Book on Epoxy Resins Technology

(Manufacturing Process, Synthesis, Epoxy Resin Adhesives and Epoxy Coatings)

www.entrepreneurindia.co
Epoxy resin is a significant raw material to many end-use chemical compounds, where per molecule holds the capability of being converted to a useful thermosetting product. The major end-use markets for epoxy resins include electronics and paints & coatings, followed by adhesives, composites, wind turbines, and others.
The term epoxy has been widely adapted for many uses beyond its original use for fiber-reinforced polymer composites. Today, epoxy adhesives are sold in local hardware stores, and epoxy resin is used as the binder in countertops or coatings for floors. The myriad uses for epoxy continue to expand, and variants of epoxies are constantly being developed to fit the industries and products they are used in.
Here are some things that epoxy resin is used in:

- General-purpose adhesives
- Binder in cement and mortars
- Rigid foams
- Nonskid coatings
- Solidifying sandy surfaces in oil drilling
- Industrial coatings
- Potting and encapsulating media
- Fiber-reinforced plastics
Epoxy resin refers to a type of reactive prepolymer and polymer containing epoxide groups. These resins react either with themselves in the presence of catalysts, or with many co-reactants like amines, phenols, thiols, etc.

Epoxy resin has many industrial applications for a variety of purposes. It possesses higher mechanical properties and more thermal and chemical resistance than other types of resin. Therefore, it has exclusive use in making aircraft components. Epoxy resin is also called polyepoxides.

Epoxy resin also finds uses in caulking and casting compounds, sealants, varnishes and paints, and other industrial applications.
Applications

*Applications for epoxy resins are extensive and include:*

- Paints and coatings.
- Adhesives.
- Composite materials such as those using carbon fibre and fiberglass reinforcements.
- Industrial tooling and composites.
- Electrical systems and electronics.
- Consumer applications.
- Marine applications.
- Aerospace applications.
- Biology.
- Art.
Market Outlook

The global epoxy resin market size was valued at $6,826 million in 2015, and is anticipated to grow at a CAGR of 6.2% to reach $10,264 million by 2022. Epoxy resin is corrosion, water, and chemical resistant; and has superior adhesion, thermal stability, durability, and mechanical strength that makes it attractive for the aircraft industry. However, fluctuating raw material cost and high prices of epoxy could hamper the market growth.

In the rapidly growing paints & coatings industry, epoxy resins are used in powder coatings applied to automotive & appliances parts, in solvent-borne coatings applied to substrates in corrosive environment, and water-based coatings as electrode position primers in automobiles.
In electronics industry theses are widely used in the manufacturing of printed circuit boards (PCBs).

Modernized consumer electronics products in tandem with the growing urbanization and rising disposable income of consumers has resulted in massive demand of such products, which in turn has risen demand for epoxy resins. Increase in construction activities in many countries and revamping of the older structures coupled with consumer demand for feature-rich coatings has mainly driven the demand of epoxy in paints & coatings industry.
The market is divided into liquid epoxy, waterborne epoxy, solvent cut epoxy, and others. The liquid epoxy resin segment accounted for the largest share of the overall market due to its wide range of applications. Yet, waterborne epoxy is set to emerge as the fastest growing segment in the overall Epoxy Resin Market due to its increasing use in powder coating applications.
The Global Epoxy Resin Market is segmented into building & construction, automotive & transportation, electrical & electronics, adhesives & sealants, marine, and others. Building & construction industry is the leading segment, growing at a considerable CAGR to reach USD 2,988.8 million till 2023, on account of rapid infrastructural development around the world. Automotive industry is another substantial segment in the Global Epoxy Resin Market, which is growing at the highest CAGR due to increasing use of epoxy resin based materials for manufacturing parts of an automobiles.
Global Epoxy Resin Market Share, by Application, 2016 (%):
Epoxy resins have a wide range of applications in the industry. Its properties have made it valuable in the paints & coatings industry. It provides two basic advantages, which include decoration and protection. There are various types of paint and coatings used by industries for different purposes. These are anti-corrosive primers, primer tie coats, primer finishes, abrasion resistant coatings, and chemical, heat and fire resistant coatings. Similarly, epoxy floor paints and sealants are some other products that are used as coatings on the floor, in order to make it decorative and durable.
Global performance is underscored by capacity installation of wind energy and melting down of conventional sources of energy. The global market has been attributed with a strong market thanks to growth of end-use industries such as paints and coatings and adhesives. The paints and coatings industry advocates two parts of epoxies have been developed for heavy duty services. These epoxy compounds take pride in applications to many formulations of protective coatings, automatic coatings, powder coatings and many other solvent-based paints. Products are used in many dimensions including solid, liquid and solution and are present in every type of paint.
Epoxy Resin Market, By Region, 2015-2026 (USD Million)
Epoxy demand in automobile and industrial applications is projected to grow on account of superior heat resistance as compared to latex based or alkyd based paints. Growing demand from water borne coatings, powder coatings, electrical & electronic laminates, flooring and paving applications is expected to further increase the growth.

Major Players: DowDuPont, Nan Ya Plastics, BASF SE, Hexion, Huntsman, Jiangsu Sanmu Group, Changchun Chemicals, and Dalian Qihua, among others
Epoxy Resins Technology Handbook

(Manufacturing Process, Synthesis, Epoxy Resin Adhesives and Epoxy Coatings) 2nd Revised Edition
About the Book:

Author: Dr. H. Panda
Format: Paperback
ISBN: 9788178331829
Code: NI305
Pages: 576
Indian Price: Rs. 1,895/-
US$: 150-
Published: 2019
Publisher: Asia Pacific Business Press Inc.
Epoxy is a term used to denote both the basic components and the cured end products of epoxy resins, as well as a colloquial name for the epoxide functional group. Epoxy resin are a class of thermoset materials used extensively in structural and specialty composite applications because they offer a unique combination of properties that are unattainable with other thermoset resins.

Epoxies are monomers or prepolymer that further reacts with curing agents to yield high performance thermosetting plastics. They have gained wide acceptance in protecting coatings, electrical and structural applications because of their exceptional combination of properties such as toughness, adhesion, chemical resistance and superior electrical properties.
Epoxy resins are characterized by the presence of a three membered cycle ether group commonly referred to as an epoxy group 1, 2-epoxide, or oxirane. The most widely used epoxy resins are diglycidyl ethers of bisphenol-A derived from bisphenol-A and epichlorohydrin.

The market of epoxy resins are growing day by day. Today the total business of this product is more than 100 crores. Epoxy resins are used for about 75% of wind blades currently produced worldwide, while polyester resins account for the remaining 25%. A standard 1.5-MW (megawatt) wind turbine has approximately 10 tonnes of epoxy in its blades. Traditionally, the markets for epoxy resins have been driven by demand generated primarily in areas of adhesives, building and civil construction, electrical insulation, printed circuit boards, and protective coatings for consumer durables, amongst others.
The major contents of the book are synthesis and characteristics of epoxy resin, manufacture of epoxy resins, epoxide curing reactions, the dynamic mechanical properties of epoxy resins, physical and chemical properties of epoxy resins, epoxy resin adhesives, epoxy resin coatings, epoxy coating give into water, electrical and electronic applications, analysis of epoxides and epoxy resins and the toxicology of epoxy resins.

It will be a standard reference book for professionals and entrepreneurs. Those who are interested in this field can find the complete information from manufacture to final uses of epoxy resin. This presentation will be very helpful to new entrepreneurs, technocrats, research scholars, libraries and existing units.
1. Synthesis and Characteristics of Epoxy Resin

Introduction
Structure of Epoxides
Epoxipation of Unsaturated Hydrocarbons
Catalytic Oxidation of Ethylene and Higher Olefins
Epoxidation by Peroxy Acids and Their Esters
Preparation of Peroxy Acids
In Situ Epoxidation
The Epoxidation Mechanism
Unsaturated Materials
Epoxidation by Inorganic Peroxy Acids
Epoxidation with Aliphatic and Aromatic Hydrocarbon Hydroperoxides
Epoxidation with Chromic Acid and Chromyl Compounds
Biological Epoxidation
Dehydrohalogenation of Substituted Hydroxyl Compounds
The Epoxidation Mechanism
Halohydrin Formation
Epoxides from Epichlorohydrin
Glycidyl Ethers
Glycidyl Esters
Nitrogen-Containing Epoxides
Thioglycidyl Epoxides
Silicon-Containing Epoxides
Organophosphorus Epoxides
Halogen-Containing Epoxides
Epoxides from Hydroxy Sulfonates or Halogenated Acetates
Epoxides from Glycols
Epoxidation by Condensation
Darzens Glycidic Ester Condensations
Epoxides from Ylids
Epoxides from Halogenated Ketones and Nickel Carbonyl
Epoxides from the Reaction of Diazomethane with Aldehydes or Ketones
Epoxides Containing Unsaturation
Conclusions

2. Manufacture of Epoxy Resins
Raw Materials
Manufacture
Plant Location
Machinery Needed
Profit

3. Epoxide-Curing Reactions
The Effect of Epoxide Structure on Reactivity with Curing Agents
The Mechanism of the Curing Reaction
Polyaddition Reactions
Polyamines
Polyamides
Polyureas
Polyurethanes
Polyisocyanates
Polymercaptans
Polyhydric Alcohols
Polyphenols
Polycarboxylic Acids
Polybasic Acid Anhydrides
Silanes and Silanols
Others
Polymerization
Anionic Catalysts
Cationic Catalysts

4. The Dynamic Mechanical Properties of Epoxy Resins
Basic Parameters
The Glassy Transition and Dynamic Mechanical Dispersion
Temperature and Frequency Interdependence
Experimental
Results and Discussion
Standard Measurements
Dynamic Measurements
Comparison of Results
Treatment by Reduced Variables
Conclusions

5. Physical and Chemical Properties of Epoxy Resins
Solubility and Surface Properties
Network Structure and Physical Properties
6. Epoxy Resin Adhesives

Introduction
Theories of Adhesion and Adhesive-joint Strength
Wetting and Spreading Phenomena
Boundary-Layer Theory
Surface-Attachment Theory of Adhesive-Joint Strengths
Stress Distribution in Adhesive Joints
Rheological Aspects of Adhesives
Unified Interpretation of Adhesive-Joint Strengths
Physical and Mechanical Aspects of Epoxy-Resin Adhesives
Dynamic Mechanical Techniques
Mechanical Behavior of Epoxy Adhesives During Joint Formation
Strength of Adhesive Materials
Chemical Aspects of Epoxy-based Adhesives
Curing Agents for Bisphenol A Epoxy Adhesives
Modifiers for Bisphenol A Epoxy Adhesives
Adhesives Based on Other Epoxy Materials
Technological Properties of Epoxy-adhesive Systems
Cure and Thermal Softening Behavior of Epoxy Adhesives
Stress and Environmental Durability of Adhesive Joints
7. **Epoxy Resin Coatings**

Classification of Epoxy-Resin Coatings
Epoxy Resins Commonly Used in Coatings
Epoxy-Resin Esters
Esters Produced from Solid Epoxy Resins
General Remarks
Formulation Latitude
Esters Produced from Liquid Epoxy Resins
Precatalyzed Liquid Epoxy Resin for the Production of Solid Epoxy Resins and Epoxy-Resin Esters
Cooking Procedure
“Two-Step” Liquid-Epoxy-Resin Route to Epoxy-Resin Esters
Cooking Procedure
Solid-Epoxy-Resin Solution Coatings
Cold-Cured Epoxy-Resin Systems
Polyamine Curing Agents
Polyamine-Adduct Curing Agents
Polyamide-Resin Curing Agents
Polyamide-Adduct Curing Agents
Tertiary Amine Curing Agents
Industrial Maintenance Coatings Based on Cold-Cured Epoxy-Resin Systems
High-Film-Build Cold-Cured Epoxy-Resin Coatings
Application Instructions
Manufacturing Instructions
Epoxy Baking Finishes
Epoxy-Phenolic Coating Systems
Epoxy-Urea-Formaldehyde Resin Coating Systems
Epoxy-Thermosetting Acrylic Coating Systems
Liquid Epoxy Resins in Solventless and Super-High-Solids Systems
Special Application Equipment and Formulation for Solventless Systems
Manufacturing Instructions
Application
Ketimine Curing Agents
Manufacturing Instructions
Application
Curing Characteristics
Powder Coatings
Application Equipment
Epoxy-Resin Powder-Coating Formulations
Fusion-Produced Epoxy-Resin Powders
Manufacturing Instructions
Applications Instructions
Dry-blended Epoxy-Resin Powders
Manufacturing Instructions
Application Instructions
Properties and Applications
Thermoplastic Epoxy Resins
Zinc-Rich and General Purpose Shop Primers
Manufacturing Instructions
Application Instructions
Manufacturing Instructions
Application Instructions
Thermoplastic-Epoxy-Resin Crosslinked Systems
Water-Reducible Epoxy Resin Coatings
Water-Reducible Epoxy-Ester Baking Finishes
Manufacturing Instructions
Application Instructions
Water-Reducible Polyamide-Cured Epoxy-Resin Coatings
Manufacturing Instructions
Water-Reducible Epoxy-Resin Coatings for Electrodeposition
General Remarks
Maleinization Step After Complete Esterification of the Epoxy Resin with Organic Acids
Cooking Procedure
Application Instructions

8. Epoxy Coating Give into Water

9. Electrical and Electronic Applications : Sealants and Foams
   Electronic and Electrical Applications

Introduction
Casting
Potting
Encapsulation
Coatings
Sealing
Molding
Formulation of the Resin System
Internal Stresses
10. Analysis of Epoxides and Epoxy Resins

Uncured Epoxy Resins
Qualitative Tests
Detection of Free Epoxy Groups
Determination of Epoxy Group—Lithium-Chloride Test
Reagents
Procedure
Determination of Epoxy Group—Periodic Acid Test
Reagents
Procedure
Determination of Epoxy Group—Pyrolysis Test
Reagents
Procedure
Determination of Epoxy Group—Lepidine Test
Reagents
Procedure
Detection of the Bisphenol A Skeleton
Determination of Bisphenol A Epoxy Resins—Mercuric Oxide and Nitric Acid Tests
Reagents
Procedure
Determination of Bisphenol A Epoxy Resins in Coatings—Nitric Acid Test
Reagents
Procedure
Determination of Bisphenol A Epoxy Resins—Filter-Paper Test
Reagents
Procedure
Determination of Bisphenol A Epoxy Resin—Formaldehyde Test
Reagents
Procedure
Determination of Bisphenol A Epoxy Resins—Phenylenediamine Test
Reagent
Procedure
Detection of Epoxy Resins Based on 4,4'-Diamino-diphenylmethane
Determination of Epoxy Resins Based on 4,4'-Diaminodiphenylmethane
Reagents
Procedure
Detection of Other Epoxy Resins
Quantitative Tests of the Epoxy Group
Hydrohalogenation Methods
Estimation of Epoxy Group—Hydrochloric Acid in Dioxane, Methyl Ethyl Ketone, or Dimethylformamide
Reagents
Procedure
Calculations
Estimation of the Epoxy Group—Pyridinium Chloride in Pyridine
Reagents
Procedure
Hydrohalogenation by Direct Titration
Estimation of Epoxy Group
Reagents
Procedure
Calculations
Other Chemical Methods
Estimation of Other Functional Groups
Hydroxyl Group
α-Glycol Group
Estimation of α-Glycol Group
Reagents
Procedure
Calculation
Chlorine
Esterification Equivalent Weight
Estimation of Esterification Equivalent Weight
Reagents
Procedure
Calculation
Infrared Spectroscopy
Technique
Epoxide Absorption Bands
Epoxide Resins
Quantitative Estimation
Following the Degree of Cure
Other Physical Methods
Ultraviolet Spectroscopy
Electron Spin and Nuclear Magnetic Resonance Methods
Gas Chromatography
Paper Chromatography
Thin-Layer and Gel-Permeation Chromatography
Handling Properties
Molecular Weight
Softening Point
Viscosity
Color
Blends and Compounds
Hardeners and Accelerators
Organic Acid Anhydrides
Determination of Acid and Anhydride Content
Reagents
Procedure
Calculations
Amines
Determination of Amine Number
Reagents
Procedure
Calculation
The Curing Process
Curing Characteristics of Epoxy Resin-Hardener Systems
Determining the Degree of Cure
Analysis of Cured Epoxy Resins

11. The Toxicology of Epoxy Resins
Introduction
Experimental Method
Materials
Acute Toxicity
Chronic Toxicity
Irritation
Sensitization
Results
Acute Toxicity
Chronic Toxicity
Irritation
Sensitization
Medical Experience with Epoxy Resins
Comment

12. Photographs of Machinery with Suppliers
Contact Details
See more
https://bit.ly/2z3t9SV
https://bit.ly/2KP3Nhe
Contact us

NIIR PROJECT CONSULTANCY SERVICES

106-E, Kamla Nagar, Opp. Spark Mall,
New Delhi-110007, India.

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

Tel: +91-11-23843955, 23845654, 23845886, 8800733955
Mobile: +91-9811043595
Fax: +91-11-23845886

Website: www.entrepreneurindia.co, www.niir.org

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/NIIReventproject
- https://plus.google.com/+EntrepreneurIndiaNewDelhi
- https://twitter.com/npcs_in
- https://www.pinterest.com/npcsindia/
For more information, visit us at:
www.niir.org
www.entrepreneurindia.co