

# The Complete Book on Water Soluble Polymers

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

**Format:** Paperback

**ISBN:** 9788178331232

**Code:** NI219

**Pages:** 672

**Price:** Rs. 1,575.00    **US\$** 42.56

**Publisher:** Asia Pacific Business Press Inc.

Usually ships within **5** days

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. POLYVINYLPIRROLIDONE

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 (ETHYLENE 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 " 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 "Model" 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-Dispersing 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 (T<sub>g</sub>)

(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

# 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.

Our Detailed Project report aims at providing all the critical data required by any entrepreneur vying to venture into Project. While expanding a current business or while venturing into new business, entrepreneurs are often faced with the dilemma of zeroing in on a suitable product/line.

---

**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)

Wed, 13 Mar 2024 16:19:29 +0530