K. G. Ahuja, P. G. Mehar, Dr. A. V. Vanalkar / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 2, Issue4, July-August 2012, pp.1572-1576

Development Of Experimental Set Up Of Improved Hydraulic Bamboo Processing Machine

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Abstract

The present work shows the development of experimental set up of improved bamboo processing machine with a capability of doing two operations in a single unit. The details of different components, construction and working are explained in this paper. The force required to split the bamboo in 8 pieces is also included in this paper. This paper also includes the traditional process of processing the bamboo.

Key Words:- Bamboo, Splitting, slicing, knot removing, Splitting force estimation.

Introduction

The initial processes to be done on a bamboo to make it as a useful product is called as bamboo processing. The initial processes include Splitting, External and Internal Knot Removing, Slicing, Bamboo sticking making, Stick length setting, Stick Polishing. Bamboo and bamboo splits are used as the fencing material and for making various types of tool handles, ladders and scaffolding. In its natural form, bamboo as a construction material is traditionally associated with the cultures of South Asia, East Asia and the South Pacific, to some extent in Central and South America. Bamboo sticks are used for various purposes like building construction. Splits as well as slivers are used to make a wide range of products such as baskets, the core of incense-sticks, kites and toys, flutes and a large number of handicraft items. They are also use to make cages for poultry, drying, packaging and transport of grains. Bamboo splits are woven into mats and use to manufacture mat boards. Traditionally the bamboo is processed in different steps and for each step a different machine is required, the main aim behind this development of experimental set up of improved bamboo processing machine is to reduce the number of steps and also to reduce the number of machines required to do the desired work. So an improved bamboo processing machine is fabricated which can perform splitting and slicing on a single machine. The design involves a new concept of making a special purpose of die for splitting and slicing, the concept behind this project is that, the machine is kept common for both the operations; Only the die for splitting and slicing is different. This will eliminate the use of special machine for slicing which is to be done after splitting the bamboo. In this research, an approximate generalized experimental data based model for bamboo processing operation such as splitting and slicing, by varying some dependent parameters during experimentation is made.

Literature Review:-

In the year 2003, International Workshop on Bamboo Industrial Utilization titled "International Network for Bamboo and Rattan" took place which was hosted by Hubei Provincial Government & Xianning Municipal Government which clearly shows although several types of bamboo processing devices have been developed, detailed in Chapter Production Process & Equipment for Bamboo Daily Products by Liu Kekun. The proposed machine in this investigation is not reported in the literature. Similarly, the proceedings of 7th World Bamboo Congress which took place in New Delhi in Feb., 2004 and shows that so far no attempt is taken in designing a machine for processing a bamboo which can perform multiple operations with a single unit. Hence, development of such type of machine is the main aim of this project. Obviously, when several operations can take place in one machine. It is bound to be commercially suitable.

Concept of project

Traditional bamboo processing machines are usually built to perform a single task as discussed above, but in our experimental set of improved bamboo processing Machine, we are planning to do two tasks with a single machine. Splitting and slicing will be performed on a single machine, by making a special purpose die.

In the first step the bamboo will be fixed in the machine between splitting knives set and a hydraulic pushing device which pushes forward the bamboo over the splitting knives. The bamboo will split in to a number of splints of equal widths depending on the number of knives present in the splitting knives set. In general width of splits varies

from 10 mm to 15 mm depending on the species and quality of bamboo.

The strips are further divided into splits and the splits into Incense Stick. The splits may be made radially or tangentially. While designing bamboo-processing machine initially various bamboo and woodworking processing machines are studied and schematic sketch of proposed machine was drawn as shown in figure 1. Further the requirement was to calculate the force required to split the bamboo into eight pieces and to further make slices from the splited bamboo pieces. Presently the formulae available to measure these quantities are for all the metals and wood but not for bamboo, hence we have adopted these formulae for bamboo as well.

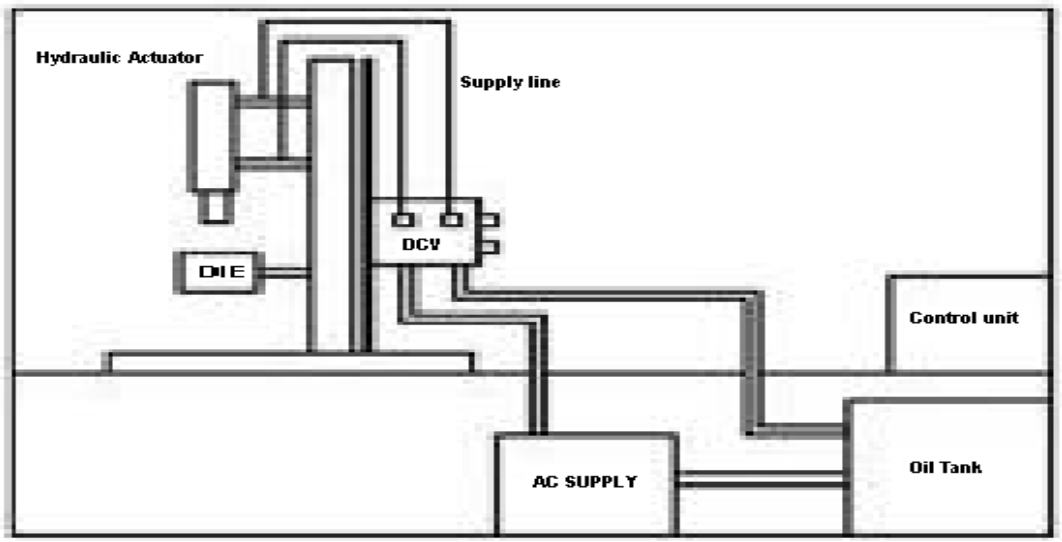

Figure 1 Sketch of proposed bamboo processing machine.

Figure 2. Actual Machine

Construction:-

Figure no 2 shows the principle parts of the improved bamboo processing machine. The components includes

a. Hydraulic actuator
b. Splitter Die
c. Slicing Die
d. AC supply
e. Hydraulic oil reservoir
f. Direction control valve
g. Control valve

Splitter Die:-

As shown in the sketch this die consists of eight cutters, when the bamboo is held against the cutter edge and hydraulic force is applied on to it so because of this force the bamboo gets splitted into eight pieces.

Splitter die is fitted in a hollow circular pipe section, 170mm in diameter and 60mm thick, sharp blades are fixed at equal distances. Blade width varies from 85 mm at center to 60 mm at outer radius with 10 mm thickness. According to number of splits of bamboo required, blades are increased or decreased. Maximum numbers of blades are six in the present splitter. Its handles are 120mm in length attach at opposite ends and supported on machine frame at back end of machine.

Slicing Die:-

This die consists of four tools having a length of 40 mm height of 25 mm and the end thickness of 2.5mm. These tools are placed parallel to each other and having a clearance of 2 mm so that we get the slices of about 1.5 mm. These tolls are fitted between two flat plates having a thickness of 4 mm. The splitted bamboo pieces are forced by using hydraulic force on to the slicing cutters in such a way that the splited bamboo piece gets sliced in four pieces of 1.5 mm. The actual slicing die and CAD model of the same is also showed in figure no 3.

EXPERIMENTATION:

A number of experiments were conducted to study the effects of various machining parameters on bamboo processing operations. These studies have been undertaken to investigate the effects of various sizes of bamboo, speed, cutters and other machine parameters on torque, energy and time required in processing operations. During experimentation various variety and sizes of bamboo samples are collected and processed at three different speeds. For splitting operation different diameter of bamboos were taken in to consideration for obtaining cutting force required to split bamboos of different diameters. The result of the same is shown below. In the next step the already splitted bamboo pieces are forced on to the slicing tool and it gets sliced in four pieces, the actual slices are also shown in figure no 4.

Figure 3:- Actual working Die of splitter, Cad model of splitter.

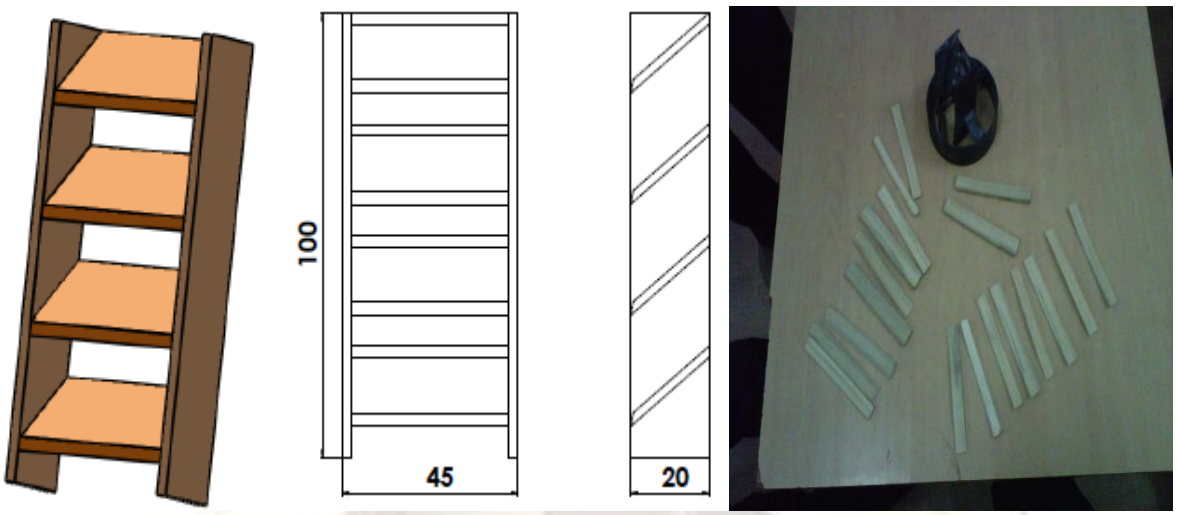

Figure 4 :- Cad model of Slicing die and actual slices of bamboo pieces.

Force calculations:-

Area Of different size bamboos

1. **A** = π /4 (28.12^2 -11.42^2) = **518.07 mm.**

2. **A** = π /4 (30.25^2 -13.37^2) = **578.29 mm.**

3. **A** = π /4 (51^2 -31^2) = **1288.05 mm.** π

4. **A** = π /4 (52.07^2 -32.07^2) = **1321.66 mm.**

5. **A** = π /4 (58^2 -38^2) = **1507.96 mm**

Pressure = Force / Area

We have already calculated area, now pressure will be taken from the pressure guage already fitted on the main line of machine, the min pressure comes out to be 6.876 mpa.

F= 6.86 × 518.07 = 3455.55 N.

BAMBOO NO.	INNER DIA. (mm)	OUTER DIA. (mm)	AREA (mm^2)	PRESSURE (M Pa)	APPLIED FORCE (N)
	11.45	28.12	518.07	6.670	3455.55
2.	13.37	30.25	578.29	6.670	3857.21
3.	31	51	1288.05	6.867	8845.06
4.	32.07	52.07	1321.66	6.867	9075.89
5.	38	58	1507.96	6.867	10355.19

CONCLUSION

The above discussed work gives a brief description regarding how a single is capable of doing two operations with a single unit. If compared with the traditional procedure of doing the above mentioned two operations, this machine can save a lot of time and cost as well. The next step in this project could be replacing the two individual die with a new improved single die which will be capable of doing the two operations at a same time.

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