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POWDER COLLECTOR FOR ELASTOMERIC MATERIALS

HP INC

Powder collector for elastomeric materials

Overview of the system

Cake is when a material “sticks” together with itself, leading to large spongy regions of powder. It is an important factor in the printing of elastomers in Multi-Jet Fusion. Cake is caused by time at temperature of the powder that causes the surface of the powder to flow, leading to change in rheological properties of the powder. The more time at temperature the powder is exposed to, the harder the cake will be.

Keeping the integrity of cake to test powder properties is incredibly difficult. It is sometimes needed to check the behavior of the white powder on online tests but requires minimal alteration to the printed white powder behavior.

A higher amount of cake leads to decreased powder processability. Increased caking of the powder can also lead to workflow issues, for example physical intervention by the user when loading powder into the processing station, which would lead to problems in scaling to a manufacturing environment. It has also been seen to affect part quality.

To be able to measure the cake, first it needs to be collected from the Build Unit. The collection should be a representation of the powder in the bed but still small enough to be collected as a whole cake. It should also be collected in a way that doesn’t affect very much the thermal or physical conditions to which it is exposed, to mimic the white powder as well as possible.

Now there isn’t a way to collect powder in situ from an online test without altering it thermally or physically.

Figure 1: Images of caking and its consequences

Novelty solution: Using our powder collector, we can collect and extract a representative amount of powder from the bed without altering it thermally or physically.

Once the powder is collected, it can be taken out of the collector with very little effort and tested for cake and powder properties (including cake hardness, viscosity, PSD, etc.).

Which are the problems that this system solves?

This approach intends to solve the issue of extracting powder from elastomeric materials from the Build Unit, while minimally altering the properties of the printed cake, to be able to evaluate its degree of caking and other material properties. A high degree of caking can spoil the powder and make it non-processable. It can also affect other part properties that are affected by powder quality – monitoring these properties could predict part quality.

By creating a powder collection box, we can collect and extract an intact piece of "cake" from the Build Unit. The cake collected with this solution is fully representative of the build unit material during the printing process. This will allow for in-situ powder characterization and quality control to avoid increased downtimes or other consequences like part quality decrease or having to dispose the powder.

How does the system work?

The aim of this method of collection of powder is to be able to collect powder from elastomeric materials used in MJF, with minimal alteration to its printing conditions and thermal conditions, so that it can be used for any experiment that requires a large amount of intact powder.

To do so, the box has a lattice structure that minimizes the heat that is released from the box to the powder while still having a solid enough structure for the cake not to be damaged during the extraction. If the box was solid, the heat generated by it would be much higher, therefore not representing the natural state of the white powder. On the other side, if there was no box, the collection of the sample would be much harder, and the cake would most definitely be damaged in the process and therefore would be of no use.

To be able to perform a test that requires a large amount of intact cake, it must be extracted from the collection box. To facilitate the extraction, the box has some grooves on the corners which allow for the box to be opened by hand and therefore minimize the risk of breaking the powder inside.

Figure 3 shows the design of the powder collection box, with a lattice structure and grooves on the corners to facilitate extraction:

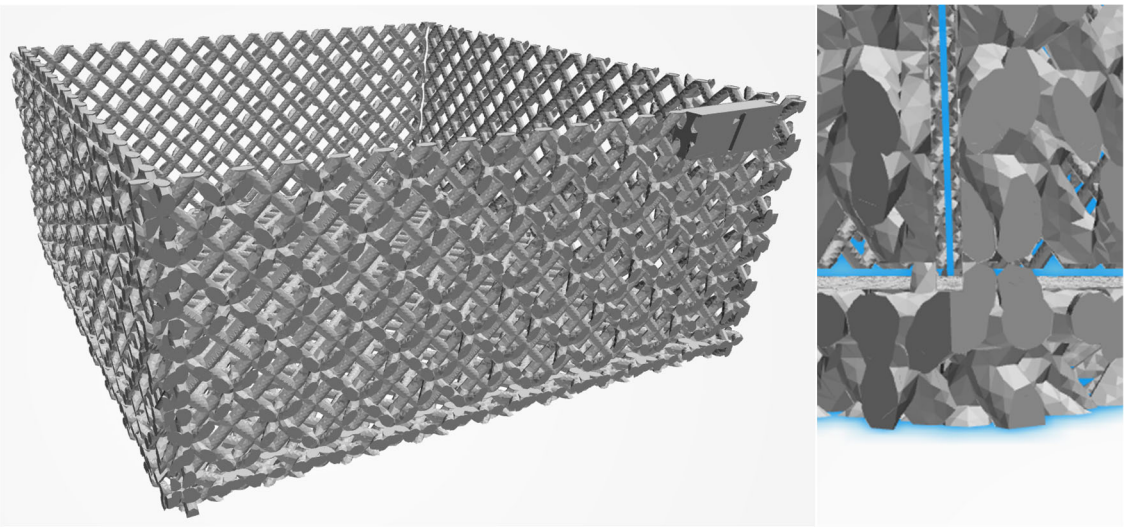

Figure 3 Design of the powder collection box. Left: the powder collection box. Right: detail of the grooves on the corners to facilitate extraction.

Figure 4 shows the ease of extraction of the cake in the box:

Figure 4. Extraction of the powder in the box. Left: powder before the box has been opened. Right: powder after opening the box.

Which are the advantages of doing it this way?

- Be able to take controlled powder samples to be analyzed in the lab without modifying their properties.
- Be able to measure powder properties from the sample – including: Cake, PSD, Shrinkage etc.
- Can potentially be used for multiple materials that are prone to cake (or even materials that flow greatly).
- Improve customer satisfaction by being able to collect samples of intact powder from the printer.
- It is an easy method for powder quality control.

Are there other kinds of solutions in the market?

Previously, closed cubes were used to extract powder from the bed, but because of their solid walls, the material inside was affected thermally and therefore changed its natural condition. It was also very difficult to remove the powder from inside in a way that it was left intact. These were also used to measure the color for polyamides.

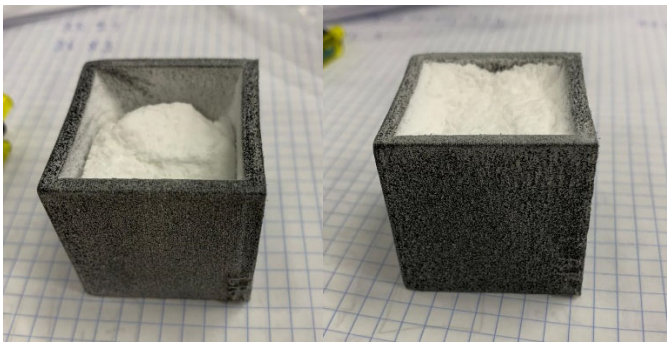

Figure 2: Prior powder collection closed cubes. Observe that powder inside is more caked than normal.

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