

# Handbook on Coal, Lignin, Wood and Rosin Processing

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Coal is one of the world's most plentiful energy resources. Coal is one of the fastest growing forms of energy after renewable sources and its share in the global primary energy consumption increasing rapidly. Lignin is the most abundant natural raw material available on Earth in terms of solar energy storage. Lignin is a complex chemical compound, cross linked polymer that forms a large molecular structure. Lignin can be used as a green alternative to many petroleum-derived substances, such as fuels, resins, rubber additives, thermoplastic blends and pharmaceuticals. Rosin is a complex mixture of mainly resin acids and small amount of non-acidic components.

Energy markets are evolving with technological advancements supporting rapid growth in renewable energy capacity. The coal market is set to witness great boost in near future because of the rising government initiatives.

Coal is one of the main power generation sources all over the world. The factors that are favoring the market growth include rising electricity demand and rapid industrialization. Presently the global coal industry market is valued at \$9.4 with CAGR of 11.21 % is poised to reach \$22 billion in coming years. Asia Pacific has the larger demand and emerging as a larger supplier of Coal. The present global lignin market demand is estimated at \$ 4,222.1 million and is expected to reach \$6,190.5 million in future.

The Major contents of the book are coal, analysis of coal and coke, cotton, lignin and hemicelluloses, degradation of wood, CCA-treated wood, wood-polymer composites, lignocellulosic-plastic composites from recycled materials, chemical modification of wood fiber, delignification of wood with pernitric acid, rosin and rosin derivatives, polymerizable half esters of rosin. It describes the manufacturing processes and photographs of plant & machinery with supplier's contact details.

It will be a standard reference book for professionals, entrepreneurs, those studying and researching in this important area and others interested in the field of these industries.

Chapter 1

Coal

Ethylene

Fischer –Tropsch Synthesis for Olefins

Direct Conversion of Synthesis Gas to Ethylene

Ethanol from Synthesis Gas  
Olefins from Methanol  
Methanol Homologation  
Methanol to Acetic Acid  
Ethylene Glycol  
Acetic Anhydride  
Vinyl Acetate  
Other Chemicals  
Coal Pyrolysis Processes  
Acetylene  
Production of Chemicals by  
Coal Liquefaction Processes  
Conclusion  
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Methods of Analysis  
Sampling  
Determination of Constitution and Physical  
Properties  
Functional Group Analysis  
Spectroscopy  
Determination of Optical Constants  
Electron Microscopy  
Density  
X-Ray Diffraction  
Specification Tests  
Proximate Analysis  
Ultimate Analysis  
Calorific Value  
Fusibility of Coal Ash  
Behaviour on Heating  
Equilibrium Moisture of Coal at 96-97%  
Relative Humidity and 39°C  
Determination of Hargreaves Grindability  
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Coal Classification  
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Cotton  
Methods of Analysis  
Modified Cottons  
Finishing Agents  
Separation and Identification  
Spectroscopic Methods  
Inorganic Constituents  
Chemical Methods  
Spectroscopic Methods  
Chapter 4  
Lignin and Hemicellulose  
Hemicellulose  
Assay systems  
Classification  
Thermophilic Hemicellulases

Alkaline active xylanases  
 $\beta$  - Xylosidase  
Mannanases and galactanases  
Accessory enzymes for Hemicellulose utilization  
Lignin  
Lignin-degrading enzymes  
Lignin degradation in whole cell cultures  
Degradation by cell-free enzyme systems  
Role of glycosides in Lignin degradation  
Lignin-carbohydrate complexes  
Fractionation of Lignin and  
Carbohydrate in wood  
Isolation of LCCs  
Chemical characteristics of LC bonds  
Ferulic and p-coimaric ester side chains  
Frequency and stability of LC bonds  
Residual lignin in kraft pulp  
Biodegradation of LCCs  
Residual LC structures after exhaustive  
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Solubitization of LCC by microbial activity  
Enzymatic treatments of pulps  
Conclusion  
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Distribution of Wall Components  
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Microstructure and Porosity  
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Biodegradation of Lignin  
Biodegradation of Cellulose  
Biodegradation of Hemicellulose  
Applications  
Conclusion  
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CCA-Treated Wood  
Introduction  
Materials and methods  
Results and Discussion  
Conclusion  
Chapter 7  
Wood-Polymer Composites  
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Wood specimens  
Treatment of specimens with monomers  
Volumetric swelling and moisture content  
Result  
Swelling of wood soaked in monomers  
Polymer loading

Volumetric swelling of WPC specimens

Moisture content of WPC specimens

Conclusions

Chapter 8

Lignocellulosic-Plastic Composites from Recycled Materials

Municipal Solid Waste as a Source of

Lignocellulosic Fibre and Plastics

Thermoformable composites

as Outlets for Waste Paper, Wood and Plastics

Recent Research on Wood

Fiber-Thermoplastic Composites

Research and Development Needs

Concluding Remarks

Chapter 9

Chemical Modification of Wood Fiber

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Experimental Procedure

Esterification Procedure

Analyses of Esterification Products

Board Formation

Board Testing

Moisture sorption

Rate and extent of swelling

Results and Discussion

Esterification of Wood Fiber

Moisture Sorption of Esterified Fiberboards

Rate and Extent of Swelling of Fiberboards in Liquid Water

Plasticization of Esterified Fibers

Conclusions

Chapter 10

Delignification of Wood with

Pernitric Acid

Generation of pernitric acid

Decomposition of pernitric acid

Delignification of aspen wood

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Chapter 11

Rosin and Rosin Derivatives

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Reaction and derivatives

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Photosensitized oxidation

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Hydrogenless Hydrogenation

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Hydrocracking of Rosin

Dehydrogenation

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Gas chromatography analysis  
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Rosin-isobutene condensate (Example-4)  
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Rosin-styrene condensate (Example-6)  
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Rosin-coumarone-indene condensate (Example-8)  
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Dehydroabietylamine  
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Preservatives  
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Stability to heat and storage  
Stability to heat and storage  
Surface Activity  
Chemical Reactivity  
Chemical and Physical Properties of  
Amine D acetate  
Solubility  
Note  
Stability to Heat and Storage

Stability to Air and Sunlight  
Surface Activity  
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Methyl neoabietate (ii)  
Methyl photolevopimarate (iii)  
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Reaction of Chlorosulphonyl isocyanate with  
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levopimaric acid  
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## Chapter 12

The Polymerizable Half Esters of Rosin  
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Maleic rosin esters with reactive groups  
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Aqueous Polymerization  
Suspension Polymerization  
Secondary reactions and graft copolymers  
Reaction Involving Crosslinking  
Applications  
Coatings  
Inks  
Textiles  
Conclusions

## Chapter 13

Photographs of Plant & Machinery with Supplier's  
Contact Details

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