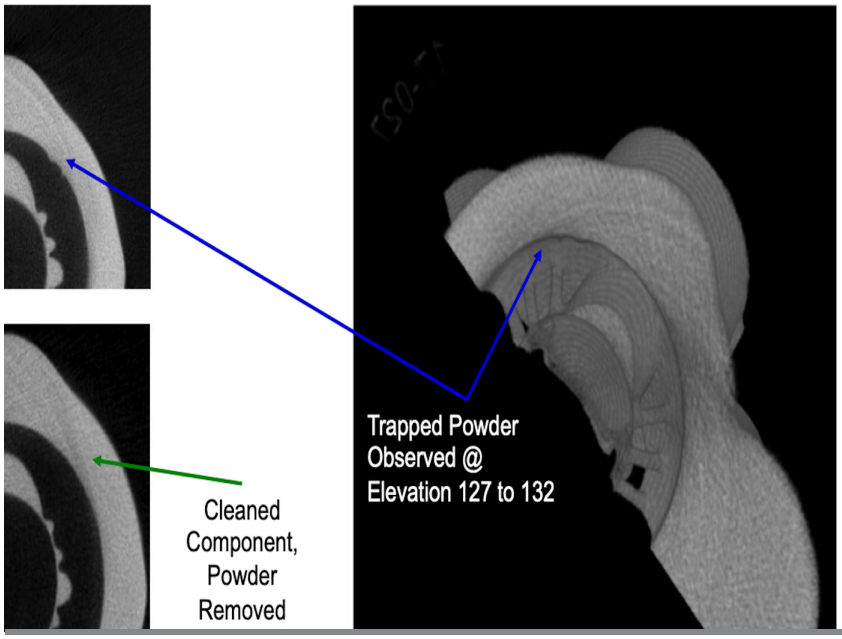


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Manufacturing

High Flow Differential Cleaning

Clean Complex Additively Manufactured Parts in Minutes - Not Hours or Days

Powder-based AM methods typically require post-fabrication component cleaning to remove residue powder from the surface and crevices of the part, a task that becomes increasingly difficult and time consuming with part complexity. Methods currently available to clean AM parts have significant drawbacks. Immersive cleaning using solvents or solutions can cause powder clumping. Forms of blasting (e.g., wet, bead, hydro, bristle, vacuum, etc.) work on line-of-site surfaces but are ineffective for recessed cavities. Such cleaning is typically manual, highly time consuming, and requires careful use of personal protective equipment to avoid powder inhalation. Thus, the AM market would benefit from a more automated, rapid, and effective method for cleaning complex parts.

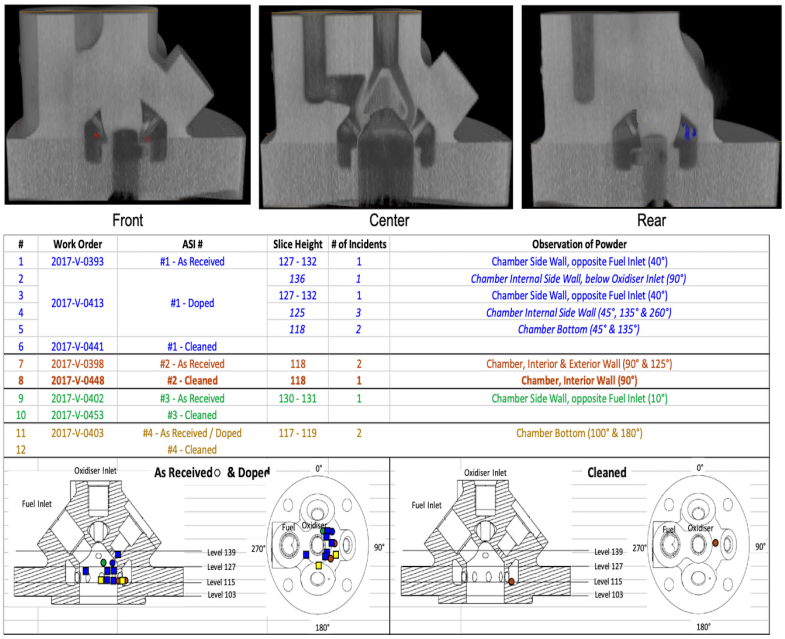
BENEFITS

- Fast, automated process: Parts are cleaned in seconds (minutes when including load/unload time), instead of hours or days
- Effective cleaning: CT-scans of cleaned parts revealed effective particle removal
- Works on complex parts: Removes remnant powder lodged in small channels and passageways found in complex AM parts

THE TECHNOLOGY

NASA developed this High Flow Differential Cleaning technology in response to in-house needs for a more automated and effective method to remove stubborn particles from complex parts fabricated using powder-bed-fusion equipment. The invention uses a large volume of pressurized air to quickly enter a cleaning chamber. Based on the Bernoulli principle and Continuity equation, the high flow results in significant air velocity and a decrease in pressure when airflow passes through smaller component orifices, which in turn removes remnant powder from the part. In one embodiment, the invention consists of a (1) high-pressure air compressor with ISO 8573 Class 2 drying capability, (2) a large pressure chamber with a fast-actuated valve system to, (3) a cleaning chamber containing various sensors, injection systems, (4) a test fixture designed for easy orientation adjustments, and (5) an expansion chamber allowing air to expand and drop in velocity, particles to settle, and filtered air to re-enter the room. This NASA technology can be implemented as a standalone cleaning system for powder bed fusion additively manufactured parts, or could be integrated into a packaged post-processing system offering. CT scans of complex NASA parts cleaned using a proof-of-concept system based upon the invention revealed very promising results.

NASA welcomes industry to test the cleaning speed and efficacy of the technology under an evaluation license.



#	Work Order	ASI #	Slice Height	# of Incidents	Observation of Powder
1	2017-V-0393	#1 - As Received	127 - 132	1	Chamber Side Wall, opposite Fuel Inlet (40°)
2			*136*	*1*	*Chamber Internal Side Wall, below Oxidiser Inlet (90°)*
3			127 - 132	1	Chamber Side Wall, opposite Fuel Inlet (40°)
4	2017-V-0413	#1 - Doped	*125*	*3*	*Chamber Internal Side Wall (45°, 135° & 260°)*
5			*118*	*2*	*Chamber Bottom (45° & 135°)*
6	2017-V-0441	#1 - Cleaned			
7	2017-V-0398	#2 - As Received	118	2	Chamber, Interior & Exterior Wall (90° & 125°)
8	**2017-V-0448**	**#2 - Cleaned**	**118**	**1**	**Chamber, Interior Wall (90°)**
9	2017-V-0402	#3 - As Received	130 - 131	1	Chamber Side Wall, opposite Fuel Inlet (10°)
10	2017-V-0453	#3 - Cleaned			
11	2017-V-0403	#4 - As Received / Doped	117 - 119	2	Chamber Bottom (100° & 180°)
12		#4 - Cleaned			

Proof-of-Concept Testing - Component Analysis

APPLICATIONS

The technology has several potential applications:

- Powder-based additive manufacturing, including direct metal laser sintering (DMLS), electron beam melting (EBM), selective heat sintering (SHS), selective laser melting (SLM), and selective laser sintering (SLS)
- Post-processing of complex additively manufactured parts

PUBLICATIONS

Patent Pending

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

MFS-33553-1, MFS-33553-1-PCT, MFS-TOPS-99

More Information

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