

Automatically Prepare 3D-Printable Pastes (from Gels, Solids, Fluids, Cells) at Varying Temperatures

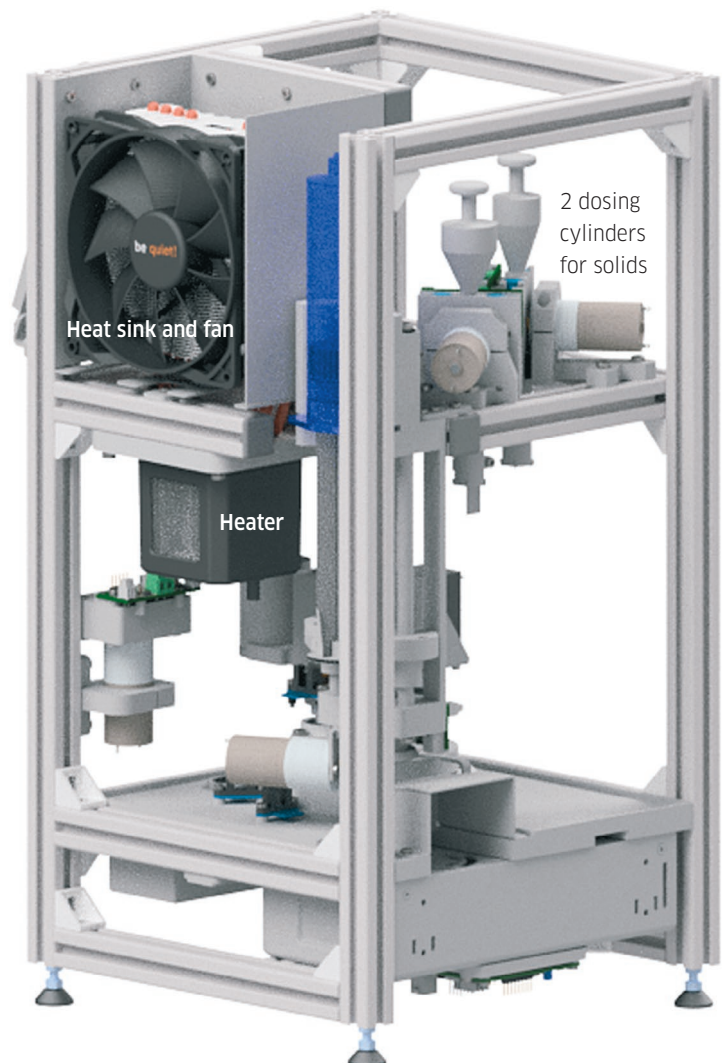
The Bioink Preparator – Why do you need it?

Bioinks are central for the additive manufacturing of 3D cell cultures, artificial tissues and organs on a chip, but the preparation of bioinks lacks automation, reproducibility and flexibility, as it depends on various parameters that are not easy to achieve, e.g. certain temperature ramps. With this in mind, GeSiM has developed the **Bioink Preparator I**.

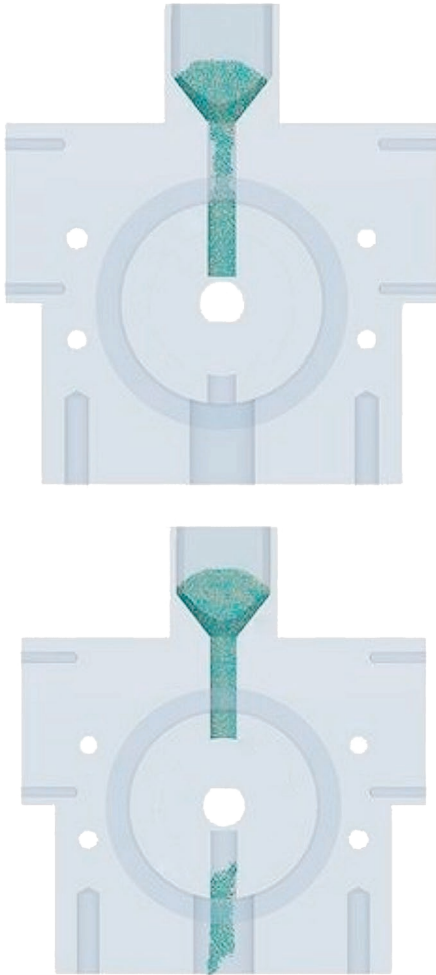
The idea behind the Bioink Preparator is the automatic delivery and mixture of fluids and solids under reproducible (and customised) conditions at certain temperatures, adding all necessary components, i.e. solids, hydrogels with just the right viscosity, and cells, to name a few. This effectively results in bioinks that are immediately ready for 3D printing.

The machine comprises the following devices:

- Rotating cylinders for the dosing of solids, e.g. dehydrated hydrogel or salts. The rotor contains cavities into which certain quantities of solid drop down. This amount is released upon downward rotation.
- One syringe for the solvent (water, buffer)
- A stainless-steel reaction vessel
- A heating/cooling coil around the reaction vessel for exact temperature control. The heater is connected to a heat sink with large fan to enable rapid heating **and** cooling.
- A stirrer for dissolving the solids (hydrogel components)
- A UV lamp for sterilization
- A syringe containing the cell suspension
- An eccentric-driven mixer to homogenize cells and hydrogel in a cartridge by vibration



Rear side of the Bioink Preparator with two dosing cylinders. The solvent syringe is depicted in blue. Not all devices are shown.



Schematic drawing of the function of the dosing cylinder. The cavities have a fixed volume.

This is how you prepare your sample

- Fill the funnels above the dosing cylinders with solid and the (sterile) solvent syringe with fluid.
- Fill the sterile cell syringe with cells suspended in medium.
- Switch the Bioink Preparator (and heater) on and start the software.
- Adjust parameters, i.e. the amount of hydrogel components and/or the amount of solvent, temperature ramps.
- Start the process.

When this is done, start the preparation procedure, which will carry out these steps:

- The content of the syringe is transferred to the reaction vessel
- One or two solids are added. For this, the cylinders rotate as many times as necessary until the correct amount of solid is transferred.
- The reaction vessel moves to the stirrer to dissolve the solids. Heat is applied as necessary.
- UV is used for sterilization.
- The solution in the reaction vessel is pumped into the cartridge containing the cells, and the hydrogel and the cells are mixed by gentle vibration.

And the good thing is: the cartridge will be filled without air bubbles and is thus ready to print right away!

After approx. 30 minutes, transfer the sterile cell syringe with the hydrogel to your 3D printer and start your print.

Two processes can be run

- **Sample preparation**, as explained above
- **Cleaning**: Fill the solvent syringe with a cleaning solution (normally water + 10 % ethanol) and start the programme. When the cleaning agent has passed through completely, remove the cell syringe with the used cleaning solution.