

# Phenolic Resins Technology Handbook

**Author:** NPCS Board of Consultants & Engineers

**Format:** Paperback

**ISBN:** 9788190568500

**Code:** NI197

**Pages:** 584

**Price:** Rs. 1,275.00 US\$ 125.00

**Publisher:** NIIR PROJECT CONSULTANCY SERVICES

Usually ships within **5** days

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.

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.

## 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, Phenoplast 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

## About NIIR

**NIIR PROJECT CONSULTANCY SERVICES (NPCS)** is a reliable name in the industrial world for offering integrated technical consultancy services. NPCS is manned by engineers, planners, specialists, financial experts, economic analysts and design specialists with extensive experience in the

related industries.

Our various services are: Detailed Project Report, Business Plan for Manufacturing Plant, Start-up Ideas, Business Ideas for Entrepreneurs, Start up Business Opportunities, entrepreneurship projects, Successful Business Plan, Industry Trends, Market Research, Manufacturing Process, Machinery, Raw Materials, project report, Cost and Revenue, Pre-feasibility study for Profitable Manufacturing Business, Project Identification, Project Feasibility and Market Study, Identification of Profitable Industrial Project Opportunities, Business Opportunities, Investment Opportunities for Most Profitable Business in India, Manufacturing Business Ideas, Preparation of Project Profile, Pre-Investment and Pre-Feasibility Study, Market Research Study, Preparation of Techno-Economic Feasibility Report, Identification and Section of Plant, Process, Equipment, General Guidance, Startup Help, Technical and Commercial Counseling for setting up new industrial project and Most Profitable Small Scale Business.

NPCS also publishes various process technology, technical, reference, self employment and startup books, directory, business and industry database, bankable detailed project report, market research report on various industries, small scale industry and profit making business. Besides being used by manufacturers, industrialists and entrepreneurs, our publications are also used by professionals including project engineers, information services bureau, consultants and project consultancy firms as one of the input in their research.

---

**NIIR PROJECT CONSULTANCY SERVICES** , 106-E, Kamla Nagar, New Delhi-110007, India. **Email:** [npcs.india@gmail.com](mailto:npcs.india@gmail.com) **Website:** [NIIR.org](http://NIIR.org)

Tue, 23 Jan 2018 01:55:00 +0530