Pellets from forest waste: A viable alternative fuel in Mexico

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Abstract. The search for non-fossil fuels is a task of global interest. In the case of Mexican forest waste (sawdust, splinters, and woodchips), it is estimated that 45% of this biomass is discarded as garbage rather than used industrially. The production of wood pellets is a viable alternative for the recovery of wooden waste from wood processing, forestry, and other industrial uses (such as the wooden pallets used with forklifts for the transport and storage of manufactured goods). Wood pellets are compressed cylinders between 6 and 10mm in diameter, used for generating thermal energy. The increase in European pellet consumption has promoted the construction of many pelletizing plants in that continent, and this trend has extended to Africa, North America, and South America. In Mexico, however, this industry does not yet exist despite the fact that 72% of the national territory is dedicated to various forestry uses. The State of Chihuahua, located in northern Mexico, has the second largest timber production in the country. This research project encompassed the 10 most significant sawmills in the region of Ciudad Madera, Chihuahua. Their timber resources and their generation rates were analyzed and quantified. The purpose of this project was to determine the technical feasibility of developing a pelletizing industry in the state of Chihuahua, Mexico.

Keywords: Wood pellets, forest waste, biofuel.

INTRODUCTION

Background

Waste from timber production (sawdust, splinters, woodchips) are not industrially used in Mexico and are frequently even considered garbage. In the region of Ciudad Madera, state of Chihuahua, Mexico, there are numerous businesses dedicated to timber production. Over many years of operation, these sawmills have developed large amounts of wood waste that present an environmental problem, are a fire hazard in the summer, and uselessly occupy valuable space in the sawmills' sites.

Pellets are small cylinders of compressed wood that are produced by pressing crushed woodchips and sawdust through a metal die. High pressure raises the temperature of the wood material to the point where the lignin in the wood partially plasticizes, holding the pellet together with no need for additives. The resulting pellets have low humidity (10%) and a density 3.2 times higher than that of sawdust, which is why these small "energy pills" require very little storage space. Two kg of pellets produce approximately the same amount of heat than 1 L of gasoil (Soto, 2008). The use of wood pellets as fuel is a common practice in Europe, the USA, Canada, and some South American countries. They have not become common in Mexico, however, despite availability of raw materials and a demand for alternative fuels.

The purpose of this work is to quantify and characterize the wood waste generated in the region of Ciudad Madera, Chihuahua, in order to determine the feasibility of producing wood pellets.

Sources of raw materials for pellet production

Wood pellets can be made from practically any kind of wood waste, so long as it hasn't been previously treated with chemicals hazardous to human or environmental health (oils, fungicides, insecticides, pigments, etc). The sources of raw materials considered in this work are sawmill waste, industrial waste, and urban waste.

Sawmill waste

Sawdust from conifers is the biomaterial most commonly used for wood pellet production. The physical properties of the different species used by the timber industry determines the final quality of the pellets produced. A previous study analyzed tree species such as the Scots Pine (*Pinus sylvestris*) and the Norway Spruce (*Picea abies*). After analyzing geographical origin, sawdust storage time, and moisture content, the study concluded that moisture content was the primary factor affecting pellet density, and storage time was the primary factor affecting mechanical durability (Samuelsson, 2009). Other experiments suggest that pine bark is the most sustainable raw material for pellet production but requires a specific burner for its use given the different combustion behaviors of the mixtures obtained from it (Granada, 2006).

Industrial Waste

John Deere corporation crushes the remains of wooden forklift pallets to make wood pellets, which are used as fuel in its heaters (López, 2010). The pallet-to-pellet process requires the wood of the former not to have been treated chemically, but there are otherwise no hurdles to this use. Great amounts of wood waste recovered from construction and other industrial activities are generated annually in countries like Sweden and used as biofuels for heaters (Krook, 2004).

Urban Waste

A study developed in the state of Michigan, USA, suggests that wood waste and urban tree clippings can be used as a source of biomass for the production of biofuels for heat generation. This would reduce the consumption of fossil fuels and the cost of disposing of urban wood waste (McFarlane, 2004).

Uses of Wood Pellets

Wood pellets can be used domestically or industrially as fuel in water heaters, water boilers, or air heaters. However, the feasibility of using pellets in electrical generation depends on the volumes and types of wood available (Lesme, 2010; Morán, 2003). Several domestic stoves have been developed in the last decade that use pellets as fuel (Gonzáles, 2004). The energy demand in residential buildings has led to the development of a complete micro-generation model, in which wood pellets are used as fuel for the simultaneous heating of air and water (Thiers, 2010).

METHODOLOGY

The biomass available in the study region's sawmills was quantified in order to determine the feasibility of transforming forest waste to pellets. With this information and the number of sawmills in other regions, it is possible to estimate the probable availability of raw materials in the rest of the state.

Quantifying existing sawdust

Quantifying the existing stores of sawdust, as well as those periodically produced in the different sawmills, was performed through a visit to Ciudad Madera, Chihuahua, and interviews with the owners of the ten most important sawmills in the region. Sawdust samples were collected for future characterization, and the owners' future growth expectations were determined.

Quantification of the rate of industrial wood pallet waste production in the city of Chihuahua, Mexico

The number of wooden forklift pallets circulating in the city of Chihuahua, Mexico, as well as their weekly disposal rate, were calculated in order to determine the amount of other wood waste that could be used as

complementary raw material for the pelletizing industry. A total of 31 companies in the northern part of the city were interviewed.

Characterization of the sawdust available in the region

Sawdust samples were taken in every visited sawmill. Given that the timber-producing species in the region are essentially the same for all sawmills, the samples were mixed and a single representative sample was produced for the entire region. In order to determine moisture content, the samples were weighed before and after drying at 100°C for 24 h. The sawdust was characterized in a EA 1110 CHNS-O elemental analyzer, in order to determine its percentage of carbon, hydrogen, oxygen, and nitrogen. Sulfur content was measured in an inductively-coupled plasma emission spectrometer, Termo Jarrell Ash model Iris/AP Duo (ICP-OES).

RESULTS

Interviews in the sawmills of Ciudad Madera

The 10 sawmills in Ciudad Madera, Chih., each have an average sawdust production of 95.5 m^3/week. Their raw material is the Mexican Weeping Pine (*pinus patula*), and they operate year-round except in case of severe snowstorms. The sawmills' owners think that, with proper reforestation and forest fire control, the local timber industry can continue indefinitely—and so will sawdust production.

Interviews in the industrial areas of Chihuahua City.

The interviews showed that approximately 30,900 wooden pallets circulate in a given month. Of those, 6,130 belong to transnational companies, 14,550 are reused, and 10,240 are discarded. Of the total number of discarded pallets, 48.15% are repaired, 37% are sold, and 14.8% (approximately 1,517 pallets/month) are sent to the city landfill. The latter represent a potential source of raw material for the pelletizing industry. Sooner or later, all pallets go through their useful life and are discarded, so their use as a complementary raw material in pellet production would contribute to reduce their current environmental impact.

Sawdust characterization

Sawdust moisture content is 54.45% immediately after its creation. This is a very important parameter, given that for pellet production sawdust must have a moisture content of about 10%. The results of chemical characterization are presented in Table 1.

TABLE 1 Characterization of sawdust from Madera City, Chihuahua

Element	%
Carbon	53.323
Hydrogen	6.747
Oxygen	0.515
Nitrogen	0.040
Sulfur	0.002

CONCLUSIONS

Pellets made from the sawdust generated in Ciudad Madera, Chih., meet the values specified in the norm "E DIN EN 14961-2, Wood pellets for use in small furnaces" July 2010, which specifies the standards for a high-quality pellet.

The quality and constant generation rate of sawdust and other wood waste in the state of Chihuahua, Mexico, make it feasible to establish a wood pellet industry.

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