PRECISION AND PERFORMANCE:

The Power of Gas in AM Post Processing

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Post Processing in Additive Manufacturing

Additive manufacturing (AM) has transformed how manufacturers design and produce complex parts, but printing is only the beginning. To meet performance standards and functional requirements, parts must go through post processing. This final step in the additive manufacturing value stream removes excess powder, refines surface finish, enhances mechanical properties and ensures precise tolerances.

This stage includes a variety of techniques, from de-powdering and thermal processing to surface finishing, all of which contribute to a part's durability, consistency and overall quality. Industrial gases such as argon, nitrogen and hydrogen play a key role throughout these processes — helping prevent oxidation, improve material properties and ensure repeatable results.

In this eBook, we'll look at how gases support these essential post processing techniques, helping manufacturers optimize quality, efficiency and performance to meet industry demands.

De-Powdering

Powder bed fusion is one of the most widely used additive manufacturing processes. Metal parts produced through this method — including Selective Laser Melting (SLM), Selective Laser Sintering (SLS) and Direct Metal Laser Sintering (DMLS) — must undergo de-powdering before further processing. Thoroughly removing excess powder is especially critical in metal additive manufacturing, as even small residual amounts can affect part performance and disrupt finishing treatments.

Gases like argon and nitrogen play an important role in making de-powdering more effective and safer. An inert argon or nitrogen atmosphere helps reduce static adhesion, making it easier to remove fine particles from the printed part. It also helps minimize the risk of combustion or explosion when working with reactive metals like titanium and aluminum, where loose powders can ignite in the presence of air.

By controlling the environment with the right gas applications, manufacturers can ensure parts come out of de-powdering clean, stable and ready for the next stage — whether that's heat treatment or final finishing.

THERMAL PROCESSING:
Sintering

Sintering is a crucial step in metal additive manufacturing, transforming printed parts into dense, high-strength components. This process involves heating metal powders to just below their melting point, allowing particles to bond and form a solid structure. To achieve optimal results, a controlled gas atmosphere — typically argon, nitrogen, hydrogen or a combination of those gases — is used to prevent oxidation and contamination and promote particle to particle bonding.

The right balance of temperature and gas flow ensures uniform heating, which contributes to material strength, density and overall durability. Without proper gas control, parts may develop inconsistencies, porosity or unwanted chemical reactions that compromise performance.

Optimized sintering with the proper sintering atmosphere gas leads to a more refined microstructure, improved mechanical properties and reduced porosity — critical factors for applications in aerospace, medical and industrial manufacturing. By maintaining a stable, oxygen-free environment, manufacturers can achieve consistent, high-quality results that meet the demanding standards of modern additive manufacturing.

THERMAL PROCESSING:

Hot Isostatic Pressing

Hot isostatic pressing (HIP) is a post processing technique used to enhance the density and mechanical performance of metal AM parts. By applying high temperature and isostatic (equal) gas pressure — typically using argon — HIP eliminates internal porosity, improves fatigue resistance and strengthens parts for demanding applications.

Argon is ideal for HIP because of its inert properties, ensuring uniform pressure distribution across the entire part without unwanted chemical reactions. This process not only increases part density but also enhances toughness, ductility and overall reliability.

Industries such as aerospace, medical and energy rely on HIP to produce high-performance components that must withstand extreme conditions. From aircraft turbine blades to biomedical implants, HIP ensures parts meet stringent quality standards by refining their internal structure and optimizing mechanical properties for long-term durability.

THERMAL PROCESSING:
Heat Treatment

Heat treatment is an essential post processing step in metal additive manufacturing, refining mechanical properties like hardness, strength and toughness to meet industry demands. By exposing printed metal parts to controlled heating and cooling cycles, manufacturers can refine the microstructure, relieve internal stresses and improve overall performance.

To ensure consistent results, gases like argon and nitrogen are used to create a controlled atmosphere that minimizes oxidation and prevents unwanted chemical reactions during heating.

Precise temperature control and gas consistency are key to achieving uniform properties across parts. Whether it's stress relief, annealing or precipitation hardening, an optimized heat treatment process ensures predictable performance, durability and compliance with industry specifications — making it indispensable for high-performance applications in aerospace, medical and industrial manufacturing.

Cleaning and Surface Treatment

Cleaning and surface treatment play a vital role in post processing, refining surfaces to meet functional and aesthetic requirements. These processes remove contaminants, improve surface finish and enhance durability for various applications.

Gases play a key role in advanced cleaning techniques. Dry ice blasting, which uses CO_2 pellets, effectively removes powder residues and surface impurities without damaging delicate features. This method is ideal for cleaning intricate AM parts, where traditional abrasive methods might compromise precision.

Beyond cleaning, surface treatments such as passivation or protective coatings improve corrosion resistance, wear properties and overall longevity. Selecting the right cleaning and finishing techniques based on part material and application ensures a high-quality final product — ready for deployment in industries where precision and reliability are paramount.

The Role of Gas in Post Processing

Gases play a crucial role in AM post processing, impacting part quality, efficiency and sustainability. Selecting the right gas with the proper purity prevents oxidation, contamination and material defects.

Gas Purity and Efficiency

High-purity gases play a critical role in post processing by ensuring material consistency and preventing contamination. In de-powdering, using a high-purity gas will help to minimize oxidation and static buildup, making powder removal more efficient. In sintering and heat treatment, the usage of a high-purity gas will help to prevent unwanted chemical reactions, which will improve part strength, density and surface quality.

Recovery and Sustainability Benefits

Optimized gas flow and recovery systems reduce waste and lower operating costs. Recycling argon from HIP not only cuts expenses but also minimizes environmental impact.

With smart gas management and precise application, manufacturers can enhance process reliability, reduce material defects and improve overall efficiency — ensuring high-quality AM parts that meet industry standards while supporting cost control and sustainability.

How Airgas Supports Your Post Processing Needs

Achieving reliable, high-quality results during post processing requires not just the right gases but also expert support in managing them. Airgas delivers tailored gas solutions designed to optimize each stage of post processing, from de-powdering and thermal treatments to advanced cleaning and surface finishing.

Airgas can also ensure your gas supply is sized to accommodate future growth, an important factor as more organizations bring post processing in-house. Airgas can help you choose a supply mode that is easily scalable and able to meet future gas requirements.

With a nationwide distribution network and industry-leading expertise, Airgas ensures consistent gas quality, efficient supply management and customized delivery solutions. Our experts work closely with manufacturers to develop optimized gas applications that improve process efficiency, reduce waste and meet stringent quality standards.

Whether you need guidance on gas selection, onsite supply solutions or advanced monitoring systems, Airgas provides the support you need.

Contact our team today to learn how our gas solutions can help you achieve superior results in your operations.

To learn more about gas usage during additive manufacturing, please continue reading this ebook series!

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3D Printing

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