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Modelling the squeeze flow in a deformed rectangular microchannel

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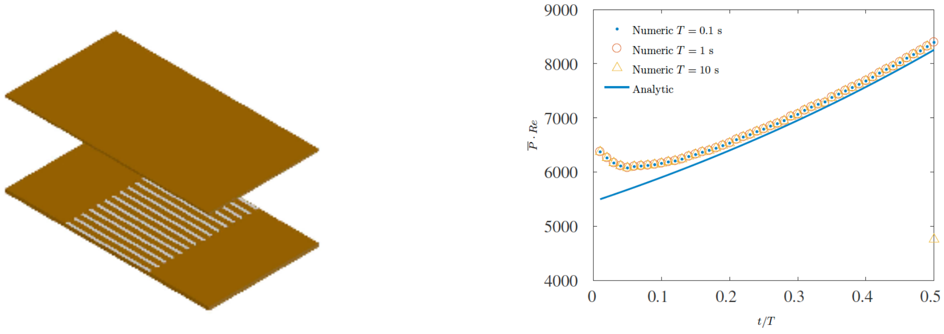
Rheinforce cork composites, previously named elsewhere as CorkSTFluidics, are sandwiches consisting of two microagglomerated cork pads embedding microfluidic patterns that are filled with a shear thickening fluid (see Figure 1 (a)), whose mechanical performance under impact loads is determined by the microfluidic pattern and the rheological properties of the fluid. From the experimental results it is impossible to decouple the fluid contribution from the solid contribution to the force-time response of the composite. In this work we have developed a simple model of the fluid-flow dynamics that it is able to predict the fluid contribution in the energy dissipation of the Rheinforce cork composites under impact loads. To that end, we model the viscous flow inside a microchannel for a known displacement of the upper lid $h(t,x)$, calculating as a result the needed force to create that movement. The numerical tests for the imposed displacement of the lid followed the law,

$$h(t_{n+1}) = h(t_n) \cdot (1 - \frac{\Delta t}{T}),$$

being Δt the time step and T the characteristic time of the movement. The results are shown in Figure 1 (b), where the analytic prediction developed exhibits an excellent agreement with the numerical tests.



(a) (b)

Figure 1: (a) Detail of the composition of a Rheinforce cork composite, with the microchannels integrated between two microagglomerated cork pads. (b) Temporal evolution of the non-dimensional power needed to move the lid for different values of T and the comparison with the theory developed.