

Chapter 5: Surface Coating

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Surface Coating

Surface Coating

The application of a wet or dry coating material to the surface of another material, either for decoration or for protection against damage or corrosion.

- Process Description**
- Surface preparation
 - Coating application
 - Drying or curing of coating

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Surface Preparation

- Cleaning
- Acid etching
- Phosphate treatment
- Chromate conversion coating
- Drying

Types of Coatings

- Conventional
- High solids
- Waterborne
- Powder
- Radiation cured

Conventional Coatings

- Use only organic solvents
- Coatings dry quickly
- Produce durable, high-quality surface
- Limited monomers and pre-polymers

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Conventional Coatings Used in Coil Coating

Coating	Volatile Content, Wt %
Acrylics	40% to 45%
Adhesives	70% to 80%
Alkyds	50% to 70%
Epoxies	45% to 70%
Fluorocarbons	55% to 60%
Phenolics	50% to 75%
Polyesters	45% to 50%
Silicones	35% to 50%
Vinyls	60% to 75%
Zincromet®	35% to 40%

Typical Solvent Content of Conventional Coatings Used in Various Industries

Industry	Coating	Volatile Content, vol %
Metal furniture	Not specified	65%
Automobile and light-duty truck	Enamel	67% to 76%
Automobile and light-duty truck	Lacquer	82% to 88%
Automobile refinishing	Enamel	72% to 76%
Automobile refinishing	Lacquer	87% to 91%
Large appliance	Not specified	70%
Traffic marking	Alkyd	50%

High-Solids Coatings

- Typically greater than 60% solids by volume
- Less drum handling
- Reduced freight costs
- Reduced solvent removal energy
- Increased viscosity

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Emission Reductions for High-Solids Coatings

Coating	Emission Reduction %
60% solids by volume	61% to 62%
65% solids by volume	69%
70% solids by volume	75%
80% solids by volume	85%

Waterborne Coatings

- Contain 2-15% by volume organic solvent
- Types of waterborne coatings:
 - Water-soluble dispersions
 - Water-soluble polymers
 - Emulsions

Waterborne Coatings

- Wide range of formulations
- Can be used with high solids
- Easier clean up
- Increased drying energy
- Need better surface preparation
- Corrosion potential

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Emission Reductions for Waterborne Coatings

Coating	Application Method	Emission Reduction, %
82/18 waterborne	Electrostatic spraying	80% to 82%
82/18 waterborne	Dip and flow coating	82%
82/18 waterborne	Electrodeposition	95%
67/33 waterborne	Electrostatic spraying	67%
67/33 waterborne	Dip and flow coating	67%

Powder Coatings

- Contain no solvent carrier
- Thermoplastic coatings melt when heated
- Thermosetting coatings polymerize
- Small quantities of VOC may be emitted during polymerization

Powder Coatings

- Better chemical and abrasion resistance
- Decreased curing energy
- Excess powder easily recovered
- Higher coating cost
- Limited number of formulations
- Higher capital equipment costs
- Higher temperatures required for curing
- Color mixing may occur during changes

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Emission Reductions for Powder Coatings

Coating	Type	Emission Reduction, %
Epoxy	Thermosetting	97% to 99%
Acrylics	Thermosetting	99%
Urethane polyester	Thermosetting	96% to 98%
Polyester	Thermoplastic	99%
Acrylics	Thermoplastic	99%

Radiation-Cured Coatings

- Contain no solvent carrier
- Cures by polymerization with UV or electron beam radiation
- High line speeds
- Decreased operating cost
- Reduced floor space
- Higher coating cost
- Limited number of formulations
- Higher capital equipment costs
- Operational hazards

Coating Application

- Spray coating
- Dip coating
- Flow coating
- Roller coating
- Electrodeposition coating

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Coating Application Methods for Various Industries

Method	Coil Coating	Metal Furniture	Auto & Light Truck	Large Appliances
Air-atomized spray			X	X
Airless spray				X
Electrostatic spray		X	X	X
HVLP			X	
Electrostatic bell & disk				X
Dip		X		X
Flow		X		X
Roller	X			
Electrodeposition	X		X	X

Coating Application Methods for Various Industries (cont'd)

Method	Can	Auto Refinish	Traffic Marking	Wood Bldg Products	Fabric
Air-atomized spray	X	X	X	X	X
Airless spray		X		X	X
Electrostatic spray		X		X	X
HVLP		X		X	X
Electrostatic bell & disk				X	X
Dip				X	X
Flow				X	
Roller	X			X	X
Electrodeposition					

Transfer Efficiency

$$\text{Transferefficiency} = \frac{\text{Solids applied to surface}}{\text{Total solids used}} \times 100$$

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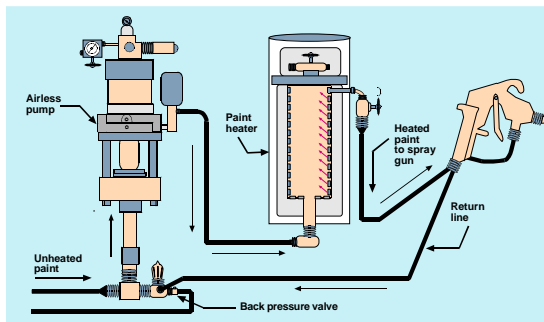
Spray Coating

- Air atomized spray
- Airless spray
- Electrostatic spray
- High-volume, low-pressure spray

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Airless Spray Gun

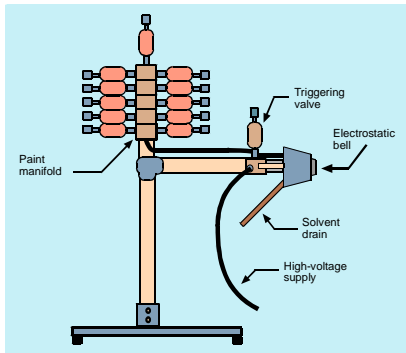


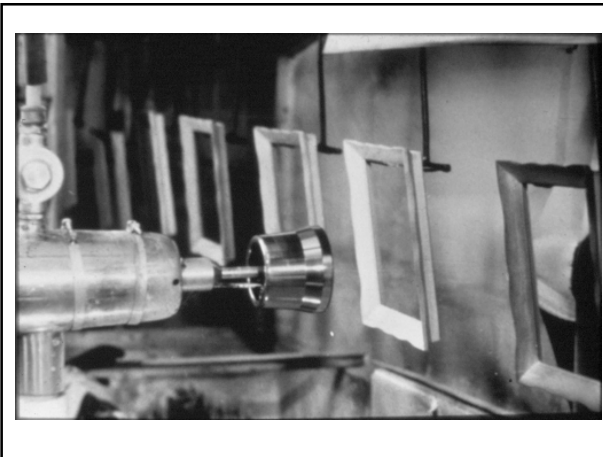
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Spray Coating

- Air atomized spray
- Airless spray
- Electrostatic spray
- High-volume, low-pressure spray

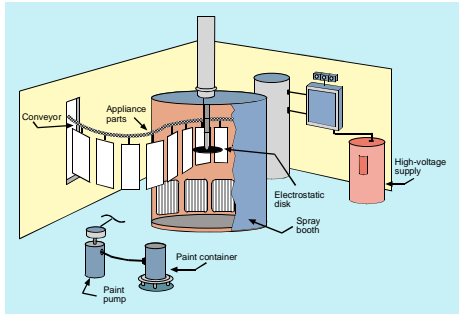
Electrostatic Bell





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Reciprocating Disk



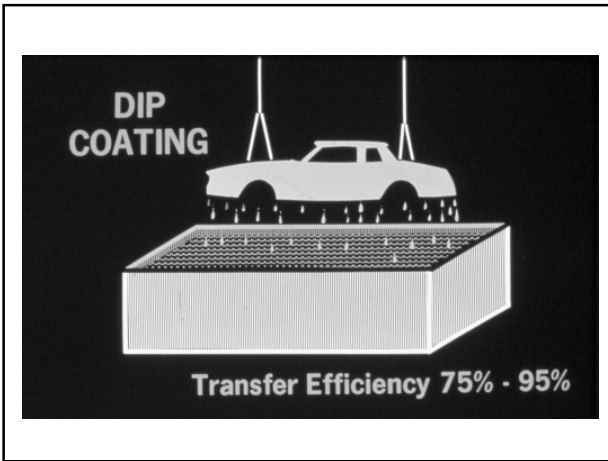
Spray Coating

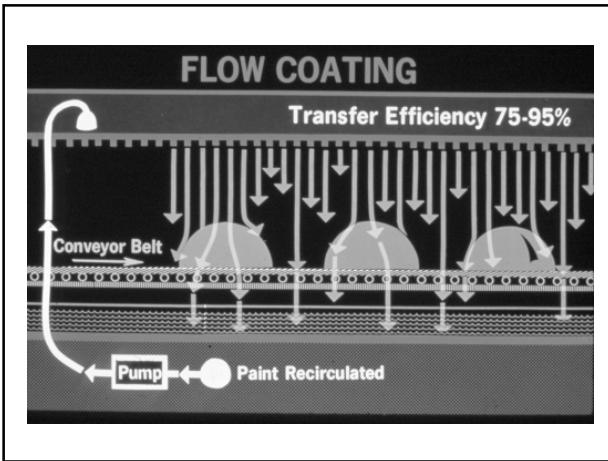
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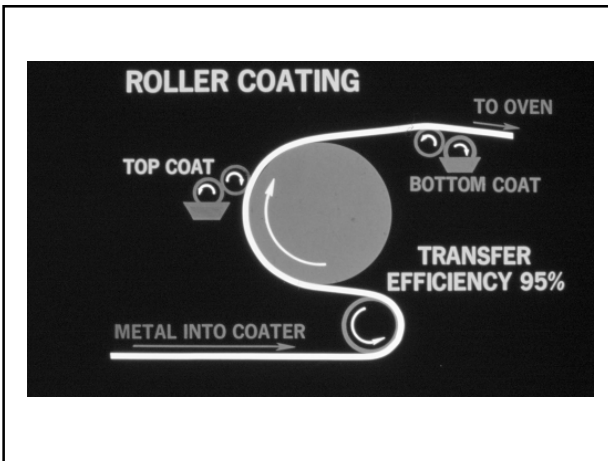
Transfer Efficiencies for Spray Application

Spraying Method	Flat Surface	Table-Leg Surface	Bird-Cage Surface
Air-atomized	50	15	10
Airless	75-80	10	10
Electrostatic air-atomized	75	65	65
Electrostatic airless	80	70	70
Electrostatic disk	95	90-95	90-95

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Electrodeposition Coating

Curing

- Pre-drying
- Staged temperature ovens
- Explosion potential
- Cooling

Emission Control Techniques

- Reduced-VOC coating
- Higher transfer efficiency application
- Add-on control equipment

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Percent of Total Emissions by Coating Step for Different Coating Methods

Coating Method	Application	Pre-Dry	Oven
Spray coating	30-50	10-30	20-40
Dip coating	5-10	10-30	50-70
Flow coating	30-50	20-40	10-30
Roller coating	0-5	10-20	60-80

Emission Regulation

Process Inspection

- Review coating composition and consumption records
- Observe coating preparation
- Observe coating application
- Observe pre-drying area
- Observe curing area

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Review Coating Composition and Consumption Records

- Composition data evaluated to determine compliance with permit and regulations
 - Solvent content
 - Solids content
 - Water content
 - Solvent density
 - Coating density
- Consumption data evaluated to determine compliance with permit

Observe Coating Preparation

- Determine if area is ventilated
- Note if drums are kept closed
- Determine if solvents have changed
- Observe spill cleanup
- Get sample of "as applied" coating

Observe Coating Application

- Determine if area is ventilated
- Note changes in application method
- Determine changes in application rate
- Determine if control system is adjusted
- Observe spill cleanup

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Observe Pre-Drying Area

- Determine if area is ventilated
- Determine if control system is adjusted

Observe Curing Area

- Check physical integrity of oven
- Check oven temperatures
- Determine changes in line speed
- Determine if control system is adjusted
