

Production of Phenolic Resins

**(Phenol Formaldehyde Resin, Resin
Production, Fillers for Phenolic Resin
Moulding Powders, Fillers and Resins,
Molded Phenolic Resins, Laminated
Phenolic Resins, Modified and
Thermal-Resistant Resins)**

Introduction

Phenolic resins are obtained by the reaction of phenols with aldehydes. The simplest representative of these types of compounds, phenol and formaldehyde, are by far most important. Phenolic resins are mainly used in the production of circuit boards. The development of synthetic resins for surface coating applications has usually followed the use of similar material in the plastic industry. One of the first synthetic resins ever used commercially, both in plastics and in surface coatings was the phenolic resin. Phenolic resins result aldehyde with or without modification.

Phenol resin bonded wood materials; particle boards (PB), plywood, fiber board (FB) and glued wood construction element are used for outdoor construction and in high humidity areas because of the high water and weathering resistance of the phenolic adhesive bond and high specific strength. The competitiveness and development of the wood working industry are of utmost importance for the development for thermosetting plastics. This industry is the largest consumer of urea melamine and phenol resins. Phenolic laminates are made by impregnating one or more layers of a base material such as paper, fiberglass or cotton with phenolic resin and laminating the resin saturated base material under heat and pressure. The resin fully polymerizes (cures) during this process. The base material choice depends on the intended application of the finished product.

Paper phenolics are used in manufacturing electrical components such as punch through boards and household laminates. Glass phenolics are particularly well suited for use in the high speed bearing market. Other applications of phenolic resins are in chemical equipments, fibers, socket putties, photo resists, tannins, brush putties, etc. Good performance at a reasonable cost has long been an important selling point for phenolic resins, especially in applications such as wood bonding and insulation, where discoloring and other drawbacks can be overlooked because of cost savings. Hence demand of phenolic resins is growing rapidly.

Phenolic resins are a group of the most versatile polymers yet invented. Although they came into existence at the very start of the age of polymers, they continued to be developed into more and more applications.

The global phenolic resin market by product type and application type, has witnessed a significant growth in the past few years and this growth is estimated to persist in the coming years. The resol type phenolic resins constitute majority of the market globally. Phenol and formaldehyde are the main consumed raw material for the phenolic resin.

Wood adhesive application of phenolic resins is expected to drive the phenolic resin market. One of the key factors contributing to this market growth that phenolic resins make excellent wood adhesives for plywood and particleboard because they form chemical bonds with the phenol-like lignin component of wood. They are especially desirable for exterior plywood, owing to their good moisture resistance. Phenolic resins are usually produced in batches. This permits a wide range of formulations and molecular weights to be manufactured using the same equipment. Continuous processes have been developed that are suitable for producing a large quantity of a single grade.

The global phenolic resins industry is anticipated to witness stable growth from 2014 to 2020 owing to rising demand from transportation and construction sector. Phenolic resins find their applications in numerous segments on account of their properties including high heat resistance & flame retardancy, low smoke & toxicity, high mechanical strength and easy blending with other polymers to attain high performance. Phenolic resins provide services to automotive, aerospace and construction via applications in laminates, insulation, wood adhesives and molding compounds.

This book basically deals with general reaction of phenols with aldehydes, the resoles, curing stages of resoles, kinetics of a stage reaction, chemistry of curing reactions, kinetics of the curing reaction, the novolacs, decomposition products of resites, acid cured resites, composition of technical resites, mechanisms of rubber vulcanization with phenolic resins, thermosetting alloy adhesives, vinyl phenolic structural adhesives, nitrile phenolic structural adhesives, phenolic resins in contact adhesives, chloroprene phenolic contact adhesives, nitrile phenolic contact adhesives, phenolic resins in pressure sensitive adhesives, rubber reinforcing resins, resorcinol formaldehyde latex systems etc.

The present book covers manufacturing processes of phenolic resins. New entrepreneurs, technocrats, research scholars can get good knowledge from this book.

Table of Contents

1. HISTORICAL DEVELOPMENT OF PHENOLIC RESINS

2. RAW MATERIALS

Phenols, Physical Properties of Phenol, Cumene Process (Hock Process), Cresols and Xylenols Synthesis Methods, Alkylphenols, Phenols from Coal and Petroleum, Other Phenolic Compounds, Resorcinol, Bisphenol-A, Formaldehyde, Properties and Processing, Paraformaldehyde, Trioxane and Cyclic Formals, Hexamethylenetetramine, HMTA, Furfural, Other Aldehydes

3. CHEMICAL STRUCTURE

General Reaction of Phenols with Aldehydes, The Resoles, Curing Stages of Resoles, Kinetics of A-Stage Reaction, Chemistry of Curing Reactions, Kinetics of the Curing Reaction, The Novolacs, Decomposition Products of Resites, Acid-Cured Resites, Composition of Technical Resites

4. PHENOLIC RESINS FROM HIGHER ALDEHYDES

Acetaldehyde, Butyraldehyde, Chloral, Furfural, Acrolein

5. PHENOLIC RESINS FROM POLYHYDRIC PHENOLS

6. REACTION MECHANISMS

Molecular Structure and Reactivity of Phenols, Formaldehyde-Water and Formaldehyde-Alcohol Equilibria, Phenol-Formaldehyde Reaction under Alkaline Conditions, Inorganic Catalysts and Tertiary Amines, Ammonia, HMTA and Amine-Catalyzed Reactions, Reaction Kinetics of the Base-Catalyzed Hydroxymethylation, Prepolymer Formation, Resole Cross-Linking Reactions. Quinone Methides, Acid Curing, Heat Curing, Phenol-Formaldehyde Reactions under Acidic Conditions, Reaction Kinetics in Acidic Medium, Reaction under Weak Acidic Conditions. High-Ortho Novolak Resins, Novolak Cross-Linking Reaction with HMTA, Reaction with Epoxide Resins, Reactions with Diisocyanates

7. THE PHYSICAL STRUCTURE OF PHENOLIC RESINS

Introduction, X-Ray Examination, Electron Microscope Examination, The Isogel Theory of Phenoplast Structure, The Spherocolloid Theory of Phenoplast Structure, Further Swelling Experiments, Development of Structure in A-Stage Resin, General Picture of Phenoplast Structure, Structure of Cast Phenoplasts

8. RESIN PRODUCTION

9. FILLERS FOR PHENOLIC RESIN MOULDING POWDERS

Types of Filler, Effect of Filler on Impact Strength and Damping, Microscopic Structure of Fillers, Ratio of Resin to Filler, Standard Classification of Phenoplast Molding Powder According to Filler, Properties of Individual Fillers, Cellulose Derivatives, Wood Flour, Walnut-Shell Flour, Cottonseed Hulls, Cellulosic Fibers, Textile By-Products, Proteinaceous Fillers, Carbon Fillers, Mineral Fillers

10. FILLERS AND RESINS FOR LAMINATES

Classification of Laminates, Laminated Phenolic Sheets, Laminated Phenolic Tubes (NEMA Classification), High Strength Paper Laminates, Plastic Bonded Cotton Fiber, Glass Fabric Filler, Resins used for Laminates

11 PHYSIOLOGY AND ENVIRONMENTAL PROTECTION

Toxicology of Phenols, Toxicology of Formaldehyde, Environmental Protection, Waste Water and Exhaust Air Treatment Processes, Microbial Transformation and Degradation, Chemical Oxidation and Resinification Reactions, Thermal and Catalytic Incineration, Extraction Processes and Recovering, Activated Carbon Process, Gas Scrubbing Processes

12. DEGRADATION OF PHENOLIC RESINS BY HEAT, OXYGEN AND HIGH ENERGY RADIATION

Thermal Degradation, Oxidation Reactions, Degradation by High Energy Radiation

13. MECHANICAL PROPERTIES OF MOLDED PHENOLIC RESINS

Introduction, Mechanical Properties Covered, Pheno-plast Properties at Room Temperature, Effect of Degree of Cure on Physical Properties, Tensile Strength, Modulus of Elasticity, Compressive Strength, Flexural Strength, Shear Strength, Bearing Strength, Impact Resistance, Creep and Stress Endurance, Fatigue Resistance, Influence of Temperature on Mechanical Properties, Influence of Temperature on Creep, Theoretical Discussion of Strength Properties of Phenoplasts, Strength-Weight Comparisons with Metals

14. MECHANICAL PROPERTIES OF LAMINATED PHENOLIC RESINS

Introduction, Mechanical Properties at Ordinary Temperatures, Tensile Strength, Modulus of Elasticity, Compressive Strength, Flexural Strength, Shear Strength, Bearing Strength, Impact Resistance, Creep and Stress Endurance, Fatigue Resistance, Abrasion Resistance, Influence of Temperature on Mechanical Properties, Effect of Resin Content on Mechanical Properties,

Effect of Moisture Content of Paper Filler Before Lamination, Effect of Laminating Pressure, Effect of Degree of Cure, Effect of Moisture Content on Physical Properties, Mechanical Properties of Post-Formed Laminates, Tensile Strength, Flexural Strength, Shear Strength, Impact Strength, Water Absorption

15. MODIFIED AND THERMAL-RESISTANT RESINS

Etherification Reactions, Esterification Reaction, Boron-Modified Resins, Silicon-Modified Resins, Phosphorus-Modified Resins, Heavy Metal-Modified Resins, Nitrogen-Modified Resins, Sulfur-Modified Resins

16. COMPOSITE WOOD MATERIALS

Wood, Residues of Annual Plants, Adhesives and Wood Gluing, Phenol Resins, Urea and Melamine Resins, Diisocyanates, Lignosulfonates, Bark Extracts, Physical Properties of Composite Wood Materials, Particle Boards, Wood Chips, Resins and Additives, Wood Chips, Resins, Hydrophobic Agents, Fungicides and Insecticides, Flame Retardants, Production of Particle Boards, Chip Blending, Pressing of Particle Boards, Properties of Particle Boards, Plywood, Resins,

Additives and Formulations, Production of Plywood, High-Densified Plywood, Fiber Boards, Wood Fibers, Resins and Additives, Production of Fiber Boards, Structural Wood Gluing, Resorcinol Adhesives

17. MOULDING COMPOUNDS

Standardization and Minimum Properties, Composition of Molding Powders, Resins, Fillers, Reinforcements and Additives, Wood Flour and Cellulose Fibers, Asbestos, Mineral Flour, Other Fillers and Fibers, Colorants, Lubricants and Release Agents, Production of Molding Powders, Thermoset Flow, Manufacturing of Molded Parts, Compression Molding, Transfer Molding, Injection Molding, Selected Properties, Thermal Resistance, Shrinkage and Post-Mold Shrinkage, Thermal Expansion

18. HEAT AND SOUND INSULATION MATERIALS

Inorganic Fiber Insulating Materials, Inorganic Fibers and Fiber Production, Resins and Formulation, Properties of Fiber Mats, Phenolic Resin Foam, Resins and Additives, Blowing Agents, Surfactants, Foaming Equipment, Foam Properties, Sound Insulating Textile Fiber Mats.

19. THERMAL PROPERTIES OF PHENOLIC RESINS

Introduction, Coefficient of Expansion, Flame Resistance

20. CHEMICAL RESISTANCE OF PHENOLIC RESINS

Introduction, Water Absorption, Effect of Reagents, Chemical Applications for Phenoplasts, Resistance to Microorganisms

21. OIL SOLUBLE PHENOLIC RESINS

Introduction, Pure Oil-Soluble Phenoplasts, The Modified Phenoplasts, Reactions of the Phenoplasts with Oils

22. FRICTION MATERIALS

Friction and Wear of Thermosets, Formulation of Friction Materials, Fibers, Fillers, Resins, Manufacturing of Brake- and Clutch Linings, Impregnation Process, Wet Mix Dough Process, Dry Mix Process

23. PHENOLIC RESINS IN RUBBERS AND ADHESIVES

Mechanisms of Rubber Vulcanization with Phenolic Resins, Thermosetting Alloy Adhesives, Vinyl-Phenolic Structural Adhesives, Nitrile-Phenolic Structural Adhesives, Phenolic Resins in Contact Adhesives,

Chloroprene-Phenolic Contact Adhesives, Nitrile-Phenolic Contact Adhesives, Phenolic Resins in Pressure-Sensitive Adhesives, Rubber-Reinforcing Resins, Resorcinol-Formaldehyde Latex Systems

24. PHENOLIC ANTIOXIDANTS

25. OTHER APPLICATIONS

Carbon and Graphite Materials, Phenolics for Chemical Equipment, Phenolic Resin/Fiber Composites, Phenolic Resin Fibers, Blast Furnace Taphole Mixes, Photo-Resists, Socket Putties, Brush Putties, Tannins, Ion-Exchange-Resins, Casting Resins

26. TECHNICAL MANUFACTURE OF PHENOLIC RESINS

Resin Manufacture, Cast Resins, Resin Varnishes, Resin Compound, Molding Powder, Phenoplast Molding Laminates

27. MOULDING TECHNIQUE FOR PHENOLIC RESINS

Introduction, Compression Molding, Transfer Molding, Injection Molding, Molding Practice, Preheating

28. MISCELLANEOUS TECHNICAL APPLICATIONS OF PHENOLIC RESINS

Wood Adhesives, Bonding of Insulating Mats, Resins for Bonding Grinding Wheels, Wood Impregnation, Miscellaneous Adhesive Applications, Brake-Lining Resins, Cross Linking of Thermoplasts, War Uses of Phenoplasts.

29. FOUNDRY RESINS

Mold- and Core-Making Processes, Inorganic Binders, Organic Binders, Requirements of Foundry Sands, Shell Molding Process, Precoated Resin "Shell" Sand, Shell Sand Properties, Hot-Box Process, No-Bake Process, Cold-Box Process, Ingot Mold Hot Tops

30. INDUSTRIAL LAMINATES AND PAPER IMPREGNATION

Electrical Laminates, Materials, Paper, Resins, Production of Electrical Laminates, Laminated Tubes and Rods, Cotton Fabric Reinforced Laminates, Decorative Laminates, Filters, Battery Separators

31. COATINGS

Automotive Coatings, Water-Borne Paints and Electrodeposition, Coatings for Metal Containers, Marine Paints, Shop Primers, Wash Primers, Oil-Modified Phenolic Resin Paints, Printing Inks, Rosin-Modified Phenolic Resins, Other Applications

32. ABRASIVE MATERIALS

Grinding Wheels, Composition of Grinding Wheels, Abrasive Materials, Fillers and Reinforcements, Resins, Manufacturing of Grinding Wheels, Cold Molding Procedure for Non-reinforced Wheels, High-Speed, Reinforced Grinding and Separating Wheels, Compression Molding Process, Snagging Wheels, Fibrous Laminated Wheels, Coated Abrasives, Composition of Coated Abrasives, Abrasive Materials, Adhesives and Coatings, Coating Process, Abrasive Papers, Abrasive Tissues, Vulcanized Fiber Abrasives

33. ELECTRICAL PROPERTIES OF PHENOLIC RESINS

Introduction, Theoretical Discussion, Numerical Data on Electrical Properties, Effect of Heating on Electrical Properties

34. ANALYTICAL METHODS

Monomers, Nitrogen and Water, Physical Properties, Reactivity, Chromatographic Methods, Spectroscopy

35. PHENOLIC RESINS AS ION-EXCHANGE RESINS

Introduction, Application of Ion Exchange: Theory, Application of Ion Exchange: Types of Processes

Niir Project Consultancy Services (NPCS)
can provide Process Technology Book on
Phenolic Resins

See more

<http://goo.gl/0Msjg2>

<http://goo.gl/KmQ0DN>



Visit us at

www.entrepreneurindia.co



**Take a look at
NIIR PROJECT CONSULTANCY SERVICES
on #Streetview**

<https://goo.gl/VstWkd>

Locate us on Google Maps

<https://goo.gl/maps/BKkUtq9gevT2>

Contact us

Niir Project Consultancy Services

106-E, Kamla Nagar, New Delhi-110007, India.

Email: npcs.ei@gmail.com , info@entrepreneurindia.co

Tel: +91-11-23843955, 23845654, 23845886

Mobile: +91-9811043595

Fax: +91-11-23841561

Website :

www.niir.org

www.entrepreneurindia.co

Take a look at NIIR PROJECT CONSULTANCY SERVICES on #StreetView

<https://goo.gl/VstWkd>

Niir PROJECT CONSULTANCY SERVICES

An ISO 9001:2008 Company

Who are we?

- *One of the leading reliable names in industrial world for providing the most comprehensive technical consulting services*
- *We adopt a systematic approach to provide the strong fundamental support needed for the effective delivery of services to our Clients' in India & abroad*

What do we offer?

- *Project Identification*
- *Detailed Project Reports/Pre-feasibility Reports*
- *Business Plan*
- *Industry Trends*
- *Market Research Reports*
- *Technology Books and Directory*
- *Databases on CD-ROM*
- *Laboratory Testing Services*
- *Turnkey Project Consultancy/Solutions*
- *Entrepreneur India (An Industrial Monthly Journal)*

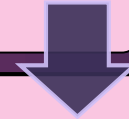
How are we different ?

- *We have two decades long experience in project consultancy and market research field*
- *We empower our customers with the prerequisite know-how to take sound business decisions*
- *We help catalyze business growth by providing distinctive and profound market analysis*
- *We serve a wide array of customers , from individual entrepreneurs to Corporations and Foreign Investors*
- *We use authentic & reliable sources to ensure business precision*



Our Approach

Requirement collection



Thorough analysis of the project



Economic feasibility study of the Project



Market potential survey/research



Report Compilation

Who do we serve?

- *Public-sector Companies*
- *Corporates*
- *Government Undertakings*
- *Individual Entrepreneurs*
- *NRI's*
- *Foreign Investors*
- *Non-profit Organizations, NBFC's*
- *Educational Institutions*
- *Embassies & Consulates*
- *Consultancies*
- *Industry / trade associations*

Sectors We Cover

- *Ayurvedic And Herbal Medicines, Herbal Cosmetics*
- *Alcoholic And Non Alcoholic Beverages, Drinks*
- *Adhesives, Industrial Adhesive, Sealants, Glues, Gum & Resin*
- *Activated Carbon & Activated Charcoal*
- *Aluminium And Aluminium Extrusion Profiles & Sections,*
- *Bio-fertilizers And Biotechnology*
- *Breakfast Snacks And Cereal Food*
- *Bicycle Tyres & Tubes, Bicycle Parts, Bicycle Assembling*

- *Bamboo And Cane Based Projects*
- *Building Materials And Construction Projects*
- *Biodegradable & Bioplastic Based Projects*
- *Chemicals (Organic And Inorganic)*
- *Confectionery, Bakery/Baking And Other Food*
- *Cereal Processing*
- *Coconut And Coconut Based Products*
- *Cold Storage For Fruits & Vegetables*
- *Coal & Coal Byproduct*

- *Copper & Copper Based Projects*
- *Dairy/Milk Processing*
- *Disinfectants, Pesticides, Insecticides, Mosquito Repellents,*
- *Electrical, Electronic And Computer based Projects*
- *Essential Oils, Oils & Fats And Allied*
- *Engineering Goods*
- *Fibre Glass & Float Glass*
- *Fast Moving Consumer Goods*
- *Food, Bakery, Agro Processing*

- *Fruits & Vegetables Processing*
- *Ferro Alloys Based Projects*
- *Fertilizers & Biofertilizers*
- *Ginger & Ginger Based Projects*
- *Herbs And Medicinal Cultivation And Jatropha (Biofuel)*
- *Hotel & Hospitality Projects*
- *Hospital Based Projects*
- *Herbal Based Projects*
- *Inks, Stationery And Export Industries*

- *Infrastructure Projects*
- *Jute & Jute Based Products*
- *Leather And Leather Based Projects*
- *Leisure & Entertainment Based Projects*
- *Livestock Farming Of Birds & Animals*
- *Minerals And Minerals*
- *Maize Processing(Wet Milling) & Maize Based Projects*
- *Medical Plastics, Disposables Plastic Syringe, Blood Bags*
- *Organic Farming, Neem Products Etc.*

Sectors We Cover Cont...

- *Paints, Pigments, Varnish & Lacquer*
- *Paper And Paper Board, Paper Recycling Projects*
- *Printing Inks*
- *Packaging Based Projects*
- *Perfumes, Cosmetics And Flavours*
- *Power Generation Based Projects & Renewable Energy Based Projects*
- *Pharmaceuticals And Drugs*
- *Plantations, Farming And Cultivations*
- *Plastic Film, Plastic Waste And Plastic Compounds*
- *Plastic, PVC, PET, HDPE, LDPE Etc.*

Sectors We Cover Cont...

- *Potato And Potato Based Projects*
- *Printing And Packaging*
- *Real Estate, Leisure And Hospitality*
- *Rubber And Rubber Products*
- *Soaps And Detergents*
- *Stationary Products*
- *Spices And Snacks Food*
- *Steel & Steel Products*
- *Textile Auxiliary And Chemicals*

Sectors We Cover Cont...

- *Township & Residential Complex*
- *Textiles And Readymade Garments*
- *Waste Management & Recycling*
- *Wood & Wood Products*
- *Water Industry(Packaged Drinking Water & Mineral Water)*
- *Wire & Cable*

Contact us

Niir Project Consultancy Services

106-E, Kamla Nagar, New Delhi-110007, India.

Email: npcs.ei@gmail.com , info@entrepreneurindia.co

Tel: +91-11-23843955, 23845654, 23845886

Mobile: +91-9811043595

Fax: +91-11-23841561

Website :

www.niir.org

www.entrepreneurindia.co

Take a look at NIIR PROJECT CONSULTANCY SERVICES on #StreetView

<https://goo.gl/VstWkd>

Follow Us



➤ <https://www.linkedin.com/company/niir-project-consultancy-services>



➤ <https://www.facebook.com/NIIR.ORG>



➤ <https://www.youtube.com/user/NIIRproject>



➤ <https://plus.google.com/+EntrepreneurIndiaNewDelhi>



➤ https://twitter.com/npcs_in



➤ <https://www.pinterest.com/npcsindia/>



THANK YOU!!!

For more information,
visit us at:

www.entrepreneurindia.co