

The Complete Technology Book on Industrial Adhesives

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Adhesives were utilized in a sophisticated manner even in ancient times. Recent years have seen the rapid development of adhesive bonding as an economic and effective method for the fabrication of components and assemblies. The great many types of adhesives are currently in use and there is no adequate single system of classification for all products. The adhesives industry has generally employed classifications based on end use, such as metal to metal adhesives, wood adhesives, general purpose adhesives, paper and packaging adhesives etc. An adhesive or formulation is generally a mixture of several materials. The extent of mixture and the ratio usually depend upon the properties desired in the final bonded joint. The basic materials may be defined as those substances, which provide the necessary adhesive and binding properties. The type of adhesive material is easier to define and usually falls into three categories; thermosetting resins, thermoplastic resins and elastomeric resins. A thermosetting system, 100 percent reactive when in a pure state, the epoxies are very desirable and more widely used than any other chemical type. Epoxy is one of the newer types and has penetrated more fields of manufacturing operations in a shorter space of time than any of its predecessors. The many catalysts used with epoxies produce systems of variable properties. The most common are the aromatic amines and cyclic anhydrides. The phenolics or phenol formaldehyde resins are formed by the condensation reaction of phenol and formaldehyde. The phenolic resins have been used extensively in the lamination of plywood and in filament wound structures. There are two basic classes of phenolic resins resoles and novalacs, and both begin as phenol alcohols. When combined or alloyed with other adhesive systems, they become excellent structural adhesives and are widely used in this manner throughout the aerospace industry. The vinyl polymers do not stand alone as a structural adhesive, but hundreds of adhesives are formulated by the use of this class of polymer. The vinyls are important to adhesive bonding not only from the adhesive standpoint, but because the films derived from these substances are widely used as vacuum bags, slip sheets, etc. The more widely used ones are polyvinyl chloride, polyvinyl alcohol, and polyvinyl fluoride. There are numerous kinds of adhesives used in different industries; polyvinyl acetate wood adhesives, aminoresin wood adhesives, phenolic resin wood adhesives, cyanoacrylate adhesives, hot melt adhesives, water based adhesives etc. The market for adhesives is comprised of thousands of end uses. The realm of market applications expands as new end uses keep developing, driven by the need for new and innovative attachment solutions. When looking at the total market, adhesives account for about 75% of the volume consumed.

This book basically deals with adhesive properties and general characteristics, adhesive materials and properties, adhesives types, thermoplastic adhesives, thermosetting adhesives, rubber resin blends, properties of basic adhesives types, acrylics acrylic acid diesters, allyl

diglycol, carbonate, animal glues, blood albumen, butadiene styrene rubbers, butyl rubber and polyisobutylene casein, cellulose derivatives, cellulose acetate, acetate butyrate cellulose, caprate cellulose, nitrate (nitrocellulose or pyroxylin), ethyl cellulose, hydroxy ethyl cellulose, methyl cellulose and sodium carboxy methyl cellulose, ceramic or refractory inorganic adhesives

cyanoacrylates, epoxy adhesives, epoxy nylon, epoxy polyamide, epoxy polysulphide, epoxy polyurethane, fish glue, furanes etc.

The present book covers the manufacturing processes of different industrial adhesives with their formulae. It is hoped that the book can serve to new entrepreneurs, technocrats and existing units to the technology of adhesive and guide them to a useful understanding of the wide variety of adhesives which exist today.

1. ADHESIVE PROPERTIES AND GENERAL CHARACTERISTICS

Epoxies

Phenolic Adhesives

Nitrile Adhesives

Vinyl Adhesives

Neoprene

Polyurethanes

Silicones

Polyesters

Acrylics

Rosin (Sometimes Called Colophony)

Polysulfide Rubber Adhesives

Ceramic Adhesives

Cyanoacrylate Adhesives

Polyaromatic Adhesives

Vinyl Phenolic Adhesives

Neoprene Phenolic Adhesives

Epoxy-Silicone Adhesives

Epoxy-Polysulfide Adhesives

Epoxy-Nylon Adhesives

Epoxy-Phenolic Adhesives

Nitrile-Phenolic Adhesives

Modified Epoxy Intermediate Curing Films

2. ADHESIVE MATERIALS AND PROPERTIES

The Components of An Adhesive

Adhesives Types

Thermoplastic Adhesives

Thermosetting Adhesives

Rubber-Resin Blends

Properties of Basic Adhesives Types

Acrylics

Acrylic Acid Diesters

Allyl Diglycol Carbonate

Animal Glues

Blood Albumen

Butadiene-styrene Rubbers

Butyl Rubber and Polyisobutylene

Casein

Cellulose Derivatives

Cellulose Acetate

Cellulose Acetate-butyrate
Cellulose Caprate
Cellulose Nitrate (Nitrocellulose or Pyroxylin)
Ethyl Cellulose
Hydroxy Ethyl Cellulose
Methyl Cellulose and Sodium Carboxy Methyl Cellulose
Ceramic or Refractory Inorganic Adhesives
Cyanoacrylates
Epoxy Adhesives
Epoxy-Nylon
Epoxy-Polyamide
Epoxy-Polysulphide
Epoxy-Polyurethane
Fish Glue
Furanes
Hot-Melt Adhesives
Inorganic Adhesives and Cements
Sodium Silicate
Phosphate Cements
Basic Salts (Sorel Cements)
Litharge Cements
Sulphur Cements
Hydraulic Cements
Inorganic Polymers
Ionomer Resins
Isocyanates
Isocyanate Adhesives
Isocyanate Modified Adhesives
Isocyanate Polyester Methane Adhesives
Melamine Formaldehyde
Natural Rubber
Nitrile Rubbers
Permanence
Nylon Adhesives
Solution Adhesives
Hot-melts
Phenolic-nylon
Phenolic-epoxy
Phenol Formaldehyde (Acid Catalysed)
Phenolic Formaldehyde (Hot Setting)
Phenolic-Neoprene
Phenolic-Nitrile
Phenolic-Polyamide
Phenolic-Vinyl Butyral
Phenolic-Vinyl Formal
Phenoxy
Polyamides
Polyaromatics
Polyimides (PI)
Polybenzimidazoles (PBI)
Polybenzothiazoles (PBT)
Polyphenylenes (PP)
Polychloroprene (Neoprene) Rubbers

Polyesters
Allyls
Alkyds (or Glyptals)
Polyesters (Unsaturated)
Polystyrene
Polysulphide (Thiokol)
Polyurethanes
Polyvinyl Acetals
Polyvinyl Acetate
Polyvinyl Alkyl Ethers
Polyvinyl Alcohol
Polyvinyl Chloride
Reclaim Rubber
Resorcinol Formaldehyde and Phenol
Resorcinol Formaldehyde
Rubber Derivatives
Chlorinated Rubber
Cyclised Rubber
Rubber Hydrochloride
Silicones
Silicone Rubber
Epoxy-silicone
Soy(a)bean and Vegetable Proteins
Starch
Thermoplastic Resins (Miscellaneous)
Coumarone-indene
Shellac
Rosin (Colophony)
Oleo-Resins (Vegetable Oils + Rosin, Phenolic or Alkyd Resins)
Bitumen (Including Asphalt)
Urea Formaldehyde
Water and Solvent Based Adhesives
Waxes

3. PHYSICAL TESTING OF ADHESIVES

Introduction
Strength Properties
Assessment of Durability and Strength
Parameters
Fatigue
Creep
Flexural Strength
Peel Strength
Durability
Non-Destructive Testing
Standard Test Methods

4. POLYVINYL ACETATE WOOD ADHESIVES

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Chemistry of Polyvinyl Acetate
A. Production of Vinyl Acetate Monomer
B. Polymerization of Vinyl Acetate
Formulating A Pva-Based Adhesive
A. General Considerations

B. Formulating and Compounding

C. Guide Formulations

Aspects of Application

A. Joint Design

B. Surface Preparation

C. Adhesive Preparation

D. Application

E. Assembly Conditions

F. Influence of Temperature

Performance of Pva Adhesives

A. Factors Affecting Durability

B. Specifications

C. Testing

Conclusion

5. AMINORESIN WOOD ADHESIVES

Introduction

Chemistry of Aminoresins

A. Urea-Formaldehyde Condensation

B. Melamine-Formaldehyde Condensation

C. Aniline-Formaldehyde Condensation

D. Reaction Kinetics: Urea-Formaldehyde

E. Reaction Kinetics : Melamine-Formaldehyde

F. Reaction of Methylolureas in the Presence of Cellulose

G. Reaction Mechanisms: Urea-Formaldehyde

H. Reaction Mechanisms: Melamine-Formaldehyde

I. Hardening

J. Analysis

Chemistry and Technology of Application of

Aminoresin Adhesives for Wood

A. General Principles of Manufacture and Application

B. Formulaire

C. Plywood and Particleboard Adhesives

D. Melamine Laminates

E. Glulam, Finger Jointing and Joinery Adhesives

F. Toxicity

6. PHENOLIC RESIN WOOD ADHESIVE

Introduction

Chemistry of Phenol-Formaldehyde Condensations

A. Reaction Mechanisms

B. Nature of Mechanism : Methylene and Methylene-Ether Bridges

C. Acid Catalysis

D. Alkaline Catalysis

E. Metallic Ions Catalysis and Orientation of the Reaction

F. Reaction Kinetics

G. Hardening

H. Resorcinol and Meta-Aminophenol Condensates

Chemistry and Technology of Application of

Phenolic Resin Adhesives for Wood

A. General Principles of Manufacture

B. Plywood and Particleboard Adhesives an
the Factors Regulating Their Application

C. Properties of Phenolic Adhesives for Plywood

D. Formulation of Plywood Glue Mixes

- E. Plywood Manufacturing Variables
 - F. Wood-Related Factors
 - G. General Observations on Particleboard Manufacture
 - H. Dry-Out Resistance
 - I. Wood Laminating and Finger Jointing Adhesives
 - J. Fast Setting Adhesives for Finger Jointing
7. TANNIN-BASED WOOD ADHESIVES

Introduction

Chemistry of Condensed Tannins

- A. General
- B. Monoflavonoids
- C. Biflavonoids
- D. Triflavonoids and Tetraflavonoids Condensed Tannins
- E. Methods for the Analysis of Phenolic Materials Content in Tanning Extract

Reactivity of Tannins as Macromolecules

- A. Reactivity and Orientation of Electrophilic Substitutions of Flavonoids.
- B. A- and B-Ring Reactions with Aldehydes and Their Kinetics
- C. Metal Ions Catalysis
- D. Hydrolysis and Acid and Alkaline Autocondensation
- E. Sulfitation

Chemistry and Technology of Industrial Tannin Adhesive Formulations

- A. General
- B. Standardization of Industrial Tanning Extracts
- C. Exterior-Grade Plywood Adhesives
- D. Cold-Setting, Fast-Setting and Radio-Frequency Laminating Adhesives
- E. Exterior-Grade Particleboard Adhesives
- F. Corrugated Cardboard Adhesives
- G. Generation of Resorcinol
- H. Infrared Analysis of Resorcinol Content in Tannin-Based Adhesives

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- A. Historical
- B. Advantages and Limitations

Chemistry

- A. Basic Concepts

Application—Meter-Mix Equipment

Curing, Testing and Durability

- A. Curing
- B. Testing and Durability

Health, Safety and Environmental Considerations

Quality Control of Urethane Adhesives

9. MODIFIED ACRYLIC STRUCTURAL ADHESIVES

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Performance Properties

- A. Advantages
- B. Disadvantages
- C. General Performance

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Handling Properties

- A. Accelerator Lacquer Method
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Representative Case Histories

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Meter, Mix, Dispense Equipment

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Phenolic Modifiers

Phenolic Modifiers as Tackifiers

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A. Neoprene-Phenolic Contact Adhesives

B. Adhesive Compounding

C. Adhesive Testing and Performance

D. Solvent Blend

E. Nitrile-Phenolic Contact Adhesives

Phenolic Dispersions

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B. Nitrile-Phenolic Structural Adhesives

C. Epoxy-Phenolic Structural Adhesives

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Limitations

Bonding Characteristics on Various Substrates

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B. Limitations

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Foamable Hot Melts

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A. Physical Properties

B. Application Properties

C. Performance Properties

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Flowing

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Low-Voltage Electric Heating (L.V.H.)

Ultrasonic Activation

Bonding Pressure

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About NIIR

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