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Review Article

Investigation and Insight into Wood Preservation: A Summary

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ABSTRACT

Wood is the most abundant non-toxic, recyclable and biodegradable natural material. The failure to control wood-destroying insects and fungi causes additional forest cutting. Wood preservation allows us to increase the service life of wood. Investigations by some researchers reveal that performance of wood preservation techniques can be changed by chemical modification of wood structure through the formation of adducts and the treatment with nano-materials. Compounds such as Acid Copper Chromate (ACC), Alkaline Copper Quaternary (ACQ), is-(N-cyclohexyldiazeniumdioxy)-copper (Cu-HDO), Borates, Chromated Copper Arsenate (CCA),Chromium, Copper Azole (CA),Creosote are used as wood preservatives. Environmental concerns and increasing energy demand calls for effective wood preservation methods.

Key words: Antifungal properties, natural, traditional preservatives, strength, decay.

INTRODUCTION

In developing countries, a wood economy, or more correctly, a forest economy is a prominent factor. In some countries Bambu economy contributes a major part of economy. The use of wood is predominant in furniture, buildings, and bridges. Also wood is a source of energy for households in many developing and underdeveloped countries. The failure to control wood-destroying insects and fungi causes additional forest cutting. Wood preservation allows us to increase the service life of wood. [1] Compounds such as Acid Copper Chromate (ACC), Alkaline Copper Quaternary (ACQ), is-(N-cyclohexyldiazeniumdioxy)-copper (Cu-HDO), Borates, Chromated Copper Arsenate (CCA), Chromium, Copper Azole (CA),Creosote are used as wood preservatives. Environmental concerns and increasing energy calls for effective wood preservation methods. Various investigators have carried out research and studies on wood preservation. The current review summarizes research and studies on wood preservation.

INVESTIGATION AND INSIGHT INTO WOOD PRESERVATION

Yildiz et.al. investigated the effects of pre-acid (sulphuric acid and phosphoric acid) treatment on preservative retention. [2] They also studied compression strength of refractory wood impregnated with chromated copper arsenate (CCA) and ammonical copper quaternary (ACQ). They found that, compared to non-pressure method, pre-acid treatment with pressure was more effective for increasing of retention of both CCA and ACQ. Ozgenc and Yildiz investigated the treatment of wood samples with new generation preservatives and traditional preservatives. [3] The traditional preservatives included didecyldimethyl ammonium chloride (DDAC), and copper (II) sulfate pentahyrate ($Cu(II)SO_4.5H_2O$). The new generation

preservatives included ammonical copper quat. (Celcure AC 500), micronized copper quat (MCQ). They characterized changes to the surface of the all weathered samples by colour change and surface roughness measurements. Their results indicated that the treatment with new generation preservatives provided less colour change than traditional preservatives.

Hyvonen et. al. studied biodegradable substances in wood protection. [4] According to them, deterioration of wood is caused by biological, chemical, and physical processes. Fungi and bacteria are responsible for the decay and discoloration. According to Humaret.al., wood is the most abundant non-toxic, recyclable and biodegradable natural material. [5] Because of its appearance and its high strength at low density, it is classified as construction material. In their work, they described use of ethanolamine for improvement of decay resistance of wood. In their investigation, they found that wood, upgraded with ethanolamine has increased fungicidal resistance. According to studies carried out by Reinprecht, the use of wood is limited by its susceptibility to organisms. [6] He prepared modified waste substances (copper and glycols) obtained from electrical and cooling waste products. Baechler studied preservative treatments of wood. [7] According to him, the older preservatives still account for a high percentage of the total volume.

Ssemaganda et.al. carried out investigation on the incidence and severity of termite attack on Eucalyptus grandis sapwood treated with Chromated Copper Arsenate (CCA), used engine oil and neem extract. [8] They carried out inspection and evaluation of stakes by visual assessments after every 30 days for eight months. They discovered a high association between treatment and incidence as well as between treatment and severity. Freeman et.al. carried out critical and comprehensive review of boron in wood preservation. [9] Their review indicates that Borates are good wood preservatives for the protection of wood from decay fungi and a wide variety of insects. The only drawback, according to them, was, they can also be readily leached from wood under certain conditions. Jitkaur et.al. carried out compressive strength analysis of eco-friendly preservative treated bamboo culm. [10] They studied effect of treatment on compressive strength. They found that preservative treatment had not altered the structural properties of bamboo culms. Their studies indicated that neem oil possessed excellent antifungal properties. They concluded that neem oil based preservatives could be exploited at commercial level. Freeman et.al carried out in detail discussion on wood preservation industry. [11] According to him, history of humankind is closely intertwined with wood utilization. They expressed need for protection of wood from degrading factors, like decay, insects, and fire. Also they expressed need to educate the consumer regarding new wood-treating chemistries and new products.

Rabbi et.al. designed a Full cell pressure wood preservation system. [12] They used locally available materials for the pressure cylinder. They studied the variation of water reduction with respect to time in the wood specimen. They concluded that proper design of a wood preservation system will minimize the price of wood. Kumar et.al. carried out review on wood preservation systems. [13] They discussed various wood preservation methods. Nurudeen et.al. carried out investigation on plant extracts as preservative against wood decay fungus. [14] For carrying out experiments, they used Triplochiton scleroxylon and Ceiba pentandra wood samples. They used ethanol and hot water extraction methods for obtaining extracts. They observed that retention levels of wood species were higher in hot water extraction method than ethanol extraction method. They concluded that all the plant extracts can be used to suppress fungal attacks. Palanti and Feci carried out investigation on a wood preservative based on commercial

silica nano-dispersions and boric acid. [15] They studied the action of this preservative against fungal decay through laboratory and field tests. In their paper, Kaps et.al. provided an overview about an effective protection technology of pinewood. [16] In their work, they developed new impregnation emulsion based on rapeseed-oil and boron compounds. They found that the new method resulted in effective protection against wood rotting fungi and discolouring fungi.

Adebawo et.al. investigated potentials of azadirachta indica seed oil as bio-preservative. [17] They used n-hexane solvent and Soxhlet apparatus to extract the oil. They observed that highest protection from termite attack was obtained for the highest concentration level i.e. 100%. This study established Azadirachta indica seed oil extract as a potential bio-preservative. Colakoglu et.al.carried out investigation on mechanical property variation due to effect of boric acid treatment. [18] They carried out investigation for laminated beech veneer lumber(LVL) made from beech wood veneers. Ustastudied the effect of moisture content and wood density on the preservative uptake. [19] He established significant correspondence between moisture content (MC) and both wood density and void volume filled, VVF%. According to him, MC values above the FSP stimulate and decrease the retention of preservative in the wood voids. He also pointed out that MC value below the FSP influence the preservative uptake due to the effect of the voids available in wood. Tarakanadha et.al. examined the effects of wood preservatives on settlement, abundance, growth and biomass development of fouling organisms. [20] They used the preservatives like Copper chrome arsenic (CCA), Copper chrome boric acid (CCB), Ammonical copper zincarsenate (ACZA), Ammonical copper quaternary (ACQ) and Ammonical copper citrate (ACC) in their investigations. They observed considerable variations among the preservatives with respect to abundance, growth and biomass of foulers. They found that preservatives had positive impact on settlement of barnacles, oysters and bryozoans.

Mantanis et.al. carried out investigation on the resistance of black pine wood against mold and decay fungi and the subterranean termites. [21] For pine wood treatment, they used vacuum-treatment with zinc oxide, zinc borate and copper oxide nanoparticles. To avoid leaching, they forced some of the nano-compounds with acrylic emulsions. They found that other than nano-zinc borate, the other nano-metal preparations did not inhibit mold fungi. Gonzalez-Laredo studied wood preservation using natural products. [22] According to them, the current concern is to avoid toxic chemicals for wood preservation. The use of natural materials for wood preservation can solve this problem to considerable extent. In their investigation, they introduced the application of natural products such as traditional tar, wood oils, tannins and plant extracts. They also studied combined method with natural and chemical components. According to them, performance of wood preservation techniques can be changed by chemical modification of wood structure through the formation of adducts and the treatment with nano-materials. Extraction of treated wood waste was carried out by Zhou to recover preservative components. [23] They carried out a study of different chemical extractions of treated wood waste. They tested different solvent extractions of CCA treated wood. Also they carried out experimentation on ion exchange, chelation and metal dissolving for component extraction. According to them, the transition of Cr(III) to Cr(VI) by oxidizing agents makes possible the direct reuse of extracted chemicals as a preservative.

CONCLUSION

Investigations by some researchers reveal that performance of wood preservation techniques can be changed by chemical modification of wood structure

through the formation of adducts and the treatment with nano-materials Compounds such as Acid Copper Chromate (ACC),Alkaline Copper Quaternary (ACQ), is-(N-cyclohexyldiazeniumdioxy)-copper (Cu-HDO), Borates, Chromated Copper Arsenate (CCA),Chromium,Copper Azole (CA),Creosote are used as wood preservatives. According to an investigator, the transition of Cr(III) to Cr(VI) by oxidizing agents makes possible the direct reuse of extracted chemicals as a preservative. Alsoconsiderable variations among the preservatives were observed with respect to abundance, growth and biomass of foulers.

REFERENCES

1. H.MichelBames, "Wood Preservation, Encyclopedia of Pest Management", Encyclopedia of Pest Management, Copyright@ 2002 by Marcel Dekker, Inc, 2002, 1-3.
2. SibelYildiz, UmitYildiz, EylemDizman, Ali Temiz, Engin Gezer, "The Effects Of Pre-Acid Treatment On Preservative Retention And Compression Strength Of Refractory Spruce Wood Impregnated With CCA And ACQ", Wood Research, 2010, 55(3), 93-104.
3. OzlemOzgenc, Umit C. Yildiz, "Surface Characteristics Of Wood Treated With New Generation Preservatives After Artificial Weathering", Wood Research, 2014, 59(4), 605-616.
4. Anna Hyvonen, PetteriPiltonen, Jouko Niinimäki, "Biodegradable Substances In Wood Protection, Sustainable Use Of Renewable Natural Resources - From Principles To Practices", University Of Helsinki Department Of Forest Ecology Publications, AnneliJalkanen & PekkaNygren (Eds.) ,2005,1, 1-13.
5. M. Humar, M. Petric, F. Pohleven, R. Despot, "Upgrading Of Spruce Wood With Ethanolamine Treatment", HolzAlsRoh- Und Werkstoff, Springer-Verlag ,2003, 61, 9–34.
6. LadislavReinprecht, "Fungicides For Wood Protection – World Viewpoint And Evaluation/Testing In Slovakia, Fungicides", OdileCarisse (Ed.), Isbn: 978-953-307-266-1 Intechopen, 2010, 95-122.
7. R. H. Baechler, "Microbiological Process Report Newer Preservative Treatments For Wood", Http://Aem.Asm.Org/ On January 31, 2017, 1-4.
8. I. E. Ssemaganda, P. Mugabi , S. B.Tumwebaze, "Effectiveness Of Selected Preservatives In Protecting Ugandan Grown Eucalyptus Grandis Wood Against Termite Attack", Maderas. Ciencia Y Tecnología, 2011, 13(2), 135-142.
9. Mike H. Freeman,Craig R. Mcintyre,Dick Jackson, A Critical And Comprehensive Review Of Boron In Wood Preservation, , Proc., Am. Wood Prot. Assoc. – AWPA 105,2009, 279–294.
10. PerminderJitkaur, SantoshSatya, K. K. Pant, S. N. Naik, "Eco-Friendly Preservative Treated Bamboo Culm: Compressive Strength Analysis", International Journal Of Chemical, Molecular, Nuclear, Materials And Metallurgical Engineering, 2015, 9(1), 43-46.
11. Michel H. Freeman,Todd H. Dhuoe, Richard P. Vlosky, H.M. Barnes, "Past, Present, And Future Of The Wood Preservation Industry", Forest Products Journal, 2003, 53(10), 8-15.
12. Md. Fazle Rabbi, Md. Mahmudul Islam, A.N.M. MizanurRahman, "Wood Preservation: Improvement of Mechanical Properties by Vacuum Pressure Process", International Journal of Engineering and Applied Sciences, 2015, 2(4), 75-79.
13. Satish Kumar, K S Shukla,Tndra Dev. P B Dobriyal, "Bamboo PreservatlonTechnlques : A Review", International Network For Bamboo And Rattan and Indian Council Of Forestry Research Education Published Jointly By Inbar And Icfre ,1994,1.,1-55.
14. Nurudeen, T.A,.Abiola, J.K., Ekpo, E.N., Olasupo, O.O., Haastrup N.O and Okunrotifa, A.O, "Effects of plant extracts as preservative against wood decay fungus Sclerotiumrolfsii (SACC)",Journal of Forestry Research and Management, 2013, 9, 73-82.

15. Sabrina Palanti, ElisabettaFeci, "A Wood Preservative Based on Commercial Silica Nanodispersions and Boric Acid against Fungal Decay through Laboratory and Field Tests", Open Journal of Forestry, 2013, 3(2), 57-61.
16. T. Kaps, R. Reiska, U. Kallavus, M. Koolme1, U. Luga and J. Kers, "Effective protection of pinewood against fungal attack", Agronomy Research Biosystem Engineering, 2012, Special Issue 1, 123-129.
17. Funke G. Adebawo, Olayiwola O. Ajala, Olajide A. Olatunji and Tunde. J. Adekanbi, "Potentials of Azadirachtaindicaseed oil as bio-preservative against termite attack on wood", Asian Journal of Plant Science and Research, 2015, 5(12), 1-5.
18. GurselColakoglu, SemraColak, Ismail Aydin, Umit C. Yildiz and SibelYildiz, "Effect of Boric Acid Treatment on Mechanical Properties of Laminated Beech Veneer Lumber", Silva Fennica, 2003, 37(4), 505-510.
19. LikerUsta, "The Effect of Moisture Content and Wood Density on the Preservative Uptake of Caucasian fir (Abiesnordmanniana (Link.) Spach.) Treated with CCA", Turk J Agric For., 2004, 28, 1-7.
20. B. Tarakanadha, Jeffrey J. Morrell, and K. SatyanarayanaRao, "Impacts Of Wood Preservatives (CCA, CCB, CDDC, ACZA, ACQ AND ACC) On The Settlement And Growth Of Fouling Organisms",www. ccaresearch. org/ ccaconference /post/pdf/ tarakanadha. pdf, 2002, accessed Feb.,4, 2017.
21. George Mantanis, EvrenTerzi, S. NamiKartal, A.N. Papadopoulos, "Evaluation of mold, decay and termite resistance of pine wood treated with zinc- and copper-based nanocompounds", International Biodeterioration and Biodegradation, 2014, 90, 140-144.
22. Ruben Francisco Gonzalez-Laredo, Martha Rosales-Castro, Nuria Elizabeth Rocha-Guzman, Jose Alberto GallegosInfante, Martha Rocio Moreno-Jimenez and Joseph J. Karchesy, "Wood preservation using natural products", Madera y Bosques, 2015, 21, 63-76.
23. Gao Zhou, "Extraction of Preservative Components from Treated Wood Waste", A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy Graduate Department of Forestry, University of Toronto,2012,1,1-178.

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