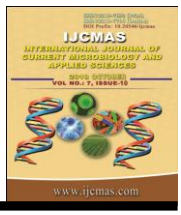
Int.J.Curr.Microbiol.App.Sci (2018) *7*(10): 720-723

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 10 (2018)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2018.710.079

Changes in the Specific Gravity in Rubber Wood Treated with Cashewnut Shell Liquid and Nano Based Wood Preservatives

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Keywords

Nano copper oxide, Wood preservative, Rubber wood (*Hevea brasiliensis*)

Article Info

Accepted:
06 September 2018
Available Online:
10 October 2018

A B S T R A C T

Specific gravity (SG) of wood is a measure of the amount of structural material a tree species allocates to support and strength. Specific Gravity of wooden sample is taken by using the ratio of oven-dried weight of the sample to its volume at 12% moisture content. Rubber wood is a moderately heavy wood which can be used efficiently as a boat building material if proper preservative procedure can be carried out. Due to its refractory behaviour it can easily take up preservative solutions. In this present study Cashewnut Shell Liquid and Copper based wood preservative (Nano Copper Oxide) were used. Specific Gravity of different treated wooden panels was carried out. The main objective of the present study is to assess the changes in the specific gravity in the wooden panels treated with different preservative solutions.

Introduction

Wood remains the most accepted material for various marine constructional purposes especially the boat building sector due to its versatility. Due to the scarcity of durable wood varieties, fishermen are going to change their focus on non-durable wood varieties. But the problem associated with non-durable wood is its biodegradation. So if proper preservative procedure can be carried out for increasing the self-life of wooden panels. Rubber wood (*Hevea brasiliensis*) is a low-value, easily available agricultural by-product gaining importance now a days. It is light-coloured with medium-density tropical hardwood found in tropical and sub-tropical regions. Malaysia, Indonesia, Thailand, Sri Lanka and India are the leading producers of rubber wood in Asia (Killmann and Hong, 2000). Treated rubber wood emerges as an alternative to the durable wood varieties.

Specific gravity is one of the most important physical properties of wood. The aim of the study was to determine the changes in the specific gravity of rubber wood treated with different wood preservatives,

Materials and Methods

Test samples

Rubber wood samples were collected from a plantation grown tree for the experiment. Wooden samples of size 120 x 30 x 30 mm were cut and edges were smoothened using a planer.

After that all the panels were air seasoned for a period of four weeks to reduce the moisture content below 15%. Wooden samples should be free from knots and without clear evidence of mould, stains or decay fungi.

Preservative solution and treatment

Preservatives selected for this experiment was Cashew Nut Shell Liquid (CNSL), Copper oxide (> 99% Nano powder) aqueous solution and Colloidal suspension of CNSL with nano CuO. Copper oxide (CuO) solution was prepared by dissolving nano Copper oxide in distilled water (0.1% w/v). Colloidal suspension of CNSL with nano CuO was prepared in three different concentrations. The concentrations are 0.05%, 0.1% and 0.2% (w/v) (Table 1).

Preservatives impregnation procedure was carried out by immersion process for getting retention up to a constant level. The retention of the preservative in the panels on wet weight basis was calculated as per ASTM D248l- 81. After preservative treatment of wooden panels air drying was carried out for period of one week.

Calculation of specific gravity

For calculating Specific Gravity ten samples were selected randomly from each preservative treated wooden panel. These samples were oven dried at 105 ± 2°C, weighed and SG was calculated.

Oven dry specific gravity = Oven dry mass/ Oven dry volume/ ρ water

Where, ρ water = density of water, which is $1.000\ g \cdot cm^{-3}$ at 4.4 ° C

Only oven dry SG is a true specific gravity where mass and volume are determined with wood in the same state.

$$\text{Percentage change in specific gravity} = \frac{\text{(Final weight- Initial weight)}}{\text{Initial weight}} \times 100$$

Results and Discussions

Wooden samples were treated with different preservatives in different concentration.

After treatment of wooden samples specific gravity was calculated for different treated wooden samples.

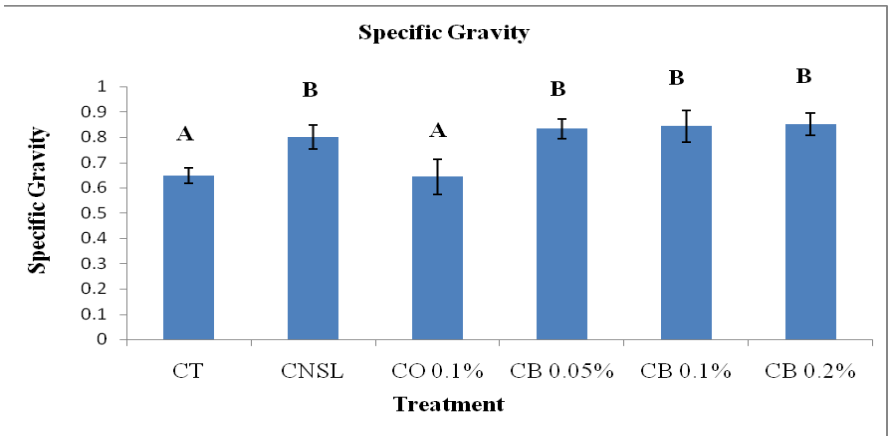
Table 2 shows the changes in specific gravity of treated wooden samples along with the percentage change in specific gravity with respect to untreated one.

Figure 1 shows the graphical representation of specific gravity along with Tuckey's post-hoc analysis which explains that control and 0.1% CuO treated panels were under the same homogeneity/group with minimum specific gravity and all other treatments were in another group with higher specific gravity.

Maximum value was 0.849±0.044 for Colloidal suspension of CNSL with nano CuO (0.2%) and minimum value was 0.644± 0.069 for wooden panels treated with 0.1% of nano CuO.

Table 3 shows that there was a highly significant difference in all the treatments with respect to specific gravity.

Fig.1 Mean±SD of specific gravity for treated and untreated rubber wood panels with Tuckey's post hoc analysis



* CT- Control
CNSL- Cashew Nut Shell Liquid
CO 0.1%- CuO (0.1%)
CB 0.05%- Colloidal suspension of CNSL with nano CuO (0.05%)
CB 0.1%- Colloidal suspension of CNSL with nano CuO (0.1%)
CB 0.2%- Colloidal suspension of CNSL with nano CuO (0.2%)

Table.1 Different preservatives solutions

Preservative Solution	Concentration (w/v)
Only CNSL	100%
Only Nano CuO	0.1%
Colloidal suspension of CNSL with nano CuO	0.05%
Colloidal suspension of CNSL with nano CuO	0.1%
Colloidal suspension of CNSL with nano CuO	0.2%

Table.2 Mean±SD and percentage change in Specific Gravity for treated and untreated rubber wood

Treatment	Specific Gravity (Mean±SD)	Percentage Change (%)
Control	0.648 ± 0.031	0%
CNSL	0.800 ± 0.048	23.53%
CuO (0.1%)	0.644 ± 0.069	-0.60%
Colloidal suspension of CNSL with nano CuO (0.05%)	0.833 ± 0.040	28.67%
Colloidal suspension of CNSL with nano CuO (0.1%)	0.843 ± 0.062	30.20%
Colloidal suspension of CNSL with nano CuO (0.2%)	0.849 ± 0.044	31.23%

Table.3 ANOVA table for specific gravity of unexposed untreated and treated rubber wood ($p < 0.05$)

Source	Sum of Squares	df	Mean Square	F
Treatment	35.999	6	6.000	2318.850**
Error	.140	54	.003	
R Squared	0.996			

At 12% moisture content, specific gravity of rubber wood was reported as 0.557 (Rubber Board, 2005). In the present study untreated rubber wood panels also showed almost similar specific gravity of 0.648. According to Williamson and Wiemann (2010) specific gravity was calculated by considering the dry weight of the wood specimen and it was intensely dependent on the weight of wood sample.

Since the weight and specific gravity of specimen were dependent. An increase in weight was observed for CNSL treated wood and a corresponding increase in specific gravity were also noted. Maximum specific gravity (0.849 ± 0.044) was observed for the panels treated with colloidal suspension of CNSL with nano CuO (0.2%) and lowest (0.644 ± 0.069) for 0.1% nano CuO treated wooden panels.

CNSL is a viscous liquid whose specific gravity is in between 0.95 to 0.97 at 30^0 C (IS 840:1964) hence the retention of CNSL was high and concurrently an increase in the specific gravity. Nano CuO is corrosive in nature.

So due to Treatment of wooden panels with Nano CuO there was a loss of structural material of wooden materials as well as decrease in the specific gravity. But in case of Colloidal suspension of CNSL with nano CuO, the effect of nano CuO is negligible, because the concentration of nano CuO is less in CNSL.

Acknowledgement

I wish to thank Director, Central Institute of Fisheries Technology, Kochi; Vice Chancellor, Kerala university of Fisheries and Ocean Studies, Kochi for the opportunity to carry out the work.

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How to cite this article:

Mosaraf Hossain, Sandipan Mondal, Arnab Banerjee, N. Manju Lekshmi and Manojkumar, B. 2018. Changes in the Specific Gravity in Rubber Wood Treated with Cashewnut Shell Liquid and Nano Based Wood Preservatives. *Int.J.Curr.Microbiol.App.Sci.* 7(10): 720-723.
doi: https://doi.org/10.20546/ijcmas.2018.710.079