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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. This can be a serious problem during printing as it can lead to large amount of powder waste if the caking material is not well controlled. It can lead to the failure of jobs due to the powder spreading poorly hence poorly fused parts, and furthermore in some cases the material is unable to be recycled. Elastomeric materials are more susceptible to caking, however it can occur in any powder if the thermal process is not well controlled.

Caking also leads to a decrease in workflow, as it often requires technician intervention for example to break the cake when unpacking, and lack of flow during loading times in the processing station. This could lead to poor scale up for manufacturing purposes.

Figure 1: Examples of consequences of cake on the powder processing. Left: Powder Caked in a storage overflow. Right: Example of dirty sieve due to high level of agglomerates caused by cake.

Novelty solution: We have designed a method for measuring the level of cake in situ (i.e., Under printing conditions), therefore being able to predict whether a powder may require extra intervention hence affecting workflow or require the user to return the material based on the given specifications.

Which are the problems that this system solves?

This approach intends to provide a method of testing of cake through a simple technique to be able detect the problem before it becomes an issue during the printing process. The level of cake dictates the amount of energy we can provide to a given material, as once a material is caked then it is unable to be recycled or processed through the normal means of powder transport.

An example of the effect of cake is seen in figure 3. where the powder is unable to be automatically collected from the overflow as it has formed a level of cake. Therefore, it requires physical handling and assistance before it can be used (if at all). The right image highlights the excessive cake in the sieve, which blocks the processing station, and requires cleaning, hence increasing downtime.

By understanding the level of cake, a given material produces, we can adjust the system accordingly. Whether that be through adjusting the manufacturing process to account for a potential increase in downtime, have adjustments on the printer to manually change the amount of energy given such as by controlling the fuse lamps or other methods that could be provided in the front panel, or even the addition of more fresh powder.

How does the system work?

The process begins by printing a cake box, that can capture the powder in a way that preserves the cake from the material. We then remove the cake and make it flush with the cake box to create a cube where the dimensions are known. This allows for the theoretical density of the material to be calculated.

The cake is then weighed, once it has been weighed it is removed from the box and left as a single brick of cake. The cake is then subjected to a compressive load, where the load extension measurements can be made and converted to stress and strain.

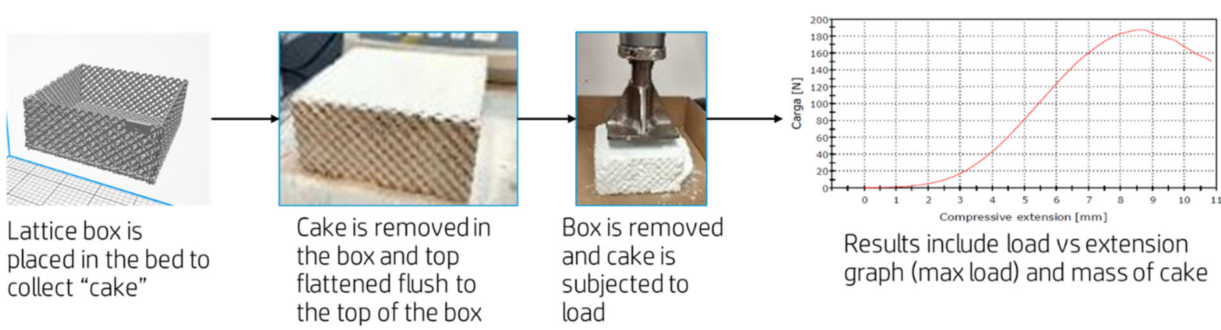

Figure 2: Schematic and diagrams of the method of cake collection and testing.

The values provided by the read out of the machine describe the “strength” of the cake, which is then normalized by the density of the powder. This strength of cake then determines the level of difficulty the user may face when dealing with the given material. The user is then able to compensate based off these results. An example is shown in figure 3:

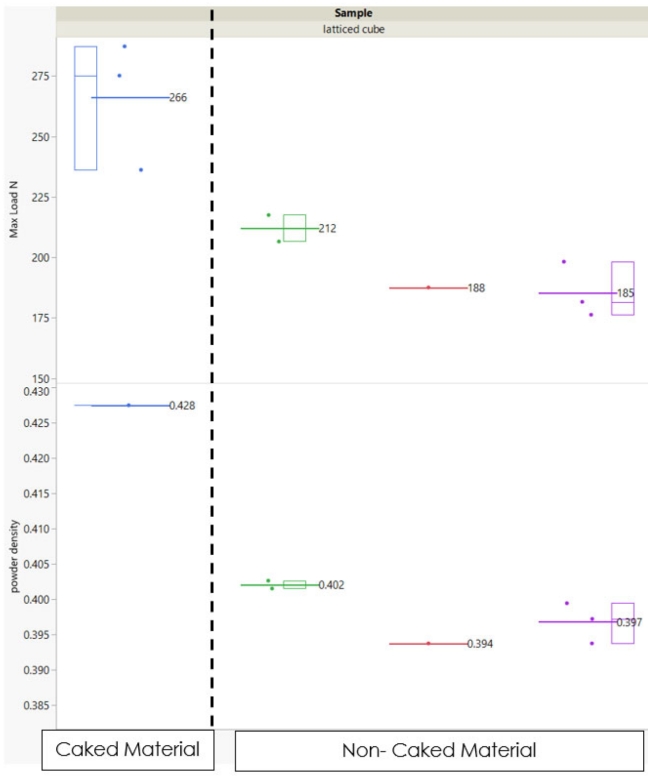

Figure 3. Results taken from a caked material and not caked material (base polymer is the same). The caked material had significantly “stronger” cake and higher powder density.

By using the cake strength, these would be the actions for clients to implement. This table would need customization per application:

Cake “STRENGTH”	Printer Actions – MJF5200	Jedha Actions
Low: <200N	Not needed	Not needed
Medium: 200-250N	Reduce top lamps (white temperature)	Manually break the cake before loading.
High: >250N	Reduce top lamps (white temperature) Reduce fusing lamps	Clean the sieve manually more often Manually break the cake before loading Agitate the powder during loading to make it more flowable.

Furthermore, there are other print mode knobs, that are currently closed to customers, that could allow the tweak of the cake hardness via for example: fluids tuning as a function of the cake hardness or printer airflows.

The workflow to implement when measuring cake using the stated solution would look like:

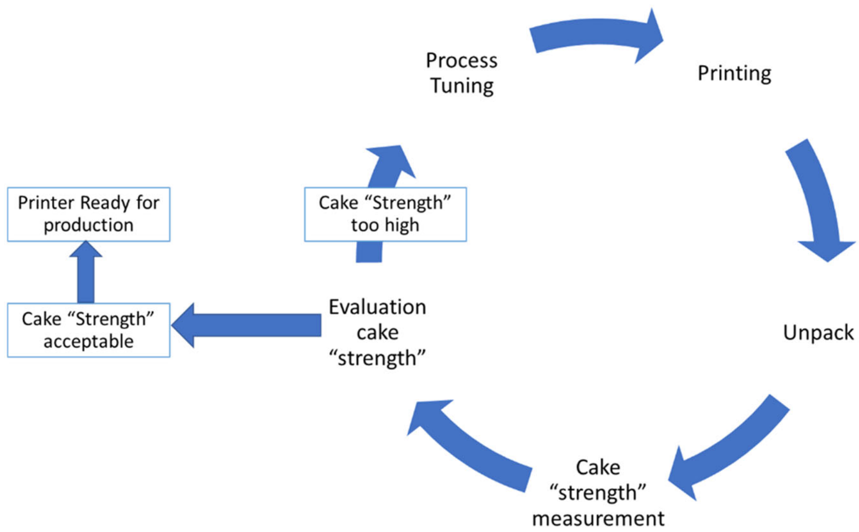

Figure 4. Workflow to implement when measuring cake using the stated solution.

Which are the advantages of doing it this way?

- Increased up time during production as the powder is easier to manage
- Higher level of powder recycling, as caked powder is difficult to recycle
- Predict behavior of the elastomer before printing over a longer term
- Decrease the amount of user intervention required
- Improve customer satisfaction
- In situ test that is quick and easy to perform, rather than slow offline testing

Are there other kinds of solutions in the market?

Prior solutions are all offline tests, which uses fresh powder and induces thermal stress. One test involves the use of a clamp around the powder and placing it under compression, the other uses an evolution tester. The results from the evolution tester did not correspond to what was seen in the printer, and the clamp tool, requires a much longer time frame and is not necessarily replicative of the powder in the machine.

Disclosed By: Gabi Newman, Jordi Bautista-Ballester, Vanesa Fal, Ariadna Marin, Tomàs Cuatrecasas, HP Inc.