# *Painting of Plastics*

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# Painting of Plastics Outline

- Adhesion basics
- Painting Process
  - Process Steps
  - How they interact
- Plastic
  - Easily painted plastics
  - Harder to paint plastics
  - Difficult to paint plastics
- Cleaning & Pretreatment
- Paint Formulations
  - Paint types for plastics
  - Formulation issues
- Drying & Curing
- Other Issues
- Troubleshooting Tips

# Why Paint?

- Address appearance issues.
  - Color
  - Gloss
  - Distinction of Image (DOI)
  - Surface quality
- Improve physical properties.
  - Chemical resistance
  - Durability
  - UV resistance

# Adhesion Basics

- Wet surface
  - Surface tension interactions
- Mechanical bonding
  - Surface profile related
- Chemical bonding
  - Chemical cross-linking
  - Coating penetration

# Adhesion Basics
# Surface Wetting

- Surface tension (dynes/cm)
- Contact angle
- Coating needs to wet total surface

# Adhesion Test Methods

- Crosshatch (ASTM D3359)
- Scrap (ASTM D2197)
- Pull (ASTM D5179, ASTM D4541 & ISO 4624)
- Other
  - Romulus II Hesiometer

# Plastics Painting Process

- Substrate
  - Selection
  - Processing
- Cleaning & Pretreatment
- Paint
  - Selection
  - Application

# Painting Process Steps

- Substrate processed to part
- Cleaning
- Pretreatment
- Priming
- Painting smooth coat
- Painting texture coat
- Flash-off & curing
- Inspection & packing

# Material Formulation

Plastics

- Resins
- Fillers
- Pigments
- Additives

Paints

- Resins
- Fillers
- Pigments
- Additives
- Solvents (paints)

# Plastic Selection

- Easily painted:
  - High surface tension & moderate chemical resistance
  - No special effort
- Difficult to paint:
  - Moderate surface tensions & moderate chemical resistance
  - Care in paint selection required.
  - Primers recommended
- Problem to paint:
  - Low surface tensions & good chemical resistance
  - Special cleaning & pretreatment needed
  - Surface activation
  - Special primers needed

# Easy to Paint Plastics

- ABS (39)
- ABS/PC hybrids
- PVC (42)
- PC (43-46)
- PET (47)
- Acrylics (39)

# Difficult to Paint Plastics

- Polystyrene (39-41)
- PPO
- RIM Urethanes (36-39)
- RIM Epoxies (45-52)
- SMC
- TPO*
- Structural Foam Plastics
  - Blowing agent specific issues!

# Problem to Paint Plastics

- Polyolefins
  - PE (33-37)
  - PP (29-30)
- Nylons (36-47)
- Teflons (20-25)
- Polysulfones (47)

# Plastic Processing Issues

- Surface Profile
  - Too smooth is not good
  - AF200 good for smooth coats
- Variations in crystallization
- Consistent Processing
  - Cycle times
  - Temperature
  - Pressures

# Cleaning

- Free of surface contaminations
- Additives removed from surface
- Surface prep
- Types
  - Solvents
  - Alkaline

# Pretreatment

- Etch and/or activate surface
  - Chemical etch:  acid / caustic
  - Plasma
  - Corona discharge
  - Flame spray

# Cleaning & Pretreatment Checks

- Test for contaminates and surface tension
- Modified water break test
  - ASTM F22-02 (latest version)
  - Use isopropanol
  - Other solvents may be required depending on plastic
- Paints surface tension should be lower than plastic

# Paint Formulation

- Paint formulations affects on process
  - Softer resins offer better adhesion
  - Formulations can be specific to a single plastic
  - Solvent blend important

# Paint Selection

- What level adhesion needed.
- What are the appearance requirements.
- What are the parts physical property needs.
  - Chemical resistance
  - Durability requirements
  - UV and Weatherability requirements
  - Other needs.

# Paint Types for Plastics

- Lacquers
- Latex (water base)
- 2K Urethanes
- 2K Epoxies
- Acrylics

# Painting Application

- Clean controlled finishing environment
  - Application temperature
  - Relative humidity
  - Control airborne contaminates
- Control thickness
- Application parameters appropriate
  - Fluid pressure
  - Atomizing pressure

# Drying & Curing

- Flash-off cycle control.
  - Time, temperature & relative humidity
- Cure cycle control.
  - Time and temperature

# Packaging

- Paints must be cured before packaging
- Sealed bags can cause problems
  - **NEVER bag 2K urethanes!!!!!!!**
- Package with non abrasive materials
  - Remember that shipping is a good non-controlled abrasion resistance test.

# Troubleshooting Tips

- Adhesion properties do not form until paint fully cured
  - Check after 7 to 14 days after painting
  - Some properties after 3 days
- Perform adhesion check on bare part
- Make sure process is being followed

# Thank You

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# Adhesion Basics

- Wet surface
- Mechanical bonding
- Chemical bonding

# Adhesion Basics
# Surface Wetting

- Surface tension (dynes/cm)
- Contact angle
- Coating needs to wet total surface

# Adhesion Basics
# Mechanical Bonding

- Surface profile related
- Needs micro structure
- Too smooth can cause problems
- Deep roughness may hinder wetting

# Adhesion Basics
# Chemical Bonding

- Covalent and other type of bonds
- Substrate / resin interaction
- Cross-linking possible
- Solvent penetration & coating migration

# Pretreatment

- Etch and/or activate surface
  - Chemical etch:  acid / caustic
  - Plasma
  - Corona discharge
  - Flame spray

# Flame Spray

- Activates surface
- Time decay
  - Paint within 4 hours
  - Humidity issues
- Good for polyolifins
- May change surface appearance

# Plasma & Corona Discharge

- Activates surface
  - Free radical generation
- Normally does not change surface appearance
- Time related
  - Finish as soon as possible
  - Within 4 hours recommended
  - Environment affects results

# Specifications for Painting on Plastics

- Adhesion, Abrasion & Mar
  - Peal tests
  - Pull off
  - Scrape tests
  - Abrasion resistance
- Flexibility
- Durability
- Chemical resistance
- Weathering
- Environmental Regulations
- Appearance
  - Color
  - Gloss
  - uniformity

# Adhesion Test Methods

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- Other
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# Painting Issues

- Masking
  - Adds costs
  - Tape
  - Permanent
- Racking
- Spraying
  - Hand spray majority
  - Automation
- Electrostatic spraying
  - Need conductive plastics or
  - Grounding plain rack
- Powder painting
  - Limited because of temp
  - Specialty applications