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A Preliminary Investigation on the Production of Bamboo Boards

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ဝါးစပြားထုတ်လုပ်ခြင်းအား ပဏာမ လေ့လာခြင်း

ဒေါ်ခင်မေလွင်၊ B.Sc. (I.C), (Rgn.), Dip. Pulp & Paper Technology (India).
လက်ထောက်သုတေသနအရာရှိ၊ သစ်တောသုတေသနဌာန၊ ရေဆင်း။

စာတမ်းအကျဉ်းချုပ်

ဤစာတမ်းတွင် ဝါးစပြား ပြုလုပ်ပုံ အဆင့်ဆင့်ကို ဖော်ပြထားပါသည်။ ၄င်းအပြင် ဝါးစပြား၏ မာခြင်းနှင့် သိပ်သည်းဆတို့ကို နှိုင်းယှဉ်ဆွေးနွေးထားပါသည်။ ဝါးစပြားတွင် ဝါးမျှင်စများဖြင့် တည်ဆောက်ထားပြီး ဝါးမျှင်ပြားများကို အလှည့်ကျ ထောင့်မှန် ပြုလုပ်၍ စီထားပါသည်။ ကော်အဖြစ် ဖီနောလစ်ရီစင်ကို အသုံးပြုထားပါသည်။ ကုန်ကြမ်းဝါးအဖြစ် ကျသောင်းဝါး (*Bambusa polymorpha* Munro.) ကို အသုံးပြုထားပါသည်။

A Preliminary Investigation on the Production of Bamboo Boards

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Abstract

The paper described the procedures involved in making bamboo board. The comparative hardness and specific gravity of the products were determined. Bamboo board was a panel consisting of an assembly of plies of bamboo fibers bonded together in alternate plies at right angles. An adhesive of phenolic resin was used in the process. The bamboo species used for the material was Kyathaungwa (*Bambusa polymorpha* Munro.)

Contents

1. Introduction

The growing shortage of supply of wood, especially the solid wood, all over the world direct man to find ways to substitute other form of materials for wood. Now-a-day, plastic, aluminium and other synthetic materials are chiefly used as wood substitutes. However, continuous use of wood still remains unchanged but more in the form of reconstituted wood such as plywood, laminated wood and particle board. Besides, other fibrous materials also find its way to be utilized as for the same purpose.

The non-wood fibrous materials suitable for fiberboard, and also particleboard manufacture are agricultural residues, chiefly from the fibrous parts of annual plants. Some of these material are already widely used in various areas of the world. Other are at present used only in limited amounts, but have growing possibilities for the future in regions with insufficient wood supply. The principal non-wood fibrous raw materials are (FAO, 1958/1959, p.42-46) bagasse, flax ahives, cereal straw, cotton stalk, corn stalk and other fibers. The other fibers, representing potential raws materials for fiberboards, are bamboo, papyrus, coconut fiber residue, palmleaf ribs etc.

The nature of bamboo cell wall substance and its distribution as a system of thin wall tubes made very efficient in rigidity. The high rigidity of bamboo is most efficient in member as beams. In comparison with other structure material, the weight strength ratio for bamboo product is very favorable for some application. (C.Guishing)

In Myanmar, the supply of timber is far below the ever increasing demand of the country. Therefore, requirement of non-wood fibrous materials to substitute wood utilization is possible in the near future. Myanmar is fortunate in having extensive bamboo resources with more than 90 species. These are growing in large quantities throughout Myanmar. One of the most common bamboo species in Myanmar is Kyathaung wa (*Bambusa polymorpha*). Therefore, it should be considered to produce new product replacement for wood by bamboo.

In this paper investigation was made for the production of bamboo board by using the species of *Bambusa polymorpha* and its some physical and mechanical properties.

2. Materials and Methods

2.1. Material

The Kyathaung wa (*Bambusa polymorpha*) was selected for board preparation and testing. Approximately, culms of 9 cm diameter were collected from Yezin area.

2.2. Methods

2.2.1 Sample Preparation.

Bamboo culm is first crosscut into desired length. The cuts are then split open into two or three pieces. Pretreatment for bamboo was made by soaking the pieces in a cooking vat for several hours at 100°C, till the pieces become soft enough for further treatment. The treated pieces are than spread out, ground and dried.

2.2.2. Adhesive Preparation

First, 600 ml of phenol and 500 ml of formalin were mixed in the resin kettle and shook well. Then 25 g of sodium hydroxide was added into the solution. The resin kettle were placed on the hot water bath set up with condenser and boiled it up at 100°C for 30 minutes. The red solution so formed was cooled to room temperature when the viscosity was about 100 cpi.

2.2.3. Board Making

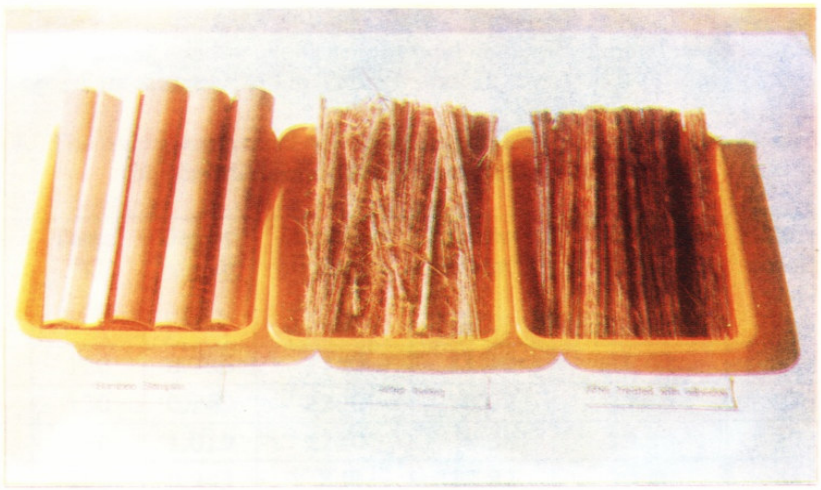
The pretreated bamboo fibers were glued by different glue amount to form (30 x 30 x 1) cm^3 sheets. After the application of glue, the bamboo fibers were arranged to form an assembly of plies of bamboo fibers bonded together in alternate plies at right angles. Then the boards were pressed at the temperature varying between 120°C to 150°C for 15 minutes by hot press at 110 psi.

2.2.4. Physical and Mechanical Test

After trimming and sanding, the test specimen were tested for the following properties.

(1) Moisture contents.
(2) Density.
(3) Hardness.
(4) Volumetric swelling.
(5) Water absorption.

Properties of bamboo board panel products are determined according to ASTM Standard and IS: 1708 India Standard.



Sample preparation for Bamboo boards.

Bamboo boards sample.

3. Results

The average results of some physical and mechanical tests conducted on bamboo board are summerized in Table I and II.

Table I. The average physical and mechanical properties of bamboo board under the condition of different press temperature range.

Sr. No.	Temp. °C	Density g/cc	Hardness lb	Moisture content %	Volumetric swelling 24 hr. soaking %	24 hr. water absorption wt %
1	120	0.786	1150	11.70	21.60	31.91
2	130	0.949	1200	10.02	23.85	27.08
3	**140**	**1.029**	**1240**	**8.63**	**19.80**	**17.95**
4	150	0.943	840	12.82	20.40	31.90

Pressure = 110 Psi
Glue amount = 400 ml
Board size = (30 x 30 x 1) cm^3

Table II. The average physical and mechanical properties of bamboo board under condition of different glue amount

Sr. No.	Amount of glue used (ml)	Density g/cc	Hardness lb	Moisture content %	24 hr. water absorption wt %
1	940	0.967	2280	5.8	18.86
2	840	0.865	1567	6.4	27.50
3	600	0.867	1200	11.32	29.58
4	400	0.786	1150	11.70	31.91

Pressure = 110 Psi
Temperature = 120°C
Board size = (30 x 30 x 1) cm^3

4. Discussion

The results indicated that the density of bamboo boards which are pressed at 140°C is the highest.

Fiber-based panel materials are broadly divided into four - insulation board (the lower density products), hardboard, medium fiberboard, and laminated paper board. The followings are (ASTM Standard) breakdown by density classes for the fiber-based panel products in their various groups:

	Density (g/cc)		
Insulation board	0.16	to	0.5
Hardboard	0.5	to	1.45
- Median-density hardboard	0.5	to	0.8
- High-density hardboard	0.8	to	1.28
- Special identified hardboard	1.35	to	1.45
Medium-density fiberboard	0.5	to	0.88
Laminated paperboard	0.5	to	0.59

When compared to the above Standard, the bamboo board panel products showed nearly equal properties as high-density hardboard.

The moisture content of bamboo board varied with environmental humidity conditions because bamboo board was a fiber - based material. The standard moisture content was ranged between 5.8 to 12.82 percent and the properties of bamboo board was also as same as the hardboard.

Product standard PS 60 - 70 indicated that standard minimum hardness of hardboard was 450 lb. The hardness of bamboo board was considerably higher than the hardness of hardboard.

The bamboo board can resist to water and high relative humidities. The volumetric swelling of 24 hours soaking in water was ranged between 19 - 24, when 400 ml of glue per board was used. The result of percent weight of 24 hours water absorption was ranged between 18 - 32 percent (table I) and 22 - 40 percent (table II). For comparison the range of value of 24 hours water absorption for standard hardboards were 10 - 40 percent.

5. Conclusion

For the economic point of view, the lowest amount of glue and lowest temperature are required for board making. From the above result, bamboo board prepared under the condition of 400 ml glue used and 140°C press temperature was found to be comparable with the standard hard boards.

Since bamboo board has suitable density, favourable moisture content, high hardness and good water-proof ability and, therefore, suitable for exterior cladding for building as floor underlays, as ceiling and as partition.

Appendix. I.

7.1. Cost estimation.

The cost estimated for one square foot bamboo board. (1997)

Particular	Cost estimate	
	Used by Phenol formaldehyde (Kyats)	**Used by Urea formaldehyde (Kyats)**
Bamboo	5	5
Chemical	100	50
Labour	10	10
Machine	10	10
Total	125	75

7.2. Compared with other board materials

Particular (1 ft^2)	**Cost estimate (Kyats)**
Bamboo board (used by phenol formaldhyde)	125
Bamboo board (used by ures formaldhyde)	75
Parquette	135

Reference

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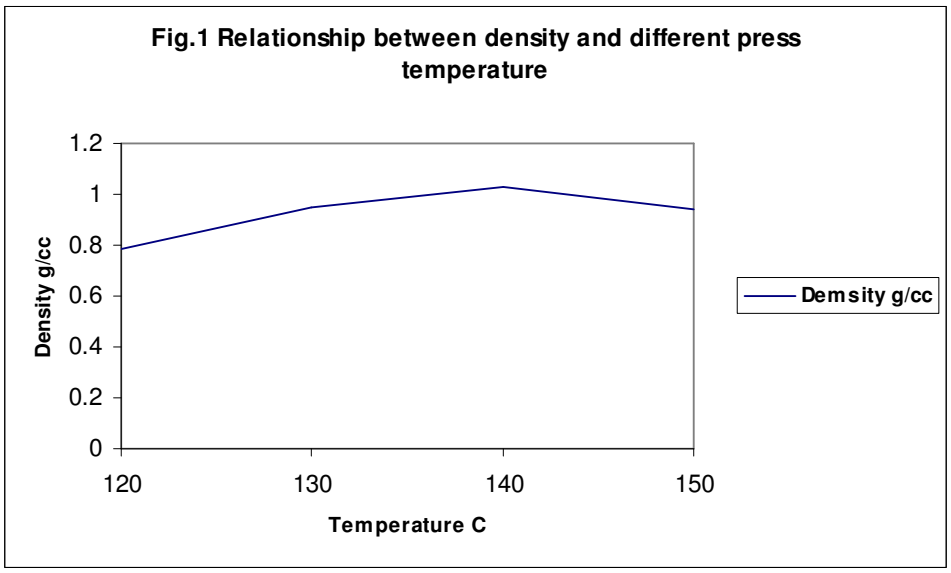
Fig.1 Relationship between density and different press temperature
1.2
1
0.8
0.6
0.4
0.2
0
Density g/cc
120
130
140
150
Temperature C
Demsity g/cc

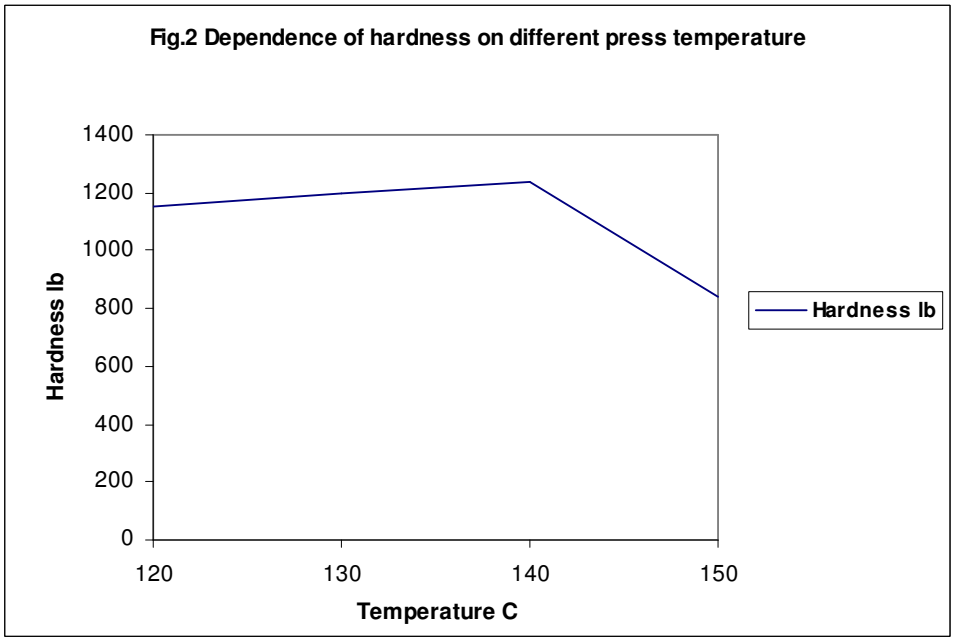
Fig.2 Dependence of hardness on different press temperature
1400
1200
1000
800
600
400
200
0
Hardness lb
120
130
140
150
Temperature C
Hardness lb

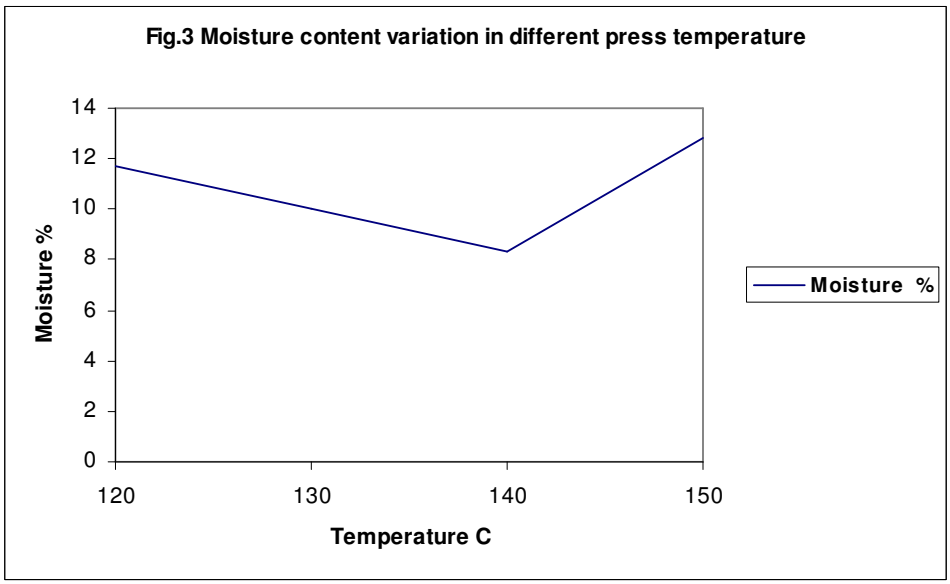
Fig.3 Moisture content variation in different press temperature
14
12
10
8
6
4
2
0
Moisture %
120
130
140
150
Temperature C
Moisture %

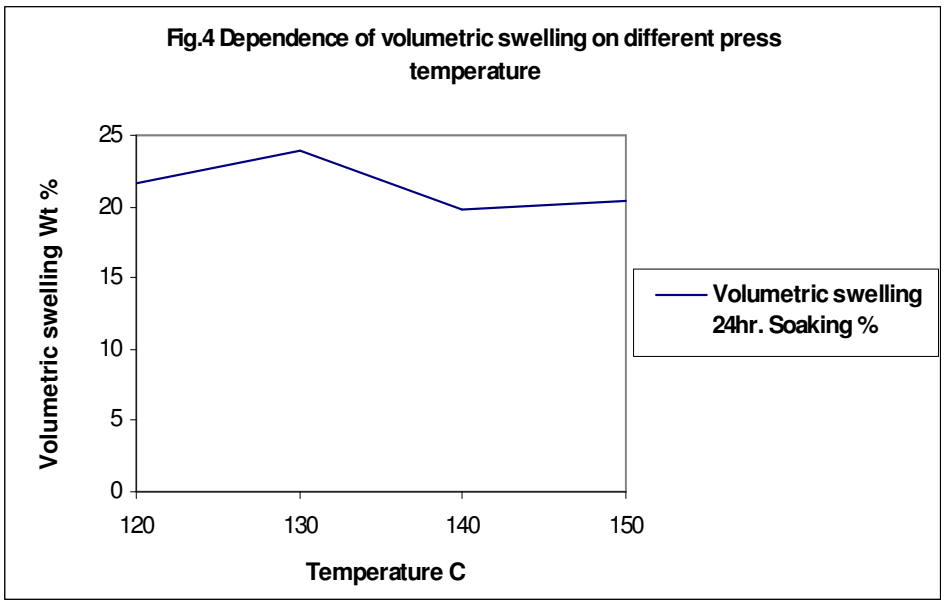
Fig.4 Dependence of volumetric swelling on different press temperature
25
20
15
10
5
0
Volumetric swelling Wt %
120
130
140
150
Temperature C
Volumetric swelling 24hr. Soaking %

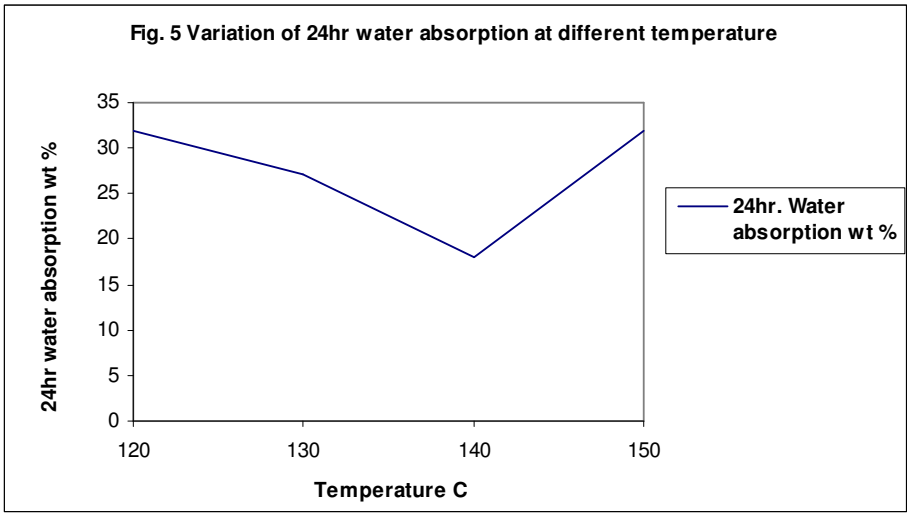
Fig. 5 Variation of 24hr water absorption at different temperature
24hr water absorption wt %
35
30
25
20
15
10
5
0
120
130
140
150
Temperature C
24hr. Water absorption wt %

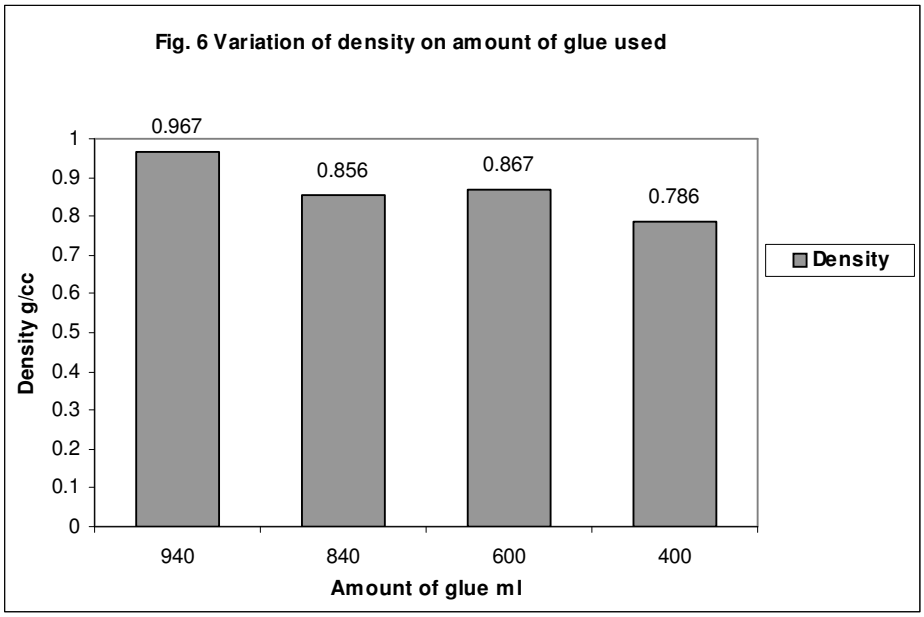
Fig. 6 Variation of density on amount of glue used
Density g/cc
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.967
0.856
0.867
0.786
940
840
600
400
Amount of glue ml
Density

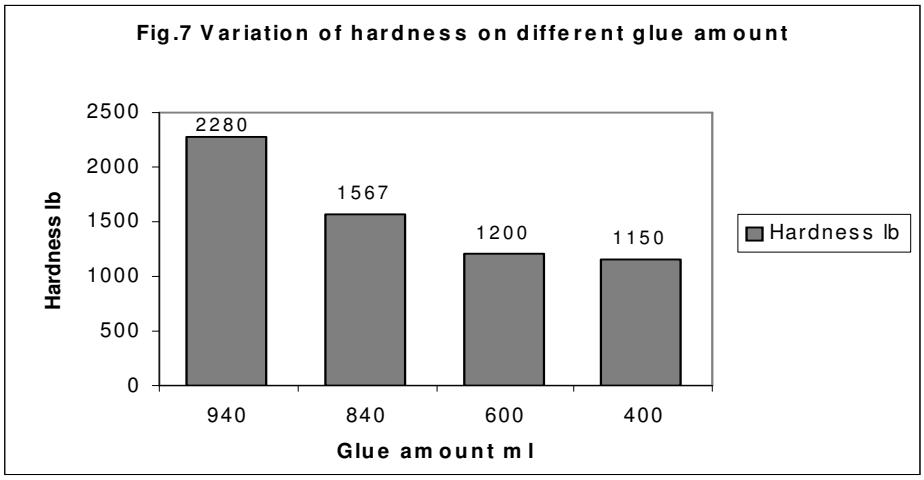
Fig.7 Variation of hardness on different glue amount
2500
2000
1500
1000
500
0
Hardness lb
2280
1567
1200
1150
940
840
600
400
Glue amount ml
Hardness lb

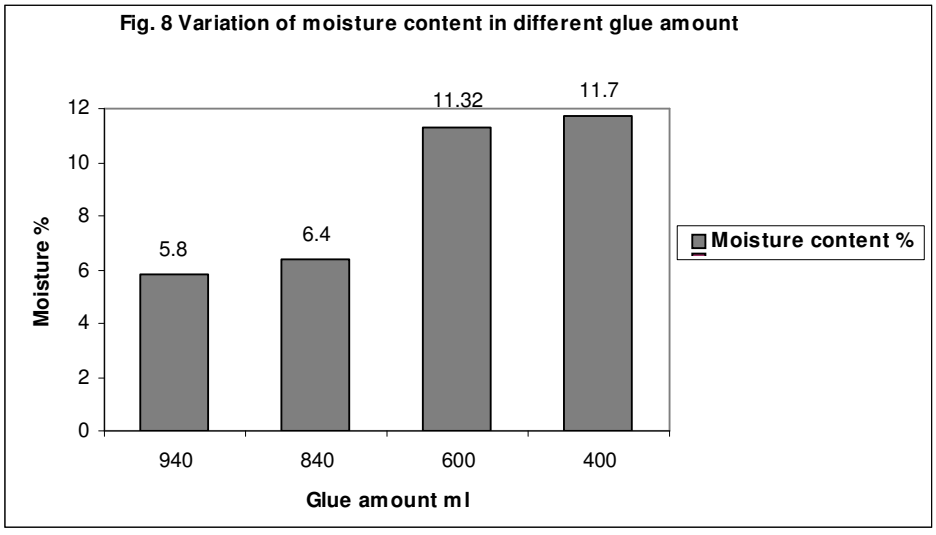
Fig. 8 Variation of moisture content in different glue amount
12
10
8
6
4
2
0
Moisture %
5.8
6.4
11.32
11.7
940
840
600
400
Glue amount ml
Moisture content %

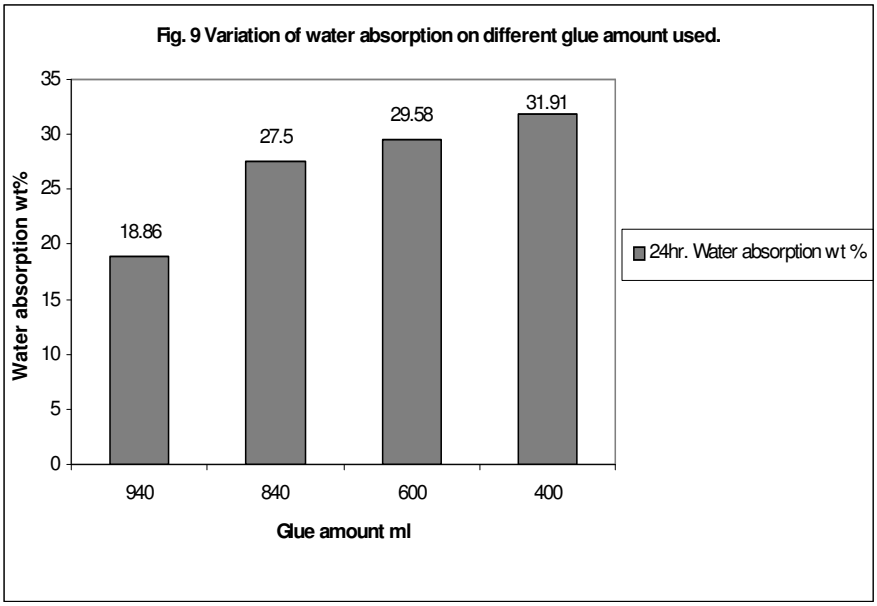
Fig. 9 Variation of water absorption on different glue amount used.
Water absorption wt%
35
30
25
20
15
10
5
0
18.86
27.5
29.58
31.91
940
840
600
400
Glue amount ml
24hr. Water absorption wt %