

The Complete Technology Book on Wood and Its Derivatives

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Wood has been used for hundreds of thousands of years for both fuel and as a construction material. Wood is an organic material, a natural composite of cellulose fibers (which are strong in tension) embedded in a matrix of lignin which resists compression. In the strict sense wood is produced as secondary xylem in the stems of trees (and other woody plants). Wood is used for millennia for many purposes, primarily as a fuel or as a construction material for making houses, tools, weapons, furniture, packaging, artworks, and paper. Wood is composed of cells, and the cell walls are composed of micro fibrils of cellulose and hemicellulose impregnated with lignin. The derivation of chemicals from wood is carried out wherever technical utility and economic conditions have combined to make it feasible. In a living tree it performs a support function, enabling woody plants to grow large or to stand up for themselves. It also mediates the transfer of water and nutrients to the leaves and other growing tissues. Wood may also refer to other plant materials with comparable properties, and to material engineered from wood, or wood chips or fiber. Wood and man have coexisted on this planet from the beginning and wood, as a renewable resource, has provided man with tools, weapons and shelter. Wood, when dry, has unique physical properties in that its tensile strength, bending strength, compression strength, impact resistance and hardness per unit weight are the highest of all construction materials. Wood polymer composites (WPC) are materials in which wood is impregnated with monomers that are then polymerized in the wood to tailor the material for special applications. The resulting properties of these materials, from lightness and enhanced mechanical properties to greater sustainability, has meant a growing number of applications in such areas as building, construction and automotive engineering. Other uses of wood in furniture, buildings, bridges, and as a source of energy are widely known. Wood is perhaps the most used component in our daily life, from home building and furnishings to everything from the tables to the doors are made of wood, and for the people living in colder climates, wood holds even greater importance. Some of the fundamentals of the book are wood structure and chemical composition, chemical change in wood associated with wood fiberboard manufacture, chemical changes in wood effected by furnish preparation processes, bark extracts as bonding agent for particle board , wood polymer composites and their industrial applications , chemical reactions of preservatives with wood, activation of wood surface and nonconventional bonding , chemistry of weathering and protection , weathering of chemically modified woods, energy and chemicals from wood, charcoal and other chemicals, etc.

The developments in wood industry in the country are mainly attributed to the pioneering work carried in the field of wooden products. There are lots of chemicals and other products extracted from wood. This book contains processes of various wooden products and its derivatives. This

is the first book of its kind which is invaluable resource to research scholars, entrepreneurs, technocrats, institutes, libraries and existing one.

1. Wood: Structure and Chemical Composition

Gross Anatomical Features

Softwood Anatomy

Hardwood Anatomy

Cell Wall Structure

Chemical Composition of Cell Wall

2. Chemical Change in Wood Associated with Wood Fiberboard Manufacture

Furnish Preparation Processes

Wet Form Process Using Pressurized Refining.

Chemical Changes in Wood Effected by Furnish Preparation Processes

Board Conversion Processes

Wet Strength Properties of Hot Pressed Boards

Mechanism of Wet Strength Properties

Chemical Changes in Wood Effected by Board Conversion

3. Review of Particleboard Manufacture and Processing

Definition

Materials

Manufacturing

Particle Drying

Blending

Mat Formation

Finishing

Conclusion

4. Bark Extracts as Bonding Agent for Particle board

Material and Preparation

Bark Extracts

Three Layer Particleboard

Testing

5. Composition Boards Containing Bark

Amounts of Bark Available

Review of Efforts to Use Bark in Composition Boards

6. Polyurethane Foams from the Reaction of Bark and Diisocyanate

7. Wood Polymer Composites and their Industrial Applications

Chemistry of the Process

Impregnation Process

Monomers For Wood Polymer Composites

Physical Properties

Commercial Applications

Radiation Process.

World Wide Production

8. Interaction of Preservatives with Wood

Major Use Wood Preservatives

Minor Use Wood Preservatives

Copper Naphthenate.

Copper 8 Quinolinolate (Copper 8)

Tributyltin Oxide.

New Wood Preservatives

Preservative Distribution in Wood

Macrodistribution

Chemical Reactions of Preservatives with Wood

Inorganic Salt Preservatives.

Organic Preservatives

9. Chemistry of Adhesion

Thermoplastic and Thermosetting Polymers

Molecular Forces Between Adherend and Adhesive

Adhesives for Wood

Phenolic Resin Adhesives

Resoles

Novolak

Resorcinol Resins

Durability and Fracture Toughness

Urea Formaldehyde and Melamine Formaldehyde Resins

Isocyanate Based Adhesives

Thermoplastic Adhesives

Hot Melt Adhesives

Acidity of Wood

10. Activation of Wood Surface and Nonconventional Bonding

Conditions and Methods of Wood Surface Formation.

Direct Covalent Wood to Wood Bonding

Bonding Through Intermediacy of Bifunctional Molecules

Bonding by Intermediacy of a Covalently Attached Polymer

Use of Oxidants

Fundamental Studies

Surface Activation.

Hydrogen Peroxide Activation

Plasma Activation

Other Oxidizing Activators

Nonconventional Bonding

Direct Bonding

Bifunctional Amines

Bifunctional Acids

Bifunctional Isocyanates

Polymers

Conclusions

Addenda

Wood Surface Studies

Nonconventional Bonding with Acid Activation

Nonconventional Bonding with Oxidant Activation

Isocyanates

Nonpolar Nonconventional Binders

Other Methods

Patents

11. Chemistry of Weathering and Protection

Backgrounds

General Aspects of Wood Weathering

Anatomic Structure of Wood and Its Weatherability

Weathering Factors

Other Factors

Penetration of Light and Wood Surface Deterioration

Property Changes During Weathering

Chemical Changes

Colour Changes
Physical Changes
Microscopic Changes
Transverse Section
Radial Section
Tangential Section
Weathering of Wood Based Materials
Plywood
Reconstituted Panel Products
Weathering of Chemically Modified Woods
Free Radical Reactions in Lignin
Free Radical Characteristics and Reactions in Weathered
Participation of Singlet Oxygen in the Weathering Process
Protection Against Weathering
Film Forming Finishes
Varnishes
Natural Wood Finishes
Film Forming
Penetrating
Transparent
Semitransparent
Protection of Wood Based Materials
Wood Coating Interactions
Summary and Future Considerations
12. Biological Decomposition of Solid Wood
Susceptibility and Resistance
Types of Wood Deterioration
Deterioration without Decomposition.
Deterioration with Decomposition
Mechanobiochemical Decomposition
Biochemical Decomposition: The Wood Decays
Types of Decay
Progressive Changes in Chemical Composition
Progressive Changes in Strength Properties
Cellulose Decomposition
Hemicellulose Decomposition
Lignin Decomposition
Control and Uses of Wood Decomposing Organisms
Uses and Potential Uses
13. The Chemistry of Pyrolysis and Combustion
Formation of Volatile Products from Cellulose
First Pathway

Second Pathway
Dehydration Reactions
Formation and Properties of Char
Char Formation
Char Reactivity
Combustion
Combustibility
14. Chemistry of Fire Retardancy
Early Studies
Protection of Wood with Fire Retardants

Thermogravimetric Analysis (TG).
Differential Thermal Analysis and Differential Scanning Calorimetry
Tunnel Flame Spread Tests
Critical Oxygen Index Test
Test Methods for Related Properties
Smoke Production.
Heat Release Rate
Toxicity
Mechanisms of Fire Retardancy
Chemistry of Burning
Vapor phase Combustion
Smoldering And Glowing
Theories of Fire Retardancy
Barrier Theories
Thermal Theories
Dilution or Noncombustible Gases Theories
Free Radical Trap Theories
Increased Char/Reduced Volatiles Theories
Reduced Heat Content of Volatiles Theories
Phosphorus Nitrogen Synergism Theories
Smoldering Inhibition Theories
Fire Retardant Formulations
Major Chemicals
Aluminum Trihydrate
Miscellaneous Chemicals
Leach resistant Chemicals
Amino resins
Future Research
Leach Resistant Compounds
Improved Fire Retardant Treatments for Panel Products
Effective Coating Systems
Reduced Smoke and Toxicity
Basic Mechanisms. Finally, further work
Summary
Mechanism.
Formulations
Future Research

15. ENERGY AND CHEMICALS FROM WOOD

Alternate Energy Sources
Available Forest Residues
Energy and Fuels from Wood
Direct Combustion
Saccharification Fermentation
Ethanol from wood
Thermal Decomposition
Charcoal and other Chemicals
Thermochemical Liquefaction
Furfural from Wood
Fiberboard, particleboard, and flakeboard
Plywood
Laminated Lumber
Industrial Use of Energy
Energy Plantations

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