Rigid Packaging
Finishing & Decoration

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Finishing

- Injection molding is the principle manufacturing method for plastic part production.
- Once produced, plastic parts may be subjected to one or more finishing processes, including:

❑ De-gating

❑ De-flashing

❑ Cleaning

❑ Decorating.

Finishing

- End customers rely on custom injection molders for plastic components for more than just injection molding.
- Customers need custom machining, assembly, and finishing services to compliment their injection molded components.
- This has led to

❑ "Cosmetic Specifications of Injection Molded Parts," The Society of the Plastics Industry Inc.; 1994

❑ "Standards & Practices of Plastics Molders," The Society of the Plastics Industry Inc.; 1998

Hence Finishing and Decoration is a well developed science with specifications and standard practices.

De-gating

- De-gating is the process of removing the molded part from the gate and runner system. De-gating can be accomplished by simply “snapping off” the runner and gate system, using hand tools such as side cutters, employing dedicated trimming fixtures, or by using special injection molding tooling such as the “cold-runner” three plate mold and runnerless style injection molds.

De-flashing

- During the injection process, excess material, called “flash”, may leak out between mold cavity halves. De-flashing methods are used to remove this flash, and include: cutting and trimming, media blasting, or cryogenic de-flashing. Cutting and trimming are the most common methods of de-flashing molded parts, and are performed manually using knives, or other cutting utensils.

Cleaning

- Plastic parts often require some form of cleaning after molding. Processing aids, such as mold release agents may leave a residue, while grease and dirt can be picked up from the molding machine. Even the natural oils of the operator’s hands can interfere with final surface treatment. All these contaminants will interfere with the bonding action of any post-molding decoration or surface treatment. Cleaning is accomplished by spraying or dipping parts in a mild detergent solution followed by a final rinsing and drying.

Decorating

- Virtually all molded plastic products receive some sort of final decoration. These decorations are either "molded-in" or "applied" types.
- Molded-in decorations are those designed into the mold, such as textures; or by implant, as with two-shot molding. Color is considered a molded-in decoration by virtue of pre-colored resins injected into the mold.
- Applied decorations are those added to the plastic part after molding. These applied decoration methods include:

❖ painting
❖ plating
❖ vacuum metallizing
❖ pad printing
❖ hot stamping
❖ silk screening
❖ fill and wipe

Decoration
In Mold Process

- Bi-injection, co-injection, co-extrusion, etc
- Coloration
- In-mold assembly (IMA) and welding
- In-mold coating (IMC), skinning, painting
- In-mold decorating, film, inserting - FIM, IMD, IME, IMF, IML, IMR, etc
- In-mold printing and marking
- In-mold surface improvement processes, RHCM, etc

Decoration
Applied Process

Pre-treatment processes

- Burnishing, polishing
- Chemical etching
- Degreasing - CO2 snow, spray, ultrasonics, vapour etc
- Flame treatment
- Irradiation, ion implantation
- Photo-grafting
- Plasma pretreatment - atmospheric, low pressure
- Sandblasting

Decorating
Coating Processes

- Atmospheric plasma deposition
- Curtain coating
- Dip coating
- Dry paint film application
- Dry offset printing, flexographic printing
- Embossing
- Flocking
- Foil transfer processes, hot stamp, cold foil, etc
- Inkjet, Tonejet, digital printing
- Labelling, sleeving, appliqués, etc
- Laser marking, etching etc
- Pad printing

Decorating
Coating Processes

- Plating, electroplating, chemical deposition, redox processes
- Powder coating
- Screen printing
- Sol-gel coating
- Spin coating
- Spray coating
- Sublimation, diffusion printing
- Thermal transfer printing
- Vacuum deposition - arc, sputtering, thermal evaporation, etc
- Water transfer printing, Cubic, Hydrographic, etc

Drying and Curing Processes

- Atmospheric corona or plasma
- Chemical methods
- Infrared and heat
- Microwave drying
- Plasma or irradiation in vacuum
- Ultraviolet, electron beam curing

Post-treatment processes

- Assembly
- Bonding, gluing
- Inspection
- Sterilization
- Welding

Functional and Aesthetic Properties created by Finishing & Decoration

Audible

- Anti-squeak
- Noise abatement

Olfactory

- Odour
- Scent

Tactile

- Braille
- Cold or warm touch
- Relief, haptic

Functional and Aesthetic Properties created by Finishing & Decoration

Visual

- Brightness, anti-glare
- Colour, hue, saturation, colour gradient
- Detail, information
- Depth effect
- Fluorescence, luminescence, phosphorescence
- Gloss, satin, mat
- Imitation surfaces - wood, marble, etc
- Interference effects, flip-flop
- Metallic look, DOI, sparkle
- Moiré effects
- Opacity

Reflectance
Shape
Smoothness
Transparency, Haze

Functional and Aesthetic Properties created by Finishing & Decoration

Functional

- Adhesion
- Antibacterial , antimicrobial effect
- Anti-counterfeit, tamperproof
- Anti-electromagnetic
- Anti-fingerprint ,easy-to-clean
- Anti-fouling, staining
- Anti-fog, anti-frost
- Antistatic, conductive
- Barrier and permeability, oxygen scavenging
- Colour indicating, smart coatings, inks, etc

Functional and Aesthetic Properties created by Finishing & Decoration

- Electronic functions
- Food contact, toxicity
- Glass or metal substitution
- Over-printability, re-coatability
- Removable, recyclable coating
- Scratch, abrasion, chemical resistance
- Self-cleaning
- Self-healing
- Slip, lubrication
- Stress crack resistance
- Thermal resistance
- UV protection

Painting

- Liquid paints may be applied to plastic parts for many reasons, but usually to ensure proper color matching between adjacent plastic and non-plastic parts. The types of paint used on plastic molded parts include epoxy, polyurethane, enamel, acrylic, and latex. These paints are most commonly applied by conventional spray painting or by more efficient high volume-low pressure or HVLP spraying systems.

- After paint application, plastic parts are allowed to dry or cure. This may be done at room temperature or through the use of a curing oven.

Plating
Electroless Plating

- Plating requires the plastic parts to be electrically conductive. To achieve this conductivity, the plastic parts are subjected to an electroless plating operation.
- Plastic parts are first submersed in a sulfuric chromic acid bath which slightly etches the plastic surface, creating microscopic pockmarks.
- The plastic parts are then placed in a activator bath, and an accelerator bath making the parts chemically attractive to the metals suspended in the electroless plating bath solution. These plating metals deposit and become trapped in the pockmarks.
- Electroless plating provides a dull metallic finish, and makes the parts electrically conductive. Electroless plating is also the first phase in the electrolytic plating process.

Plating
Electrolytic plating

- Electrolytic plating creates bright chrome surfaces. The conductive parts are negatively charged and referred to as the cathode, while the metals suspended in the bath are positively charged, and referred to as the anode.
- Actual plating occurs when these metals precipitate out of solution and adhere to the part surface.

Vacuum Metallization

- Vacuum metallizing is a physical, rather than electrochemical, process of depositing a metal layer onto a plastic part's surface. Plastic parts are first prepared with a lacquer and fixtured onto a rack. Small clips of the desired metal finish material are then strategically located on the rack, which is then placed into a vacuum chamber.
- Once the proper vacuum level is achieved, an electrical charge is applied to the metal clips. This causes them to vaporize, covering everything within the chamber, including the plastic parts, with a metal layer.
- Any metal or metal alloy can be vacuum metallized. But aluminum is the most popular because of its physical properties, and low cost.

Pad Printing

- Pad printing uses silicon rubber transfer pads to pick up ink or paint from a plate called a "cliché" on which there is an etched image. The cliche may be made of steel for larger productions run or made of nylon for shorter runs.
- Pad printing is widely used because of its ability to transfer images onto a wide range of surface types and geometries, and its wet-on-wet printing capabilities.

Hot Stamping

- The hot stamping process uses heated silicon rubber dies to force ink from a foil film carrier onto the plastic part.
- The most typical hot stamping method is performed with parts held in a fixture and with the heated rubber die dropping vertically to force the foil against the part surface. After contact, the die retracts. The hot stamped part is then removed and replaced while the strip of foil indexes to an unused section.

Silk Screening

- In silk screening, an image is exposed onto a fabric screen containing a photosensitive chemical. The exposure "cures" the area not covered by the image and adheres the photosensitive chemical to the screen. The screen is then washed, rinsing away the uncured chemical, leaving only the actual image. The silk screen is then placed on the part. Ink or thick paint is then forced through the porous screen image and onto the part’s surface.

Fill & Wipe

- The fill and wipe process involves applying paint or ink to a part with a grooved or etched impression. The excess material is then wiped off, leaving material only in the impression area.

Decoration

- Manufacturers and retailers of nearly every type of product know the value of the decoration placed on that product. The right product decoration can lead to increased sales and a competitive advantage by standing out from other items on the shelves.
- Product decoration also can increase the value of the manufacturer’s brand by prominently displaying company logos and brand names. Distinctive product decoration can lead to a high level of customer satisfaction.

New Decoration Technologies

TPC should take interest in following two decoration technologies ,

- In-Mold Labeling (IMD) for Injection Molding, Blow Molding & Thermoforming

- Shrink Sleeves for Blow Molding and Thermoformed Containers.

In-Mold Labeling
IMD

- IMD Label bonds with the molded part, providing permanent, non-removable labeling that lasts the life of the product.
- Manufacturers that traditionally use pressure-sensitive labels or other forms of post-mold decoration many times are unaware of IMD or assume it to be too complicated and/or too expensive. However, IMD is quite the opposite of these assumptions – producing a superior overall product at lower costs.
- By including the decorative label in the molding process, it becomes a permanent piece of the product that improves accuracy and durability of the finished label on the part or product.
- In addition to durability and permanence, manufacturers can benefit in a variety of ways by using in-mold labeling on their plastic components. These include adding value to the product, promoting and protecting the brand, and ensuring proper safety messaging.

IMD - Process

- IMD is the application or bonding of a decorative label during the plastic molding process. By applying the label within the molding equipment, a manufacturer is able to eliminate the post hand- or machine-applied pressure-sensitive label from the container or plastic molded part.
- By including the decorative label in the molding process, it becomes a permanent piece of the product that improves accuracy and durability of the finished label on the part or product.
- In addition to product decoration, IMD integrates colorful safety messages into a manufacturer’s plastic product with no fear of peeling, cracking, or wearing off. Incredibly sharp, picture-perfect images are fused into the plastic during the molding process without adhesives, allowing the graphics to become part of the product itself.

IML Project

To perform in mold labeling during the molding or thermoforming process, the involvement of the following partners is required:

- the processing machine partner
- the IML automation partner
- the mold maker
- the resin supplier
- the IML label specialist

Shrink Sleeve Labels

- Flexible sleeve labels are providing new ways to blend design esthetics with safety (tamper-evident features) rigid packaging.
- Technology improvements during the past decade have enabled sleeve labels to cover many types of packaging contours smoothly, thereby eliminating packaging creases known as “frowns and smiles”
- Sleeve labels today can significantly improve shelf impact via 360-degree graphics from the tops to the bottoms of packages. Traditional labels typically allow 40% coverage while shrink-sleeve labels provide nearly 100% package coverage. This expanded coverage translates into 150% more container coverage and a differentiated “billboard effect” for brands.
- Tamper evidence is another growth driver for shrink sleeves.

Shrink Sleeve Labels

- Looking beyond expanded design esthetics, sleeve labels are especially alluring because they can incorporate/embed advanced tracking and security features such as ultraviolet light (UV) blocking capabilities, RFID chips, scanable QR codes, and tiny fragrance beads that release scents when opened.
- Shrink sleeves can provide cost advantages for single-serve products. Shifting consumer trends are forcing brands to rethink package size as consumers are increasingly “on the go.” Companies in food & beverage and other industries are responding by providing smaller package sizes, and bundling smaller sizes together using a single shrink sleeve instead of individual labels. This approach provides a packaging cost advantage because only one label shrink sleeve is needed instead of multiple sleeves or labels

Shrink Sleeve Label Applicator

Innovation in decoration and surface treatment technologies for molded plastics is thriving and is being spearheaded by the packaging, cell phone and automobile industries. If we allow the subject to encompass all that relates to improving the aesthetic and mainstream functional quality of a plastic component, as well as processes to deposit a finish or image on its surface, at least three new patent applications appear every day.

Thank You