Additive Manufacturing
on a New Level

Get Higher-Volume Production With SAF 3D Printing Technology

The demand for plastic parts across multiple industries shows no sign of slowing down. After a slight downturn in 2020 due to the worldwide pandemic, current projections call for an 8% compound annual growth, reaching $1.2 trillion in 2023[1]. One of the technologies manufacturers rely on to meet this production demand is 3D printing. It offers a way for automotive companies, commercial goods producers and consumer product manufacturers to make plastic production parts when other technologies like molding aren't optimal.

If you're not familiar with the technology, 3D printing builds objects using an additive process. For this reason, it is also known as additive manufacturing. A CAD model of the part to be built is virtually "sliced" using 3D print preparation software. This information is then used by the 3D printer to deposit material to build each slice in a layer-on-layer fashion until the part is complete. 3D printers employ a variety of materials using different methodologies.

For production volumes below several hundreds of thousands, 3D printing is in many cases the best solution. That's because 3D printing has inherent advantages over technologies such as injection molding for this scenario. For starters, additive manufacturing is a "tool-less" technology. There is no tooling investment required to make the parts, as there is with molding. This frees it from the limitations posed by economies of scale, enabling on-demand production and the ability to manufacture in quantities not economically possible with the other technologies.

1 https://www.businesswire.com/news/home/20200429005290/en/Global-Plastic-Products-Market-Set-to-See-a-Resurgence-from-2021-Post-COVID-19-Impacts---ResearchAndMarkets.com

Solution Guide

Additive Manufacturing on a New Level

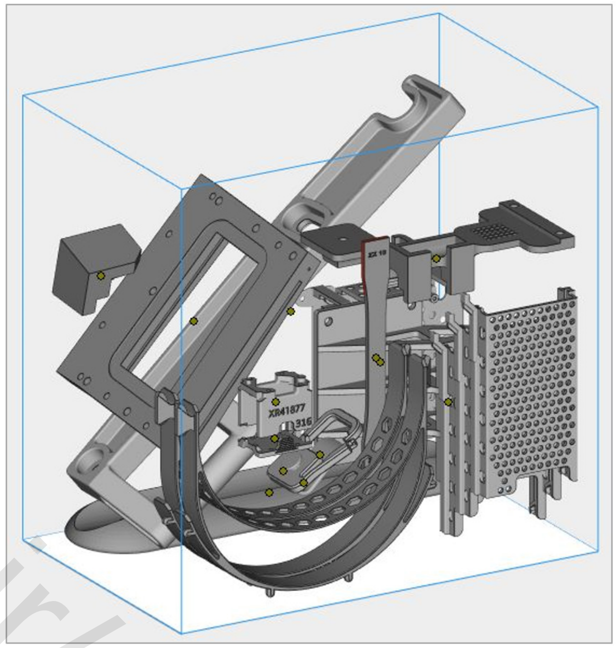
Freedom of design is another valuable benefit. 3D printing's additive nature means you can make geometric shapes and features that just are not possible with molding or machining. This potentially opens new opportunities both from a design and a business perspective. Assemblies can be made into a single part, reducing labor and part count. Jobs you could not previously take because they could not be molded or machined are now possible.

3D printing also shortens the supply chain and gives manufacturers more options including making parts at or closer to the point of use. This can be critical to meeting production target dates when traditional supply chains are hampered by factors outside your control, such as shortages from material or tooling suppliers to transportation disruptions due to global pandemics. It reduces the need for a large inventory, letting you produce and scale as needed to meet production demands.

An Optimal 3D Printing Technology for Plastic Parts

Powder bed fusion (PBF) is one of the seven 3D printing categories defined by the American Society for Testing and Materials (ASTM).[2] PBF includes the additive manufacturing technologies in which thermal energy selectively fuses areas on a powder bed. For plastic parts, this technology has mostly relied on a laser as the heat source, in a process known as laser sintering (LS). While this is a highly effective production method, time-to-part is based on the time it takes for the laser to fuse every single point in the layer of the part being printed, one at a time. Larger, more complex parts and higher production quantities will take much longer than fewer, less complex parts.

A key benefit of PBF 3D printing is its ability to efficiently and cost effectively produce numerous parts in a single build operation. Parts can be nested in three dimensions, within the entire build chamber, maximizing production output per build. This makes it particularly attractive for production-scale manufacturing. Another benefit is the capability to batch different parts within the same build; in other words, the parts within a build do not all have to be the same design. This provides flexibility to cost effectively produce parts as they are needed, free from minimum quantity limitations.



An illustrative view of how multiple parts can be nested in the printer's build chamber.

2 ISO/ASTM 52900 - 15, Standard Terminology for Additive Manufacturing – General Principles – Terminology

An Optimal 3D Printing Technology for Plastic Parts

Recent innovations in plastic PBF have spawned faster processes where, instead of having to fuse point-by-point with a laser, fusing of a full swath of the powder bed is done all at once, using the combination of print heads and a heat source. In these faster processes, print heads accurately deposit a fluid along the powder bed onto the areas to be fused. This fluid enables the polymer particles to absorb more heat than the particles without the fluid, selectively fusing them together when a heat source, like an infrared lamp, passes over the powder bed.

Most importantly, the leap in printing speed provided by these innovative print-head PBF 3D printers multiplies the production levels at which functional plastic parts can be manufactured cost-effectively. This creates opportunities to 3D print plastic parts in higher volumes and capture new business.

Not All Printers are Created Equal

To make the most of an investment in this technology, it's important to pay attention to the differences among the various PBF 3D printing technologies. These differences beget different results based on specific manufacturing needs such as cost-per-part, productivity, consistency, accuracy and mechanical properties. When the goal is manufacturing higher volumes of production parts, certain needs stand out as significant:

- Part consistency within and between production lots
- Competitive and predictable cost per part

Let's take a closer look at each of these items.

Production Consistency

As a manufacturer, one of your primary metrics is producing parts that meet specifications. Quality slips and variability among parts aren't acceptable, as they only increase per-part cost and jeopardize on-time production.

The key to 3D printing consistent parts with PBF is maintaining thermal control across the build surface. Without tight control, temperature will vary, which leads to variability in part properties, low accuracy and inconsistencies part-to-part.

For example, printers that don't maintain consistent temperatures across the build surface can produce variations in part properties and inaccuracies along the build envelope. This can cause part warping and the inability to maintain proper part flatness. The result is that not all of your parts will meet specifications.

Competitive and Predictable Part Costs

Several factors contribute to printer operational costs which ultimately impacts per-part costs. A printer designed to produce parts that consistently meet design requirements minimizes scrap and its associated cost. Consumables such as print fluids are another consideration. All things being equal, printers that use fewer fluids to build the parts result in lower operational costs. Print head reliability also impacts cost based on how often they need to be replaced. Print heads with higher reliability mean less frequent replacement. Together, these factors all play a role in the cost to operate your printer and the determination of whether or not you can produce parts at a competitive cost.

At this point, you might be asking which 3D printing technology has what it takes manufacture end-use parts with production-level throughput at a predictable and competitive cost. What's the answer?

A 3D Printer Platform
Built for Production

The answer is the Stratasys H Series™ production platform, the 3D printing solution developed to meet the need for higher-volume manufacturing. The H Series production platform embeds SAF Selective Absorption Fusion – a uniquely different powder bed fusion technology.

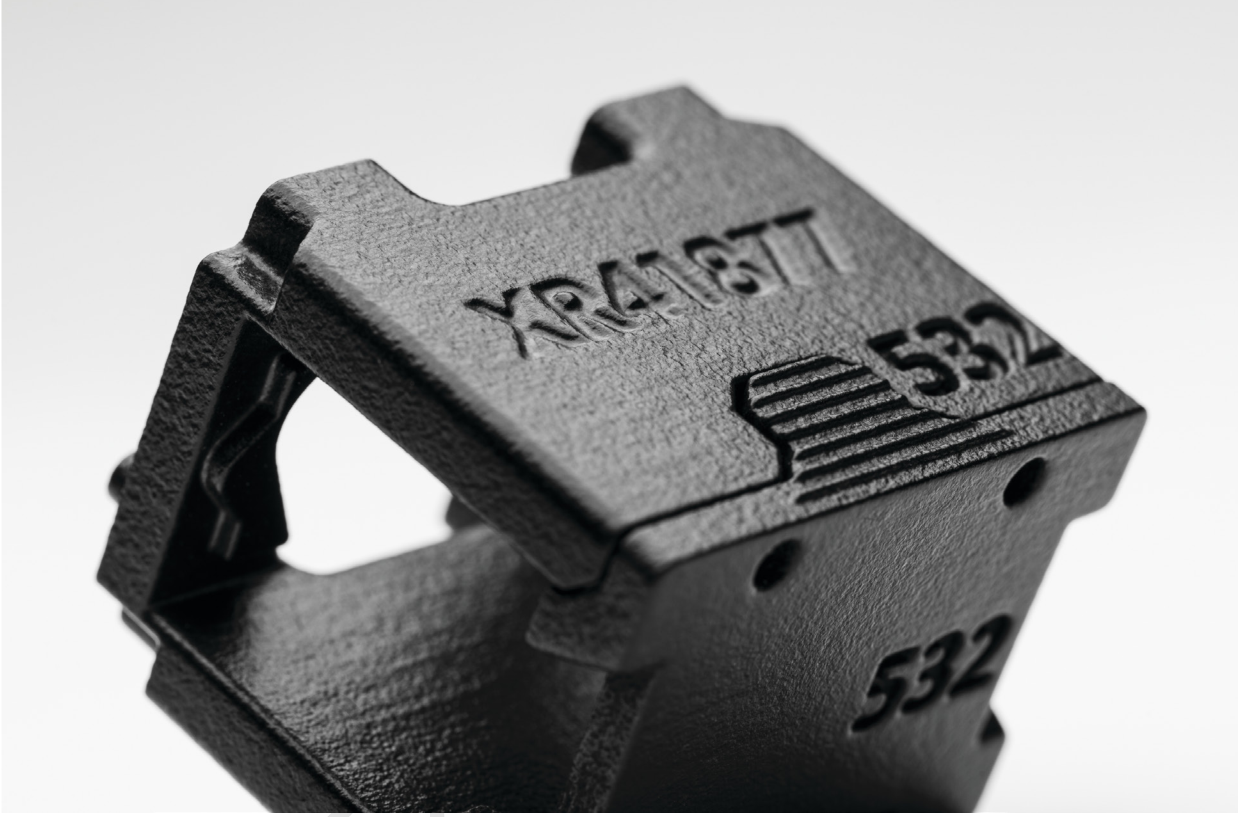
The benefits of SAF are its industrial grade technology, which allows production-level throughput of end-use parts. It is the cornerstone of the H Series production platform, designed to remedy the shortcomings of existing 3D printing solutions that lack the consistency and cost containment needed by manufacturers.

SAF technology achieves these goals by taking a new and different approach to PBF printing. It uses proven industrial print heads combined with an innovative methodology for powder management. High nesting densities and one-pass print-and-fuse enables higher production throughput. SAF technology's single print fluid and its unique time-and-thermal management result in the ability to achieve precise production parts at competitive costs.

Let's look more closely at what the H Series production platform with SAF technology offers and why these features are important.

Uniform Thermal Control Across the Entire Build Platform

Manufacturing consistency, whether it's for two parts or thousands of parts, requires an unvarying, dependable process. SAF technology maintains a uniform temperature profile within the printer bed producing consistent, repeatable results. This capability is due to the fundamental difference in the application of powder, heat and High Absorption Fluid, relative to other PBF printing solutions. High Absorption Fluid is an infrared-absorbing fluid, fusing the powder to form the part.



A 3D Printer Platform
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Industrial Print Head Design

SAF technology uses Piezo-electric print heads proven in a variety of industrial environments and applications like the ceramic tile printing industry, where the print heads are exposed to very high utilization cycles in harsh environments. In the print heads selected for SAF technology, the print fluid acts as an efficient coolant and maintains nozzle health. This proven design results in long-lasting performance, with corresponding low operational costs and virtually no production disruption. These print heads are able to stand high-temperature environments, like those required to fuse polymers with higher melting points.

Efficient Powder Management

How the polymer powder is managed and distributed within the printer has a direct effect on printer performance and part results. SAF technology includes Big Wave™ powder management that ensures the necessary powder is always deposited across the whole print bed, preventing thin areas which can result in overheating. Big Wave technology quickly recirculates any overflow powder directly back into the feed. This quick recirculation significantly minimizes powder thermal exposure, reducing powder aging (which impacts the polymer's mechanical and thermal properties) and the need to refresh with virgin powder, lowering operational costs.

The H Series platform with SAF technology lets you achieve production-level throughput of end-use parts free from the constraints of traditional tooling. It achieves this with a predictable, competitive cost per part.

Answering
Your Questions

SAF technology is a powerful manufacturing tool but it doesn't have to be mysterious or difficult. We've compiled these questions and answers as a start to help provide more clarity about the technology on the H Series production platform.

Q. What exactly is meant by "SAF technology?"

SAF Selective Absorption Fusion is the 3D printing technology behind the H Series production platform. SAF is one category of powder bed fusion 3D printing processes as defined by the ASTM. SAF technology uses an infrared-absorbing fluid to help fuse the polymer powder. This fluid is selectively placed where it's needed to create the shape of the part in any given layer. When the infrared-sensitive fluid is exposed to the printer's fusing lamps, it heats up to a higher temperature than the surrounding material. This "selectively" fuses the powdered particles together but leaves the adjacent material unfused.

Using highly reliable print heads, tight thermal control and an innovative powder management system, SAF technology offers a new alternative to other forms of PBF printing.

Q. How is SAF technology different from other powder bed fusion printers?

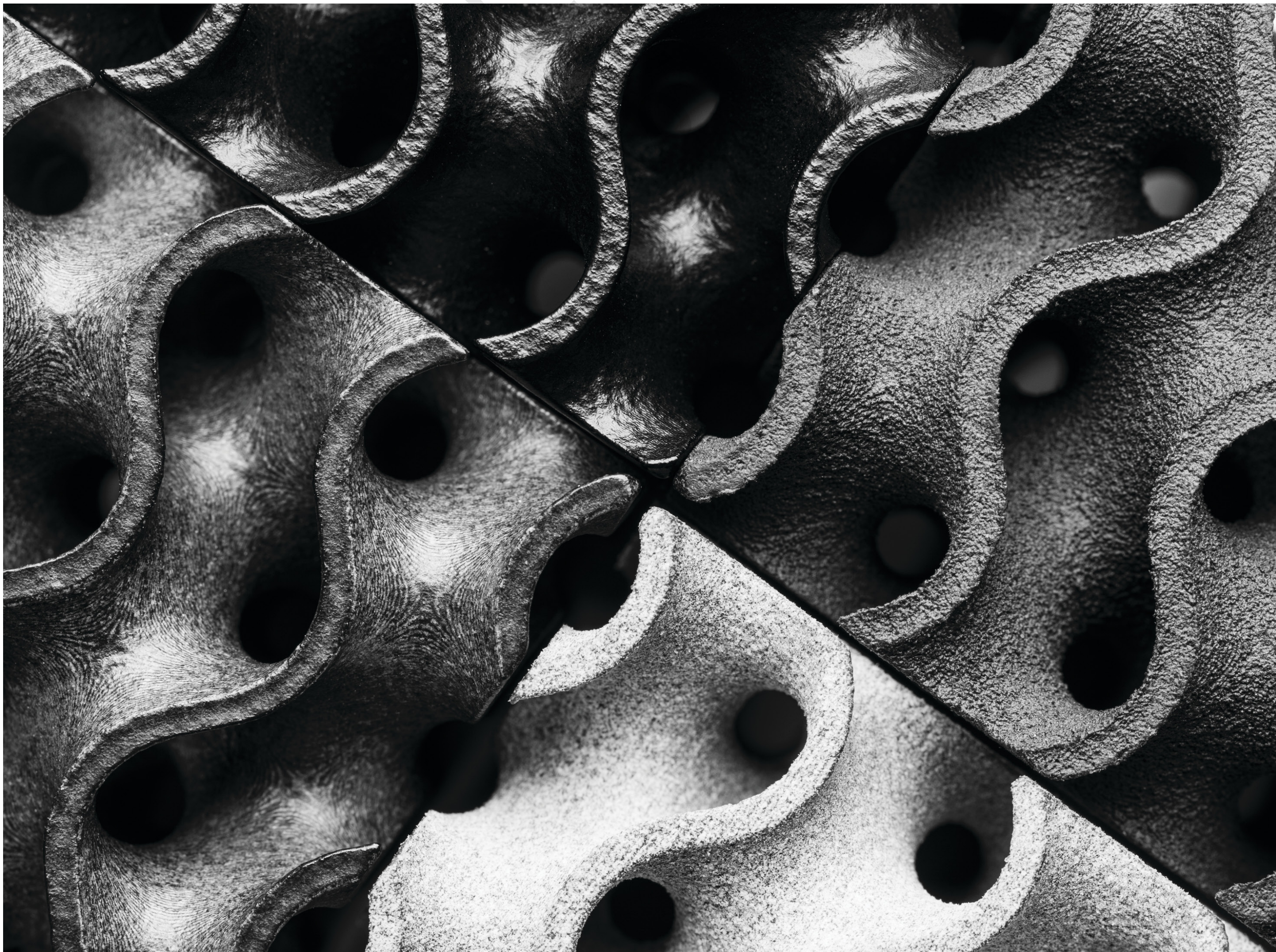
SAF's primary difference involves the process by which the polymer powder is distributed, heated and fused. SAF technology provides a high level of part detail requiring just one High Absorption Fluid. SAF technology's unique powder management ensures there's sufficient powder to cover the entire next layer, even when printing large cross-sectional areas, and reduces powder aging. This results in greater thermal stability, which provides better results in the form of part repeatability and material property consistency.

Answering
Your Questions

Q. What are the main elements in the printing process workflow with SAF technology?

SAF technology follows the same processing steps as other powder bed fusion printers:

- CAD files are input to the printer for printing. When parts are finished printing, they are embedded in a "cake" of unused, loose powder.
- After printing, the cake is removed from the printer and allowed to cool. After cooldown, the cake is broken apart to extract the printed parts.
- Parts can then be used or post-processed as needed.



Grow Your Manufacturing Capability

The H Series production platform with SAF technology provides opportunities that traditional manufacturing and other 3D printing methods don't. In practical terms, it gives manufacturers the ability to take on jobs that weren't possible before in a rapidly changing business environment.

Stratasys is no stranger to manufacturing. We've been providing 3D printing solutions to help customers solve their problems for over 30 years. Through our Stratasys Direct Manufacturing® contract experience we've helped customers achieve their goals using multiple forms of additive as well as conventional manufacturing technologies.

We also recognize that manufacturing needs differ based on design specifications, time schedules and customer requirements, so more than one solution is needed. That's why we developed the H Series production platform – to give customers more tools to expand their manufacturing capability with effective solutions for higher volume production.

To stay updated on the development of the H Series production platform and SAF technology, contact us.

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