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Research Paper

Studies on Efficacy of Multi Component Preservative Chemical Against Mould Fungi

Chemistry

KEYWORDS : Tannic acid, Boric acid, Bavistin, Poplar veneers, Incubation chamber

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ABSTRACT

Timbers are susceptible to rapid deterioration by variety of organisms. The fungi and insects are major causes of wood decay. Wood products are subject to various bio-hazard attacks if preventative measures are not taken. The proper preservative treatment can reduce the damages and increases the longevity of wood. Study was carried out to find the effect of multi component preservative chemical consisting of chemicals at proportions of 0.2% tannic acid, 0.3% boric acid and 0.5% of Bavistin (Carbendazim) in an aqueous solution to test its efficacy. Results reveal that there is no mould attack on veneer samples of 2% concentration as compared to 1% concentration.

Introduction:

Wood is a biological material consisting primarily of cellulose, lignin and hemicellulose. These three structural polymers make up 90 to 99 percent of the wood mass and give wood its unique properties that make it an excellent structural material. Wood also contains a variety of other materials, including sugars, starch, proteins, lipids and fatty acids. Some of the woods are natural very much durable due the presence of some natural preservative chemicals in the wood. Wood degrading agents are both biotic and abiotic, and include heat, strong acids or bases, mechanical wear, and sunlight (UV degradation).

Wood Decay Fungi is often not considered a serious problem of timber, but it can become such a severe problem that color and appearance are affected. A wood decay fungus requires Oxygen, Water, Suitable Temperature, and Food Source basically for growth and development. If the moisture conditions are suitable (approx.28-30%) they will germinate, so keeping moisture content below 10-12%, we can avoid fungal growth on wood veneers.

Protecting wood from degradation can take a number of forms. By far the simplest method is to employ designs which limit wood exposure to moisture. In some cases, water exclusion is not possible, therefore alternative methods must be employed like spraying, dipping, soaking, or pressure treatment with preservatives. Development of synergistic biocides to protect wood in interior applications has been of particular interest since the recent increase of indoor mould infestations. Researchers must emphasize the use of environmentally benign chemicals due to the need for safety of human occupants. Some typical strategies employed include one or more of the following: naturally occurring antimicrobial or insecticidal chemicals, synergistic combinations of chemicals, to use as preservative chemicals.

Unfortunately, Use of naturally occurring antimicrobials needs to be approached with caution. Chemicals with previous EPA approval are limited, but certainly and new, unique combinations of such chemicals can create new formulations with antimicrobial or insecticidal properties. Occasionally, combinations of known fungal or insect inhibitors are synergistic, i.e. combined chemicals are more effective than the individual components at higher concentrations. One such synergistic combination, called Durazol, incorporates some known antimicrobials and insecticides, namely boric acid and tannic acid with a quaternary amine compound and an azole to provide protection against mould fungi, stain fungi, decay fungi, and termites at lower concentrations than any of the individual components alone.

Due to non-availability of the primary species, more & more secondary species are being used for plywood manufacture. Mould fungi always occur in damp conditions. Mould will not affect the strength of the wood but they will reduce atheistic look and market price. So, it is very important to take precautionary measures to avoid the mould attack on veneers.

The present study is to carry out with the following objectives:-

1. Optimise the concentration of multi component wood preservative chemical against mould Fungi.
2. To test the efficacy of multi component wood preservative to control mould Fungi.

Literature Survey:

Wood is a type of material demanded by humans for certain uses related to construction, furniture, household articles, and hand craft items. Natural durability becomes one of the several considerations by customers in selecting proper wood materials conforming to their uses. Unfortunately, the existing stocks of wood, which is naturally durable, cannot cope with the ever-increasing demand by customers. Moreover, the available wood is mostly of low durability and vulnerable to destroying organisms, thereby necessitating preservation. Wood preservation treatment is a protective treatment given to wood before used in any applications. This treatment protects the wood from being damaged by insects or fungi. Mould can grow on unprotected wood causing wood staining, which can also damage the structure of the wood and cause health issues for some people.

Most wood treating facilities use a product called Chromated copper arsenate (CCA). When applied to wood protect it against moisture and decay fungi. However, this product does not penetrate into the heartwood and a sealer is recommended on the cut ends, which hardly anyone uses. The EPA has approved CCA, zinc napthenate, and tributyltin oxide for use as wood preservation treatments, and requires strong environmental safety precautions from facilities that use these chemicals.

The toxicity of these chemicals and the strict EPA use requirements has caused treatment facilities to look for other alternative preservative treatments. Some methods being considered are the use of borates which come from borax. Homes in New Zealand and Australia use this material to protect wood from insects and because of its fire retardant properties. However, commercial use in the United States is not as widespread because borates are water soluble and can dilute. This leaves the wood unprotected afterwards. If it is used on wood that is not exposed to water, it is an effective wood preservative against termites and fungi.

Another less toxic wood preservative is Ammoniacal Copper Quaternary (ACQ). This is a new preservative and uses “general

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use" pesticides listed by the EPA. It is less toxic than CCA but works in a similar way. With the ever increasing demand for the environment friendly wood preservatives, it is essential to find out the alternate wood preservative chemical. The conventional wood preservatives chemicals are very prominent against wood destroying organisms but they are creating environmental problems.

Boron is biocide recognized to be effective and toxic. It is widely used industrially for wood preservation, but can only afford a short term protection to timber due to his leach ability.

Tannins are polyphenol that are obtained from various parts of different plants belonging to multiple species. The name tannic acid comes from the fact that the compound is used in the process known tanning; tannins that mean converting animals hides to the leather through chemical process, tannins are basically used for this function. Tannic acid is a pale yellow amorphous powder, shiny scales, or spongy material that gradually darkens when exposed to air. It is odourless but has a strong, bitter taste**.**

Bavistin (Carbendazim) is a broad spectrum light brown powder of Benz imidazole carbamate fungicide with systemic activity. Pure carbendazim is a colorless, white crystalline, odorless solid which decomposes on melting at approximately –250ºC. Technical grade is >98% pure (FAO specification). It is difficult to dissolve in water, micro-soluble acetone, chloroform, ethyl acetate, soluble inorganic acid and acetic acid, oleic acid, stearic acid and other organic acids and the corresponding formation of the salt.

LD50 (mg / kg): Acute oral: more than 15,000 rats, rabbits and dogs over 8000; 10996mg/kg male quail feed. Mice acute percutaneous above 10,000. In rats and dogs fed two years without trial role for the 300 mg dose of feed. Right rabbit eyes and skin stimulation. Carp 40th (48) 40 mg / L, steelhead 40th (96h) to 0.36mg / L, respectively. ADI for 0.25mg/kg.

Material and method:

1. Poplar veneers were used for the study of the size 15cm.*15cm.*1.4mm of moisture content between 30-60% and exposed to mould attack.
2. Mould fungi were used namely
   a. Penicillium
   b. Aspergillus
   c. Mucor
3. Chemical formulation: The multicomponent preservative chemical consists of 0.2% tannic acid, 0.3% boric acid and 0.5% of Bavistin (Carbendazim) in an aqueous solution, however due to; low solubility of bavistin must be solubilized in acetone prior to addition to the treatment solution.
4. Air dried Poplar veneers were immersed (1 hour) into 1% and 2% preservative solution. Chemical treatment retentions (1% and 2%) were determined from the average difference in specimen weight before and after dipping. Veneers were kept in incubation chamber at 27°C with R_H 85±5ºc for 30 days.

Calculation of Retention of chemicals

Retention of the preservative chemical was calculated after the treatment for one hour .average percentage of retention was shown in table 2.

Retention of Preservative Chemical(R) (%) =GC/v*100

Where

R = Retention of the preservative chemical

G= (W2-W1) W1=initial weight of the veneers, before treatment.

W2 = Final weight of the veneers after the treatment.

C= concentration of Chemical

V= volume of the veneer samples

Results and discussions:

Air dried Poplar wood veneer samples of size 15cm.*15cm.*1.4mm, were taken for each concentration and dipped into preservative solutions of 1% and 2% concentration for one hour and weights were recorded as shown in the table 1. After dip treatment samples were calculated for retention of the chemical and average retention as shown in the table 2.After retention calculation samples were exposed to mould attack in an incubation chamber at RH 85±5 and temperature 27±3°C for 30 days along with control samples. Observations were made by weekly intervals and results were recorded. After 30 days exposure studies both treated and untreated control samples were taken out and calculated for percentage of area of attack by physical observations.

From the experimental studies it is showing that 2% chemical concentration is more effective for controlling mould growth on poplar wood veneers compare to 1% and control samples as shown in the fig 1 and 2. Whereas control samples showing more affected surface area as shown in the fig: 3. From the experimental studies, it is shown that 1% chemical concentration showing less area of mould attack where as 2% chemical concentration is showing no mould attack on the surface of the poplar wood veneers, but control samples were fully attacked by mould fungi.

CONCLUSION:

From the above experimental studies, 2% concentration of tannic acid, boric acid and Bavistin preservative chemical showing less mould growth on poplar veneers samples compare to 1% concentration. From the result it is indicated that boric acid is an insecticide which is insufficient to control the mould growth on poplar veneers samples. Hence it is conformed that the addition of some fungicide chemical into the preservative solution to control mould attack is more effective than single chemical.

Table 1.

SL. No	Concentrations				Control samples weight
	1%		2%		
	Intial wt (Grms)	Final wt (Grms)	Intial wt (Grms)	Final wt (Grms)	(Grms)
1	16.9	20.3	17.7	19.3	24.2
2	16.0	17.5	16.8	18.8	18.9
3	16.5	18.4	10.5	11.9	10.2
4	17.3	19.5	18.4	20.9	15.0
5	18.5	20.9	17.3	19.9	16.2
6	19.0	21.7	20.3	21.5	18.1
7	15.1	17.0	15.1	17.0	20.1
8	16.6	19.2	20.8	22.8	15.6
9	15.7	17.4	17.9	19.6	18.6
10	15.7	17.0	20.0	21.8	16.8
11	18.6	19.9	16.6	18.2	18.3
12	10.3	10.6	16.6	18.6	16.5

Concentration of Solution	average % of retention
1%	0. 054 g/cm^2
2%	0. 101 g/cm^2
Control (Untreated)	0 g/cm^2

Table 2. Average Percentage Retention

PHOTOGRAPHS:

Fig: 1 1% concentration Tannic acid, Boric acid and Bavistin preservative chemical treated poplar veneers samples, showing moderate mould attack

Fig: 2 2% concentration Tannic acid, Boric acid and Bavistin preservative chemical treated poplar veneers samples, showing moderate mould attack

Fig: 3 untreated poplar veneers samples, showing moderate mould attack

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