Plastics Part Design (Injection Moulding) – 2 day

COURSE CONTENTS:

Fundamentals of Injection Moulding Process:

- Introduction to plastics
- Why Plastics is indispensible in home, office, industries ?
- Injection Molding Machine Basics
- Cycle Time: Injection, Holding, Cooling, Ejection
- Importance of Cooling Time
- Troubleshooting overview:
    - Warpage, Sink Marks, Shrinkage, Weld lines, Short Shots
    - Air Traps, Burn Marks, Flash, Flow Marks, Hesitation, Jetting, Parts not ejecting from mould

Plastic Raw Materials:

- Plastic material types: Thermoplastic & Thermoset
- Thermoplastic Vs Thermosetting overview
- Overview of Commodity and Engineering Plastics
- Structures: Crystalline, Amorphous & Liquid Crystal Polymers
- Material properties of PE, LDPE, HDPE, PC, PMMA, PVC, PS, PP, ABS, Nylons, TPE, etc
- How to select a appropriate plastics raw material to suit desired application
    - Material Initial Selection & Screening:
        - Thermal Behavior, Automotive Chemicals
        - Tensile, Flexural, Creep, Abrasion, Shear & Electrical insulation, Weatharability
        - Dimensional Stability
        - Impact, Specific Gravity & Cost
        - Engineering Properties, Snap Fits & Living Hinges
        - Assembly Methods
        - Reinforcements: Glass Fibers, Carbon Fibers
        - Fillers: Talc, Mica, Calcium Carbonate, Carbon black

Injection Mould Design Fundamentals:

- **General Injection Mould Construction**: Basic Terminologies of Core, Cavity
- **Types of Mould**: 2-plate mould, 3-plate mould, Unscrewing mould, Side-action mould, hot runner mould
- Essential mould Systems: Ejection, Cooling, Feed System, Design Principles
- **Feed System**: Types of Runners, Gates: Fan, Tab, Diaphragm, Submerged, Pin-point & Spru gate
- **Ejection Systems**: Pin Ejection, Stripper Ejection, Forced Ejection, Blade Ejection etc.
- Designing Components for ease of mould making, avoiding undercuts/for undercuts,
- Understand undercut handling with side cores, splits, angular lifters, collapsible cores, inserts
- How to reduce mould cost
- Cooling: cooling lines placement
- Things to consider before approving mould concept design
- **Parting Surfaces**: General Considerations for parting Line decision, Stepped or Profiles parting surfaces
- Mold filling considerations, Shrinkage and warpage of molded parts, mould cooling considerations

Plastics Product Design Principles:

- Plastics Product Design Basics: Injection moulding
- Steps involved in the development of a new part (including materials selection)

- Ribs Design
- Gusset Design
- Boss Design - general, Boss Design for fasteners
- Holes and opening
- Knock-out for ejector pins and rib junctions
- Crushed-Ribs (deformable)
- Uniform wall thickness
- Coring-out the features

- Snap Fit: designs fundamentals, formulas
- Press fit / Interference fit designs
- Living-Hinge design
- Rim / Lip designs for stiffness
- Alignment features: Lead-in edges, mating edges, locators, interlocks
- Avoiding part mismatch, Add Glamour gap
- Crowning of the surface
- 2-way and 4-way locators
- Molded-in Inserts

- Material Shrinkage
- Parting line: types of parting line, draft and ejection consideration
- Draft Angles: Core Vs. Cavity
- Texture Considerations: grade, draft required to eject
- Decals and labels

- Undercuts: Internal & External
- Shut-offs to avoid undercuts or side cores
- Threads: Internal & External
- Replacable metal inserts
- Flow leaders and flow restrictors
- Mould finish: Mirror finish, Sand blasting, As-milled finish, polish direction

- Designing for avoiding defects like; sink marks, Burn marks, warpage etc
- Weld and Meld Lines: How to move them to less problematic area by correct gate location
- Flash considerations
- Secondary operations: de-gating, de-flash
- Cosmetic surface issues like ejector pin marks, parting line witness mark, etc

- Painting, electroplating, Printing on the plastics
- Transparent part considerations

- Add text, lettering, embossing, logo
- Various Agency Compliance and Approvals: UL, CE, etc

Assembly considerations of Plastics:

Mechanical Fasteners, Press & Snap Fits

- Assembly techniques
- Snap fit design and considerations
- Design for assembly and dis-assembly
- Boss and screw design, Hi-Lo, Tinnerman clips, Push-on fastener
- Press fit design

Drawing Creation Tips:

- Appropriate Dimension scheme to be followed on the plastics drawing
- 3D CAD data note to refer 3D model for all unspecified dimensions and information
- General plastic notes on the production drawing
- Notes: Texture note, Parting line note, Replacable insert note, No ejector pin note
- Highlighting Text area, Add Standards symbols like CE, UL, etc

Some important design considerations:

- Class-A (Styling), Class-B surfacing overview
- Ergonomics overview
- Draft Analysis
- Process capability and general process capable tolerances for injection moulded plastics
- Considerations for Metal to Plastics conversions

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