

# Surface Coating Technology Handbook

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

**Format:** Paperback

**ISBN:** 9788178331188

**Code:** NI216

**Pages:** 680

**Price:** Rs. 1,475.00 US\$ 39.86

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

Usually ships within **5** days

Surface Coating is in use since long back is rapidly increasing with the development of civilization. There has been considerable impact in this field. Surface coating technology specializes in finding out engineering solutions to all the critical production problems related to coating the products on a continuous and consistent basis in your production plant. Surface coating can be defined as a process in which a substance is applied to other materials to change the surface properties, such as colour, gloss, resistance to wear or chemical attack, or permeability, without changing the bulk properties. Production of surface coating by any method depends primarily on two factors: the cohesion between the film forming substances and the adhesion between the film and the substrate. The development of science and technology revolutionized the surface coating industry in the progressive countries of the world. Surface coating technology involves the use of various types of products such as resins, oils, pigments, polymers, varnishes, plasticizers, emulsions, etc. We have completely replaced costly petroleum solvents with water and we get cheaper finished products with no evaporation loss and fire hazards. Paint is any liquid, liquefiable, or mastic composition which after application to a substrate in a thin layer is converted to an opaque solid film. It is most commonly used to protect, colour or provide texture to objects. The paint industry volume in India has been growing at 15% per annum for quite some years now. Varnish is one of the important parts of surface coating industry. They are used to change the surface gloss, making the surface more matte or higher gloss, or to provide the various areas of a painting with a more unified finish. Plasticizer plays an important role in the formation of polyvinylchloride (PVC). It is also used to plasticize the polymers. Polymers are divided into three different types; linear polymers, branched polymers and cross linked polymers. Polymer Energy system is an award winning, innovative, proprietary process to convert waste plastics into renewable energy. On the basis of value added, Indian share of plastic products industry is about 0.5% of national GDP.

This book basically deals with principles of film formation, evaporation of solvent from a solution, chemistry and properties of drying and other oils, glyceride structure and film formation, the size of polymer molecules, processing of oil and resin, inorganic pigments, classification by chemical constitution, azo pigments, organic pigments in architectural (decorative), organic pigments in industrial finishes, solvent requirements of specific resins convertible systems, molecular structure of polymer plasticiser systems, properties of plasticised polymers, surface active agents, optical properties, rheological characteristics, emulsions and other aqueous media, formation of polymer emulsions, modern methods of analysis etc.

The book presents a concise, but through an overview of state of technology for surface coating. This is organized into different chapters like principal of film formation, chemistry and properties of drying and other oils, processing of oil and resin, organic pigment, solvents, plasticizer, surface active agent, surface preparations etc. This book is an invaluable resource to technocrats; new entrepreneurs, research scholars and others concerned to this field.

## Contents

## 1. PRINCIPLES OF FILM FORMATION

### Cohesive and Adhesive Forces

1. Mechanical Forces
2. Molecular Forces

### Evaporation of Solvent from a Solution

1. Typical Materials
2. Properties of Materials
3. Effects of Evaporation

### Evaporation of One of the Phases of an Emulsion

### Evaporation of Solvent Plus Polymerisation

1. Oxygen Induced Mechanisms
2. Heat Induced Polymerisations
3. Use of Water as a Curing Agent
4. Systems Using Catalysts

### Systems Employing Substantial Amounts of Curing Agents

### Systems Employing the Solvent as a Film Former

## 2. CHEMISTRY AND PROPERTIES OF DRYING AND OTHER OILS

### Vegetable Oils

1. Origin
2. Production of Oils
3. Composition of Crude Oils
4. Refining

### Fatty Acids

1. Saturated Acids
2. Monoethenoid Acids
3. Polyethenoid Acids
4. Substituted Acids

### Glyceride Structure and Film Formation

1. Fatty Acid Composition
2. Fatty Acid Distribution

### Chemical Reactions of Glycerides

1. Ester Reactions

### Industrial Applications of Ester Reactions

1. Synthetic Oils
2. Fat Splitting
3. Alcoholysis

### Reactions Associated with Unsaturation

1. Oxidation
2. Polymerisation
3. Isomerisation
4. Hydrogenation
5. Reaction with Sulphur
6. Reaction with Maleic Anhydride

### Specific Reactions

1. Castor Oil Reactions
2. Dehydrated Castor Oil

### Film Properties

1. Oily Media
2. Varnish Media
3. Alkyd Media

### Synthetic Drying Oils

1. Hydrocarbon Drying Oils
2. Fatty Acid Condensation Products
3. CHEMISTRY OF RESIN FORMATION AND ITS PROPERTIES
- Introduction
- Fundamentals of Polymer Formation
  1. Functions or Reactive Groups
  2. Classification of Polymers
- Formation of Polymers
  1. Condensation Reactions
  2. Addition Polymerisation
- Types of Polymers
  1. Polyesters
  2. Polyamides
  3. Phenolic Resins
  4. Amino Resins
  5. Epoxide Resins
  6. Vinyl Polymers
  7. Acrylic Polymers
  8. Silicones
- The Size of Polymer Molecules
  1. Estimation of Molecular Weight
  2. Measurement of Mn
  3. Measurement of Mw
  4. Viscosity Relationship
- Physical Properties of Polymers
  1. Factors Affecting Tensile Strength
  2. Cohesive Energy
  3. Influence of Molecular Order
  4. Intermolecular Attraction
  5. Crystallinity
  6. Achievement of Flexibility
- Chemical Properties of Polymers
  1. Effect of Molecular Weight on Solubility
  2. Effect of Polymer Structure
- Selection and Design of Polymers
  1. Addition-Condensation Polymers
  2. Designing for Water Solubility
  3. Use of Inorganic Ingredients
  4. Advent of Truly Synthetic Polymers
4. PROCESSING OF OIL AND RESIN
- General Requirements for Processing Equipment
- Materials of Construction
- Design of Reaction Kettles
  1. The Kettle Body
  2. Branches and Connections
  3. Stirring Equipment
- Fume Disposal and Scrubbing
  1. Disposal Systems for General Use
  2. Water Scrubbing of Anhydride Vapours
  3. Packed Scrubbers
- Condensing and Refluxing
  1. Condensers for P.F., V.F. and M.F. Resins

## 2. Condensers for Alkyd and Polyester Type Resins

### Ancillary Equipment

1. Thinning and Blending Tanks
2. Instruments
3. Vacuum Equipment
4. Valves and Fittings
5. Inert Gas Pipes
6. Pressure and Flow Indication
7. Fume Extraction
8. Lagging
9. Miscellaneous

### Heating and Cooling

1. Criteria for Selection of Heating and Cooling Systems
2. Heating of Low Temperature Products
3. Heating at Higher Temperatures
4. Fluid Heat Transmission
5. Heating by Electricity
6. Heating of Pipework and Ancillaries

## 5. INORGANIC PIGMENTS

### Introduction

#### Origins of Pigments

1. Comparison of Natural and Synthetic Pigments
2. Problems in Producing Natural Pigments
3. Pigment Classification

#### Pigmentary Properties

1. Particle Size and Particle Size Distribution
2. Particle Shape
3. Colour
4. Refractive Index

#### Chemical Engineering Processes of Manufacture

1. Precipitation
2. Vapour Phase Oxidation
3. Heterogeneous Surface Reaction (Corrodibility and Corrosion)
4. Solid Phase at Elevated Temperature

#### Important Groups of Pigments

1. Titanium Dioxide Group
2. Lead Group
3. Zinc Group
4. Antimony Group
5. Lead Chrome Group
6. Chrome Green Group
7. Iron Oxide Group
8. Iron Blue Group
9. Ultramarine Group
10. Cadmium Yellow and Red Group

## 6. ORGANIC PIGMENTS

#### Important Properties of Organic Pigments

1. Light Fastness
2. Fastness to Solvents
3. Heat Fastness
4. Chemical Fastness

#### Types of Organic Pigments

1. General Classification
2. Classification by Chemical Constitution
- Azo Pigments
  1. Monoazo Pigments
  2. Disazo Pigments
- Non-azo Pigments
  1. Miscellaneous Products
  2. Phthalocyanine Pigments
  3. Vat Pigments
  4. Miscellaneous Heterocyclic Compounds
- Factors Governing Choice of Organic Pigments
  1. Hiding Power
  2. Dispersion
  3. Stability of Pigmented Systems
- Organic Pigments in Architectural (Decorative) Finishes
  1. Solvent-Based Paints
  2. Water-Based Paints
- Organic Pigments in Industrial Finishes
  1. Air-Drying Industrial Finishes
  2. Finishes Drying by Solvent Evaporation
  3. Heat-Cured Industrial Finishes
  4. Chemically Cured Finishes
7. EXTENDERS
- Introduction
  1. Production and Manufacture
  2. Opacity
  3. Chemical Constitution and Composition
- Oxides
- Silicas
- Hydroxides
- Alumina
- Carbonates
  1. Calcium Carbonate
  2. Magnesium Carbonate
  3. Calcium-Magnesium Carbonate
  4. Barium Carbonate
- Silicates
  1. Aluminium Silicates
  2. Calcium Silicates
  3. Magnesium Silicates
  4. Asbestos
- Sulphates
  1. Barium Sulphate
  2. Calcium Sulphate
8. SOLVENTS
- Introduction
- Characteristics of Solvent Groups
  1. The Terpenes
  2. Hydrocarbon Solvents
  3. Ketones
  4. Esters
  5. Glycol Monoethers

6. Ethers
7. Alcohols
8. Halogenated Compounds
9. Nitroparaffins

#### Evaluation and Selection of Solvents

1. Solvency
2. Tolerance for Non-solvents
3. Viscosity of Resin Solutions
4. Drying Time
5. Final Properties of the Film
6. General Conclusions

#### Solvent Requirements of Specific Resins-Convertible Systems

1. Oil Varnishes
2. Alkyd and Alkyd/Amino Resin Composition
3. Silicones
4. Acrylic Resins
5. Urethanes
6. Phenolic Resins
7. Epoxy Resins
8. Polyester Resins

#### Solvent Requirements of Specific Resins-Non-Convertible Systems

1. Cellulose Compositions
2. Vinyl Resins
3. Acrylic Resins
4. Shellac and Other Spirit-Soluble Resins
5. Rubber Resins and Derivatives

#### 9. PROPERTIES OF SOLVENTS

#### 10. PLASTICIZERS

##### Introduction

##### Molecular Structure of Polymer-Plasticiser Systems

1. Effect of Molecular Size
2. Types of Polymers
3. Identification of Polymer Types

##### Criteria of Plasticiser Efficiency and Compatibility of Polymers

1. The Second-Order Transition Temperature
2. Tests to Show Whether A Given Polymer System Can Be Plasticised
3. Properties of Concentrated Polymer Solutions
4. Compatibility of Resin and Plasticiser
5. Vapour Pressure of Plasticisers

##### Properties of Plasticised Polymers

1. Exudation Phenomena and Exudate Composition
2. Migration of Plasticisers
3. Tensile Strength
4. Viscosity of Plasticisers and Its Effects
5. Inflammability

##### The Chemical Types of Plasticisers

1. Hydrocarbons
2. Esters
3. Epoxidised Vegetable Oils

#### 4. Polyesters

#### Toxicity of Plasticisers

##### 1. Hydrocarbons

##### 2. Halogenated Hydrocarbons

##### 3. Alcohols

##### 4. Glycols

##### 5. Ketones

##### 6. Esters-organic

##### 7. Esters-Inorganic

#### 11. SURFACE ACTIVE AGENTS

##### Introduction

##### Types of Surfactants

##### 1. Anion Active

##### 2. Cation Active

##### 3. Ampholytic

##### 4. Non-ionic

##### 5. Miscellaneous

##### Properties

##### 1. Compatibilities

##### 2. Chemical Stability

##### 3. Physico-Chemical Characteristics

##### 4. Surface and Interfacial Tension

##### Suspension, Sedimentation and Flocculation

##### 1. Factors Governing Sedimentation Rate

##### 2. Emulsions

##### Choice of Surfactant

##### 1. Effect of Chain Length

##### 2. Hydrophile/Lipophile Balance

##### 3. Foaming and Anti Foaming

##### Pigment Treatment

##### 1. Surfactants as Additives in Grinding and Dispersion

##### 2. Pigment Pretreatment

##### 3. Pigment Flushing

##### Specific Uses in Paints

##### 1. Oil-Bound Water Paints

##### 2. Emulsion (Polymerised) Paints

##### 3. Adhesion of Paints

##### 4. Rheological Properties

##### 5. Speciality Paints

##### 6. Miscellaneous Allied Applications

#### 12. OPTICAL PROPERTIES

##### Introduction

##### 1. Factors Affecting the Appearance of Coatings

##### 2. Application of Optical Data

##### Light Transmission, Absorption and Reflection

##### Correlation of Light Beam Phenomena

##### Scattering

##### Opacity

##### Types of Transparent Coatings

##### Methods of Measuring Clarity

##### Scattering Materials

##### Effects of Pigment Properties

##### Reflectance Measurement

Gloss  
Gloss Measurement Techniques  
Colour  
Spectrophotometry  
Colorimetry  
Alternative Methods of Colour Measurement  
Appearance of Coatings  
Fluorescence  
Fading  
Lightfastness Tests  
External Influences on Lightfastness  
Standards of Lightfastness  
13. RHEOLOGICAL CHARACTERISTICS  
Introduction  
Rheological Behaviour In Liquids  
1. Newtonian Flow  
2. Non-Newtonian Flow  
Theories of Viscosity  
Eyring's Theory  
Einstein's Equation  
Molecular Complications  
Relaxation Mechanisms  
Rheological Measurements  
1. Coaxial Cylinder Viscometer  
2. Cone-and-Plate Viscometer  
3. Capillary Flow Viscometers  
4. Falling Sphere Viscometers  
5. Efflux Viscometers  
Practical Applications  
1. Brushing Properties  
2. Sagging and Flow  
14. EMULSIONS AND OTHER AQUEOUS MEDIA  
Introduction  
Emulsion Media  
Emulsion Polymerisation  
Polymerisation  
Copolymerisation  
Formation of Polymer Emulsions  
Particle Charge in Polymer Emulsions  
Surface Coating Emulsions  
Polyvinyl Acetate and Its Copolymers  
Polystyrene  
Butadiene/Methyl Methacrylate Copolymers  
Emulsified Resins and Oils  
Coacervate Emulsions  
Emulsion Paints  
Film Formation  
Composition and Rheology  
Solution Media  
Proteins  
Synthetic Water-Soluble Polymers  
Maleinised Oils  
Silicates and Siliconates



Solid Cementitious Binders

## 15. CORROSION

Corrosion of Metals

Electrochemical Basis of Corrosion

Electronic Permeability of the Oxide Film

Permeability of the Oxide Film to Metal Cations

Electrolytic Resistance of the Solution

Effect of an Applied E.M.F.

Protective Action of Organic Coatings

Permeability of Organic Coatings to Oxygen and Water

Permeability of the Oxide Film to Metal Cations

Resistance Inhibition

Metallic Pigments

## 16. FILM PROPERTIES AND DEFECTS

Properties

1. Adhesion

2. Hardness

3. Flexibility

4. Film Strength or Cohesion

5. Abrasion Resistance

6. Water Absorption

7. Water Permeability

8. Chemical Resistance

9. Solvent Resistance

10. Heat Resistance

11. Colour Retention

12. Fungus Resistance

13. Durability

Defects

1. Black Spotting

2. Blistering

3. Bloom

4. Blushing

5. Bronzing

6. Chalking

7. Cracking

8. Cratering

9. Flaking

10. Floating and Flooding

11. Gas-Checking and Frosting

12. Orange Peel

13. Ropiness or Ropy Finish

14. Seediness

15. Sheariness

16. Silking

17. Sleepiness

18. Sulphide Staining

19. Sweating

20. Wrinkling or Rivelling

## 17. SURFACE PREPARATIONS

Metal Surfaces

1. Iron and Steel

2. Aluminium

3. Cadmium
4. Copper and Brass
5. Lead
6. Magnesium
7. Stainless Steels, Nickel and Chromium
8. Tin
9. Zinc
10. Pretreatment Primer for Metallic Surfaces

#### Wood

1. Characteristic Properties
2. Preparation for Painting
3. Preparation for Varnishing and Lacquering

#### Plaster and Cement Surfaces

1. Drying and Priming
2. Treatment of Efflorescence
3. Control of Drying Out Process
4. General Principles
5. Asbestos Cement

#### Masonry and Building Boards

1. Brickwork
2. Stone Masonry
3. Miscellaneous Building Boards

#### Preparation for Repainting

1. Removing Old Paint
2. Dealing with Contaminated Surfaces
3. Schedules of Painting

### 18. APPLICATION TECHNIQUES

#### Introduction

#### Brush and Roller Application

#### Use and Maintenance of Brushes

#### Roller Application—Hand

#### Roller Application—Machine

#### Spray Application

#### Compressed Air

#### Spray Guns and Accessories

#### Metering Spray Equipment

#### Spray Booths

#### Hot Spraying

#### Steam Spraying

#### Petroleum Solvent Spraying

#### Cold Hydraulic Spraying

#### Hot Hydraulic Spraying

#### Electrostatic Spraying

#### Dip Application

#### Slipper Dip

#### Trichloroethylene Dip

#### Controlled Extraction

#### Flood Coating

#### Flow Coating

#### Curtain Coating

#### Barrelling and Centrifugal Application

#### Stoving

#### Operation of Stoving Ovens

Convection Ovens  
Radiant Heat Ovens  
19. MODERN METHODS OF ANALYSIS  
    "Absorption spectroscopy  
    Introduction  
    General Features  
    Wavelength  
    Intensity  
    Quantitative Analysis  
    Ultra-Violet Spectroscopy  
    Principle  
    Instruments and Technique  
    Analytical Applications  
    Infra-Red Spectroscopy  
    Principle  
    Instruments and Technique  
    Analytical Application  
    "Gas chromatography  
    Introduction  
    Basis of System  
    Injection System  
    Detector  
    Applications  
    Solvent Analysis  
    Plasticiser Analysis  
    Hydrocarbon Analysis  
    Fatty Acid Analysis  
    Phenol Analysis  
    Resin and Polymer Analysis  
    Recent Developments

## 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)

Sat, 15 Jun 2024 10:02:04 +0530