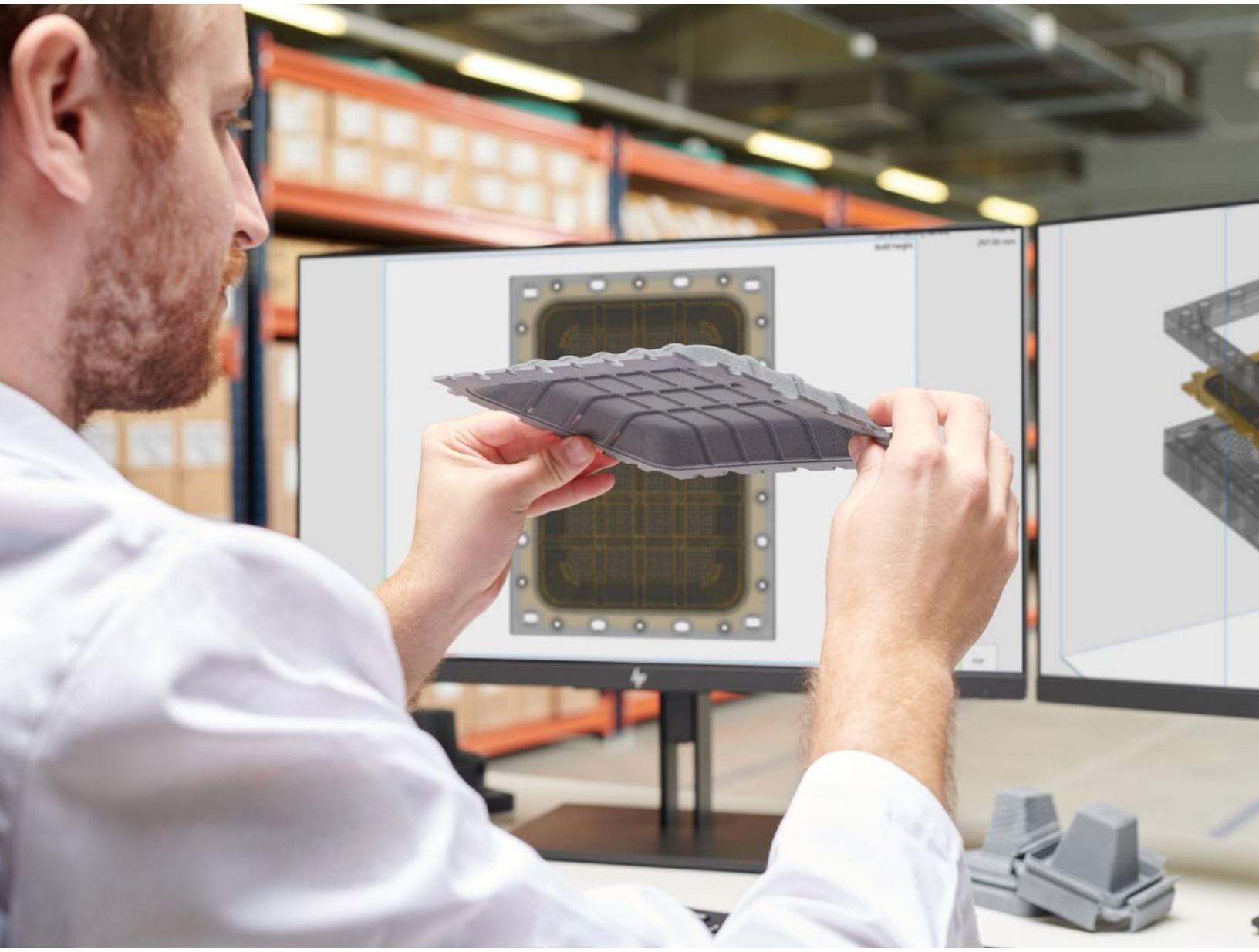
White paper

The HP Molded Fiber Advanced Tooling Solution



Macrotrends Driving the Packaging Market

The packaging market is transitioning from foam/plastic to molded fiber (also known as molded pulp) packaging for sustainability reasons, with environmental packaging (i.e., replacing foam with paper) favoring the growth of this segment.

The molded fiber packaging market is a worldwide industry, valued at $8 billion, and is the fastest-growing segment in the packaging market, with growth being fueled by growing consumer demand for sustainable and environmentally friendly packaging solutions, as well as the increase in take-out food and e-commerce.[1]

Asia-Pacific countries (APAC) are the biggest geographical market, especially China, Hong Kong, and Taiwan. The region is experiencing the highest growth, and is expected to be the largest market by 2024. This growth can be attributed to the rising importance of disposable packaging,[2] as well as the lower cost of tooling production in these areas, which presents a significant price advantage over other regions.

The primary segments currently are food and beverage and electronics, which are estimated to have the highest growth. The increasing use of molded pulp products for the packaging of various electronic products (including mobile phones and its accessories, computers, printers, modems, trimmers, and projectors, among others) due to its convenience, sustainability, and low cost are some of the factors contributing to the growth of this segment.[2]

Molded Fiber Manufacturing

The thermoformed tooling segment is expected to outgrow other segments, propelled by increased consumer demand for high-quality molded fiber packaging and ongoing innovation driving down the cost of thermoforming-packaging manufacturing costs.

Ongoing operational improvements will drive down the cost of packaging production and decrease barriers for new entrants.

Large manufacturers of molded fiber products are vertically integrated, but beneath them, players are rather fragmented, with the majority residing in Asia as regional and local players. Major players lean heavily toward insourcing machining and tooling, considering it to be a source of competitive advantage; other players are more likely to outsource, leaning on a few players with global expertise to provide tools and machinery.

Molded fiber supplies are largely commoditized, with little differentiation between different products of the same type, and currently custom short runs are not economically viable, presenting a barrier of adoption of molded fiber products in the packaging industry.

Market Trends and Challenges

In the previous 20 years, the industry has not experienced many changes, but manufacturers of molded fiber products are looking for ways to improve operations and enhance current efficiencies.

Tooling is an important factor impacting operational efficiency, with current key pain points including downtime (planned and unplanned), tooling replacement time (stops and starts), rejected product (worn out screens leading to bad parts), and semi-skilled labor costs for maintenance.

Today, manufacturers of molded fiber products typically produce screens manually, which can be time consuming and somewhat limiting, due to its intrinsic design constraints. Some manufacturers are also trying to optimize the screen production process using robots, but highly skilled laborers are required for programming tasks, which in turn has a significant impact on labor costs.

Outsourcing CNC tooling services can be a cost-effective option when using low-cost suppliers, typically located in Asia, but this typically results in long delivery times.

Manufacturers of molded fiber products have already tried to improve tooling production efficiency by searching for new capabilities, such as 3D printing but there hasn't been an optimal solution yet that delivers on key requirements, and a feeling of disappointment prevails in the sector.

Limited 3D Printing Adoption for Molded Fiber Tooling

Manufacturers of molded fiber products have been using 3D printing technologies—mainly fused deposition modeling (FDM)—but with little success to date. The lack of an optimal 3D printing technology to help solve some of the molded fiber industry's major pain points has created skepticism that 3D printing can serve as anything useful beyond prototyping.

FDM tooling is used primarily for prototyping, and other techniques have been applied for this purpose, from machining of porous materials to temporary castings, among others, but these are not production solutions.

A New Solution to Address Tooling Pain Points

When HP researched the market and learned about the pain points, it became clear that existing 3D printing technologies were not meeting all the requirements for production tooling in the molded fiber industry. As such, HP pursued different approaches in solving these pain points.

The HP Molded Fiber Advanced Tooling Solution provides advancements in the molded fiber product manufacturing industry, with expanded tooling capabilities for both molded fiber manufacturing efficiencies and product performance. It addresses common tool sourcing and maintenance challenges, allowing manufacturers to focus on production efficiencies instead of tooling operations.

HP chose to deviate from the usual path based on joining the screen and the form, and instead investigated emulating the traditional molded fiber tooling design. In order to address the current architectural issues such as difficulties in manufacturing, securing the screen to the form or, screening and keeping the screen maintained in the form, HP has developed a screen that can be 3D printed in one piece and that fits on top of a 3D printed lightweight form and is easily assembled.

Delivering Quality Molded Fiber Products, Faster[3]

Traditionally, the tooling manufacturing process is necessarily sequential: the form is machined with CNC, drilled, then a screen that fits on the form is manufactured. However, with the HP Molded Fiber Advanced Tooling Solution, leveraging HP's digital manufacturing process, none of these operations are necessary as the forms and screens are printed at the same time, enabling production-ready tooling in as little as 2 weeks.[4]

Manufacturing molded pulp parts efficiently means sucking the fibers in the slurry onto the screen (i.e., forming) and removing the excess water from the formed part as quickly as possible while avoiding clogging the tool with fibers. Good through and lateral flow of water is essential as it means less clogging, that requires halts for in-machine cleaning, resulting in an increase in productivity.

HP's team of experts leverages HP's proprietary digital technology, applying a design process to engineer toolsets with fluid pathways that put the fiber in the desired location.

Further efficiency gains are enabled via HP's secure online platform,[5] as having a digital tooling design stored in a digital warehouse allows for quick design changes and iterations even adding key features of the toolset. The platform offers password-protected intellectual property and encrypted access control.

Increased OEE and Reduced Downtime[3]

Because HP molded fiber tooling screens are not subject to corrosion[6] or calcification[7] in water (a common problem with metal tooling), manufacturers can keep their machines up and running by reducing the need for time-consuming maintenance.

Molded fiber tools produced with HP 3D High Reusability PA 11 polyamides were tested over 5 days at 50° C (122° F) using four different solvents (tap water, a $CaCO_3$-saturated solution, a 5% wt solution of aluminum potassium sulfate, and DI water as a test negative control) and presented no visual signs of corrosion.

A complementary study was conducted to test signs of calcification. Other molded fiber tools produced with HP 3D High Reusability PA 11 polyamides were tested over 17 days at ambient temperature using 3 different solutions (super-saturated $CaCO_3$, tap water, and DI water as a test negative control). No visual signs of calcifications were found.[7]

Both studies were conducted under conditions representative of extreme (and non-extreme) corrosive or subject-to-calcification environments at molded fiber manufacturing facilities.

Aside from reduced maintenance, the HP solution also helps increase operational efficiency with smooth part release and fewer hang ups that can cause parts to catch on the form tool, and by reducing stoppages with enhanced flow tooling. Hang-ups can occur when fibers get caught on seams, broken wires, and interfacial spaces between the screen and the deckle ring or block-outs. HP's SmartScreens reduce this possibility because they have no seams and because they integrate features such as a deckle ring or block-outs, which are common striking points. Thus, unlike for traditional tooling, virtually no chemical bath time is required to dissolve the fiber build ups.

With traditional tooling, periodic equipment maintenance is required, most of which is related to the screen. However, screens made with HP's Molded Fiber Advanced Tooling Solution require virtually no maintenance, freeing up semi-skilled labor time. HP's screens can be replaced in seconds[8] and don't involve removing tools from the machine, avoiding the need to section tools and drill holes, thus giving competitive advantage to HP's technology compared to the traditional one. Furthermore, HP's Molded Fiber Advanced Tooling Solution delivers a lightweight plastic toolset that translates into efficient frequent changeovers. Further enhanced with a unique rapid snap-fit screen replacement system.[9] Depending on the design and the requirements of the toolset, HP hot swap SmartScreens can be fixed to the form through a snap-fit, reducing the need to remove any tool from the machine for screen replacement.

HP's easily replaceable screens can also help reduce inventory of safety stock replacement tooling. Moreover, production-ready tooling can be delivered as quickly as 2 weeks after finalizing design specs with HP's engineering team.[4]

Opening New Revenue Streams with Economically Viable Short Runs

Traditional tooling typically requires production runs above 50,000 or 100,000 parts to make it economically viable. In addition to the cost of tooling, the costs of developing new products are also a key factor (e.g., time spent on packaging design and business development, semi-skilled labor resources to assemble and maintain tools, fixed costs of logistics, etc.). It also can take time to set up a new product, which may not be worth the costs if the parts are pulped in a few hours.

The speed and the ease of changeovers that the HP Molded Fiber Advanced Tooling Solution provides, finally helps make higher value customized production short runs economically viable. HP's secure online platform (digital warehouse),[5] helps enable new levels of agility and versatility for tooling design and fabrication. Changing customer requirements can be easily accommodated with fast design iterations and quick modifications of the same toolset.

Our digital workflow makes changing screen designs to convert a commodity into a high value branded product quick and easy. Manufacturers can offer additional value to their customers with quick and cost-effective custom features such as embossed brand logos, model numbers, or traceability information.

Reinventing Production Tooling for the Molded Fiber Industry

The HP Molded Fiber Advanced Tooling Solution provides manufacturers of molded fiber products with expanded tooling capabilities for greater production efficiencies and design opportunities. HP's end-to-end service can enable additional profitability by combining proprietary tooling technology and engineering expertise to help cut lead times, reduce maintenance time, and enable customized short runs.

Learn more at
hp.com/go/MoldedFiberTooling

1. See futuremarketinsights.com/reports/moulded-fibre-pulp-packaging-market.
2. See marketsandmarkets.com/Market-Reports/molded-pulp-packaging-market-36997090.html.
3. Compared to traditional CNC and manual tooling processes as of June, 2020. Based on internal HP analysis and testing including expert interviews and a review of published market reports. 4-6 weeks average fabrication lead time when producing in CNC.
4. Delivery as quickly as 2 weeks after HP receipt of design file, detailed specs, the tool design quotation approval, purchase order, and receipt of first payment. Shipping time not included.
5. Secure online platform offering password protected intellectual property and encrypted access control.
6. Polyamides in HP 3D High Reusability PA 11 material do not corrode with water (a common problem with metal tooling). Based on internal HP testing, August 2020. HP tools produced with HP 3D High Reusability PA 11 material were tested over 5 days at 50° C (122° F) using different solvents (DI water - control, tap water, $CaCO_3$ saturated, and 5 wt% aluminum potassium sulfate), and presented no visual signs of corrosion.
7. Polyamides in HP 3D High Reusability PA 11 material do not present calcification signs with water (a common problem with aluminum tooling). Based on internal HP testing, November 2020. HP tools produced with HP 3D High Reusability PA 11 material were tested over 17 days at ambient temperature using 3 different solvents (DI water - control, tap water, $CaCO_3$ super-saturated), and presented no visual signs of calcification or weight changes.
8. HP hot swap SmartScreens can be replaced in seconds.
9. No machining, drilling, or manual screening needed.

4AA7-7869ENW, December 2020