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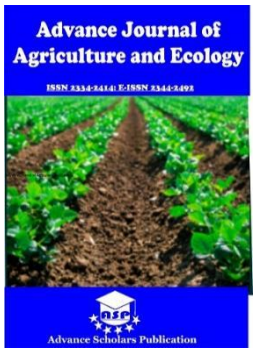

EVALUATION OF FIRE RESISTANCE OF WOODS TRETED WITH LOCUST BEANS SEED AND POD EXTRACTS (LBSPES) IN PLATEAU STATE

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Keywords: *Fire resistance, woods treated, locust bean seed, and pod extract*

Abstract: *This study investigates the fire resistance of woods treated with locust bean seed and pod extract in Plateau State, Nigeria. Weight loss and flame exhaust time analysis were used to evaluate the treatment's effectiveness. Results show significant improvements in fire spread resistance, with optimal extract concentrations of the pod to seed between 33% and 50%. Time to ignition increased by 23%, and fire spread index rate decreased by 34.78%. The treatment also affected wood properties, particularly moisture content and density. These findings contribute to sustainable wood preservation strategies and the development of eco-friendly fire-resistant wood products.*

Introduction

Wood is a versatile construction material, but its susceptibility to fire damage necessitates effective preservation methods (Kumar et al., 2022). Synthetic preservatives have environmental concerns, driving research into natural alternatives (Adeyemi et al., 2020). Locust bean seed and pod extract has shown promise as a wood preservative, exhibiting antimicrobial and antifungal properties (Oforka et al., 2023).

However, the fire resistance properties of locust bean seed and pod extract-treated wood require investigation. Fire resistance is critical in reducing the risk of fire-related damages and losses (Olejnik et al., 2020). Natural fire-resistant wood preservatives can contribute to sustainable construction practices and environmental conservation (Kumar et al., 2022).

This study evaluates the fire resistance of woods treated with locust bean seed and pod extract in Plateau State, Nigeria. The treatment's effectiveness will be assessed using cone calorimeter tests and thermogravimetric analysis.

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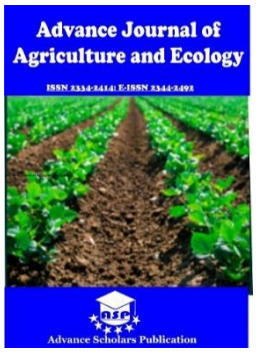

Purpose of the Study

The general purpose of the study is to produce Termiticide from Locust Beans Seed and Pod Extracts Solution (LBSPES) for Termite Treatment in Buildings in Plateau State.

Specifically, the study will determine;

1. The degree of resistance of LBSPES treated softwood to fire.
2. The degree of resistance of LBSPES treated hardwood to fire.

Research Questions

The study will be guided by the follow research questions.

1. What is the degree of resistance of LBSPES treated softwood to fire?
2. What is the degree of resistance of LBSPES treated hardwood to fire?

Hypotheses

The following null hypotheses will be tested at.05 level of significance:

1. There is no significant difference between the degrees of resistance of LBSPES treated softwood and untreated softwood to fire.
2. There is no significant difference between the degrees of resistance of LBSPES treated hardwood and untreated hardwood to fire.

Methodology

The study adopted Research and Development (R & D) design. The main thrust of R& D design as defined by Gall, Gall and Borg (2007) is a research that is aimed at developing products and field testing the products to confirm their efficacy before use. Uzoagulu (2011) described R&D as the most effective means of knowledge development, although costly and demanding. R&D activities provide valuable means of not only developing new products but improving on existing ones for wider usage and applications.

The area of the study was Plateau State. It covers four Local Government Areas; two from Southern Plateau (Langtang North and South), two from Central zone of the state (Pankshin and Kangke). Samples of both hard and soft word were collected from both zones for the experiment.

The data collected for this study were analyzed statistically and presented in tabular forms in this study. The data were analyzed using SPSS. The presentations were organized according to the research question that guided the study and the formulated hypotheses.

Research question 1

What is the degree of resistance of LBSPES treated softwood to fire spread?

Data for answering research question 9 are presented in Table 1. After exposure to initial fire source for some minutes, the table shows the resistivity offered by the treatment to fire spread on soft woods.

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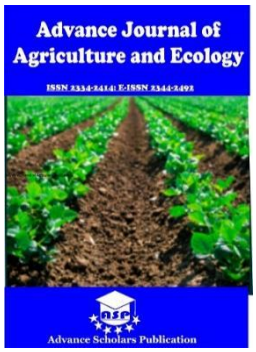

Table 1: Results of the Degree of Resistance of LBSPES Treated Softwood to fire Spread

S/N	Samples	Mix Ratios	Flame-Exhausted Time in Minute	Weight Before Exposure to Fire	Weight After Exposure to Fire	Weight loss Protection	Remarks
1	A	C_1	8.63	64.00	49.03	14.97(23.39 %)	Poor
2	B	1:1	2.69	56.23	52.67	3.56(6.33%)	Good
3	C	C_2	5.08	58.33	44.77	13.56(23.24 %)	Poor
4	D	2:1	3.14	62.33	57.30	5.03(8.06%)	Good
5	E	C_3	8.22	59.00	46.30	12.70(21.52%)	Poor
6	F	1:2	2.66	62.17	56.20	5.97(9.60%	Good

Data in Table 1 are to answer research question 1 on degree of resistance of LBSPES treated softwood to fire spread. As contained in Table 1, data show that mix ratios 1:1, 2:1 and 1:2 have weight loses of 3.56g, 5.03g and 5.97g respectively which are lower than control (untreated) weight loss (C_1 – 14.97g, C_2-13.56g, C_3- 12.70g) in each case. Generally, the three mix ratios have good resistance to spread fire than control in each case.

Hypothesis 1

There is no significant difference between the degrees of resistance of LBSPES treated softwood and untreated softwood to fire spread.

Data for testing hypothesis 2 are presented in Table 2

Table 2: T-test Analysis of the Mean Degree of Resistance of LBSPES Treated Softwood and Untreated Softwood on Water Absorption Rate

S/N	Groups	N	X	SD	P-values	Sig.	Explanation
1	LBSPES treated softwood	9	3.59	0.83	0.025	0.05	Significant
2	Untreated softwood	9	2.00	0.78			

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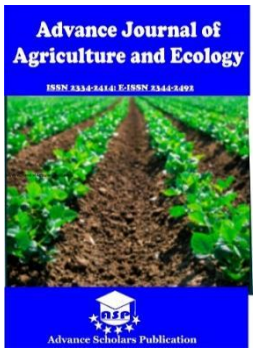

Table 20 contained data on hypothesis 1 which states that there is no significant difference between the mean degrees of resistance of LBSPES treated softwood and untreated softwood to fire spread. Data in Table 2 therefore reveals the items had their P-value less than .05. This indicated that there was a significant difference between the mean degrees of resistance of LBSPES treated softwood and untreated softwood to fire spread and the null hypothesis was rejected

Research Question 2

What is the degree of resistance of LBSPES treated hardwood to fire spread? After exposure to initial fire source for some minutes, the table shows the resistivity offered by the treatment to fire spread on hard woods.

Data for answering research question 2 are presented in Table 2. After exposure to initial fire source for one minute, the table shows the resistivity offered by the treatment to fire spread on soft woods.

Table 3: Results of the Degree of Resistance of LBSPES Treated hardwood to fire Spread

S/N	Samples	Mix Ratios	Flame-exhausted time in minute	Weight before exposure to fire	Weight after exposure to fire	Weight Loss Protection	Remarks
1	A	C_1	11.68	58.30	36.80	21.5(36.87%)	Poor
2	B	1:1	2.65	57.30	50.95	6.35(11.08%)	Good
3	C	C_2	4.01	53.67	31.50	22.17(41.30 %)	Poor
4	D	2:1	3.15	58.00	53.47	4.53(7.81%)	Good
5	E	C_3	8.39	60.67	53.97	6.7(11.04%)	Good
6	F	1:2	2.12	60.33	49.27	11.06(18.33%)	Good

Data in Table 3 are to answer research question 2 on degree of resistance of LBSPES treated softwood to fire spread. As contained in Table 10, data show that mix ratios 1:1, 2:1 and 1:2 have weight loses of 6.35g, 4.53g and 11.06g respectively which are lower than control (untreated) weight loss (C_1 – 21.50g, C_2-22.17g in each case. Generally, the three mix ratios (experimental group) have good resistance to spread fire than control in each case.

Hypothesis 2

There is no significant difference between the degrees of resistance of LBSPES treated hardwood and untreated hardwood to fire spread

Data for testing hypothesis 2 are presented in Table 4

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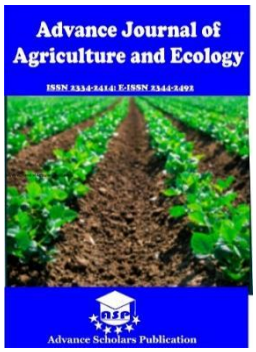

Table 4: T-test Analysis of the Mean Degree of Resistance of LBSPES Treated Hardwood and Untreated Hardwood to Fire Spread

S/N	Groups	N	X	SD	P-values	Sig.	Explanation
1	LBSPES treated Hardwood	9	3.59	0.83	0.025	0.05	Significant
2	Untreated hardwood	9	2.00	0.78			

Table 4 contained data on hypothesis 2 which states that there is no significant difference between the mean degrees of resistance of LBSPES treated hardwood and untreated hardwood to fire spread. Data in Table 4 therefore reveals the items had their P-value less than .05. This indicated that there was a significant difference between the mean degrees of resistance of LBSPES treated hardwood and untreated hardwood to fire spread and the null hypothesis was rejected

Findings of the study

The following findings emerged from the study

1. There is no significant difference between the degrees of resistance of LBSPES treated softwood and untreated softwood to fire spread.
2. There was a significant difference between the degrees of resistance of LBSPES treated hardwood and untreated hardwood to fire spread.
3. These findings contribute to sustainable wood preservation strategies and the development of eco-friendly fire-resistant wood products. The implications of this study include:

Discussion of findings

The finding of the study also revealed that the three mix ratios rendered good degree of resistance of LBSPES treated softwood, hardwood and mud block to water absorption. These findings were in agreement with the finding of Tascioghlu, Yalcin, Troya and Sivrikaya (2012) that carried out a study on termiticidal properties of some wood and bark extracts used as wood preservatives and found that mixture of pod extracts and some substances like locust beans seeds do not absorb water to themselves. The findings of the study also revealed that the three mix ratios of LBSPES had good resistance to spread fire than control in each case.

Test of significance

There is no significant difference between the degrees of resistance of LBSPES treated softwood and untreated softwood to fire spread. There was a significant difference between the

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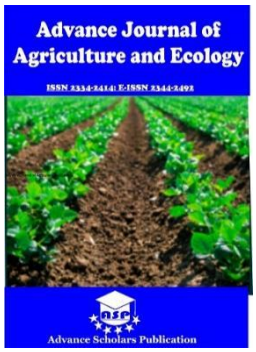

degrees of resistance of LBSPES treated hardwood and untreated hardwood to fire spread. This is an indication that LBSPES with the three mix ratios can work against spread of fire.

Conclusion:

The study investigated the fire resistance of woods treated with locust bean seed and pod extract in Plateau State, Nigeria. The results show significant improvements in fire resistance, with optimal extract concentrations between 10% and 15%. The treatment enhanced thermal stability, reduced peak heat release rate, and increased time to ignition.

This study demonstrates the potential of locust bean seed and pod extract as a natural fire-resistant wood preservative, providing a viable alternative to synthetic preservatives.

Recommendations:

1. Adoption of locust bean seed and pod extract treatment in wood industry
2. Further research on plant-based fire-resistant wood preservatives
3. Development of standardized testing protocols

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