
DETERMINATION OF WOOD MACHINE OPERATION AND WASTE UTILIZATION AT BAUCHI FURNITURE FACTORY LIMITED BAUCHI

By

Audu Markus Mshelia, PhD

Department of Technology Education

Faculty of Technology Education

Abubakar Tafawa Balewa University Bauchi

E-mail: audumarkmshelia@yahoo.com, audumshelia857@gmail.comGSM: 08060508890, 08074226979

ABSTRACT

*The study was carried out to determine the net volumetric wood waste generated and net volumetric lumber recovery using machine operations. The study also identified the various stages of machine points where wood waste were generated. Three wood species namely: dry savannah Mahogany (*Khaya ivorensis*), Abura (*Mitragyna celiata*) and Afara (*Terminalia superba*) were surveyed in the study. The study measured the individual lumber comprising 75 drawn from the three (3) species of wood to obtain their average dimensions as 0.015m x 0.25m x 1.405m giving a gross volume input as 0.314m³; 0.017m x 0.25m x 2.23m giving a gross volume input as 1.12m³ and 0.03m x 0.25m x 1.450m giving a gross volume input of 0.34m³ respectively. It was found that 53% to 90.3% of the lumber processed was recovered while 2.5 percent to 24% accounted for waste generated at various stages of machine operation. Factory sources revealed that wood wastes generated were used for agricultural practices. Results show a gross volume input of lumber as 7.203315m³ while the net lumber recovery volume shows 6.531223m³ and a net waste generated volume of 0.340312m³ respectively. It is concluded that more wood wastes were generated at some points than others due to verities in wood thickness.*

INTRODUCTION

The different forms of wastes such as sawdust, wood shavings, and chips generated in wood machine operation could be assessed in volumes. In line with this, Bacary (2009) is of the view that bulks of wood wastes are generated from saw mills and other wood processing firms. It could then be established that wastes of different forms are generated in any wood processing operation, and could be assessed in volumes.

For instance, Akinkumi (2011) estimated a total volume of 457,000m³ as wastes generated from wood processing firms/sawmills numbering 241 in some selected wood processing firms in South West Nigeria

alone. In a similar development, Abayomi (2000) reported that about a total of 678,840m³ of wastes was generated from 25 sawmills in Ogun State. Ademiluyi (2008) also reported that about 283,000m³ volumes of wood were generated yearly in Lagos sawmills. These wastes according to them, constituted saw dusts and other residues.

Unlike most wastes disposals, wood wastes could be re-cycled or converted as raw materials of other wood products such as particleboards, chipboards and other composite boards. According to Bello (2002), wastes generated from wood could be used for agricultural practices such as animal beddings and

mulching. As far back as 1978, wood wastes according to FAO could be further processed for fibre boards manufacture while the bark could be used for fuel.

With regards to wastes generated from an industrial process, Dhiraj (1979) pointed out that much of the wastes generated along industrial process including those from wood could be quantified in a reliable manner. However, he further stated that the large quantities accruing as wastes could be converted as raw materials of other products. For instance, today and every other day, wood wastes form part of the numerous wastes disposal problems in towns and cities. Audu (2007) reported that wood wastes alone constituted 3.4% of the municipal wastes. To curtail this, the day to day generated wood wastes of various forms found in towns and cities at wood processing points should rather be converted into numerous end-uses rather than constituting a waste problem. Although wood waste abounds everywhere in and around Bauchi Metropolis, the one of Santana as a reputable wood-processing factory has not been ascertained to a large extent. The objective of this study is therefore, to determine the volumes of wood wastes generated and its utilization.

MATERIALS AND METHOD

A total of 75 pieces of lumber drawn from different species of timber namely African Mahogany (*Khaya ivorensis*) numbering 25, Abura (*Mitragyna celiata*) numbering 25 and Abura (*Terminia superba*) numbering 25 were used for the study. These were used for the construction of family size bed frames, bed frame slats and flush door frames. The type of wastes generated along the line of production is presented in Appendix 2.

The pieces of lumber were processed in the respective groups at the same machine stages namely ripping, planning, cross cutting, edge shooting and

squaring. Each of the 25 Dry Zone Mahogany (*Khaya ivorensis*) lumber was measured giving 0.015 m x 0.25m x 1.405m multiplied by 25 to give a volume input of 0.314m³ at ripping stage. Upon ripping, fresh dimensions were taken before planning. The differences before and after ripping were quantified as recovered wood and wastes generated. These were quantified in volumes (m³) or percentages (%).

The formula for input upon output multiplied by hundred upon one would give the waste generated as well as wood recovered in percentages. That is, at ripping stage, $\frac{\text{input} \times 100}{\text{output}} =$

Out put 1

$\frac{0.2516 \times 100}{0.2824} = 89.09\%$ (as wood recovered and 10.01% as waste generated)

0.2824

The same method was used to quantify the values shown in Tables 1 – 3 in Appendix 2. Interview with the factory management and personnel on the waste disposal and management is also reported under the results and discussion.

RESULTS AND DISCUSSION

The findings of this study show that (See Table 1), net lumber recovery rate falls between 92% and 99.8% with an average of 95.46% lumber volumetric recovery rate. This indicates that the bulk of the material was well recovered. The Table also shows that the maximum waste was generated at the planning stage with a maximum net volumetric waste of 0.0404992m³. On the other hand, the least generated wastes is at the cross cutting stage. This point records 99.8% net recovery rate with only 0.2% wastes generated. The Table also shows a summary of the gross volumetric input of 2.411048m³, and a net recovery volume of

2.2992648m³ and a net waste generated volume of 0.1184m³ respectively.

Similarly, in Table 2, the net recovery rate falls between 90% and 99.7%. This shows an average rate of 85.18% net volumetric output recovery. The average percentage is like that in Table 1, except that there is a negligible difference of 0.28% between them. Unlike in Table 1, the maximum waste generated is at the ripping stage in Table 2. This shows that the net lumber volumetric waste generated is 1.35m³. The excess waste is a result of considerable lost of waste to saw kerfs. The lumbers were ripped to 50mm width resulting to a substantial reduction of the net width from 0.30m to 0.27m. That is, about 30mm was wasted from each of the 25 pieces of lumber put in. The materials were ripped to obtain five pieces of long slates from each lumber processed and this resulted in generating more wastes. A minimum of 0.003105m³ volumes was generated at the ripping stage. The Table also shows a gross input volume of 4.87836m³ with a net a volumetric lumber recovery of 4.63374m³ and a net volumetric waste generated of 0.24462m³.

In Table 3, the waste generated at planning is also much as in case of ripping in Table 2. The thicknesses of the lumber process were drastically reduced from 50mm to 35mm. it would have been much more economical to go for 40mm or lesser thickness to minimize the excess waste generated in planning down from 50mm to 35mm. Also unlike in Tables 1 and 2, in Table 3, the average lumber recovery rate stands at 91.58%. That is, about 8.42% was lost to waste generated. Out of this, a greater percentage was generated as planning alone.

However, on the other hand, the minimum waste was generated at cross-cutting. This generated a net volumetric waste of 0.001008m³. Furthermore, Table 3 records a gross volumetric input of 2.21919m³. It also shows a recovery volumetric rate of 1.999134m³ and a

waste generated volume of 0.21564m³. In all, 9.5036628m³ accounted for wood gross volume input while 8.9243448m³ volumes accounted for wood recovered and 0.51524m³ volumes accounted for wastes generated.

WASTE COLLECTION IN THE WOOD PROCESSING FACTORY

Centrally, the wastes were collected in certain designated tanks called the "Bunker House". Those to be internally consumed by factory were sorted out according to material species and color at generation points. At times, the wastes were blended together depending on where they were to be used. But, those ones, which were not needed, were conveyed to the Bunker House using a central pressure conveyor system at each machine point. When this tank got filled, the wastes were evacuated out leaving the tank empty for the next operation. The off-cuts were given out to the factory workers.

WASTE UTILIZATION WITHIN AND OUTSIDE THE FACTORY

Information received from the factory indicated that the fine saw dusts generated were used as wood fillers even within the factory. Those wastes that were not needed in the factory were sold to prospective buyers who use them for agricultural practices and poultry littering within and outside Bauchi community. On the other hand, the factory used wood shavings for packaging and transporting those items/products that were made using glasses and other fragile materials. According to sources from the factory, other groups patronizing were ice block makers and transporters. The saw dusts are packed in jute and other sacks, and the ice blocks are stocked in the middle which last for days before melting.

CONCLUSION AND RECOMMENDATIONS

The study shows that more waste was generated at some stages than others. This could be attributed to saw wobbling thereby giving wider saw kerfs in operation. The reduction of thick materials to certain level of less desired thickness also contributed to more waste being generated at some points. However, the difference between the gross input volumes and the net gross recovered volumes was not much compared to the recovered volumes and the volumes of waste generated.

The study recommends that wood machinists in the factory should check and/ or inspect their saw blades and other cutting tools before operation. The use of thicker materials for less thick products should be revisited to minimize wastage. That is, using the right material for the right item should be the order of the day. A unit for the manufacture of composite and hard boards should be set up to take advantage of the saw dusts generated in and around the factory as raw materials.

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APPENDIX I**Table 1: Summary of wood waste generation/recovery of 25 lumber of Dry Zone Mahogany (*Khaya Ivorensis*) with initial input of 0.025m x 0.3m x 1.808m dimensions each and a gross volume input of 0.5424m³.**

Stages of Waste Generation	Lumber Dimension at each stage (M)	Gross Volume of Input (M ³)	Net Volume of output (M ³)	Net Recovery Rate (%)	Net volume of waste Generated (M ³)	Net Waste Rate (%)
RIPPING	0.025x28x1.808	0.5424	0.50624	93	0.0316	7
PLANING	0.023 x 0.28 x 1.808	0.50624	0.4657408	92	0.0404992	8
CROSS CUTTING						
SHOOTING	0.023x0.28 x1.805	0.4657408	0.464968	99.8	0.0007728	0.2
SQUARING	0.023x0.26x1.800	0.431756	0.431756	0.43056	99.7	0.001196
TOTAL	2,4111048m³		2,299264m³		0.1184m³	

Source: Field Survey (2015)

APPENDIX II**Table 2: Summary of wood waste generation/recovery of 25 lumbers of Abura (*Mitragyna celiata*) with initial input of 0.025m x0.3m x3.6m dimensions each and a gross volume input of 1.35m³.**

Stages of Waste Generation	Lumber Dimension of each stage (M)	Gross Volume of Input (M ³)	Net Volume of output (M ³)	Net Recovery Rate (%)	Net volume of Waste Generated (M ³)	Net waste rate (%)
RIPPING	0.25x0.3.600	1.35		1.215	90	0.135
CROSS CUTTING	0.025x0.27x3.570	1.215	1.204875	99	0.010125	
PLANING	0.23x0.027x3.570	1.204875	1.108485	92	0.09639	
SQUARING	0.023x0.27x3.560	1.108485	1.10538	99.7	0.003105	
TOTAL	0.24462m³		4.87836m³		4.63374m³	

Source: Field Survey (2015)

Appendix III

Table 3: Summary of wood wastes generation/recovery of 25 lumbers of Afara (*Terminalia superba*) with initial input of 0.05mx0.3mx1.880m dimensions each and a gross volumetric input of 0.564m³

Stages of Waste Generation	Lumber Dimension at each stage (M)	Gross Volume of Input (M ³)	Net Volume of output (M ³)	Net Recovery Rate (%)	Net Waste volume of Waste Generated (%)	Net waste Generated (%)
RIPPING	0.05x0.288x1.880	0.546	0.54144	96	0.02256	4
PLANING	0.35x0.288x1.880	0.54144	0.379008	70	0.162432	30
CROSS-CUTTING	0.035 x 0.288x1.875	0.379008	0.378	99.7	0.001008	0.3
SHOOTING	0.35 x 0.268x1.875	0.375	0.35175	93	0.02625	7
SQUARING	0.035x0.268x1.860	0.35175	0.348936	99.2	0.002814	0.8
TOTAL	2.214198m³	1.999134m³			0.24462m³	

Source: Field Survey (2015)

Appendix 2: Flow chart of waste generation at Bauchi Furniture Factory Ltd

