Additive Manufacturing Depowderer

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L3HARRIS™

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Background

L3Harris uses Multi Jet Fusion (MJF) printing in their additive manufacturing lab (Figure 1, Left). MJF printing is a type of 3D printing that creates 3D objects by fusing layers of nylon powder together.

Problem

MJF printed parts come out of the printer caked in loose nylon powder, which must be removed (Figure 1, Right). Currently, L3Harris depowders these parts by hand, but for high production volumes, this is very time consuming. **Our team has been tasked with building a machine to depowder parts automatically.**

Figure 1: (Left) The HP-MJF printer at L3Harris' additive manufacturing lab. This printer fills an entire 15" cube with nylon powder layer by layer and fuses the powder to print parts. (Right) Manually vacuuming MJF printed parts, which are covered in loose nylon powder.

Testing

Our testing phase covered several methods of depowdering and analyzed the efficiency of each method (Figure 2). Our testing revealed rotary tumbling to be the most effective way to depowder MJF printed parts. This testing was done on "worst-case" scenario parts with intricate geometry including cavities, slots, holes, and lattices.

Method	Depowdering Efficiency	Depowdering Time	Powder Separability	Expected Cost	Mechanical Complexity	Total Score
Tumbling (ceramic beads)	4	3	4	5	3	19
Tumbling (steel pins)	5	2	4	4	3	18
Tumbling (steel shot)	4	4	1	3	3	15
Vibartory tumbling (corn husk)	2	2	3	2	1	10
Sand Blasting (steel shot)	5	5	1	2	1	14
Sand Blasting (glass beads)	4	5	1	1	1	12
Ultrasonic Bath (isopropyl alcohol)	0	0	1	1	5	7
Ultrasonic Bath (kerosene + vinegar)	0	0	1	1	5	7

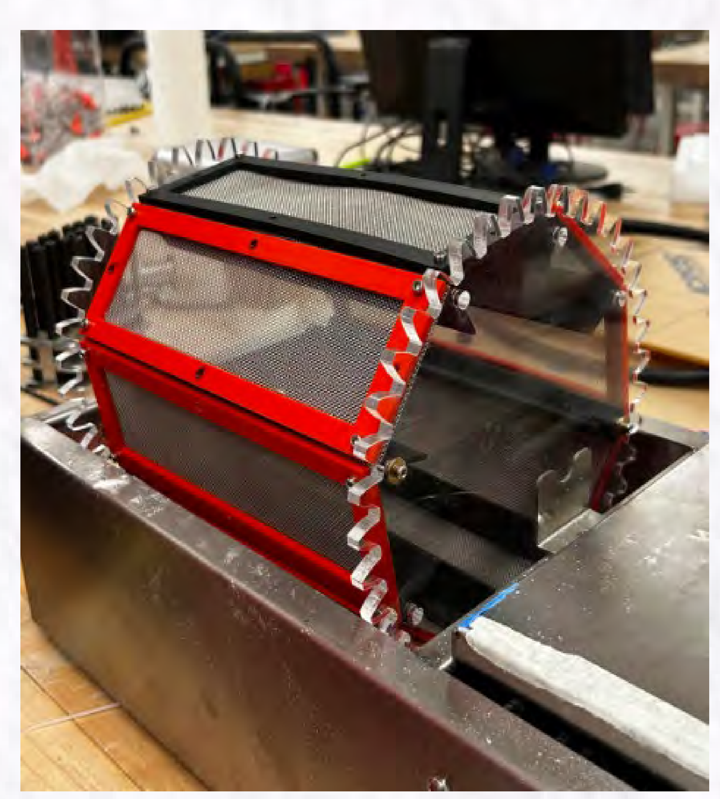

Figure 2: (Middle) We then evaluated the performance of each technique across our design metrics. We found rotary tumbling had the best performance. (Right) We then created a small-scale prototype of an automatic depowdering tumbler to inform our full-system design.

Design

After testing, we designed and manufactured an end-driven rotary tumbler with a touchscreen HMI, powder separation, and powder collection (Figure 3).

Figure 3: Front view of the depowdering system. The assembly height with the lid closed stands at 4'6". A user takes the lid off and places the parts inside the barrel. As the barrel spins, powder falls through the mesh into the powder collection chamber below.

Results

From preliminary data, our rotary tumbling was able to remove at least 85% of bulk powder from MJF printed parts while collecting around 70% of bulk powder for re-use and taking only 20 minutes of hands-on operation time.

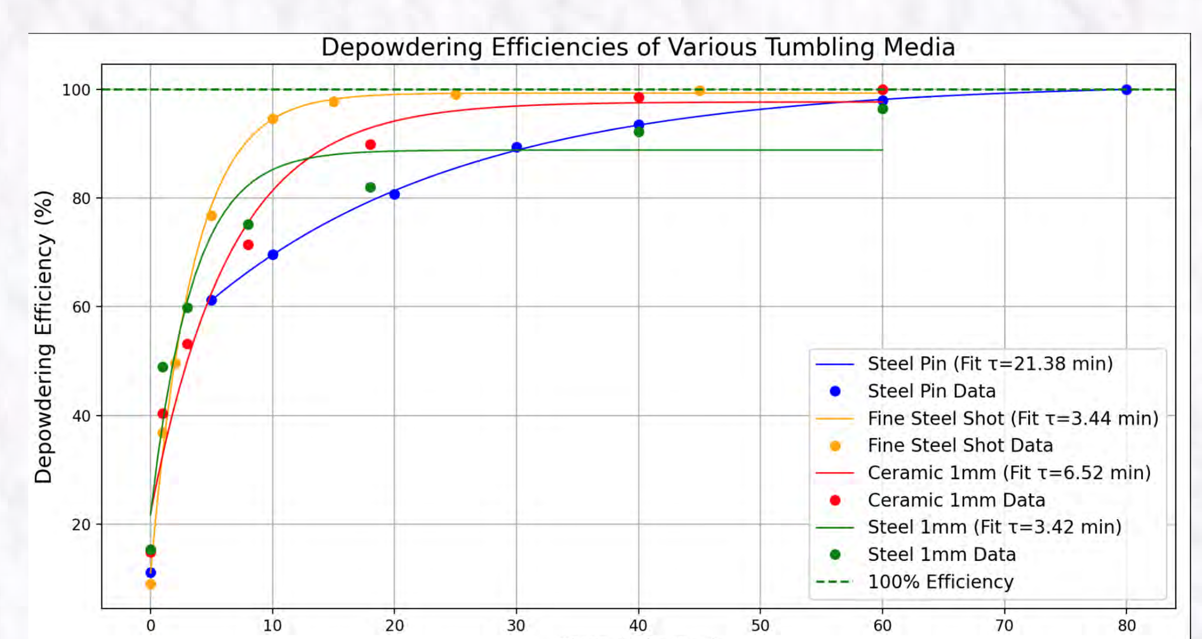

Figure 4: Timeseries plots of depowdering efficiency over time with various tumbling media. All media performed well, but fine steel shot and ceramic beads had the lowest time to 100% depowdering efficiency.

Conclusion

Our design successfully depowders parts with at least 30% powder collection automatically. It can depowder parts up to 15"x15"x15" in size, and depowder holes as small as 0.1" in diameter. Our team will now handoff the system to L3Harris for use in their additive manufacturing lab.

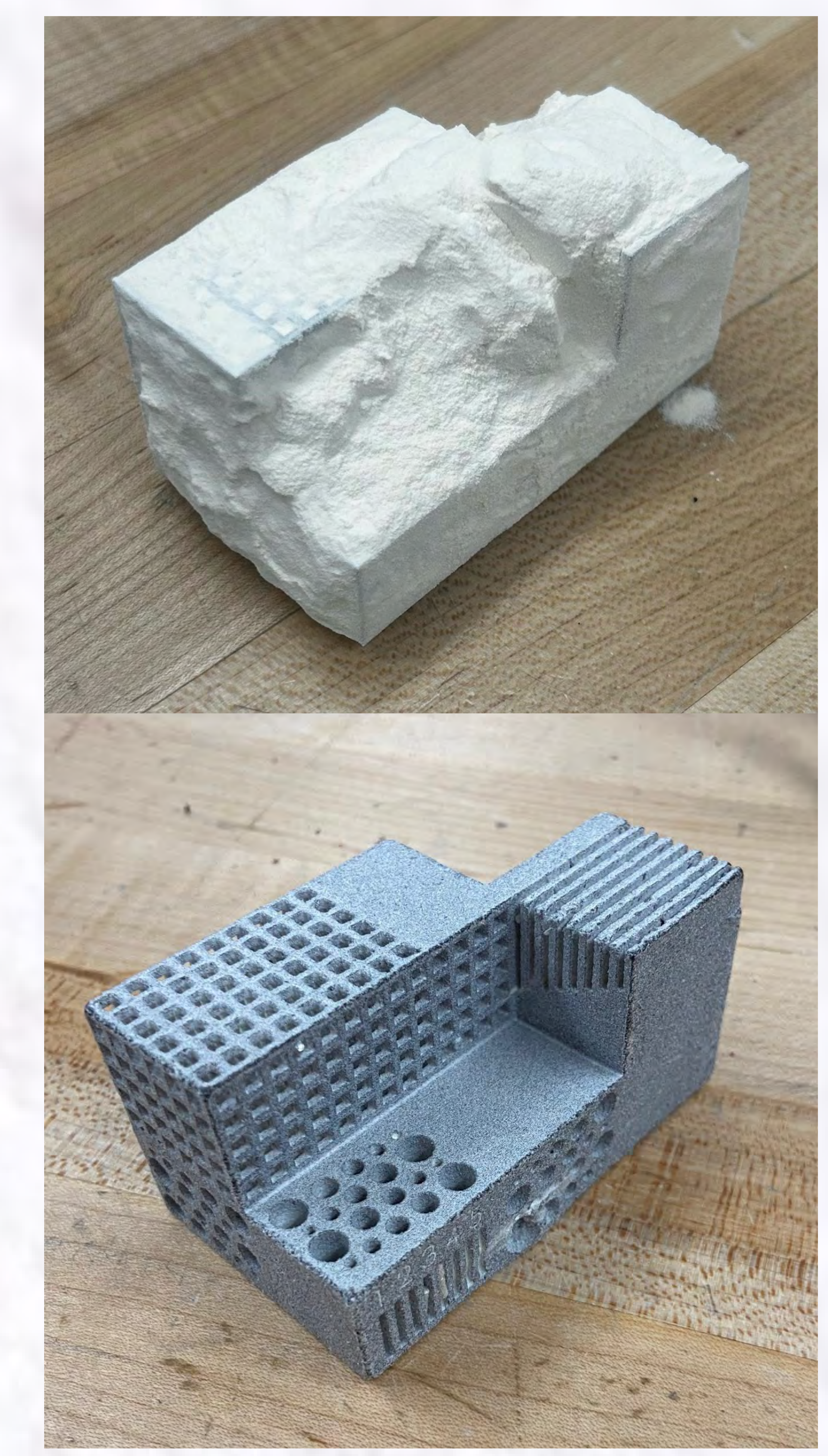

Figure 5: Our standardized test part before and after depowdering in our machine for 2 hours.

Overall, our system minimizes labor and also enhances workflow productivity for MJF printed parts. This makes our approach a practical and accessible alternative for users seeking a simple solution without the significant cost of existing depowdering solutions.