How the O_2 control system works in SnowWhite^2

Dear Supporter,

The selective laser sintering process has the potential to definitively overcome the boundary between model construction and functional components. The basic prerequisite for this is that components with reproducible quality can be manufactured. For this purpose, the virgin material must already be of the same quality. During the process, the laser sintered powder is heated to temperatures just below the melting temperature and maintained until the end of the construction process. This causes the thermal aging of the powder. The powder, which is not sintered, is refreshed after the production process with new powder and can be reused.

This process is useful with industrial machines in order to maintain stable quality in production. This is possible thanks to the chemical process used to treat the base polymer during the powder production with the aim of preventing oxidation, preventing yellowing of the printed parts, having humidity control, keeping the flow of powder stable for the process.

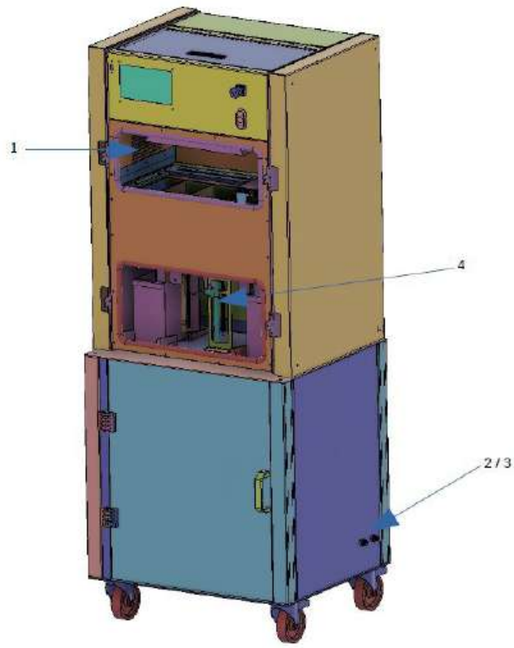
Many times on the laboratory scale process when new polymeric powders or composite powders are tested the materials are not treated and to prevent oxidation and yellowing it is important to set up a controlled atmosphere process environment.

For this reason we have decided to add an oxygen control to the last relese of our SnowWhite.

The oxygen control is performed by several elements that help manage the inert gas (usually nitrogen, N2) inside the SnowWhite2 printing chamber.

The inert gas system is composed of:

- O2 zirconia sensor (1)
- Gas solenoid valve IN (2)
- Gas solenoid valve OUT (3)
- Gas heater (4)



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The zirconium oxide oxygen sensor is located in a room near the printing chamber, but separated from that by a carbon activated dust filter to protect the sensor. The oxygen sensor is able to measure the percentage of oxygen (O2) in a gas, in particular our sensor is able to detect an oxygen range from 0.01% to 25% with an accuracy of 0.5% . The sensor can detect in the gas temperature range from -100 to +250 °C, which means that it falls within the temperature range of the SnowWhite2 chamber, which ranges from room temperature up to 180 °C.

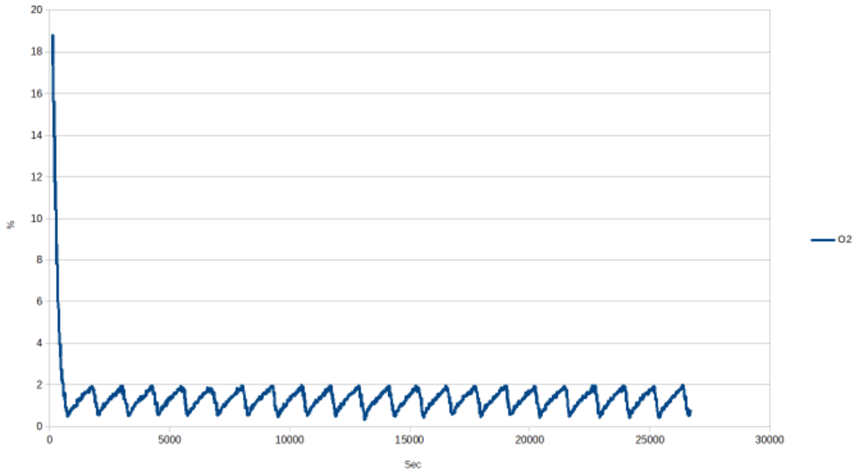
The minimum percentage of oxygen that we can detect inside the SnowWhite2 chamber is 0.3%.

The percentage of oxygen inside the chamber is controlled by two solenoid valves, the IN gas solenoid valve and the OUT gas solenoid valve. The IN gas solenoid valve has a pressure regulator that is set at 0.5 Bar.

The IN gas solenoid valve, injects the gas into the lower part of the chamber, under the pistons and is equipped with a gas heater that could be used for experimental processes. The OUT gas solenoid valve extracts the gas on the upper part of the chamber, it is usually open only when the machine makes the first injection.

This whole process could be modified defining the percentage of O2 at which a single valve is opened or closed. i.e. for each value you have two parameters, the minimum that when reached closes the valve and the maximum at which the valve opens.

For example in a standard cycle we set the IN valve to 2% - 0.5% and the OUT valve at 5% - 2%. Usually we start at ~20% of oxygen so at the beginning all the valves are open, when O2 reaches 2% the OUT valve closes (and we expect that it will remain closed for the whole cycle) and will reopen only if the O2% exceeds 5%. The IN solenoid valve will close when O2 percentage reaches 0.5 and will reopen when O2 will rise to 2%. This happens because the chamber is not airtight, so from this time we can also estimate the consumption of N2 at about 175 l/h of N2.



The previous graph show the O2% of a print cycle, this data are automatically saved by the SnowWhite2 in its internal registers. These data include the internal temperature of the chamber, the temperature of the powder bed surface and the image of the powder bed taken by the internal camera.

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