Proceedings of the
International Conference on Mechanical Engineering 2007
(ICME2007) 29- 31 December 2007, Dhaka, Bangladesh

ICME07-AM-18

AN EXPERIMENTAL INVESTIGATION OF MECHANICAL PROPERTIES OF LOCALLY PRODUCED PLASTIC WOOD

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ABSTRACT
This paper presents some common mechanical properties of locally produced plastic wood, which have been obtained experimentally according to the ASTM standard. The mechanical properties considered for investigation are tensile strength, percentage elongation, flexural strength and hardness. The analyses of the various properties as mentioned have been done statistically. The results of the investigation suggest that plastic wood can be used as a substitute of natural wood for many applications reasonably well.

Keywords: Plastic wood, Mechanical properties.

1. INTRODUCTION

The search for the lightweight and highly efficient structural components is a continuing process. Reducing the structural weight and improving the load carrying capabilities of these structures will allow designers to provide additional capability while reducing cost.

Plastic wood is a polymeric matrix composite material, which has low density in comparison with its strength. The technical name of plastic wood is PVC Low Density Free Foamed (LDFF) sheets/boards. It may be used as a substitute of natural wood, plywood and other similar products for many applications. It is non-corrosive and perfectly weather resistant. It has smooth surfaces, easy to clean and it can be used with or without coating of paint or varnish. It can be planed, drilled and sawn just like natural wood. It is also impervious to insects including termites and chemicals.

Plastic wood has its wide use in Europe and America in a number of fields, such as construction, building, sport, furniture and advertising. Now a day plastic wood is widely used for doors, windows, furniture and different decorative functions.

Many companies are manufacturing plastic wood to meet the various demands of the people. But their quality control and overall properties are still unknown to many of them.

Considering its wide range of application, it is essential to know the different mechanical properties of plastic wood. As such, an experimental investigation has been conducted in order to determine the most common mechanical properties of it. The elaborate study has been conducted on locally available plastic wood by Islam A.B.M.I and Faria R. [2]. The mechanical properties of various kinds of locally available natural wood have been reported in the references [3,4].

2. TEST PARAMETERS

The tensile strength and percentage elongation at break have been conducted in accordance with the standard ASTM D638 - 03 [1] using a 5kN capacity tensile testing machine. The accuracy of the testing machine for the load was 5 N and for the extension it was 0.01 mm. The testing speed was considered as 5 mm/min as per the standard.

The flexural strength was performed in accordance with the standard ASTM D790-03. The test speed was considered as 3 mm/min. Hardness test was conducted according to the standard ASTM D785-03. The hardness was measured by the Rockwell hardness tester in the

scale of R. According to this scale the ball indenter diameter was 12.5 mm, preload was 98.1 N and the test force was 490.5 N. The load was applied for 15 s.

All the test specimens were conditioned at room temperature and the relative humidity of 23 ± 2^0C and 50±5% respectively in order to satisfy the requirement of the standards.

3. RESULTS AND DISCUSSION

In Figure 1 the histogram of tensile strength has been shown. To make the histogram 150 numbers of specimens was considered. The average tensile strength is 13.27 MPa and standard deviation is 0.47 MPa. The range of the tensile strength values is in between 12. 03 to 14.88 MPa, as shown in the histogram. The normal distribution curve of the test results of tensile strength values is also shown in the same figure. It is observed from this figure that the distribution follows more or less symmetrical nature. Higher number of specimens than that in the present analysis is necessary to make the histogram more symmetric and the result will be more precise.

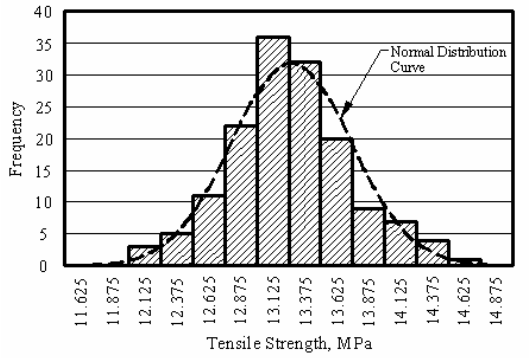

Fig 1: Histogram of Tensile Strength

The histogram for percentage elongation at break is shown in Figure 2. The results were obtained from 150 numbers of tests. The average percentage elongation at break is 4.82 and the standard deviation is 1.88. The normal distribution curve of percentage elongation is also shown in this figure. The distribution is not that much symmetric as the figure shows. Higher number of specimens will be necessary for the histogram to be more symmetric.

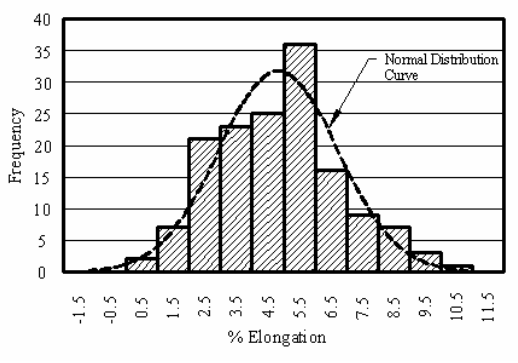

Fig 2: Histogram of Percentage Elongation at Break

The stress-strain curve of a particular tensile test specimen is presented in Figure 3. It can be observed from this figure that it does not show the property like that of the brittle material rather it provides plastic deformation for a reasonably wide range. The modulus of elasticity is calculated from the slope of the stress-strain diagram and its value is obtained as 0.55 GPa.

The average tensile strength of locally produced Gamari and Garjan wood are respectively 60 MPa and 115 MPa while the modulus of elasticity of Garjan is 22 GPa [3]. On the other hand the average tensile strength of locally produced Silkaria and Shal are respectively 68 MPa and 135 MPa while the modulus of elasticity of them are respectively 8.5 GPa and 8.2 GPa [4]. But for the plastic wood these values are smaller compared to them thereby limiting its application in the places where higher strength is required.

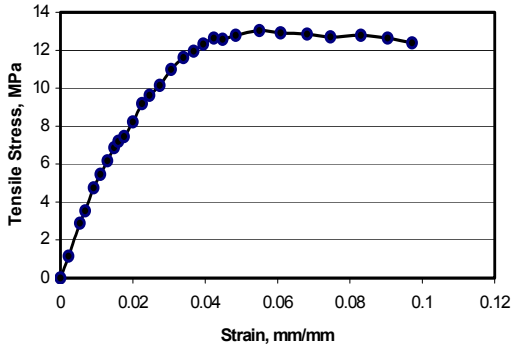

Fig 3: Stress-Strain Curve for Tensile Test

The histogram of flexural strength for 100 numbers of specimens is shown in Figure 4. The average flexural strength is 27.29 MPa and the standard deviation is 1.69 MPa. The normal distribution curve of flexural strength is also presented in the same figure. The stress-strain diagram of bending test for a particular specimen

is given in Figure 5. The modulus of elasticity of this specimen is found to be 0.90 GPa, which is obtained from the slope of the stress-strain diagram.

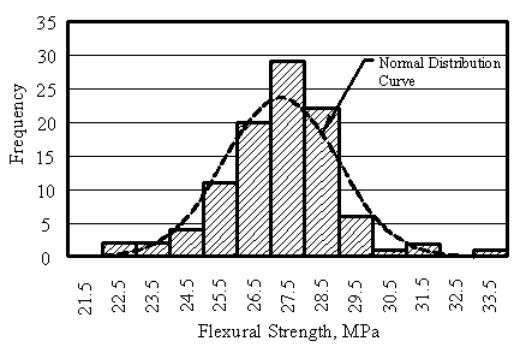

Fig 4: Histogram of Flexural Strength

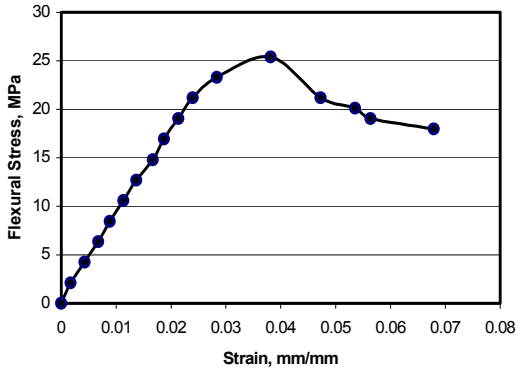

Fig 5: Stress-Strain Curve for Bending Test

The histogram of hardness values in the R scale of Rockwell hardness tester is presented in Figure 6. The normal distribution curve for the hardness is shown in this figure. The total number of specimens was 100. The average value and the standard deviation of hardness are respectively 17.32 HRR and 0.69 HRR.

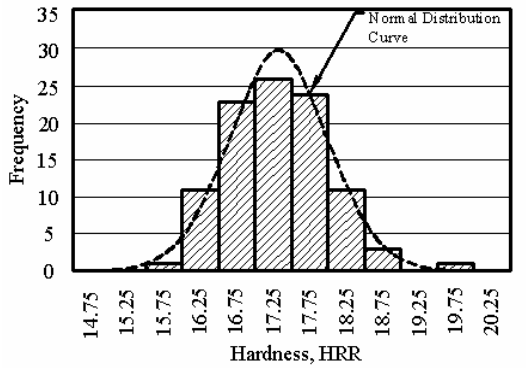

Fig 6: Histogram of Hardness Values

4. CONCLUSIONS

- The results of the investigation suggest that plastic wood can be used as a substitute of natural wood for the applications where higher strength is not necessary.
- The histogram will be more symmetric and the result will be more precise, if larger number of specimens than that in the present analysis is considered.
- Other properties such as, crushing strength, impact etc. are also necessary for the plastic wood in order to make the final comment in regard to its application.

5. REFERENCES

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