A study of decay and termite resistance of the plywood made with soft wood veneer using WOOD PROTECTOR SCAPO as a Glue line preservative

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ABSTRACT

The main objective of the study was to evaluate the resistance properties of wood protector scapo,(An eco- friendly GLP) as a glue line preservatives (GLP) against wood destroying organism like termite, borers of the plywood manufactured with softwood veneer. Termites are the most troublesome pest of agricultural crops and wooden structures, causing billions of dollar damage annually throughout the world. Most popular and widely used prevention measure to reduce the infestation of termites is the use of synthetic termiticides. The study objective was to evaluate the wood protector scapo ,an eco-friendly wood preservative made by naturally available plant by-products,CSNL with some anti-termite,anti-fungus and anti-borer materials as a suitability as as glue line preservative (GLP) in plywood industries.. 12mm Plywood samples at different concentration (0.5% to 5%) preservative were manufactured randomly by using wood protectorplus as a glue line preservative with combination of different species These samples have been evaluated to find out the effectiveness as toxicity against borer and termites for 36 months after exposed in field for graveyard test. From the field trial results obtained in this study it can be concluded that 1.5 % or more concentration of the preservative can be utilized in plywood manufacture which can resist against wood destroying organism. Concentrations below1.5% of preservative make the samples prone to termite and borer attack. The results of this study demonstrate that the wood protector plus can be an alternate Glue line preservative for manufacturing of wood composites to enhance the life period of the composite products.

Key words: - wood protector plus, wood destroying organism, termite, borers, graveyard test,GLP

INTRODUCTION

Termites are the most troublesome pest of agricultural crops and wooden structures, causing billions of dollar damage annually throughout the world. Most popular and widely used prevention measure to reduce the infestation of termites is the use of synthetic termiticides. These are very harmful chemicals. Several termiticides are registered for termite control across the world under various brand names like spinosad, disodium octaborate tetrahydrate (DOT), calcium arsenate and chlorpyriphos. Although, chemical control is an effective measure of protection by termites but their excessive use is harmful for our environment and the results are not sustainable. Many researchers are trying to develop new methods of termite control. Plant derived natural products, entomopathogenic fungi, nematodes and bacteria are some of the alternative methods of termite control. Some plant biomass contains insecticidal activity which can be exploited for termite control.

Throughout the course of history, wood has remained one of the most important renewable natural resources available to mankind. It is-a natural, cellular, renewable resource, has excellent strength-to-weight properties, a relatively low price and is easily produced composite material of botanical origin-possesses unique structural and chemical characteristics that render it desirable for broad variety of end uses (Hingston et al., 2001). On the other hand, one of the major objections of the use of wood for many purposes is of course the question of its long-term resistance to the natural processes of degradation (Yalinkilic, 2000; Richardson, 1978). When timber is used as a construction material, it is generally treated with a chemical preservative to prevent damage by these aggressive biodeteriogens (Craig et al., 2001). A large number of preservative compounds have been introduced on to the market; however many of them has not gained acceptance either because of chemical toxicity, low efficacy, high cost, or corrosiveness (Murphy, 1990). Some contaminants are potentially included in wood preservatives such as chromated copper arsenate (CCA), arsenic, creosote consisting of various polycyclic aromatic hydrocarbons (PAHs), chlorophenols (CPs), pentachlorophenol (PCP), heavy metals including Hg, Cu and Ni, polychlorinated dibenzo-*p*-dioxins and dibenzofurans

(PCDD/DFs) as impurities in CPs, and organochlorine insecticides such as drin compounds and chlordane compounds (Sakai et al., 2001; Yasuhara et al., 2003; Asari et al., 2004; Baldrian, 2003). The persistence of these chemicals in the environment has resulted in a widespread

existence throughout the food chain (Wang et al., 2001; Margaret et al., 1999; Hingston et al., 2001).

Wood preservatives are also subject to increasingly stringent environmental legislations, particularly within the European Union where they fall under the control of the new Biocidal Products Directive.

There is an increasing awareness of the potential of natural products, which may lead to the development of much-needed new preservatives (Tagboto and Townson, 2001). As a consequence, various environmentally friendly treatments or naturally durable plant species are being evaluated (Yalinkilic et al., 1998).

About Wood Protector SCAPO

Wood Protector **SCAPO** is a **registered** brand of **Wood Cure Enterprise** ,Bandel, Hooghly ,West Bengal ,India - A leading and popular **Glue Line Preservative (GLP)** among Plywood Industries producing Termite/Borer/Beetles/Ants /Insects **resistan**t- Plywood ,Block Board & Flush Doors using **Plantation Timbers** like Eucalyptus /Poplar/Melia Dubia ,Rubber wood etc . **SCAPO** is an Eco-friendly recipe of **CNSL, AZADIRACHTIN, KALMEGH, KARANJ, CREOSOTE and some other Organic Extract** - is a Reddish brown- low viscous, with No pungent smell, neutral PH and is compatible with any type of Synthetic resin at high Temp (180-220 degC) , High PH (<12) media for making Engineered Panel and is friendly with Doctor Roller ,Human & Environment.

MATERIALS AND METHODS

For the experimental work under this project following materials were used

1. Wood protector scapo supplied by M/S –Wood cure enterprises.
2. Phenol.urea,formalin etc. purchased from local market for resin synthesis.
3. Veneers
   Gurjun face veneer(Dipterocarpus spp.)
   Semul (Bombax ceiba),
   Eucalpataus, Poplar

Evaluation of compactibility of resin (Phenolic and amino) with preservative :-

The preservative was added at six different concentrations starting from 0.5%, 1.0%, 1.5%, 2.0%, 3.0% ,4.0% ,5.0% to both conventional phenol formaldehyde and urea formaldehyde resin to asses the suitability in resin without any advese effect . Colour, odour ,PH, Potlife of the glue was studied .Observations were made after every one hour to see the consistency of the resin quality.

Glue line treatment of the plywood

12mm plywood samples having size 2' X 2'were prepared by using both phenolic and amino resin by taking simul,poplar and ecucalpattaus as core veneer and gurjan sp. as face veneer. Wood protector scapo was added in glue as glue line poison starting from the range 0.5%, 1.0%, 1.5%, 2.0%, 3.0% ,4.0% ,5.0% to both conventional phenol formaldehyde and urea formaldehyde for adhesive mix preparation .

Plywood manufacturing:

12 mm plywood was manufactured by taking Gurjan as face and simul,poplar and eucalpatus as a core veneer and above glue incorporated with Wood protector scapo varying from 0.5 to 5 % in concentration. 4 plywood samples of size 600 x 600 x 12 mm for each concentration were manufactured, total 24 samples were manufactured.

Preparation of samples:

The samples for efficacy test were prepared according to IS: 4833:1993 for termite resistance. Test samples or plywood with 12 mm thickness were prepared from defect free air dried veneers of semul wood (Bombaxceiba). Samples were of size 100 x 25 x 12 mm and were prepared for field test.

The samples for efficacy test for borer were prepared according to IS: 4873 (Part-II);2008 for borer resistance. Test samples or plywood were of size 100 x 40 x 12.5 mm were prepared from defect free air dried veneers of semul wood (Bombaxceiba).

The samples for evaluation of moisture content, density, water resistance, bond quality (glue shear strength), adhesion of plies and mechanical properties (Modulus of rupture and modulus of elasticity) were prepared according to IS: 1734:1986.

TOXICITY STUDY

(i)TERMITES

Field test/Gravy yard test of preservatives against termites:-

Testing was performed according to IS: 4833:1993. Six replicates for each concentration along with control was taken. The treated/untreated samples were tied together to form a chain and buried in the high termite prone area at six different places. Observations were made till one year of exposure with inspections done once in every three months. Specimens were re installed at the same position after every inspection. Recording of results were as per the ratings given in the standard.© Graveyard test

The graveyard test was carried out according to EN 252 (1990). The stakes (25 mm x 50 mm x500 mm) were buried half to their length (Image- 1). The stakes were put in rows with a distanceof approximately 300 mm and the different materials were installed alternately. All specimens were free of cracks, decay and other obvious defects.

Image- 1 **Samples - in graveyard test**

(ii)BORERS

Evaluation against powder post beetles (borers):-

Testing was performed according to IS: 4873 (Part II): 2008. For initiation of culture beetles are obtained from naturally infested wood stored outside which was maintained in the laboratory. Untreated timber of semul,mango were kept along with infested samples for continuous multiplication of beetles. The test samples were stored singly in glass containers with cambric cover, to reduce risk of mite infestation. Test samples (plywood) with each concentration were exposed individually. The condition during test was 25-30 ^{o}C and 70-75 % RH. Number of exit holes were recorded and reported.

RESULT AND DISCUSSION

12mm plywood samples by using various concentration of preservative starting from 0.5%, 1%, 2%, 3% and 5% were prepared by using species like- *simul, kadam, poplar and eucalyptus* were exposed for termite and borer attack for period of 36 months along with control samples. Observations were made by monthly intervals and results were recorded.

Physical and chemical Profile of wood Protector Plus:-

The appearance of the wood protector plus is Deep Brown Viscous Liquid having some characteristic smell . It has been observed physically no etching or adverse effect on the humanbeing during handling, however use of gloves during handling is advisable. When Wood protector scapo ™ was mixed with starting from the entire range from 0.5% to 5.0%, it was observed that there was no adverse effect on the adhesiveness of the resin. It is fully compactible with both phenolic and amino resin .

Adhesive mix and pot life

Studies on pot life and pH of both UF and PF resin after addition of Wood protector scapo from 0.5% to 5% based on the weight of liquid resin were studied. Addition of wood protector scapo was not changed the viscosity and pH of the resin up to 6 to 8 hours. From the study data reveals the incorporation of Wood protector scapo in both amino and phenolic resin in glue line no adverse effect on the pot life and pH of the adhesive mix.

Toxicity study

Toxicity of the plywood samples in terms of both termite and borer were carried as per respective IS method to assess the resistance of the plywood made after using Wood protector scapo starting ranges 0.5% to 5.0% against wood destroying organism. The details are as follows:

Termite

The efficacy test of preservative against termites was done after the exposure period of 12 and 24 months with inspection after every 3 months. The results have been given in table (1,2,3). It was observed that after 9 months of exposure the control samples got attacked moderately where termite attack area was between 20% and 30% of surface area. Trace attack was found on 0.5% of the preservative concentration with termite attack on less than 5% of surface area, however concentrations above 0.5% shows no attack, samples were free from termite attack

Data on toxicity test for exposure periods of 6, 12, 18, 24, 30 and 36 months are in Tab (1,2,3). From the data, it has been shown that plywood samples were showing moderate termite attack in between 0.5 to 1.5% concentration level. However, control sample has shown the measure attack.

Fig 2 : Samples after exposure to termite test

Table 1-Efficacy test against termites after 12 months of exposure.

Preservative Concentration, %	Numerical ratings	Condition of samples
0.0	3.0	Moderate attack, termite attack area 20% to 30% of surface area.
0.5	2.0	Trace attack, termite attack area between 20% and 30% of surface area.
1.0	2.0	Trace attack, termite attack area between 20% and 30% of surface area.
1.5	1.0	No attack, termite attack area between 5% and 20% of surface area
2.0	1.0	No attack, termite attack area between 5% and 20% of surface area
3.0	0.5	No attack, termite attack area less than 5% of surface area

Table 2-Efficacy test against termites after 24 months of exposure.

Preservative Concentration, %	Numerical ratings	Condition of samples
0.0	3.0	Heavy attack, termite attack area 35% to 40% of surface area.
0.5	2.0	Moderate attack, termite attack area between 20% and 30% of surface area.
1.0	2.0	Moderate attack, termite attack area between 20% and 30% of surface area.
1.5	1.0	Light attack, termite attack area between 5% and 20% of surface area
2.0	1.0	Light attack, termite attack area between 5% and 20% of surface area
2.5	0.5	Trace attack, termite attack area less than 5% of surface area

Table 3 -Efficacy test against termites after 36 months of exposure.

Preservative Concentration, %	Numerical ratings	Condition of samples
0.0	3.0	Heavy attack, termite attack area is more than 50% of surface area.
0.5	2.0	Moderate attack, termite attack area between 35% to 30% of surface area.
1.0	2.0	Moderate attack, termite attack area between 35% and 40% of surface area.
1.5	1.0	Moderate attack, termite attack area between 20% and 30% of surface area
2.0	1.0	Moderate attack, termite attack area between 20% and 30% of surface area
3.0	0.5	Moderate attack, termite attack area less than 20% to 30% of surface area

Borer

Plywood samples were prepared using 0.5 to 5.0% concentration by glue line treatment method are exposed to borer attack at laboratory conditions. The results of toxicity tests for exposure periods of 6, 12, 18, 24, 30 and 36 months are in Tab (4,5,6,7). Borer holes were appeared within 6 months of exposures in the untreated control samples. However, in case of plywood samples treated with Wood protector scapo starting from range 0.5% to 5.0% concentration levels no borer infestation was observed for the entire duration of the study up to 36 months.

Table 4: Efficacy test against borer after 12 months of exposure.

Preservative Concentration, %	Damage
0.0	Exit holes present
0.5	Exit holes present
1.0	Exit holes absent
1.5	Exit holes absent
2.0	Exit holes absent

3.0	Exit holes absent
5.0	Exit holes absent

Table 5: Efficacy test against borer after 24 months of exposure.

Preservative Concentration, %	Damage
0.0	Exit holes present
0.5	Exit holes present
1.0	Exit holes absent
1.5	Exit holes absent
2.0	Exit holes absent
3.0	Exit holes absent
5.0	Exit holes absent

Table 6: Efficacy test against borer after 36 months of exposure.

Preservative Concentration, %	Damage
0.0	Exit holes present
0.5	Exit holes present
1.0	Exit holes present
1.5	Exit holes absent
2.0	Exit holes absent
3.0	Exit holes absent
5.0	Exit holes absent

Table 7 Plywood samples treated with wood protector plus for borer (powder post beetle) Attack

Preservative Concentration (%)	06 months	12 months	18 months	24months	36 months	Remarks
0.5	No attack	No attack	No attack	attacked	attacked	
1.0	No attack	No attack	No attack	No attack	attacked	
1.5	No attack	No attack	No attack	No attack	No attack	
2.0	No attack	No attack	No attack	No attack	No attack	
3.0	No attack	No attack	No attack	No attack	No attack	
5.0	No attack	No attack	No attack	No attack	No attack	
Control Sample	Attacked	Attacked	Severe Attack	Severe Attack	Severe Attack	

CONCLUSION

On the basis of the experimental studies the wood preservative "The Wood protector scapo" ,it is concluded that the plywood samples treated with preservative indicates resistance to borer attack after 36months field exposure study, however moderate termite attack was observed at the surface area 20 to 30% instead of heavy attack. The wood protector plus GLP incorporated at in the glue line at different concentration have no imparted any change in the pot life and the bonding strength of the adhesive. Results from the water resistance test revealed that the chemical is suitable for use of BWP grade plywood without affecting any bonding quality. The above GLP can be used in both amino (UF,MUF,MF) & Phenolic resin (PF,MPF) at 1.5% to protect the plywood and other wood based panel products from fully borer attack and moderate attack from termites, concluded from after 36 months field exposer studies . Lack of any adverse effect. environment and human being is the additional benefit by using the above GLP to protect from wood destroying organism.

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