Water soluble polymers cover a wide range of highly varied families of products of natural or synthetic origin, and have numerous uses. A water soluble polymer is a polymer that can be diluted in water, with or without the assistance of co solvents and neutralizing agents, to form transparent solutions. They may be classified into two types, totally synthetic polymers and natural products together with their chemically modified derivatives and further can be grouped into three main headings; naturally occurring, semi synthetic and completely synthetic polymers. The water based polymers are quick drying non inflammable, having mild odour and more environmentally acceptability than any other polymers. Most conventional coating polymers at present can be produced in a form that will allow them to be solubilized in water. These include alkydes, polyesters, acrylics epoxies. There are various types of polymerization methods of water soluble polymers such as bulk polymerization, solution polymerization, copolymerization, emulsion polymerization and suspension polymerization. Water soluble polymers are used widely as stabilizers or protective colloids in emulsion polymerization. Its most common use are gum acacia, starch either etherified or in its degraded form, dextrin, polyvinyl alcohol and hydroxyethyl cellulose. Polymers find many applications in oil recovery and production, including areas such as; drilling fluids, cementation of well bore, reservoir fracturing, controlling fluid flow in the reservoir and multistage processes of oil production and refining. The water soluble polymers market encompasses several categories, including starch, cellulose ethers, polyvinylacetate, polyvinyl alcohol and other synthetic water soluble polymers. The starch market is the largest.

This book basically deals with flow characteristics of water soluble polymer solutions, emulsion polymerization, water reducible resins, silicone modified alkyds and polyesters, cross linking of water soluble coatings, formulation of water soluble coatings, trouble shooting with water soluble polymers, acrylic solution resins, polyvinylpyrrolidone, commercial uses: compounding and formulating adhesives, methods of polymerization, methods for polymerization of acrylamide, fabrication of water soluble polymers, excluded volume interactions of neutral polymers etc.

The book covers classification of water soluble polymers, processes, properties, uses and applications of water soluble polymers with lot of other information. This book will be very resourceful for new entrepreneurs, existing units, technocrats, researchers and technical libraries.

Contents

1. WATER-SOLUBLE POLYMERS
   Classification
   Synthetic Polymers
   Natural Products and their Derivatives
   Properties of Cellulose Ethers
Degree of Polymerization
Degree of Substitution
Molar Substitution
Application
Basic Concepts of Rheology
Flow Characteristics of Water Soluble Polymer Solutions
Thixotropy
Uses
Latex Paints
Emulsion Polymerization
Other Applications
2. WATER-REDUCIBLE RESINS
History
Water-soluble Polymers
Maleinized Drying Oils
Alkyd Resins
Acrylic-modified Water-soluble Alkyds
Polyesters
Silicone-modified Alkyds and Polyesters
Epoxy Resins
Acrylics
Amino Resins
Other Water-soluble Polymers
Viscosity Characteristics
Amines
Viscosity
Drying
Stability
Gloss
Foam Control
Colour Retention
Toxicity
Variation of Amine Levels
COSOLVENTS
Coupling Efficiency
Viscosity
Stability
Drying Properties
Foam Control
Driers for Air Dry and Force Dry Systems
Cross-linking of Water-soluble Coatings
Additives for Coatings
Driers and Drier Accelerators
Surfactants
Flow Modifiers
Thixotropes and Thickeners
Volatile Additives
Pigments
Formulation of Water-soluble Coatings
Solubilization of Polymers
Trouble Shooting with Water-soluble Polymers
Vehicle Separation
Low Opacity
Photographing of Surface Defects
Viscosity Variations
Foaming and Air Entrapment
Sags and Runs
Poor Flow, Levelling and Orange Peel
Low Gloss and Micro Wrinkles
Flooding and Floating
Cratering and Pinholing
Picture Framing and Fat Edges
Blistering and Solvent Popping

3. ACRYLIC SOLUTION RESINS
Terminology
Backbone Monomers
Synthesis
Addition Polymerization
Copolymerization
Thermoplastic Acrylics
Selection of Monomer
Solution Polymerization
Properties and End Uses
Thermosetting Acrylics
Selection of Monomer
Classification and Properties
Acrylamide Copolymers
Acid Copolymers
Hydroxy Copolymers
Curing Reactions
Aqueous Solution Acrylics
Non-Aqueous Dispersions (NAD)

4. POLYVINYLPYRROLIDONE
Introduction
Chemical Nature
Physical Properties
Manufacture
Toxicological Properties
PVP Films
Compatibilities
Future Developments
Application of PVP
Pharmacy
Medicine
Beverages
Cosmetics and Toiletries
Textiles
Paper
Adhesives
Detergents and Soaps
Polymers and Polymerization
Agricultural
Photography and Lithography

5. POLY (ETYLENE OXIDE)
Introduction
Chemical Nature
Physical Properties
Manufacture
Biological/Toxicological Properties
Rheological Properties
Additives/Extenders
Applications
Application Procedures
Commercial Uses: Compounding and formulating Adhesives
Industrial Supplies
Constructions Products
Paints and Paint Removers
Pharmaceuticals
Printing Products
Soap, Detergents, and Personal â€“ Care Products
Water-Soluble Films
Commercial Uses: Processing Aids
Binder
Coatings and Sizes
Dispersant
Flocculation
Hydrodynamic Drag Reduction
Thermoplastics Manufactures
Thickening/Rheology Control
Water Retention
Industries Using Polyethylene Oxide
Formulations
Aluminum and Metal Cleaner
Calamine Lotion
Denture Flexative Powder
Detergent Bars
Detergent Liquid
Lithographic Press Dampening Fluid
Micro Encapsulation
Paint and Varnish Remover
Thickened Acetic Acid
Thickened Hydrochloric Acid (Muriatic Acid)
Thickened Sulfuric Acid
Rubber Lubricant (For Mounting of Tires)
Toothpastes
6. METHODS OF POLYMERIZATION
Acrylamide
Initiation Methods
Single Component Initiators
Redox Initiators
Mechanism of Initiation
Dependence of Polymerization on Temperature
Propagation and Termination
Effect of pH
Effect of Monomer Concentration
Effect of Polymerization Medium
Inorganic Salts
Effect of Surfactants
Nature of the Termination Process
Substituted Acrylamides
Heat of Polymerization
Methods for Polymerization of Acrylamide
Acrylic and Methacrylic Acids
Effect of pH
Effect of Polymerization Medium
N-vinyl Pyrrolidone (NVP)
Other Water Soluble Polymers
Vinyl Alkyl Ethers
Ethylene Oxide (Cyclic Ether)
Ethylene Imine
Conclusions
7. CHEMICAL MODIFICATIONS
Cross-Linking with Functional Groups
Cross-Linking by Hydrogen Bonding
Effects of Cross-Linking on the Physical Properties of Polymers
Principal Types of Water-soluble Polymers
Determination of Cross-linking Density
Chemical Reactions of Water Soluble Polymers
Reactions of Cellulose and Starch
Structure and Cross-Linking Reactions of Proteins
Cross-Linking Reactions Involving Metal Ions
8. FABRICATION OF WATER SOLUBLE POLYMERS
Extrusion
Molding
Calendering
Thermoforming
Bonding
Foams
Plastisol Processing
9. COMPOUNDING OF WATER SOLUBLE POLYMERS
Compound Ingredients
Plasticized Poly(vinyl Chloride)
Plastisols
Techniques
10. POLYMERIZATION OF WATER SOLUBLE POLYMERS
Bulk Polymerization
Effect of Oxygen
Solution Polymerization
Chain Transfer and Molecular-Weight Control
Copolymerization
Industrial Manufacture
Emulsion Polymerization
Suspension Polymerization
Solution and Bulk Polymerization
11. PROPERTIES OF WATER SOLUBLE POLYMERS
Structure
Property Values
Testing
Specifications
Degradation and Stabilization
12. SOLUTION THERMODYNAMICS OF NON-IONIC WATER SOLUBLE POLYMERS
Experimental Techniques
Theory
Comparison with Aqueous Solutions
Possible Reasons for the Deviations
The Hydrophobic Interaction
Evidence for Hydrophobic Interaction for Polyoxyethylene Solutions
Aggregation
Conformation
13. FRACTIONATION AND CHARACTERIZATION
Molar Mass and Its Distribution
Preparative Fractionation
Molar Mass Measurement
Reference Methods
Solution Viscosity
Analytical Size-exclusion Chromatography
Characterization of Polyacrylamide
14. WATER SOLUBILITY AND SENSIVITY
Scope and Classification
Thermodynamic Formalism
Experimental Data
Hydrophobic Effects
Concentrated Solutions
Non-Equilibrium Behaviour: Bound and Unfreezable Water
Time Dependent Properties
Conclusions
15. AQUEOUS SOLUTIONS OF POLYELECTROLYTES
The Phenomenological Approach
The Theoretical Approach
16. POLYMER SMALL MOLECULE INTERACTIONS
Interaction of Polymers with Water
(i) Hydrophobic Interactions
(ii) Hydrophilic Interactions
Interaction with Ions
Interaction with Surfactants
17. EXCLUDED VOLUME INTERACTIONS OF NEUTRAL POLYMERS
General Thermodynamic Relationships
Expression of Chemical Potentials in Terms of Composition
Binary (One-Solute) and Ternary (Two-Solute) Systems
Consequences of Non-Ideality
Excluded-Volume Interaction of Polymers
Approximate Expression of Available Volume
Effect of Concentration on the Configuration of Chain-Polymers
Some Experimental Examples
18. POLYMER ADSORPTION
Theoretical Predictions
Experimental Methods
(a) Macroscopic Interfaces
(b) Particulate Dispersions
Experimental Results
19. POLYVINYL ALCOHOL
General
Film Solubility and Swelling in Water
Solubility in Organic Solvents
Properties of Polyvinyl Alcohol Films
Gelling and Precipitation of Polyvinyl Alcohol
Conclusion
20. ROLE OF POLYMERS IN THE STABILIZATION OF DISPERSE SYSTEMS
   The Attractive Interaction
   General Methods for Imparting Colloid Stability
   Steric Stabilization
   The Phenomenology of Flocculation
   Identification of the Critical Flocculation Point
   Notes on the Theta-point
   Classification of Sterically Stabilized Dispersions
   The Unimportance of Dispersion Forces in Incipient Flocculation
   Qualitative Discussion of the Origins of Steric Stabilization
   Non-Aqueous (and some aqueous) Dispersions
   Aqueous Dispersions
   Quantitative Calculation of Repulsive Potential Energy
   Enhanced Steric Stabilization
   Elastic Steric Stabilization in Polymer Melts
   Heterosteric Stabilization
   Depletion Stabilization
   Schematic Representation of the Effects of Idealized High Molecular Weight Polymer
21. WATER SOLUBLE POLYMERS AS STABILIZERS
   Adsorption Behaviour of Water-Soluble Polymers
   a. Adsorption on â€”Modelâ€™ Polymer Dispersions
   b. Adsorption on Inorganic Dispersions
   c. Effect of Low Molecular Weight Surfactants on Adsorption
   Interactions of Water-Soluble Polymers with Surfactants
   Effects of Water-Soluble Polymers Added to Dispersions
   Water-Soluble Polymers as Stabilizers in Dispersion Polymerization
   a. Technological Aspects
   b. The Function of WSPs in Polymerizing Dispersions
22. POLYMERIC FLOCCULANTS
   Nature of Polymeric Flocculants
   Bridging Flocculation
   Adsorption Mechanisms
   Flocculation by Bridging
   Kinetic Aspects of Bridging Flocculation
   Charge Neutralization
23. THERMOREVERSIBLE GELATION
   Conclusion
24. WATER SENSITIVE GELS
   Structure of Synthetic Hydrogels
   Preparation
   Swelling of Gels
   Surface Properties
25. RHEOLOGICAL CHARACTERIZATION OF
   SOLUTION AND GEL
   Interpretation of Results
   Concentrated Solutions
   Polymer Networks
   Surface and Interfacial Rheological Behaviour
26. THE INTERFACE BETWEEN AQUEOUS POLYMER SOLUTION AND ITS APPLICATION
   Types of Water-Soluble Polymers
   Technological Aspects
Scientific Aspects
Interaction Forces
27. POLYMERS IN OIL RECOVERY AND PRODUCTION
Operations Employing Polymers
Drilling Fluids
Cementing Fluids
Fracturing Fluids
Mobility Control for Water Flood Recovery
Polymers Employed in Reservoir Preparation and Oil Recovery
Cellulose Derivatives
Naturally Occurring Gums and their Derivatives
Starch and Its Derivatives
Acrylamide Polymers
Oil Production Polymers
Scale Formation
Corrosion Inhibitors
Demulsifiers
28. MEDICAL AND PHARMACEUTICAL APPLICATIONS
Polymers Used Therapeutically/Prophylactically
Biomedical/Prosthetic Uses
Pharmaceutical Applications
Processing and Formulation Aids; Disintegrants
Tablet Coating
Microencapsulation
Sustained Drug Delivery
Degradation
Disintegration and Dissolution of Polymers
Diffusion
Drug Complexing Agents
Stabilization of Dispersions/Controlled Flocculation
Conclusion
29. APPLICATIONS OF POLYMER EMULSIONS FOR WATER-BASED PAINTS
Historical Changes in Demand
Selection of Raw Materials
Monomers
Range of Products
Resin Emulsions: Thermoplastic Type
Polyvinyl Acetate Emulsions
Vinyl Acetate - Acrylic Copolymers
Styrene Acrylic Copolymer Emulsions
Vinyl Acetate - Veova Copolymers
Acrylic Emulsions
Film Forming Mechanism
30. AQUEOUS POLYURETHANE DISPERSION TECHNOLOGY—AN UPDATE
Introduction
Concept of Aqueous Pud
(1) Definition
(2) Dispersion Behaviour
(3) Film Formation
Chemical Classification
(1) Anionic
(2) Cationic
(3) Nonionic
Preparation Procedures
(1) Acetone Process
(2) Prepolymer Mixing Process
(3) Hot-Melt Process
(4) Ketamine/Ketazine Process
(5) Self-Dispensing of Solids
Chemical Crosslinking
(1) Blocked Isocyanates
(2) Radiation Induced Crosslinking
(3) Crosslinking with Melamine/Formaldehyde Resin
(4) Aziridines
(5) Zirconium Compounds
Factors Influencing Performance
(1) Type of Polyols
(2) Type of Isocyanates
(3) NCO/OH Ratio
(4) Effect of Pendant Functionality
(5) Effect of Catalysts
(6) Particle Size
(7) Glass Transition Temperature (Tg)
(8) Molecular Weight
(9) Intermolecular Forces
(10) Crosslinking Density
Recent Advances
(1) Improvement in Storage Stability
(2) Improvement in Water and Chemical Resistance
(3) Improvement in Mechanical Properties
(4) Improvement in Other Important Properties
Combination of PUD with acrylics
Characterisation of Aqueous PUDs
(1) Abrasion Resistance
(2) Solvent Resistance
(3) Thermal Analysis
(4) Fourier Transform - Infra Red Spectroscopy (FT-IR)
Applications
The Future
Acknowledgment

31. MAINTENANCE COATINGS BASED ON WATERBORNE DISPERSIONS

Introduction
Formulating Principles
Pigments
Additives
Binders
Acrylics/Vinyls/Vinyl-Acrylic Emulsions
Polyurethane Dispersions
Cross Linking
Epoxy Dispersions
Miscellaneous Systems
Conclusion
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.


NPCS also publishes varies 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 Website: NIIR.org