

Micromolding

Micromolding is a set of fabrication techniques for replicating microstructures in polymers using molds (also commonly known as masters or tools) to define features. The three most common micromolding techniques are *injection molding*, *hot embossing*, and *casting*.

Micromolding involves four primary steps: microfabrication of the mold containing a negative or inverse of the desired pattern geometry, introduction of polymer material to the mold, curing or cooling of the polymer material, and release or separation of the molded polymer from the mold.

Table 1. A list of thermoplastic polymers that have been used for micro molding.

Acronym	Full name	Temperature stability [°C]	Properties	Structure
COC	Cyclo-olefine copolymer	140	High transparency	Amorphous
PMMA	Polymethylmethacrylate	80	High transparency	Amorphous
PC	Polycarbonate	130	High transparency	Amorphous
PS	Polystyrene	80	Transparent	Amorphous
POM	Polyoxymethylene	90	Low friction	Semi crystalline
PFA	Perfluoralkoxy copolymer	260	High chemical resistivity	Semi crystalline
PVC	Polyvinlchloride	60	Cheap	Amorphous
PP	Polypropylene	110	Mechanical properties	Semi crystalline
PET	Polyethylene terephtalate	110	Transparent, low friction	Amorphous/Semi crystalline
PEEK	Polyetheretherketone	250	High temperature resistivity	Semi crystalline
PA	Polyamide	80–120	Good mechanical properties	Semi crystalline
PSU	Polysulfone	150	Chemical and temperature resistivity	Amorphous
PVDF	Polyvinylidene fluoride	150	Chemically inert, piezo-electric	Semi crystalline

Common materials used un
micromolding

Process steps

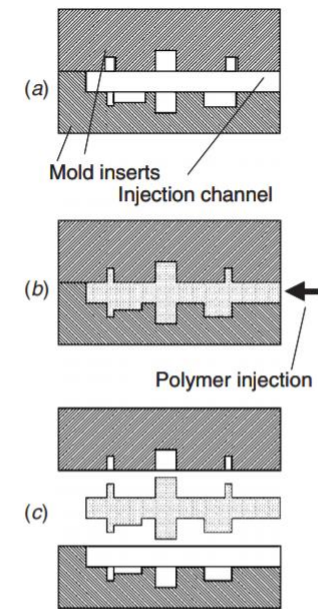


Figure 1. Principal process steps of micro injection molding: (a) the molding tool is closed, evacuated, and heated above the glass transition temperature of the polymer, (b) the polymer is injected into the tool, and (c) tool and polymer are cooled down and the polymer is demolded.

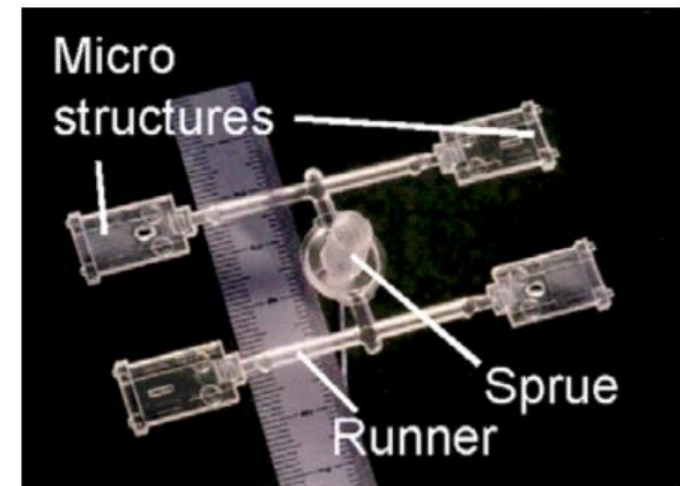


Figure 2. Typical batch of micro structures as it comes from an injection-molding machine.

Micro Injection and Compression Molding

- Injection molding and/or compression molding that allows researchers and manufacturers to produce small features, typically ranging from 1 to 1,000 μm , for microfluidic and microelectromechanical applications. This process typically involves the injection or compression of a molten thermoplastic/thermoset material into a mold cavity that contains tooling with the features to be replicated into the plastic.

Hot embossing

- In terms of cost and time Hot Embossing is the best replication technique for the manufacturing of micro-component on a mass scale. In the Hot Embossing, mostly polymers like PMMA, PC, etc. are mainly used as the work material.

- In single-stage hot embossing the parameters which are considered are: applied pressure, heating temperature, embossing time, and demolding temperature

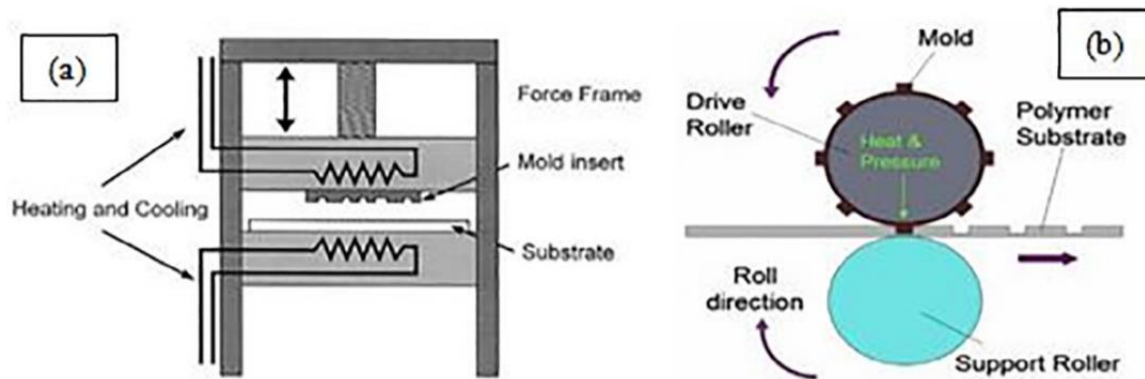


Fig. 1. (a) Conventional/Single-stage Hot Embossing [1], (b) Roller to Roller Hot Embossing [2].

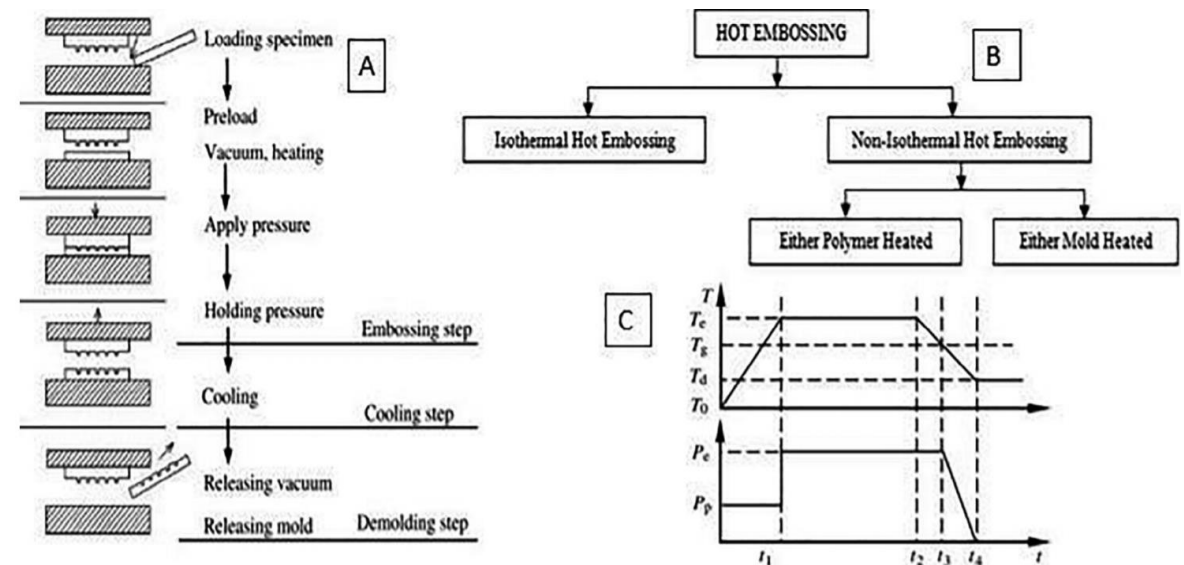


Fig. 2. (A) Stages of hot embossing process [3], (B) Classification of hot embossing according to heating of substrate, (C) Hot embossing process.

Casting

- By far the most widely published polymer fabrication process is the casting of elastomeric material, also often referred to as soft lithography.

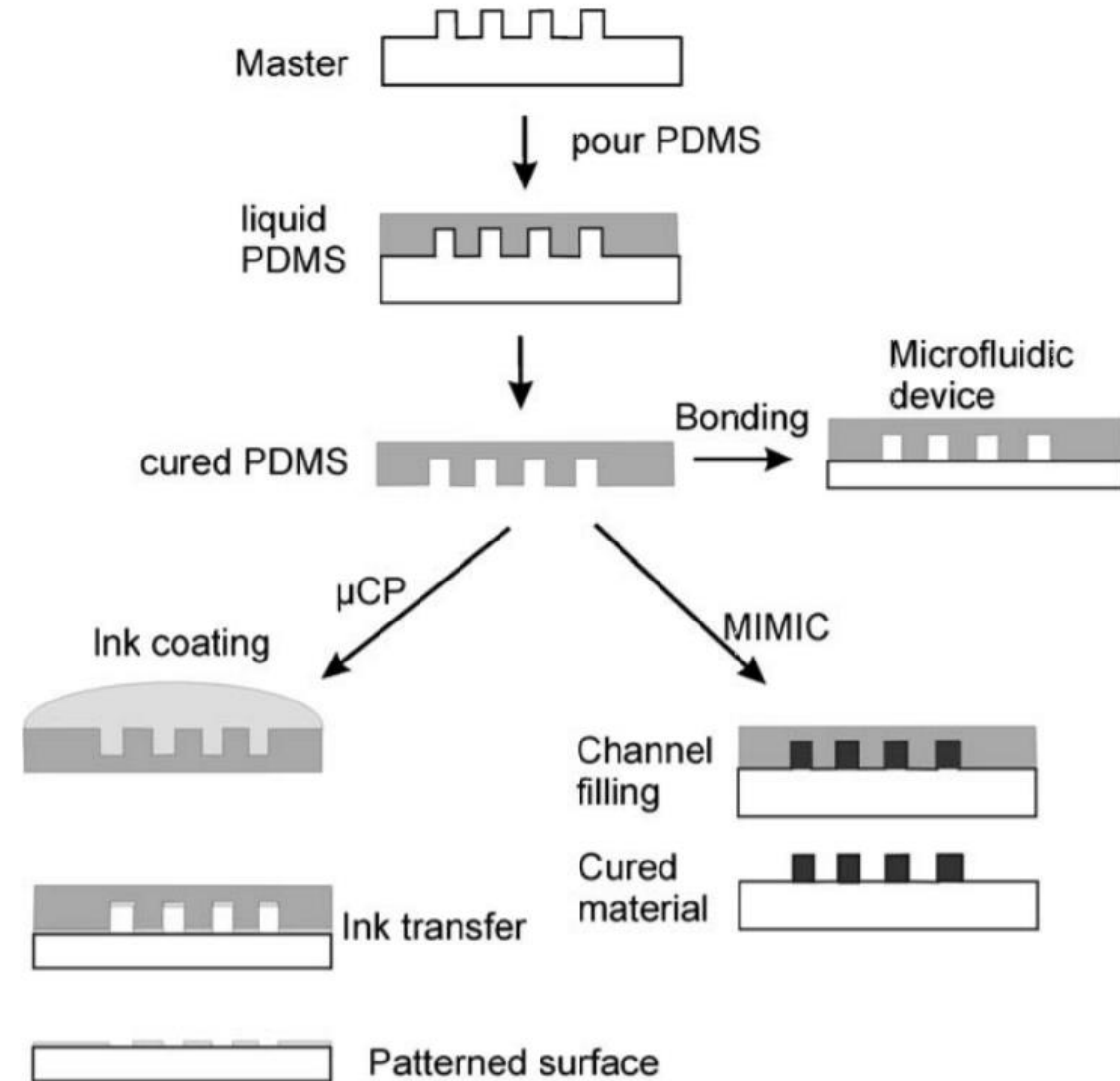


Fig. 15 PDMS casting processes

Injection softwares

- Autodesk MOLDFLOW

Plastic Injection Molding | Software, Tools, & Resources | Autodesk
<https://www.autodesk.com/solutions/plastic-injection-molding>

How does injection molding simulation software help?

Molding simulation can help designers and engineers to understand risks early in the design process, allowing the ability to address these before becoming fully invested. Simulation software gives engineers, mold makers, and other molding professionals accurate digital prototyping solutions, and help bring better products to market faster.

Moldflow simulation can be paired with other simulation tools, including mechanical stress, vibration, motion, computational fluid dynamics (CFD), and Multiphysics, providing a fast, accurate, and innovative approach to solving the most challenging design problems.

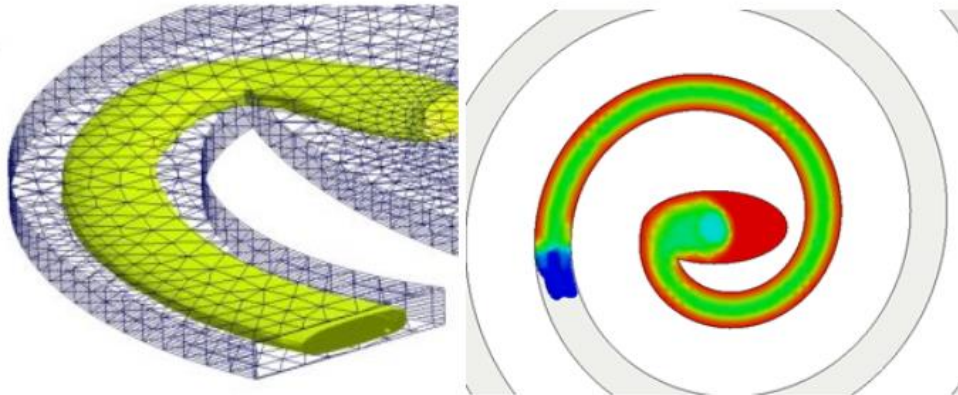


Simulation and design tools for plastic injection and compression molding.

Injection softwares

What Can Moldex3D Do?

- Visualize the flow behaviors of skin and core materials before and after breakthrough happens
- Predict the core expansion region near the breakthrough area
- Optimize geometry thickness and process conditions based on blow through prediction



- Consider temperature imbalance and pressure resistance variations of skin layer and center core
- Predict potential defective locations under high temperature and stress.

- Moldex 3D (For co-injection)

More options

Autodesk, Inc.

Autodesk® Simulation Moldflow® software provides simulation tools for injection mold design, plastic part design, and the injection molding design process. Autodesk® Simulation Moldflow® Adviser and Autodesk® Simulation Moldflow® Insight software help reduce the need for costly physical...

CoreTech System Co., Ltd (Moldex3D)

CoreTech System Co., Ltd. (Moldex3D) was founded in 1995, it has provided the professional plastic injection molding simulation solution “Moldex” series for the plastic injection molding industry, and the current product “Moldex3D” is marketed worldwide. Committed to providing the advanced...

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Siemens PLM Software

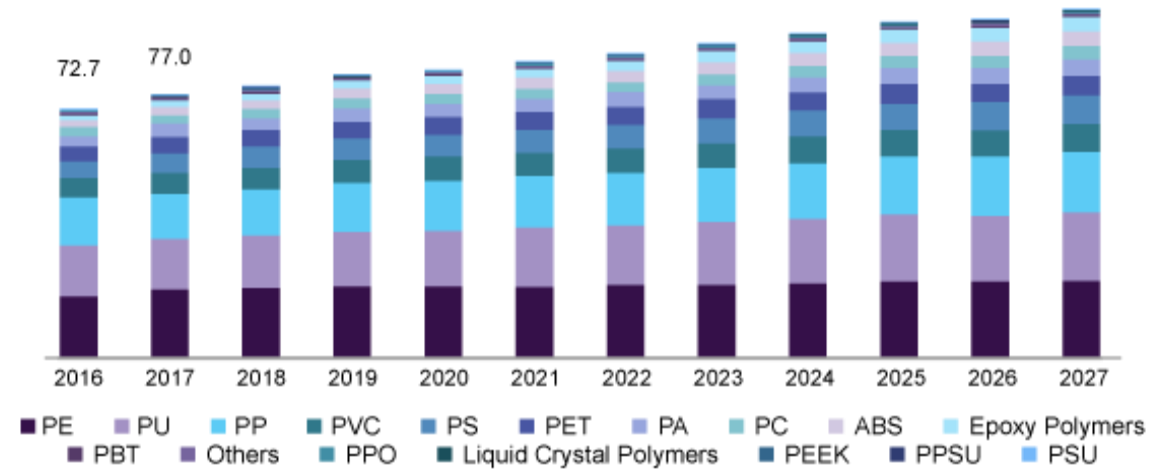
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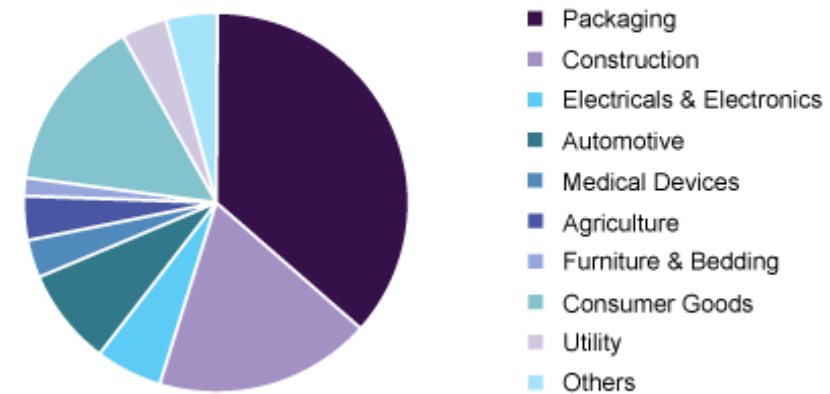
Polymer Market Size

U.S. plastic market size, by product, 2016 - 2027 (USD Billion)



Source: www.grandviewresearch.com

Global plastic market share, by application, 2019 (%)



Source: www.grandviewresearch.com



Waste **Plastic** Recycling Granule **price of plastic extrusion machine**

Up to 5 years warranty

US \$15000-\$50000 / Set

1 Set (Min. Order)



plastic extruders for drinking straw **extrusion**

Up to 5 years warranty

US \$10500-\$14500 / Set

1 Set (Min. Order)



single screw **Plastic extrusion machine** extruder line high accuracy

Up to 5 years warranty

US \$50000-\$50000 / Set

1 Set (Min. Order)



Individually designed **of** melt-blown nonwoven **extrusion machine**

Energy-saving Up to 5 years warranty

US \$400000-\$420000 / Set

1 Set (Min. Order)



PP flat fiber extruder **machine** / raffia film **extrusion** line/hdpe monofilament...

US \$19200-\$21440 / Piece

1 Piece (Min. Order)

Extrusion machines



Taiwan CH 50-650 tons 90% new used **injection molding machine** Second han...

Ready to Ship
Used machinery Highly automatic Up to 5
US \$7000-\$7000 / Set
1 Set (Min. Order)



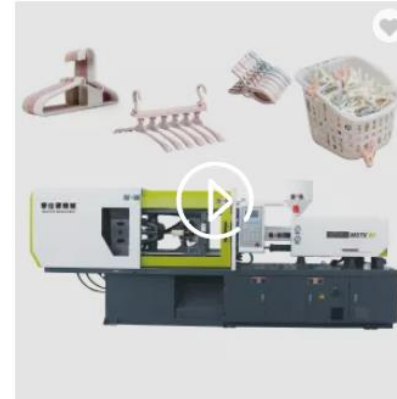
Used Mold Supplying Vertical Plastic **Injection Molding Machine Price**

Ready to Ship
US \$3787-\$3787 / Unit
1 Unit (Min. Order)



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Injection molding machines