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AUTOMATIC ADJUSTABLE PRINTHEAD SERVICING WITH WET WIPE BY PRINTING AGENT IMPREGNATION ASSIST

HP INC

Automatic adjustable printhead servicing with wet wipe by printing agent impregnation assist

Multi Jet Fusion technology works by printing 2D layers of a given thickness one on top of another. For every layer, a uniform layer of powder is placed in the whole printer's build bed, and agent fluids are placed at the specific points which are willing to be melted to form the part. The way to deposit these agents is made by a printing head, moving across the printing area, ejecting small drops of fluid agent.

Those printing heads are not always ejecting ink and are most of the time idle in a hot environment. Therefore, these printing components need to be kept healthy during their idle times by performing a continuous servicing, otherwise they could accumulate dry agent puddles and collect 3d material powder existing in the chamber in form of airborne.

As mentioned, thermal inkjet printheads (PHs) are key for 3D printing with MultiJet Fusion. Those are the ones in charge of deposing the agents that will be used for conforming parts once fused. A printhead is composed of thousands of ejector nozzles that need to be as clean as possible. To do so, a common way is to wipe them and make them spit. The purpose of both steps is:

- **Wipe***: remove dry ink from the surroundings of the nozzle and other debris like particles and external contamination that could be attached*
- **Spit***: eject some drops to remove debris and dry ink that were either not fully removed by wiping or just refresh the nozzle with new ink to keep it alive during idle time, leaving it ready for a good ejection in the immediate printing event.*

Printhead servicing routines normally consist of using a web wipe that wipes the print head surface, removing excess of ink (puddles) and plastic particles laying on the surroundings of the firing nozzle. The wiping step is very important and needs to be calibrated or modified depending on its application. For example, some 2D inks need dry wiping, other dry wiping with Deionized water impregnation and other with oil PEG impregnated webs.

On 3D printing, one can imagine that the hot environment (above 100 Celsius) can easily dry the ink that was formed around the nozzles. This needs to be removed fast, before particles attach to it or dries clogging the nozzle. Using dry web wipe is a problem as ink dries faster creating a crust of dry ink, which end up clogging and damaging the printing printheads. Therefore, usually impregnated wiper is used, like in the example below the PEG impregnation.

From the many different types of web wipes, it has been proved that fluid impregnated web wipes are more effective when removing puddles and dry ink. The impregnation can be done before inserting it to the printer by the supplier or in the printer.

Currently, impregnating inside the printer, water dispensers are commonly used, wetting the web right before printing. It is an independent system, that needs maintenance, and it is not very flexible to changes.

This new suggested approach uses one of the agents that are normally ejected by the printhead as an adjustable impregnator inside the printer. The agent used is the one closer to water properties as has been proved to be very effective in water dispensers, with the advantage that can be changed on the fly and no need of a full water dispense system. This way, printheads are serviced with a wiper that has no need on external fluid application which is susceptible of impregnation variability and cost by using the printhead itself to impregnate the web. In addition, this process changes the impregnation weight across the web, giving fluid to different regions at different conditions. Finally, using printheads instead of other dispensing systems increases reliability of the system as printhead reliability is usually highly monitored and controlled.

The Printing agents in 3d printing as impregnators.

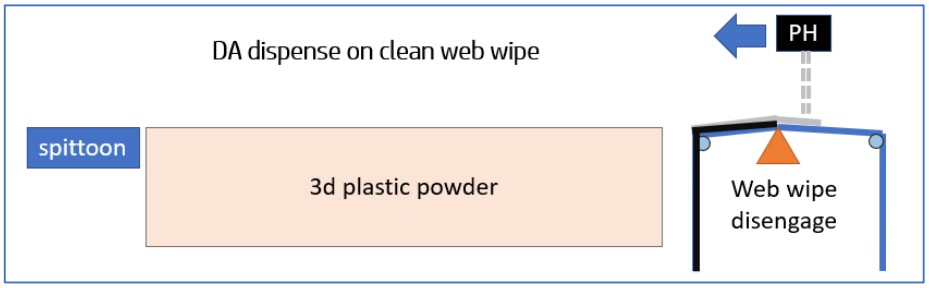
One of the advantages on 3d printing with TIJ printheads is that some agents could be used as impregnators. This is the case for example of the Detailing Agent, which is transparent and 99% water.

The idea is to use this agent (which is also used for printing) to impregnate the web.

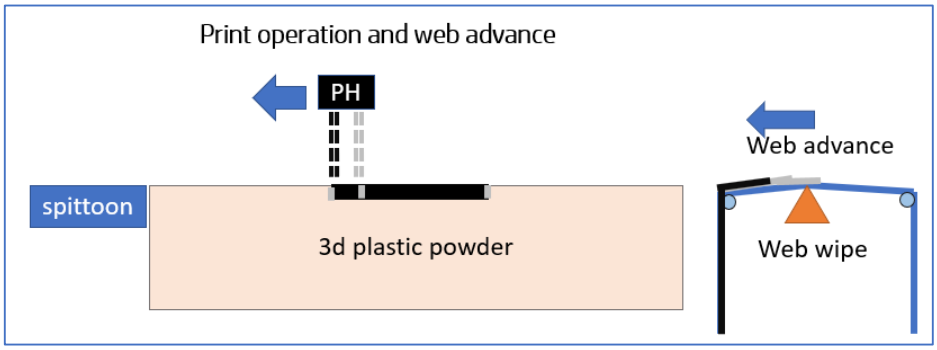
The impregnation mechanism.

The system follows this example:

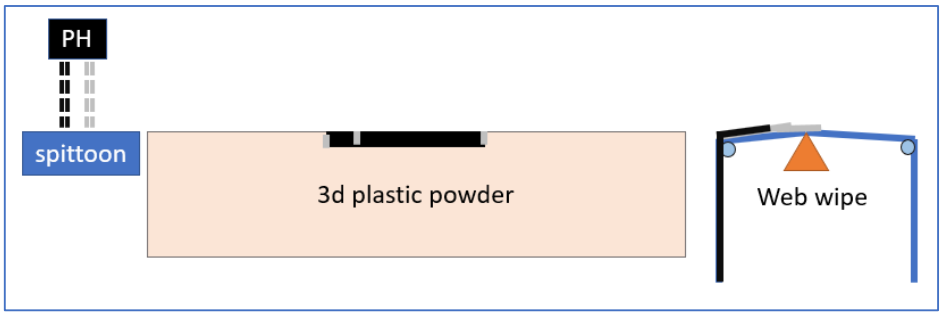
1) *before printing any layer, the DA agent is ejected close to the rubber blade (orange) on the clean side of the web.*



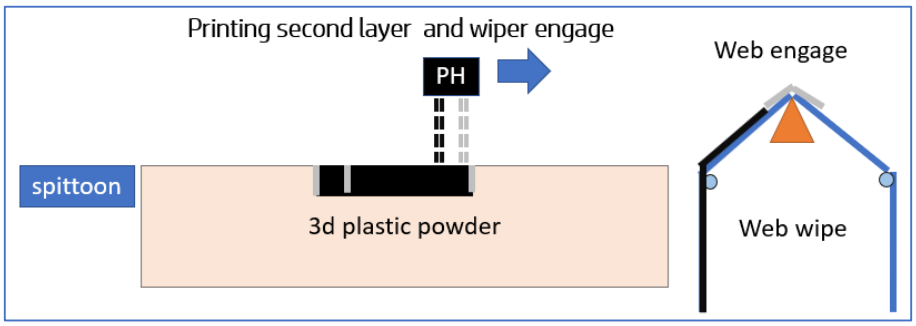
2) *After this, printheads travel across the bed printing the content for the layer that will be part of a 3D printed part later on using all agents.*



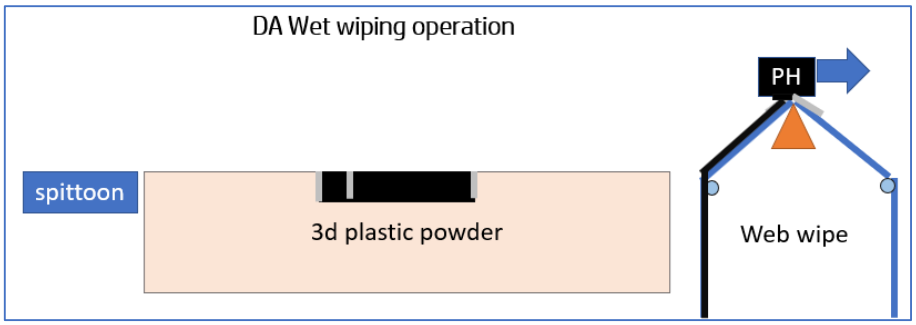
3) *Once finished, will spit ink to refresh nozzles and maintain them alive during short periods of idle time.*



4) *Then will travel back to the wiper side, printing one new layer. Before arriving to the wiper it will engage so the printhead and the web has the wiping interference needed.*



5) *Finally the printhead will perform the wiping, with a clean web impregnated with DA*



The automated DA dispensing depending on printing conditions.

As mentioned before, dispensing water with DA is a very flexible and easy to control mechanism that can be easily modified and calibrated at each layer.

In normal operation one would eject the minimum water on the web wipe in order to maintain the printhead alive (the agent has a cost, and also too much could create condensations)

Conditions that could need specific changes on dispense would be:

- **Printed content***:*
  - **Packing Density (general):** *high density parts might need extra wet wiping, ensuring removal of puddles generated close to the nozzle.*
  - **Packing density (across bed):** *We can decide variable dispensation of fluid across the cross-direction printing, so can be adapted to the different packing densities across that direction.*
- **Chamber temperature***: the higher the temperature the more water might be needed. This can depend on materials (PA11>PA12>PP ≈ TPA).*

The main advantages of using this technique are:

- *Avoid variability from offline impregnation: by impregnating inside the printer with such a high-resolution component like the printing head the regions to be wet can be fully controlled to achieve the desired weighted or uniform spread.*

- *Save on offline impregnation costs: impregnation of the webs prior to installation are not needed, decreasing cost of operation, material, and packaging (sealing)*

- *Increase reliability: by using printheads to impregnate, other dispensing systems are removed, together with all reliability issues it has. Printhead reliability is highly monitored and automated and can be leveraged for this application.*

- *Decrease system HW cost: no need of a secondary system to impregnate in the printer*

- *High control of ejected fluid: the water dispensed is fully controlled by the system as are drops (the same drops that print) this is much more accurate than using, for example, a water dispense nozzle which usually clog and add variability.*

- *Impregnation flexibility: water can be dispensed depending on the needs of the system and changed in a very controlled manner depending for example on the content, the material printed or the bed temperature.*

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