ADDITIVE MANUFACTURING | CLEANING AS AN INTEGRAL PART OF FUTURE-ORIENTED MANUFACTURING PROCESSES

Technical Cleanliness as an additive Quality Factor

Additive manufacturing, often referred to as 3D printing, stands for design freedom and technological innovation – and challenges conventional cleaning processes at their core. Complex geometries with internal channels and functionally integrated structures set entirely new requirements for process reliability and cleanliness. For a leading manufacturer of additively produced high-performance components, MAFAC demonstrates that even in this forward-looking sector, perfect cleaning results are achievable when paired with future-ready technologies.

NEW REQUIREMENTS FOR INDUSTRIAL CLEANING

In additive manufacturing, components differ fundamentally from those produced using conventional methods. While traditional processes are limited by tool geometries and machining steps, the various additive technologies largely remove these restrictions. They enable extremely complex and delicate designs – bionic structures, internal lattice geometries, or multifunctional components. The result is lighter, stronger, and more efficient products that would be impossible to realize with traditional methods.

The technology expands the freedom of design, development, and production and has long found its way into many industries – from customized medical implants and precision parts to complex lightweight structures for aerospace, energy systems, and even architecture.

Yet with these new opportunities come new challenges. Powder residues, sintered deposits, and filmic contaminants settle deep within microstructures, adhere to surfaces, or accumulate in areas that are difficult to access. Conventional cleaning methods quickly reach their physical limits. Spray or immersion processes cannot fully reach internal cavities, while manual rework is error-prone and barely reproducible.

Especially in safety-critical applications or when components are subsequently coated, painted, or functionally finished, absolute cleanliness is essential. What has been missing so far is a stable, validated process that can be automated, documented, and integrated into quality assurance.

This was precisely the gap a leading manufacturer of additively produced high-performance components set out to close.

As a pioneer in additive manufacturing, we constantly evolve our technologies and processes – even in areas where no standards exist yet. Industrial cleaning was one of those challenges.

With openness and precision MAFAC handled this topic in the same way as we understand innovation. The result is impressive – both technically and in terms of partnership.

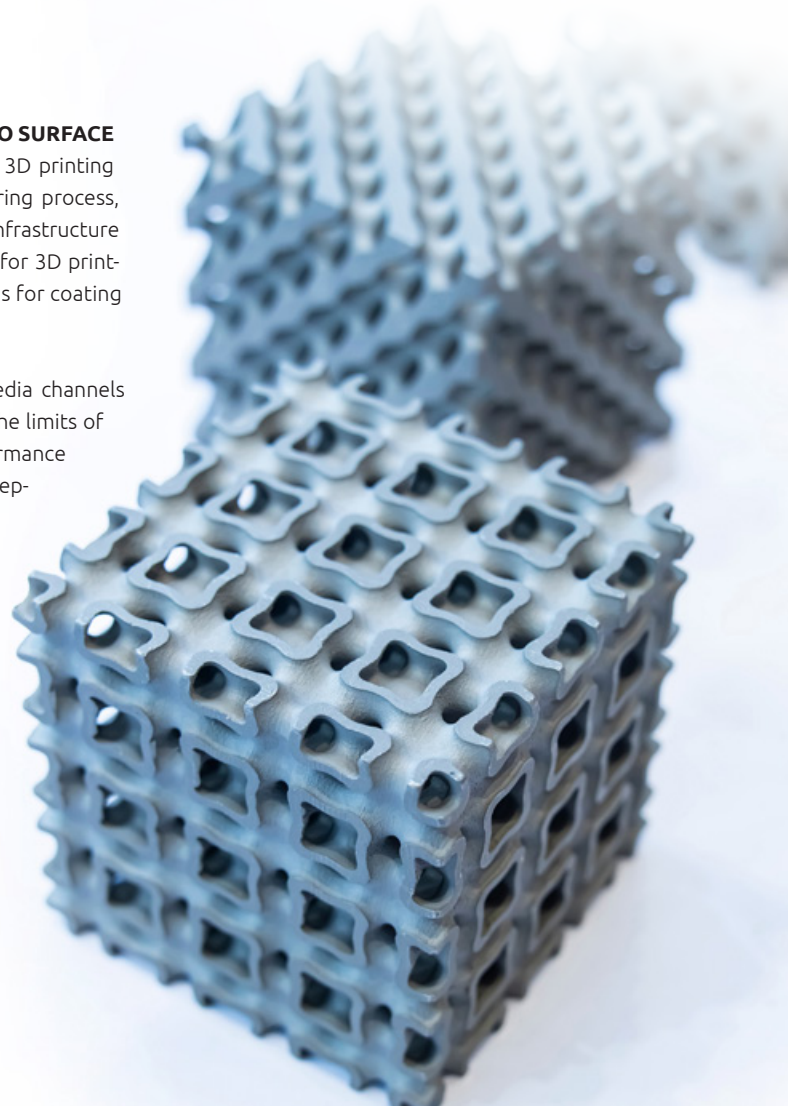
Customer feedback

ADDITIVE MANUFACTURING WITH SYSTEM – FROM POWDER TO SURFACE

The company ranks among the technological pioneers in industrial 3D printing and has continuously advanced its laser-based additive manufacturing process, known as Laser Powder Bed Fusion (LPBF). Its digital manufacturing infrastructure includes ten laser sintering systems, a dedicated research platform for 3D printing, a proprietary chemical smoothing process, and specialized areas for coating and painting.

The result: highly complex lightweight structures with internal media channels and functional interfaces – monolithic components that transcend the limits of conventional production. The materials used range from high-performance polymers such as PA12, PA11, or TPU to specialty materials with exceptional thermal and chemical properties.

Depending on the application, the printed parts are color-finished or optically refined before being precisely processed in post-treatment and assembly. This manufacturing depth is supported by a multi-stage quality assurance system that extends from powder management and the build process to surface finishing. Cleaning has become an increasingly critical stage in this process chain – one that until recently could not yet be seamlessly integrated into additive manufacturing.



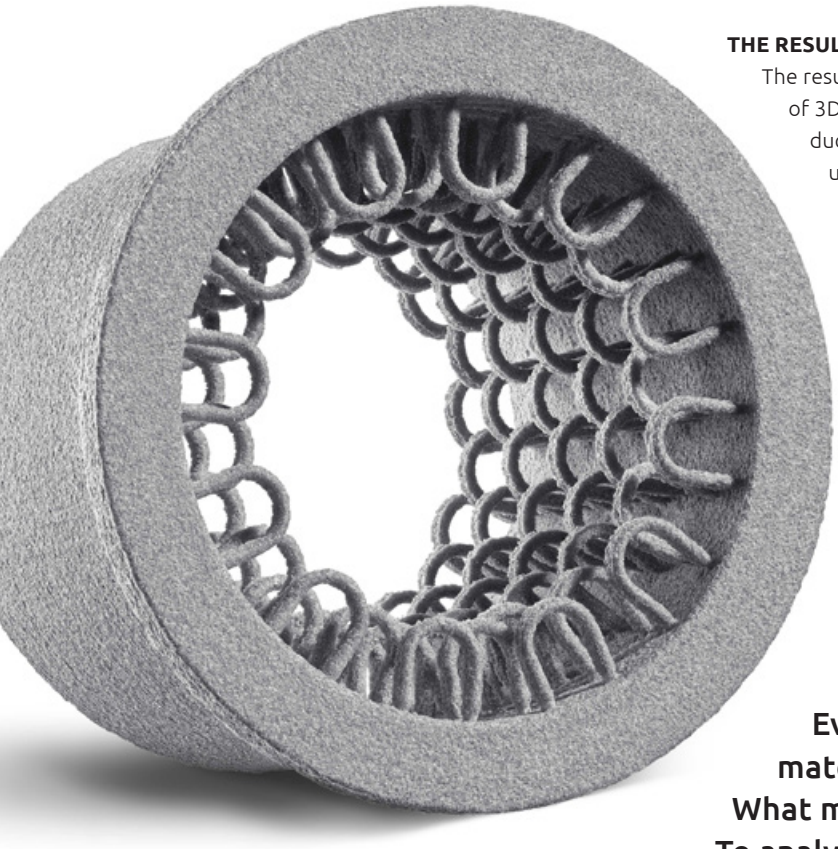
FROM ANALYSIS TO THE RIGHT TECHNOLOGIES

That cleaning within the additive process chain was still an open issue served as an incentive for MAFAC. From the outset, the company delved into the specific demands of additive manufacturing – from materials and part geometries to typical powder and post-processing residues.

Collaboration with the customer took place on equal footing. Together, they evaluated sample parts, identified critical areas, and compared different cleaning strategies. It quickly became clear that conventional systems could only meet the requirements of additive manufacturing to a limited extent. The key was to tailor the cleaning process precisely to geometry, material, and residue type – ensuring maximum process stability and reproducible cleanliness.

After extensive testing, MAFAC selected two of its in-house developed, patented technologies, supplemented by ultrasonic cleaning. With MAFAC Vectorkinematics, the basket and spray system rotate while the spray arm simultaneously performs swiveling motions. The constantly changing spray angles deliver a significantly higher cleaning effect compared with rigid systems. During flooding, increased flow turbulence enhances the interaction between cleaning medium and surface. The motion of the nozzles also supports uniform and efficient drying in the subsequent process step. The MAFAC VAP (Vacuum Activated Purification) process adds another dimension: alternating vacuum and overpressure cycles in the cleaning bath generate dynamic flow patterns that reliably flush even the smallest channels and complex internal cavities.
All process parameters – pressure, temperature, media quality, and time – can be precisely controlled, stored, and, if necessary, adjusted for new geometries or materials. This ensures reproducible process quality and consistently high cleaning results.

In further test series using original parts, MAFAC validated the performance of the selected configuration. Different materials and geometries were analyzed, parameters fine-tuned, and results documented. The outcome is a stable, auditable cleaning process that integrates seamlessly into the customer's digital manufacturing workflow – and demonstrates the potential created when additive manufacturing meets innovative cleaning technology.



THE RESULTS – CLEAN PERFORMANCE, NEW PERSPECTIVES

The result speaks for itself: internal structures and complex geometries of 3D-printed products and components can now be cleaned reproducibly and with full material protection. There is no need for manual rework, inspection effort is reduced, and the cycle times are significantly shorter. The additive manufacturing process chain is now fully closed for the first time.

MAFAC also draws a positive conclusion. The project provides valuable insights for future applications and demonstrates how flexibly the company's technologies and expertise can be transferred to new industries. At MAFAC, there are no standard solutions.
Every task calls for a customized combination of cleaning system, process, and application design.

**"Exploring new grounds is our daily business.
Every project brings new geometries, materials, and process conditions.
What matters is embracing these challenges.
To analyze, to develop and to test until the result is meeting the requirements.
That's how convincing solutions are created, that truly make a difference."**

B. Eng. Lukas Baier, Head of Global Service & Industrial Solutions MAFAC

ADDITIVE MANUFACTURING PROCESSES

GLOSSARY

Additive manufacturing employs a range of technologies to build parts layer by layer.
Depending on the material, energy source, and application, the following processes are commonly used:

Laser Powder Bed Fusion
The customer's process is based on the layer-by-layer application of a fine metal or plastic powder, which is then selectively fused by a laser. The result is highly precise, durable components with complex internal structures.

Binder Jetting
Metal Binder Jetting
A liquid binder connects powder particles layer by layer before the component is sintered in a furnace. This method allows the production of fine geometries and high part volumes.

Material Extrusion
Fused Deposition Modeling
Fused Filament Fabrication
A thermoplastic filament is melted in the nozzle and deposited layer by layer. Primarily used for plastics, especially for prototypes and small series.

Directed Energy Deposition
Laser Metal Deposition
Powder or wire feedstock is deposited directly into the melt pool and simultaneously fused by an energy source – usually a laser, but sometimes an electron beam or plasma.
The process is mainly used for metals and is ideal for repair, reinforcement, coating, or hybrid manufacturing applications.

Electron Beam Melting
Similar to LPBF, but using an electron beam instead of a laser. Especially suitable for titanium alloys and parts used in aerospace applications.

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What drives us, what we offer

MAFAC. That meant, and continues to mean, the vision of setting industrial parts cleaning into motion.
By water, without solvents.
To protect people and environment.

Today, this vision is motivation for about 100 people at MAFAC, who are passionate about developing and perfecting innovative technologies. Patented technologies for faster cleaning and targeted drying. For reproducible best results and sustainable, high process reliability.

With these water-clear advantages and decades of in-depth expertise, we are a trusted partner to well-known companies in various fields of application.
Based on on the MAFAC machine portfolio, we implement efficient cleaning solutions tailored to industry and customer-specific requirements - from quick basic cleaning to high purity.

And in everything we do, we remain true to our core principle. Stay in motion, to expand our position as technology leaders into new industries and new markets.

MAFAC optimizes your cleaning process: Technologies | Cleaning systems | Process solutions | Services | Turnkey solutions

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