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PIPING POWDER DETECTION SYSTEM

HP INC

Piping Powder Detection System

Overview of the system

In some 3D printing systems, after printing, powder must be recovered from the build unit, and transported to the storage tanks so that it can be sieved and then loaded again for the next job. To perform this, multiple circuits of pipes are needed from volume to volume.

With the introduction of new materials and the option of switching from one to another, it is important to guarantee that the system is clean from the previous material before loading the new one to ensure quality and that the printed parts will have the expected mechanical properties. Currently the process used to clean is to use vacuum to try to transport all the powder out of the circuit, but it is not 100% effective, the only way to guarantee this it to dissemble all pipes and hoses to check if there is powder inside.

This disclosure is to present a system that would tell the user if there is powder left in the system and exactly where it is using simple temperature sensors and a heater, eliminating the need of disassembling everything and wasting time. It would consist of sensors installed along the pipes and tubes that would monitor the temperature of that segment. Vacuum would be used to try and transport the powder out as it is done now but with the add in of knowing the temperature evolution of each segment. Checking which segments took longer to go back to ambient temperature would tell the user where the powder is.

Which are the problems that this system solves?

The solution solves the following problems:

- No need to completely remove all tubes and piping to visually check if there is powder inside
- Reduces the risk of creating leakages or mistakes while reassembling the pipes is reduced
- Reduced time of powder change process which leads to reduced unit down-time
- Reduce risk of cross contamination of 2 different materials when the user wants to switch materials
- Guarantee that there is not leftover material after cleaning, increasing the confidence in the process.
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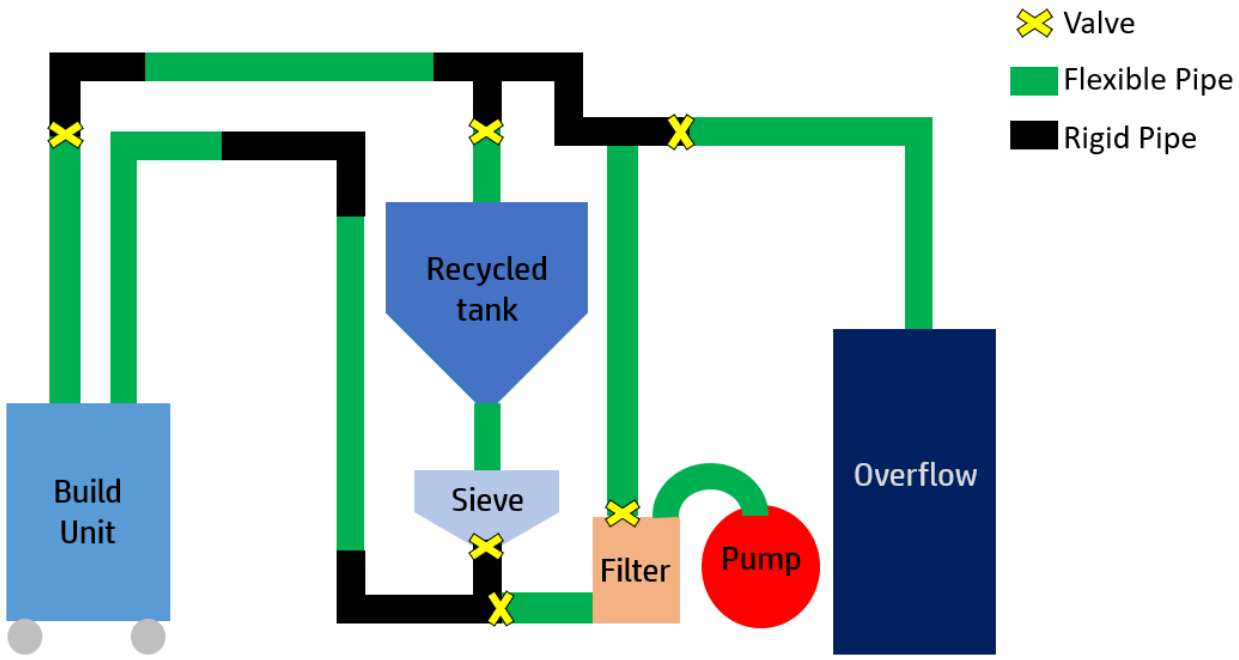
How does the systems work?

Disclosure to explain a system that can automatically detect the presence of powder in the piping or tubing used to transport it during the unloading and loading steps involved in the 3D printing process.

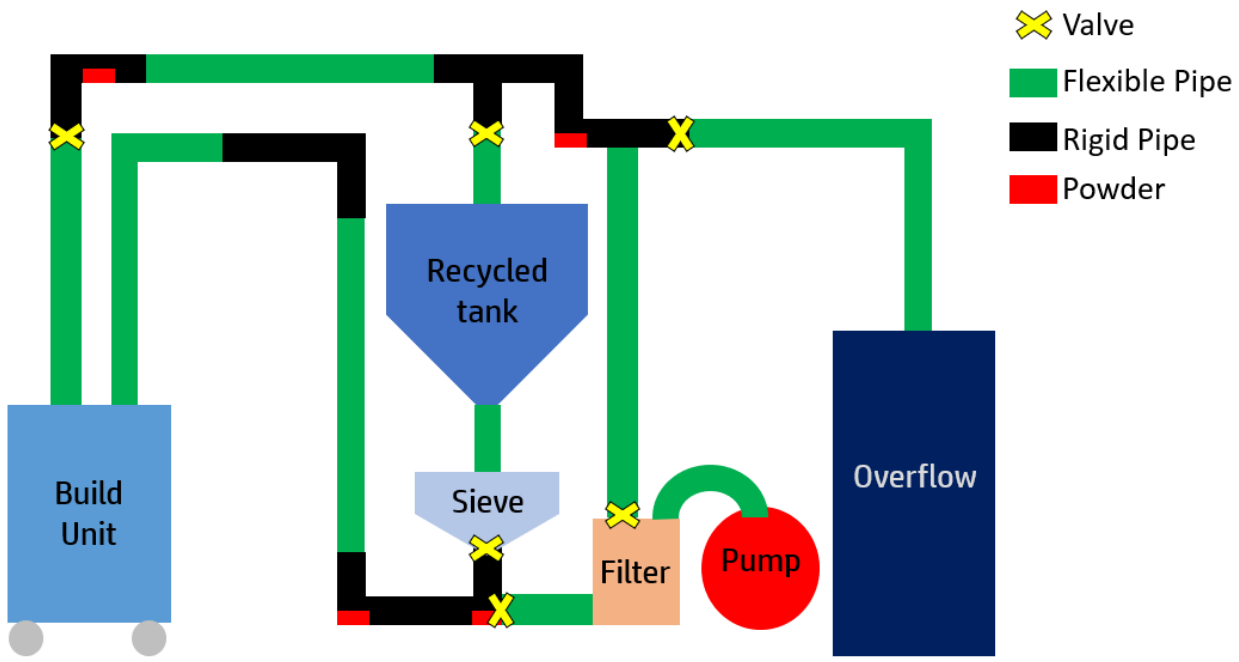
A simplification of a processing station schematic can be found below, it is composed of multiple volumes, systems that will be used to store and process the powder and of course many rigid and flexible pipings through which the powder will circulate using the vacuum generated by the unit's vacuum pump, a series of valves are used to determine the circuit that the powder will follow.



The current issue that this disclosure is trying to solve is what is shown in the illustration below. After loading and unloading processes and transporting powder through the different circuits of the units, remaining of the material can be stucked at some points and sometimes the airflow generated by the vacuum pump may not be enough to remove it and make it go to the desired volume.

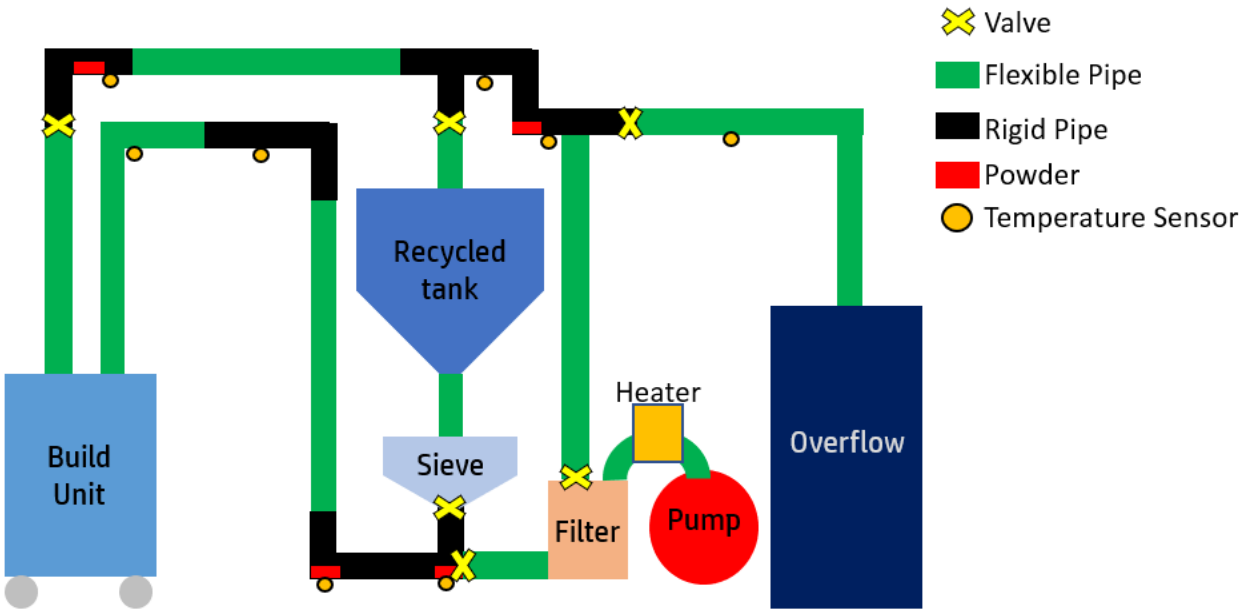
Currently there is no way to know if powder is stuck in the circuit, where it is, or how much of it. The only way is to disassemble each piping and visually checking, which is very time consuming and the risk of causing leaks or not reassembling the unit correctly is high.

This becomes a big issue every time the user wants to switch material for printing because to guarantee that the parts printed will have the correct mechanical properties, the system must be fully cleaned of the previous material before loading the new one. Cross contamination could cause unknown issue in the quality of the parts.

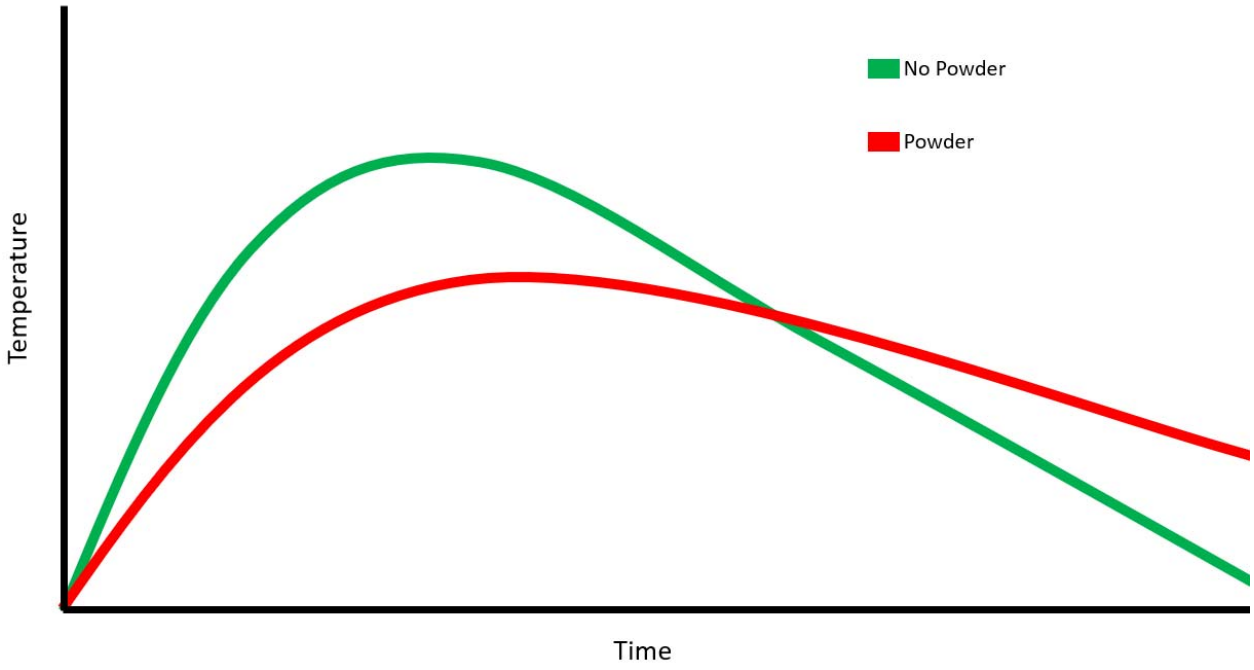


The Solution

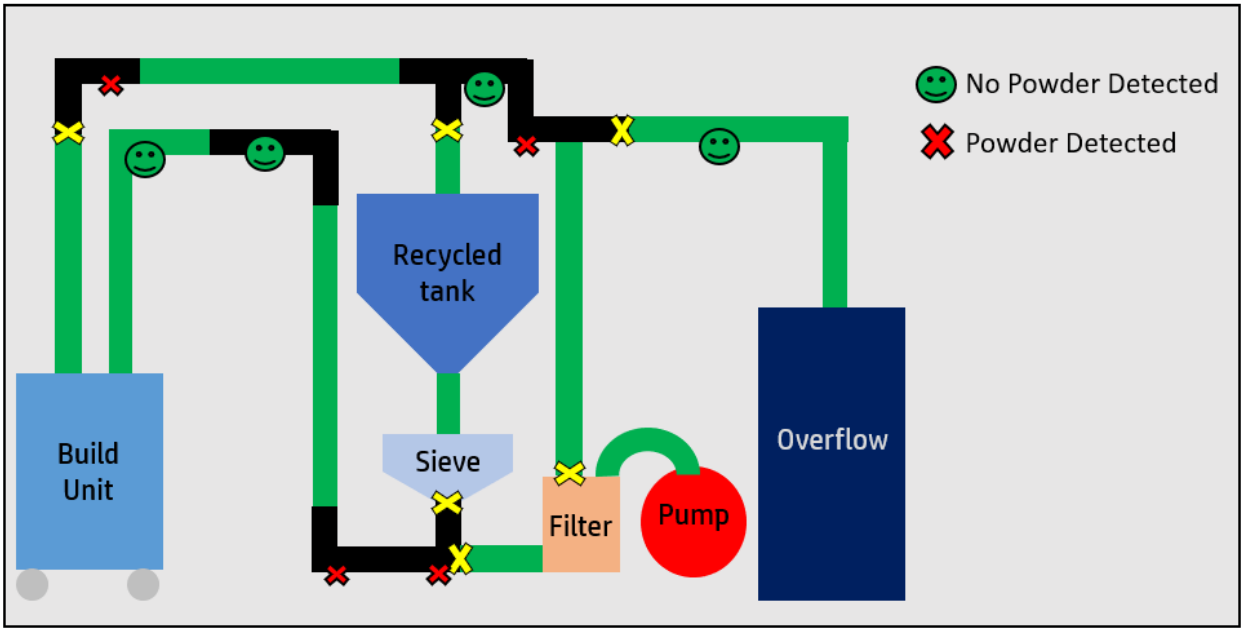
Using a heater at the air entry point and temperature sensors along the piping as shown below, hot air could be introduced in the system during time X, then it would be turned off and the temperature evolution of each sensor would be monitored. Those sensors that would take longer to cool down, would indicate that powder is stored/stucked at that location. This way the user would only have to dismount those pipes.



The temperature evolution of each point could be used to determine if there is powder and even how much. Below are represented the temperature VS time for both scenarios (with powder stuck at that point and without). The point with powder would take longer to heat up and to cool down, while the segment with no powder would heat up and cool down much faster.



A picture like the one shown below could be displayed in the Front Panel of the unit after the temperature evolution for each point had be analyzed:



Which are the advantages on doing in this way?

- Improved cleaning process of Processing Station
- Reduced risk of cross-contamination between the new and the old material
- No need to disassemble all hoses of the unit to check if there is powder inside
- Reduced cycle time of material change process

Are in the market other kind of solutions?

This solution could be applied to all 3D Processing Station as a method to improve powder cleaning processes and material changes, reducing the risk of cross-contamination.

Disclosed by: Miguel Vega, Alejandro Torres Pinero and Eduard Galdeano, HP Inc.