STUDY OF MECHANICAL PROPERTIES OF WOOD POLYACRYLONITRILE COMPOSITES

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Abstract :.

Wood polyacrolonitrile composite (WPC) from neem ,mango andcork wood was synthesized. The process was carried out through benzoyl peroxide(0.05mol/l)catalyzed impregnation polymerization of acrylonitrile,4mol/l,6mol/l into cork woodand mango wood in benzene medium at 75+-1^{0}c.The properties of WPCs over untreated woods were evaluated in terms of compressive test ,hardness of wood were improved with impregnation of polyacrylonitrile .Impregnation of polyacyrlonitrile (PAN) into neem wood,mango wood and cork woods were was confirmed through scanning electron microscope.

Keywords: benzoyl peroxide, Polyacrylonitrile, impregnation.

1. Introduction

Wood polymer composites (WPCs) results from the polymerization of liquid monomers already impregnated in wood. In principle WPCs should display super mechanical properties; dimensional stability to chemical degradation and less moisture absorb temperature than non-impregnated wood. A number of wood preservatives developed during those wood treatment processes and are under continuous demands which can develop the modified wood materials with improved mechanical strength, thermo-oxidative stability and resistance biodegradation for the better outdoor applications. Polymerization of polyacrylonitrile into poplar wood has also been reported and the composites indicated excellent moisture resistance and thermo oxidative stability [1,2]. Temperature affects physical, structural properties of wood. Several affects have been made to establish the relationship between temperature and thermal stability of wood [3,4,5,6].The physical and mechanical properties of wood may be improved by preparing composites of wood with vinyl monomers [7]. Reinforcement of several monomers like styrene, methyl methacrylate has provided substantial thermal stabilities to different types of woods[8,9].However, since most vinyl monomers are non-polar; there is little interaction between these monomers and hydroxyl groups of the cellulose fibers. Wood, a renewable resource and naturally occurring material abundantly available has a wide range of applications as construction material ,pulp,paper,fire board products as well as source of energy and as raw materials for various industrially important chemicals. Considerable work has been done on the modification of wood [10].Meyer(1981)[11] reported that wood treated with vinyl type monomer followed by curing(radiation or catalyst)significantly improves the moisture resistance, hardness etc. The advantage of impregnation at normal conditions is the large quantities of samples of various sizes and shapes can be conveniently impregnated compared to vacuum impregnation [8]. Thermo gravimetric analysis (TGA) is one of the major thermal analysis techniques used to study the thermal behavior of carbonaceous materials. The rate of weight loss of the sample as a function of temperature and time is measured to predict thermal behavior of the materials. Thermal analysis as TG has become the polymer characterization method the most frequently used.The TGA is particularly more adopted for mass variation study.In this work,we studied the process of degradation of wood poly acrylonitrle composites.compressive streangth of imprenated eucalyptus wood specimens is greater than that of non impregnated ones indicating that monocomponent polyurethane resin can be considered for impregnated impregnating wood[12].In thermo gravimetric list thermal decompositions of rice husk floor from room temperature to 3500 was similar to that of wood floor.Thus rice husk floor was thought to be a substitute for wood floor in agricultural lignocellulosic fiber-thermoplastic polymer composites in the aspect of thermal decomposition[13].Physical and mechanical grown A auriculiformis of three different ages(8,12,13 years)from sirsi,Karnataka indicate that the wood can be used for tool handles in work shops and factories and agricultural sectors ,light packing cases[14].

The mechanical stability of cedar wood samples were increased by using P(AGE/AN),P(AGE/MMA)copolymers.[15].Polymerization of polymethyl methacrylate and acrylonitite into Block Berry Wood has also been reported and composites indicated excellent wear stability and thermo oxidation stability[16].Polymerization of acrlonitrile into Indian Cork wood has also been reported and composites indicated excellent compressive resistence and thermal stability[17]. The effect of moisture content on mechanical properties of wood polystyrene composites in relation to their mechanical properties was studied[18].. A number of composites have shown improved dimensional stability and mechanical properties and proposed that they could replace the quality woods in high grade products[19]. Better tensile properties were observed in poly methyl vinyl methacrylate impregnated kadom and mango woods in presence of N-vinyl pyrrolidone tripropylene glycol diacrylale, trimethyloyl propane triacrylale, copper sulphate and urea [20]. Poly methymethacrylate was impregnated into low-grade woods in ligand paraffin, the composites so formed have shown increased hardness, impact strength dimensional stability and were proposed to be useful for tools and roofing [21].

2. EXPERIMENTAL METHODS

2.1 Materials

All the chemicals and solvents (AR) were purchased from M/S SDFCL Chemicals Ltd; Mumbai.

The monomer acrylonitrile was purified by extracting it with aqueous NAOH (10%) to remove inhibitor contents fallowed by repeated washings with distilled water. The fraction at 78^0C was used for the impregnation polymerization reaction. Other chemicals and solvents were used without further purification.

2.2a.Sample Preparation:

Wood specimens were prepared as per IS:1708-1986.The moisture content of wood was deduced according to ASTMD1037-72a and was found to be 12.75%.

2.2b Impregnation Procedure:

The Benzene solution of acrylonitrile at concentration of 4M, 6 Moles and Benzene solution of benzoylperoxide at 0.05M have also been prepared. Samples were then placed into an impregnation chamber. Some loads were applied on the samples before impregnation so that no flotation occurs. The appropriate monomer system was then introduced through a dropping funnel and the specimens were left immersed while atmospheric pressure was reached and allowed to stand for up to 24H(ASTMD-1413-61).Treated wood specimens were then wrapped in commercially available Al foil and cured in oven at 95^0 C for 2H to induce the impregnation polymerization reaction. Impregnation of polyacrylonitrile into neem,mango and cork woods were confirmed through scanning electron microscopy.

Fig1.Polymerization Process

3.0 Measurement

3.1 Compression Test

The size of specimen prepared as per IS: 1708-1986.Load was applied at the 2cmx2cm cross section on the tangential surface at a rate of 0.6mm/min. The compressive strength perpendicular to the grain was calculated by the equation

CS=P/A where P= load at the proportionality(kN)

A=are of the cross section of the specimen on which force was applied (mm^2)==400mm^2.

3.2 Hardness: Hardness testing model manufactured by Saroj Industry has been used to find out the variation in hardness of the untreated and Polyacrylonitrile PAN composites of the Neem,Cork and Mango wood and its affinity.The brinell hardness test was performed on the work table of the machine after turning the capstone

wheel to elevate the test specimen into contact with indenter point and also further turning the wheel forcing the test specimen again the indenter pushing back gradually the load application liver of the machine to apply the major load.

Fig.2 Experimental setup for Brinell Hardness strength test

Majoring the diameter of indentation on the specimen with the help of brinell hardness tester.

$$B.H.N. = \frac{2P}{\pi D[D - \sqrt{D^2 - d^2}}$$

WhereP = Measure load in kgf.
D = Diameter of steel ball indentor in mm
d = Diameter of indentation of mm

4.0 RESULTS AND DISCUSSIONS

4.1 Compression test

This is a mechanical test to measure how easily a matter can undergo deformation under stress. it can be expected that a material which is dense due to the presence of void spaces within the material will undergo deformation more radically than another piece of similar but denser material when both are Generally speaking, there are a number of possibilities to measure thermal conductivity, each of them suitable for a limited range of materials, depending on the thermal properties and the medium temperature. A distinction may be observed between steady-state and transient techniques. In general, steady-state techniques perform a measurement when the temperature of the material measured does not change.

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Fig.3 Experimental setup for Compressive strength test

The compressive strength of Neem,Mango and Cork wood and their Polyacrylonitrile reinforced were tested as discussed. There tests indicated that the compressive strength of woods increased as Concentration of PolyAcrylonitrile (PAN) increased. As a result of impregnation polymerization of acrylonitrile compressive strength for the synthesized WPC were improved as shown in Table.1toTable.3

Table.1 Compressive Strength for Neem Wood

S.No	Concentration	σ(N/m^2)
1	0M	4.0×10^7
2	2M	4.5×10^7
3	4M	5.5×10^7
4	6M	6.0×10^7

Table.2 Compressive Strength for mango Wood

S.No	Concentration	σ(N/m^2)
1	0M	3.0×10^7
2	2M	3.25×10^7
3	4M	3.5×10^7
4	6M	3.75×10^7

Table.3 Compressive Strength for Cork Wood

S.No	Concentration	σ(N/m^2)
1	0M	5.85×10^7
2	2M	6.00×10^7
3	4M	6.25×10^7
4	6M	6.5×10^7

The aim of the experiment is to find the Compression test of the given wood specimens.

4.2 Hardness :

Hardness Testing model manufactured by Saroj Industry has been used to find out the variation in hardness of the treated and Polyacrylonitrile(PAN) composites of the, neem,mango,cork woods and its affinity.

The brinell hardness test was performed on the work table of the machine after running the capstone wheel to elevate the test specimen into contact with indenter point and also further turning the wheel forcing the test specimen again the indenter pushing back gradually the load application liver of the machine to apply the major load.

As recorded the hardness of treated at various concentration and untreated composites table .4 for neem, table .5 for mango and table .6 for cork wood no remarkable changes has observed.Majoring the diameter of indentation on the specimen with the help of brinell microscope.

$$B.H.N.= \frac{2P}{\pi D[D-\sqrt{D^2-d^2}}$$

WhereP = Measure load in kgf.
D = Diameter of steel ball indentor in mmd = D
iameter of indentation in mm

Table.4 Hardness Tests of Neem Wood and its PAN Composites

S.No	Concentration	BHN
1	0M	58
2	2M	61
3	4M	61
4	6M	62

Table.5 Hardness Tests of Cork Wood and its PAN Composites

S.No	Concentration	BHN
1	0M	62
2	2M	64
3	4M	64
4	6M	66

Table.6 Hardness Tests of mango Wood and its PAN Composites

S.No	Concentration	BHN
1	0M	43
2	2M	45
3	4M	48
4	6M	56

5.0 CONCLUSIONS: results of these tests demonstrated that the Mechanical properties of impregnated wood specimens are greater than that non impregnated ones. The mechanical properties such as compression strength ,Hardness of woods are enhanced due to the reinforcement of PolyAcrylonitrile PAN .

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