# MODELLING AND QUANTIFYING THE FLUID TRANSPORT THROUGH POLYLACTIC ACID SCAFFOLDS

## AIM

As part of our research on understanding the determinants of intraperitoneal (IP) chemotherapy, we are developing controlled environments in which tumor cells can be seeded and cultured in order to test the therapeutic effects of cytotoxic drugs. In this work, we aim to mimic tumor tissue by developing scaffolds, of which the permeability characteristics can be theoretically predicted based on its printing parameters.

## METHODS

Three polylactic acid (PLA) scaffolds were printed using a target filament thickness of 400 µm and an interfilament distance of 500 µm (Fig. 1a). To measure the scaffold permeability experimentally, a gravity-based setup was built to perfuse the scaffold with a constant fluid height of 20 cm$H_2O$ (DeltaP) and measure the resulting flow (Q; Fig. 1b). The Darcy permeability $k$ [m²] was calculated based on the Darcy equation for porous media as follows for a cylindrical scaffold with length $l$ [m], area $A$ [m²] and $\mu$ the dynamic viscosity [Pa.s]:

$$k = -\frac{Q.l.\mu}{A.\Delta P}$$

Next to the experimental approach, a virtual 3-dimensional scaffold model was created in pyFormex using the printing parameters and meshed in ICEM. Subsequently, CFD simulations were performed to calculate the theoretical permeability, allowing comparison with the experimental results (Fig. 1c).

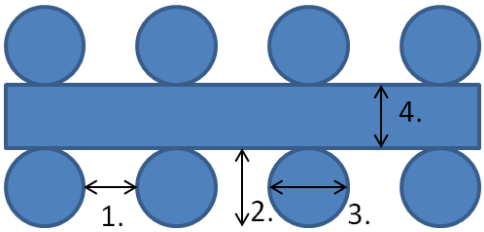
## RESULTS

The experimentally measured permeabilities of the scaffolds are 7.27 ± 0.10 $\cdot 10^{-10}$, 6.89 ± 0.05 $\cdot 10^{-10}$ and 7.70 ± 0.14 $\cdot 10^{-10}$ $m^2$, respectively, resulting in an overall average of 7.29 ± 0.36$\cdot 10^{-10}$ $m^2$. The theoretical permeability obtained from the CFD simulation was 7.85$\cdot 10^{-10}$ $m^2$.

## CONCLUSION

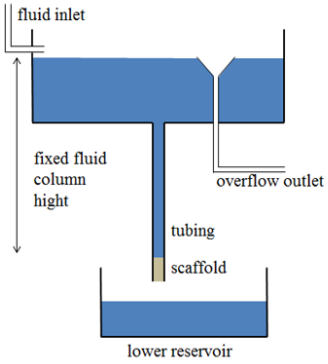
In this work, a framework is presented for developing scaffolds of which the permeability characteristics can be predicted based on their printing parameters. Comparison of the experimental and virtual permeability values showed that values were in the same order of magnitude, but virtual permeability was slightly overestimating the experimental values.

A




1. Pore size in the x-direction = 472 ± 16 µm
2. Pore size in the y-direction = 503 ± 22 µm
3. Strut size in the x-direction = 418 ± 16 µm
4. Strut size in the y-direction = 387 ± 7 µm
5. Strut size in the z-direction = 250 µm

B




C