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Experimental Investigation on the effects of Thermal Treatment on the Physical and Mechanical Properties of *Acacia* hybrid

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Research Outline

01 **Objectives & Introduction**

02 **Material & Methods**

03 **Results & Discussion**

04 **Conclusion**

Objectives

Objective 1:
To determine the physical properties on untreated specimen as a control purpose.

Objective 2:
To investigate the physical properties of treated specimen based on different portion, temperature, and duration.

Objective 3:
To justify the mechanical properties of treated specimen based on different portion, temperature, and duration.

Introduction

Heat treatment is one method used to modify the properties of wood by improving the dimensional stability and resistance to bio-corrosion.

01

Acacia hybrid has better prospects in large scale plantations due to its high adaptability to grow in poor soil with no adverse effects on the environment.

03

05

Its utilization includes furniture making purposes, doors and window frames, parquet flooring and tool components. Also, recommended for engineered wood products such as LVL, GLULAM, scrimber, and other composites types.

04

Acacia hybrid has a promising potential in the timber industry due to extensive utilization of other acacia species and has currently become a substantial alternative choice for timber plantation species

02

The *Acacia* hybrid possesses better characteristics compared to its parent species, such as bigger, straighter trunk, less branching system and less knots.

Material & Methods

Sample Preparation

The randomly selected three (3) log with DBH 40 were harvested and the sample was cut into three portion. The trees was harvested 50 cm from ground level and 50 cm below the first main branch. Total length of the *A.* hybrid logs were divide into 3 portion and 100 mm disc were taken.

Thermal Treatment

The thermal treatment were conducted using an electric oil-curing machine and a palm oil as a heat medium at different temperatures and durations. The specimens were cut according to the ISO 3129:1975 standard.

Moisture Content

The determination of moisture content on *A.* hybrid was conducted follow the standards specified in the International Organization for Standardization, ISO 3130-1975E.

Material & Methods

Density & Basic Density

The test was conducted based on standards specified in the International Organization for Standardization, ISO 3131-1975E. Density is the mass per unit volume of solid wood matters.

Static Bending Test

The static bending from tangent surface of *A.* hybrid was carried out as follow the ISO 3349 standards. The samples was cut into specific size (20 x 20 x 320 mm) to find the MOE and MOR value

Compression Test

The compression test of *A.* hybrid was carried out as follow the ISO 3787 standards. The specimens was cut into specific size (20 x 20 x 60 mm) and to be conditioning before test conducted.

Research Conducted

Sampling and specimen cutting

Results & Discussion

Physical Properties on *Acacia* hybrid

Physical Properties of *A. hybrid*

The moisture content value ranges from 65% to 71% with the highest mean result is the middle portion at 71.0%, followed by the middle portion at 68% and finally the top portion with the lowest value at 65.2%..

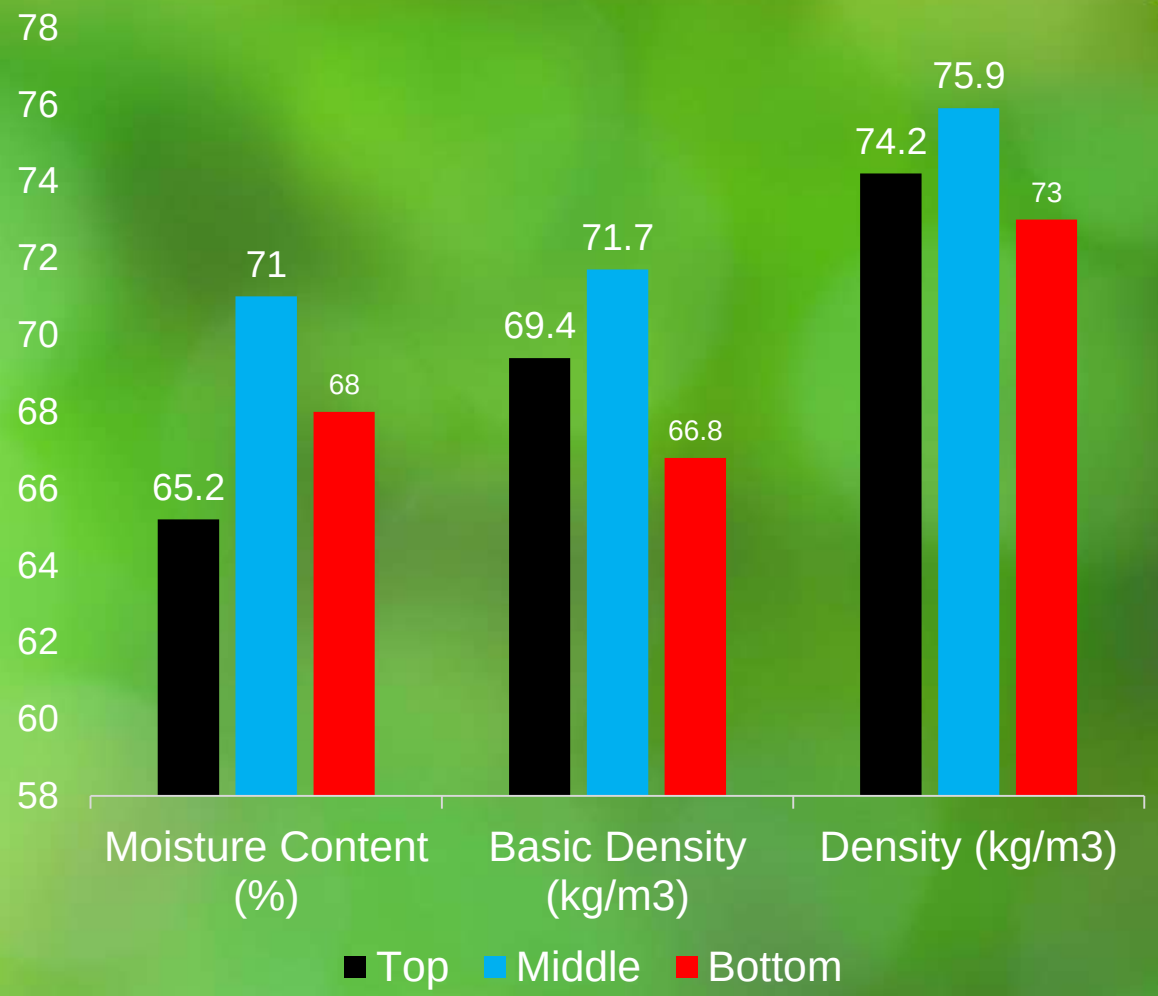
Moisture Content

Basic Density

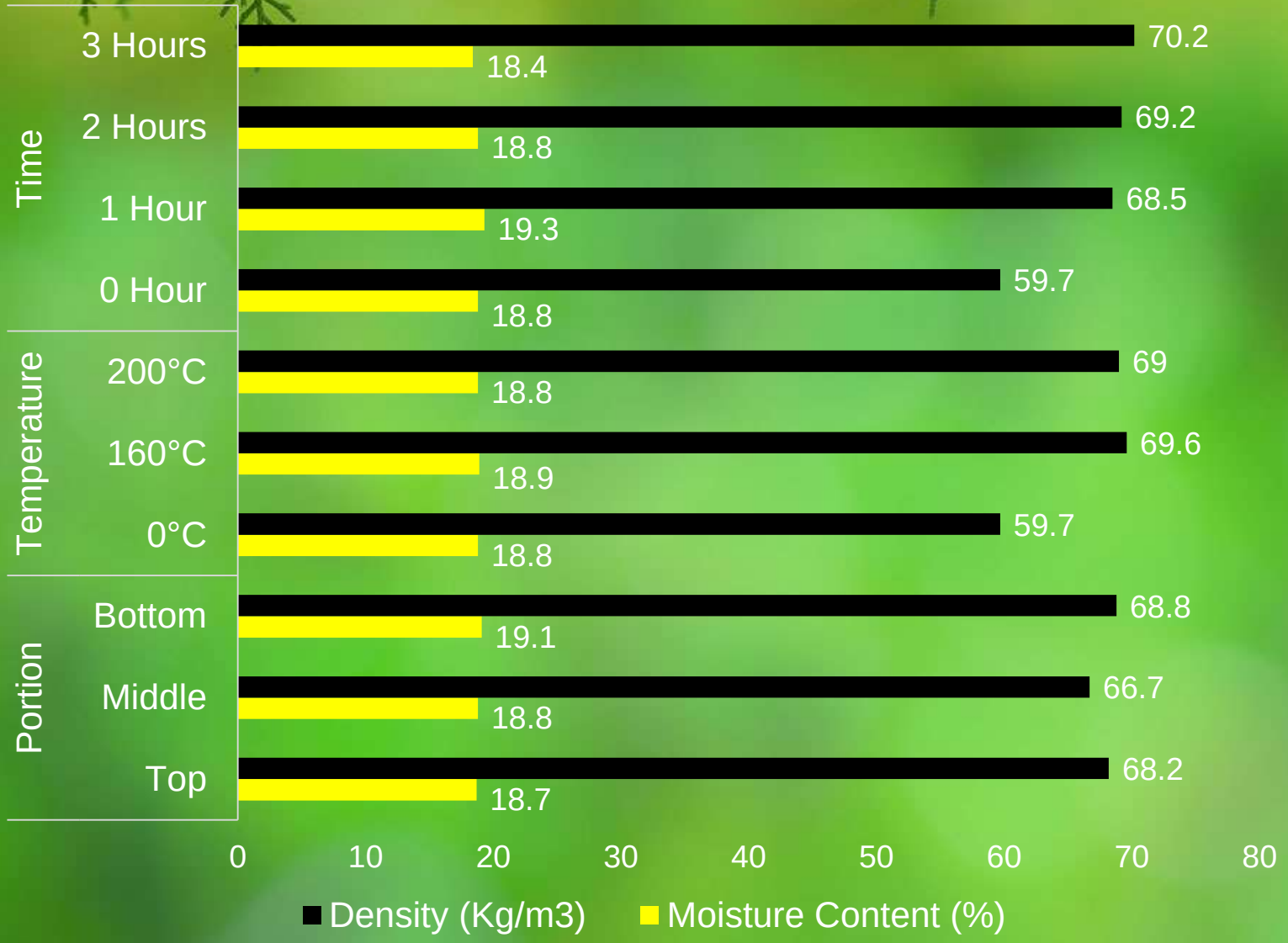
The range of basic density value were 66.0 kg/m^3 to 72.0 kg/m^3 with the mean from the middle portion showed the highest value which was 71.7 kg/m^3, followed by the top portion at 69.4 kg/m^3 and then the bottom portion at 66.8 kg/m^3.

Density

The range of density was 73.0 kg/m^3 to 76.0 kg/m^3 with the middle portion again showed the highest value at 75.9 kg/m^3, followed by the top portion at 74.2 kg/m^3 and then the lowest mean value at 73.0 kg/m^3 at the bottom portion.



Modification of Physical Properties on *A.hybrid*



Moisture Content

- The average mean of moisture content around 18% to 19%, represented that the thermal treatment process had reduced the moisture content of all the samples at different portions with mostly the same effects.
- The differentiate of MC value in portion recorded between 1.57% to 2.09% based on the highest value.
- For temperature and time parameter found that 0.53% and 2.59% - 4.66% of differentiate value respectively.

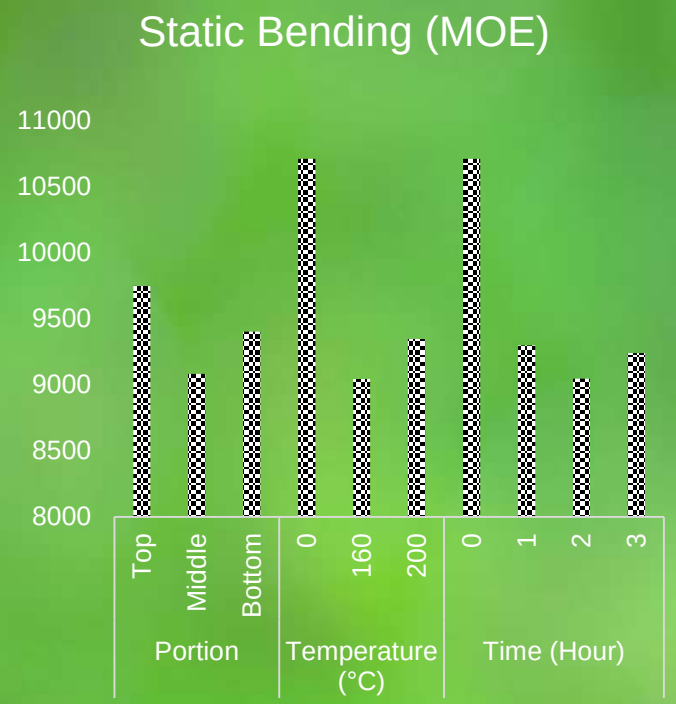
Density

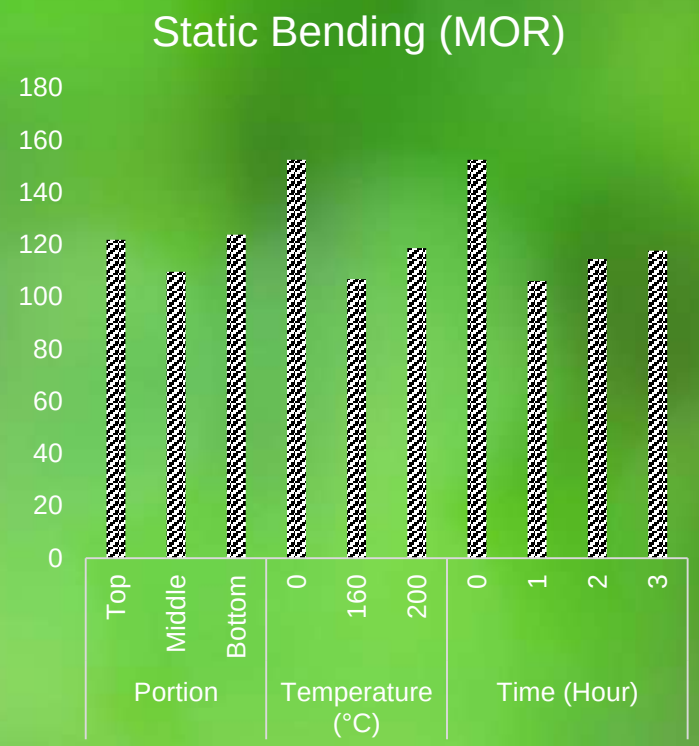
- The portion as the main factor that influence the density with mean value indicated at different samples were around 66.7 kg/m^3 to 68.8 kg/m^3
- The highest mean density was 68.8 kg/m^3 at the bottom portion, followed by the top portion with a mean density of 68.2 kg/m^3 and lastly the middle portion with a mean density of 66.7 kg/m^3

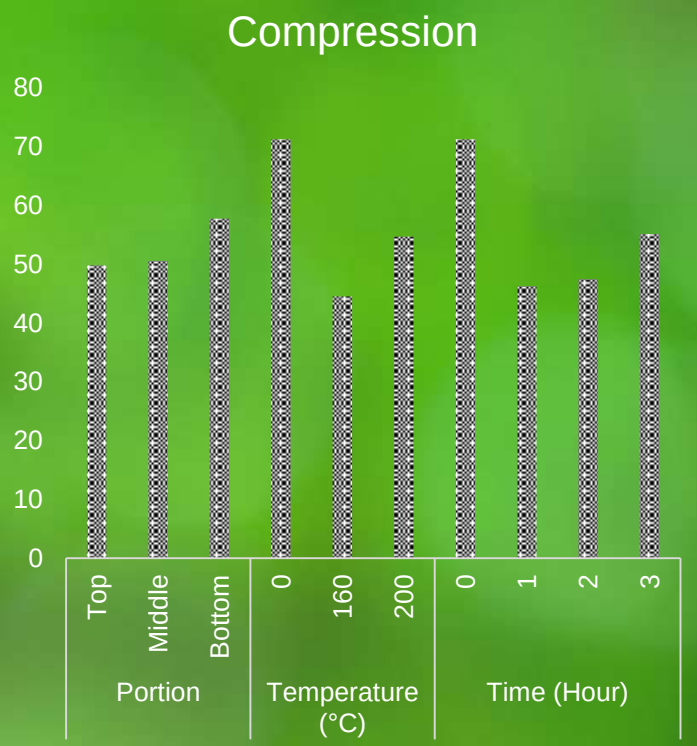
Results & Discussion

Mechanical Properties on *Acacia* hybrid

Modification of Mechanical Properties on *A.*hybrid

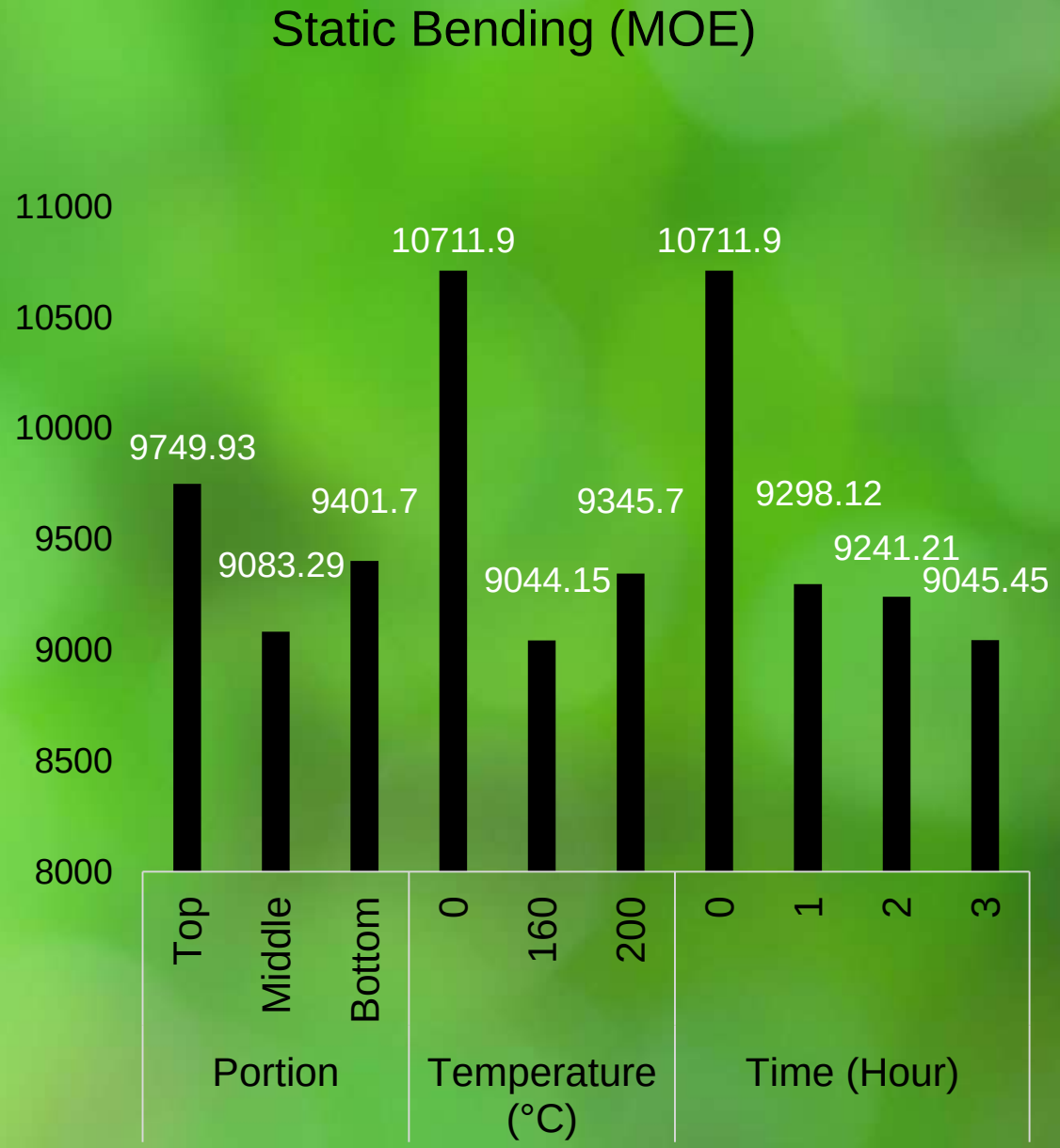






> The graphs indicated that the Modulus of Elasticity (MOE) and Modulus of Rupture (MOR) for static bending and also compressive test value under the thermal treatment process at different portion and durations.

- Portion parameter indicated that the highest MOE value was 9749.93 N/mm^2 and followed by the top and middle portion with 9401.70 N/mm^2 and 9083.29 N/mm^2, respectively.
- The highest MOE for heating stage represented at 10711.90 N/mm^2 and followed by 9345.70 N/mm^2, and 9044.15 N/mm^2 at 200^{O}C and 160^{O}C, respectively.
- Then at duration the highest MOE shows at 10711.90 N/mm^2 at control, followed by 1, 2, and 3 hours with 9298.12 N/mm^2, 9241.21 N/mm^2 and 9045.45 N/mm^2 at 2 hours, respectively



- For portion parameter, the highest MOR value highlighted at bottom and follow by top and middle.
- Then, at different temperature shows the highest MOR was 152.59 N/mm^2 from control, followed by 118.72 N/mm^2 from 200^{O}C and 106.84 N/mm^2 from 160^{O}C.
- Nonetheless, the control sample indicated the highest MOR with 152.59 N/mm^2, and followed by 3, 2, and 1 hours with 117.74 N/mm^2, 114.56 N/mm^2, and 106.04 N/mm^{2,} respectively

- Compression force highlighted the highest value at the bottom with 57.77 N/mm^2, followed by the middle, and top with 50.59 N/mm^2 and 49.84 N/mm^2, respectively.
- The highest compression force at different temperature shows on control sample with 71.26 N/mm^2, followed by 200^{O}C and 160^{O}C with 44.56 N/mm^2 and 44.56 N/mm^2, respectively.
- At different time stages, control sample had the highest value and followed by 3, 2, and 1 hours.
- The strength of a piece of wood in compression is closely related to its density though influenced by its moisture content

Conclusion

01

Effect on mechanical properties under thermal treatment

The study found a thermal treatment process did not achieve a desirable outcome such as getting a positive effect on the mechanical strength of the treated *Acacia* hybrid.

02

Effect on physical properties

However, the thermal treatment gave better effects on the physical properties in terms of faster time of wood drying and higher density than the control samples.

03

Weakness

There are supported by the analysis highlighted that an almost all values of strength assessments with different levels of temperatures and time durations showed lower values compared to the untreated samples.

04

Strength

Nonetheless, the factors of temperature and time duration of thermal treatments were more influential towards the physical and mechanical properties of treated *Acacia* hybrid than the portion factor.


Thank you
Q&A