets, doors, and windows. A portion of the raw material becomes waste during the production process.

These wastes vary due to the differences in raw materials that are involved in production, in the actual production processes, and in the different finished products in the primary and secondary wood-product industries. Wood waste refers to materials that are unsuitable for the production of wood products. They take different forms such as bark, small chips, sawdust, wood edges, and low-quality wood rejected by the manufacturing process.

These wood wastes can be classified into three types: bark, coarse, and fine waste. Bark waste consists of the bark on the exterior part of the log. Coarse wastes include slabs, timber edges, and veneer cores that are suitable for chipping. Fine wastes include by-products that are not suitable for chipping, such as sawdust and veneer clippings. Wastes generated in primary and secondary wood- product factories are biomass resources. The intended use of this

biomass can be divided into energy and non-energy applications. The use of biomass for energy involves combustion to meet the energy needs of homes and industrial enterprises. Non-energy uses include the production of composite boards and wood pulp, land reclamation, animal bedding materials, landscaping, and agricultural mulch; the remainder is sent to landfills.

The type and quantity of emissions arising from burning wood wastes depend on two main factors: the type of biomass (chemical composition) and its physical properties, and the technology used to burn the biomass. Although there are limited data regarding the exact emissions generated in the combustion process, biomass is also an important source of particulate emissions as well as combustion by-products. This is particularly true when they are not incinerated correctly or under conditions of incomplete combustion. The burning of wood wastes can cause serious particulate matter emissions. Pollutants other than particulate pollutants, particularly carbon monoxide, manganese, and organic compounds, can be released in large quantities under conditions of incomplete combustion.

The main drawback of biomass burning is the large amount of emissions that result from improper combustion compared to fossil fuel combustion. This is especially true for the burning of biomass using devices such as woodstoves, ovens, and wood boilers. Therefore, to reduce emissions, wastes generated during the processing of engineering panels, such as MDF, should be burned only in industrial locations rather than in conventional home stoves, and at temperatures of about 1000 C

II. MATERIALS AND METHODS MATERIALS

In this study, micro -sized enterprises (with 1–9 employees) operating in the furniture manufacturing sector in Gumushane province, one of the 81 provinces of Turkey, were selected for investigation. The furniture manufacturing industry is classified as a sub- section of the manufacturing sector and is coded as Section 36 within the Statistical Classification of Economic Activities in the European Community. According to TSI data, there are 33 enterprises in Gumushane that fall under Section 36 coding. The number of enterprises engaged in the production of furniture in the province of Gumushane corresponds to 4% of all of the manufacturing industry in the province. In addition, 47% of provincial manufacturing sector businesses are micro-sized enterprises, 48% are small enterprises, and 5% are medium-sized enterprises. All businesses operating in the furniture-manufacturing industry in the province of Gumushane are micro-sized

A. Method

A face-to-face interview method was used to collect data. The questionnaire has been applied to the SME owner manager, and its questions were prepared as open-ended, multiple choice, or with two options (yes–no). In addition, a field study was initiated to survey each business selected. However, it was not possible to visit some businesses for various reasons (e.g., not all addresses could be identified in the records of the Gumushane and Kelkit Chamber of Commerce), while other non-registered businesses were identified following information obtained from the businesses that were interviewed. As a result, the final number of completed questionnaires was 31. As confirmed by the 2002 General Industry and Business Census conducted by the TSI, 93% of the businesses that make up the main segment of the furniture manufacturing sector were reached. The research was conducted between the years 2012 and 2013. The data obtained were arranged into a cross table using a software, Statistical Package for Social Sciences (SPSS_). However, correlations among categorical variables in the table could not be made because more than 20% of the expected frequency values in cells were below five and the expected frequency of any given cell was less than one.

III. RESULT AND DISCUSSION

The mean number of employees per enterprise in the furniture manufacturing industry in Gumushane province was less than 3.4 which is the mean value across Turkey. The mean number of years of operation of these businesses was less than 34, which is the mean value across Turkey. Although there are many vocational schools in Turkey that provide education related to furniture manufacturing, as well as institutions that grant degrees in furniture manufacturing, the employment rate of graduates in this sector is low. Only 13.2% of vocational school graduates are employed in this sector. However, the employment rate of graduates from non-vocational educational institutions employed in this sector is 68.4%. It can be concluded from this that the majority of employees in the sector do not have an in-depth knowledge of the physical and chemical properties of wood or wood composites. In a study conducted in an industrial zone comprising SMEs, it was concluded that the environmental responsibilities companies are usually limited and directly proportional to the scale of the company demonstrated that small businesses, most of which were micro sized businesses, had very little interest in environmental protection. In Europe, SMEs include businesses with less than 250employees and an annual turnover of a maximum of € 40 million, whereas micro-sized businesses are those with less than 10employees and an annual turnover of less than € 2 million. Given this definition and the studies referred to here, it is understandable that the micro-sized businesses in Gumushane have few or no environmental concerns.

A. Types of waste and methods for their utilization

Fig. 2 shows the typical waste generated by a company that produces furniture in Gumushane. The waste produced during the cutting of boards is in the form of fine dust, while those generated during drilling and milling operations have a less dense structure.

As seen in Fig. 2, some businesses collect the wastes in a mixed manner without sorting them at source. Some businesses collect their wastes in the form of sawdust using vacuum systems, such as that shown in Fig. 3. Fig. 4 shows waste in the form of small pieces of board generated after cutting MDF and particleboards. These pieces, which are too small to be used in the manufacture of furniture, are left after cutting out the sections needed. This type of wood waste can be used to make new boards. Two major types of solid waste are generated during the processing of boards in the manufacture of furniture: sawdust and small pieces of boards.

Half of the enterprises investigated in this study utilised a system to collect dust. However, businesses usually do not do so diligently. The most important reason for this is the lack of available space and tools for collection (Fig. 2). Reported that specific technologies are required to collect bulky wastes such as paper, cardboard, plastic, and wood. The methods adopted to utilise wastes generated during the production of furniture were determined and are shown in Fig. 5. Wastes are basically utilised in three different ways. Individual businesses usually prefer to adopt only one of these different methods. Only one company stated that it utilises its wastes in two different ways. A very large proportion (96.9%) of the wastes generated in furniture- manufacturing businesses in Gumushane province was found to be utilised as fuel in workplaces and homes. This is not surprising, given that half of the world's wood is consumed as firewood, and wood is still the primary energy source for the vast majority of the world's population. In many developing countries, wood and charcoal are the primary fuels used by people to prepare food and they are also important fuels for SMEs. The primary condition for the use of wood as an environmentally sustainable fuel is that it burns completely and efficiently.

Fig. 2: Wastes generated during the processing of MDF and particleboard in furniture manufacturing.

Fig. 3: Collection of dust generated during the cutting of wood by suction using a vacuum system

Fig. 4: Small pieces of board left over after the cutting of larger boards

Basic stoves, such as those, are used to burn wastes. These stoves are not considered suitable for burning composite board wastes because they create conditions that lead to incomplete combustion. It is important to have suitable combustion conditions during the incineration of particleboards. Incomplete combustion can result in the formation of toxic components (Risholm-Sundman and Vestin, 2005, cited in. Because these stoves are used in Gumushane to burn waste, the waste produced in the region is likely to be burnt under conditions of incomplete combustion.

IV. CONCLUSION

The manufacturing industry is one of the solid waste resources in Turkey as in other developing countries. Around 17,497 thousand tonnes of solid waste were generated in 2004. In the same year 149,265 thousand m3 of solid waste, 140 thousand m3 of which were hazardous, were generated by the furniture industry, a sub-sector of the manufacturing industry. There are infrastructural and technical capacity issues in management of those solid wastes created by the manufacturing industry in accordance with by-laws and requirements on waste management. The Turkish furniture-manufacturing sector is a labour-intensive industry, in which micro-sized enterprises are predominant. The mean number of employees and period of operation of the enterprises in Gumushane were found to be lower than the mean values for Turkey as a whole. These micro-sized enterprises are important in terms of job creation in places where there is relatively little capital available, such as Turkey, which is a developing country with little capital accumulation. However, the percentage of the workforce that has received vocational training in furniture manufacturing is low, which is an obstacle to the utilisation of waste materials in a variety of ways. Waste management practices in SMEs in EU or other developed countries can serve as precedent for SMEs in developing countries. The number of systems used to collect the wastes generated during conversion of materials is inadequate, including those for the collection of fine dust. In addition, the wastes generated in one process are not collected together, or separated according to their properties. Another important observation is that the wastes generated at the sites investigated were not disposed in landfills or by incineration in open conditions. Composite board wastes are used to heat the workplace by burning them under conditions of

incomplete combustion, using stoves that are insufficient for effective incineration. Very few businesses choose to utilise their wastes other than using them for their own needs. These businesses either sell wastes to provide for the energy needs of others or give them away as bedding. It was found that wood waste is primarily used for energy purposes, consistent with the results of previous studies. Waste materials from the furniture industry contain urea or melamine formaldehyde, and therefore must be incinerated by complete combustion in a special furnace at high temperatures. However, this was not observed in the study area. Waste was burnt using inappropriate devices under inappropriate conditions. The amount of waste generated in these businesses and incinerated under inadequate conditions is low; however, there are large numbers of such businesses and it is evident that the total emissions generated by them as a whole has a significant negative impact on the environment. There are reports of re-utilisation of composite board waste in the manufacture of boards and the safe agricultural utilisation of dust generated during the cutting of boards. However, in this study, the utilisation of wastes for board production and agricultural purposes was not identified. The relationship between the methods used to utilise waste in the furniture industry and certain properties of the businesses can be summarised as follows: enterprises that operate from the basement or first floor of buildings in cities, those that continue production throughout the year, those in need of capital, and those that do not have dust-collection systems utilise their waste in three different ways: as fuel in the facility, as residential fuel, and as bedding for animals. In contrast, enterprises without these characteristics utilise their waste only as fuel. The proportion of waste used as fuel is also higher than that of the other utilisation methods in the enterprises that utilise the three different methods. The quantity and type of waste generated by micro-sized enterprises should also be included in annual waste statistics. Actual waste data that include businesses of all sizes will facilitate an understanding of the importance of the potential for waste utilisation and waste management. More importantly, the by-laws related with waste management in Turkey must be put into practice. Combustion of wood waste with improper equipment shave to be prevented as well.

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