



OVERVIEW

Molded paper pulp, which is also called molded fiber, has been used since the 1930s to make containers, trays and other packages. Molded pulp packaging experienced a decline in the 1970s after the introduction of plastic foam packaging. But more recently the use of molded pulp packaging is growing because it fits in well with today's emphasis on environmental friendliness and sustainability. Paper pulp can be produced from old newsprint, corrugated boxes and other plant fibers. Today, molded pulp packaging is widely used for electronics, household goods, automotive parts and medical products. It is also used as an edge protector or pallet tray for many shipping and handling applications.

APPLICATION OUTLINE

The two most common types of molded pulp are classified as Type 1 and Type 2. Type 1 is commonly used for support packaging applications with 3/16 inch (4.7 mm) to 1/2 inch (12.7 mm) walls. Type 1 molded pulp manufacturing uses a fiber slurry made from ground newsprint, kraft paper or other fibers dissolved in water. A mold mounted on a platen is dipped or submerged in the slurry and a vacuum is applied to the backside. The vacuum pulls the slurry onto the mold to form the shape of the package. While still under the vacuum, the mold is removed from the slurry tank, allowing the water to drain from the pulp. Air is then blown through the tool to eject the molded fiber piece. The part is typically deposited on a conveyor that moves through a drying oven.

Type 2 molded pulp manufacturing is typically used for packaging electronic equipment, cellular phones and household items with containers that have 1/16 inch (1.6 mm) to 3/16 inch (4.7 mm) walls. Type 2 molded pulp uses the same material and follows the same basic process as Type 1 manufacturing up to the point where the vacuum pulls the slurry onto the mold. After this step is completed, a transfer mold mates with the fiber package on the side opposite of the original mold. A vacuum is then pulled through the transfer mold and the vacuum is released from the original mold so that the package adheres to the transfer mold. The transfer mold then moves the molded article to the drying conveyor. Type 2 molding provides a smoother surface on the transfer mold side of the package.

Molded pulp packaging tools are normally made by machining a metal tool in the shape of a mirror image of the finished package. Holes are drilled through the tool and then a screen is attached to its surface. The vacuum is drawn through the holes while the screen prevents the pulp from clogging the holes. It costs about \$30,000 and takes two weeks to make a metal tool for a typical large package.

Fused Deposition Modeling (FDM) provides an alternative method for producing molded pulp tooling that can provide dramatic time and cost savings and improve the appearance of the finished product. FDM technology is an additive manufacturing process that builds plastic parts layer by layer, using data from computer-aided design (CAD) files. FDM molded pulp tooling can

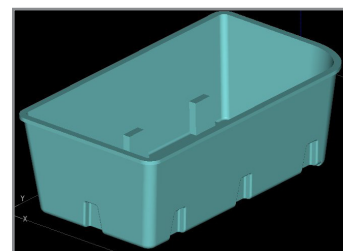
APPLICATION CHECKLIST

FDM IS A BEST FIT FOR MOLDED PULP PACKAGING WHEN:

- ✓ Sample molded pulp parts needed for evaluation.
- ✓ Short-run production up to 10,000 pieces.
- ✓ Design changes are likely.
- ✓ Product customization is desirable.
- ✓ Complex designs with many features.

BENEFITS OF FDM FOR MOLDED PULP PACKAGING INCLUDE:

- ✓ 80 – 95% cost reduction.
- ✓ 50 – 85% lead time reduction.
- ✓ Minimal direct labor needed.
- ✓ No process changes in molding operation.



CAD model of FDM packaging tool



FDM paper pulp tool



FDM paper pulp tool with custom sparse fill



Paper pulp part produced by tool shown above

be produced in a fraction of the time and cost of conventional tooling because the FDM tool can be produced to be both porous and rigid. FDM eliminates the need for costly machining of the contour of the tool as well as the holes required to draw the vacuum. FDM also eliminates the need to attach the screen to the mold. FDM molds can be run alongside traditional molds with no alternation to the slurry formula, cycle time, vacuum pressure or other process variables, making it easy to integrate FDM tooling into any molded fiber operation.

PROCESS OVERVIEW

The geometry of the FDM pulp tooling is very similar to metal tooling except that the holes are eliminated. In some cases, the wall thickness of the mold may be reduced to decrease build time and material consumption and supporting ribs may be added to ensure rigidity. Within the Insight FDM preprocessing software, build parameters are specified to produce porosity. Designers can easily maximize air flow and minimize clogging by altering the raster gaps in the FDM toolpath. ABS-M30 and polycarbonate (PC) are the preferred materials for FDM molded pulp packaging tooling. PC is preferred when maximum strength and stiffness are needed while ABS-M30 is used when strength is needed along with a small degree of flex. When transfer molds must be porous, so that a vacuum can hold the molded piece while freeing it from fiber clogging, they are constructed using the FDM default sparse fill build style.

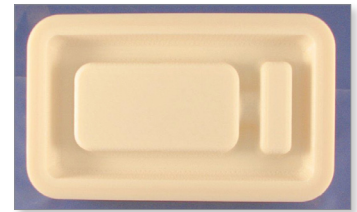
CUSTOMER STORY

SML Group is a leading supplier of garment trim and various types of packaging. Based in China, the company operates over 30 facilities around the world including the largest label factory in China. In the past, SML was not able to compete in the molded pulp packaging market in the United States because the time and cost involved in making conventional metal tools made it impossible to provide a prototype to customers. "We decided to work with Stratasys to see if it was possible to make an FDM packaging tool," said Jeremy Wolf, Structural Packaging Designer for SML. Stratasys' digital manufacturing service, Redeye On Demand, worked with SML to provide a series of different FDM molded pulp tools in order to optimize the sparse pattern that allows a vacuum to be drawn through the tool." The entire FDM tool is porous, which spreads the vacuum suction and produces a cleaner package with a better surface finish," Wolf added.

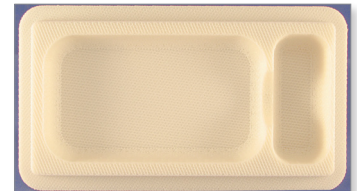
How Did FDM Compare to Conventional Methods for SML?

Method	Cost	Time
Conventional Metal Tooling	\$30,000	2 weeks
FDM Tooling	\$600	1 week
SAVINGS	\$29,400 (98%)	1 week (50%)

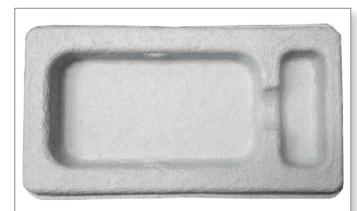
"We can get an FDM tool from RedEye for about \$600 in two days," Wolf said. "At this price and lead time and we can easily make prototypes for companies that are interested in molded pulp packaging. Prototypes are critical because OEMs often show them to retailers that they want to have carry the product. FDM tooling can also be used for production in quantities up to 10,000 or so. We have used FDM tooling to produce molded pulp packages for two customers, an electronics OEM and a retailer. FDM tooling has opened up exciting new business opportunities by making it practical to produce molded pulp packaging in low quantities that did not make sense in the past."



FDM tool for electronics packaging.



Transfer tool for the paper pulp package.



Molded pulp packaging from the FDM tool.



Electronic device with complete packaging.

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