Supporting information for:

3D Printing of PEEK Reactors for Flow Chemistry and Continuous Chemical Processing

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1. Simple channel pressure testing

The simple channel test piece had a single inlet connected with a short straight channel, with no internal mixers, to the outlet (Figure 1). Threads were printed into the inlets and cleaned with a tapping tool if the fluidic fittings could not be easily tightened.

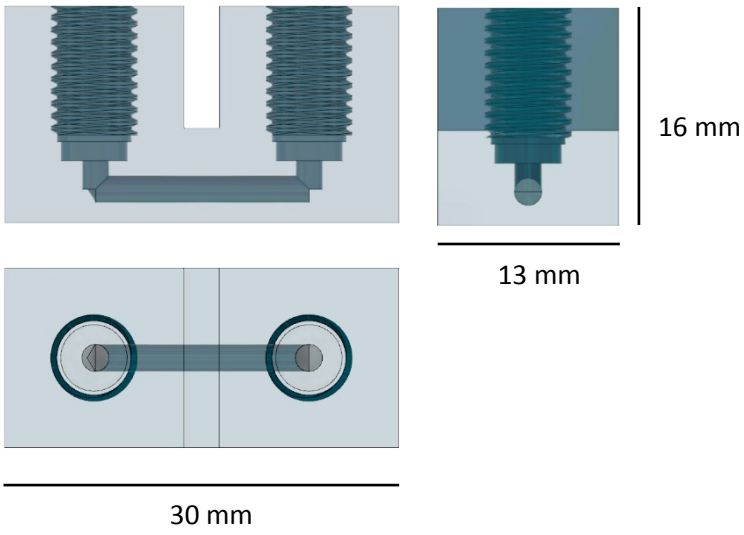

Figure 1. (Top left) Side profile of pressure test part (bottom left) top profile view (right) end profile view.

All connections were made using 1/4”28 UNF fittings using flat bottom 1/16” I.D. ferrules and 1/16” PFA or PEEK tubing depending on the pressure being used (Figure 2). Backpressure was generated by using spring-based backpressure cartridges such as Idex HS part number P-789. Cartridges were joined in series if the appropriate pressure was not available. Parts were assessed visually for leaks before flow rate testing was performed.

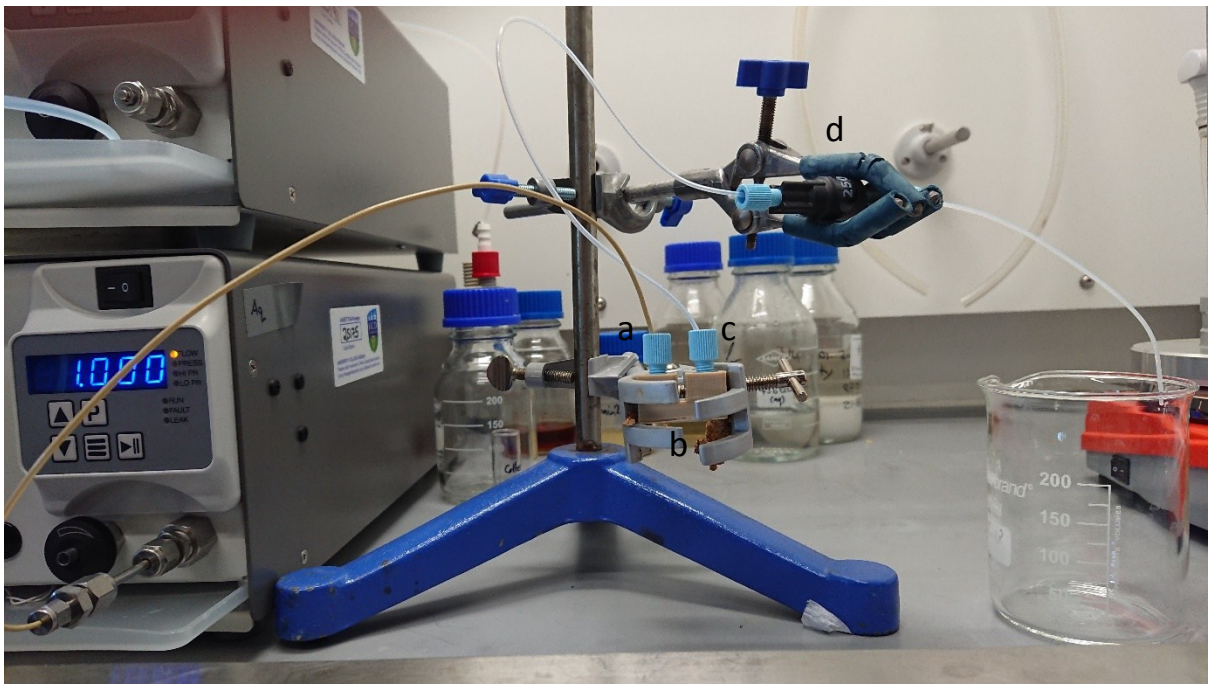

Figure 2. (a) Connection from HPLC pump (b) pressure test piece (c) connection to back pressure cartridge (d) back pressure cartridge.

2. Residence time distribution analysis

The residence time distribution profiles obtained within a 4 mm I.D. 3DP mixer with 8 elements and a simple T-mixing inlet followed by tubing with a volume to match the 3DP part were determined at flow rates of 0.6, 0.8 and 1.0 mL/min. An Agilent 1100 HPLC was used to make the injections, providing half of the experimental flow rate and the injected acetone tracer into one side of the mixing sections, while another HPLC pump was used to deliver the other portion of the flow to the second mixer inlet. The absorbance at 300 nm was measured to obtain the tracer profile with time. Peaks were integrated using the HPLC software and the statistical moments obtained from the peak analysis report to give

the mean residence time (τ) and the peak variance (σ^2) (Table 1). The value of τ was used to generate the $E(t)$ and $F(t)$ from the HPLC data and these were then plotted against t/τ.

In all cases the variance decreased with flow rate while the mean residence time decreased. The 3DP mixer had lower variance than the simple T mixer at all flow rates, with narrower peaks obtained (Figure 3).

Table 1. Mean residence time (τ) and variance (σ^2) results for residence time distribution experiments.

Flow rate (mL/min.)	Mixer geometry	τ (min.)	σ^2 (min.)
0.6	3DP	2.89	1.17
	T & tube	3.60	1.41
0.8	3DP	2.12	0.73
	T & tube	2.81	0.99
1.0	3DP	1.63	0.48
	T & tube	2.32	0.81

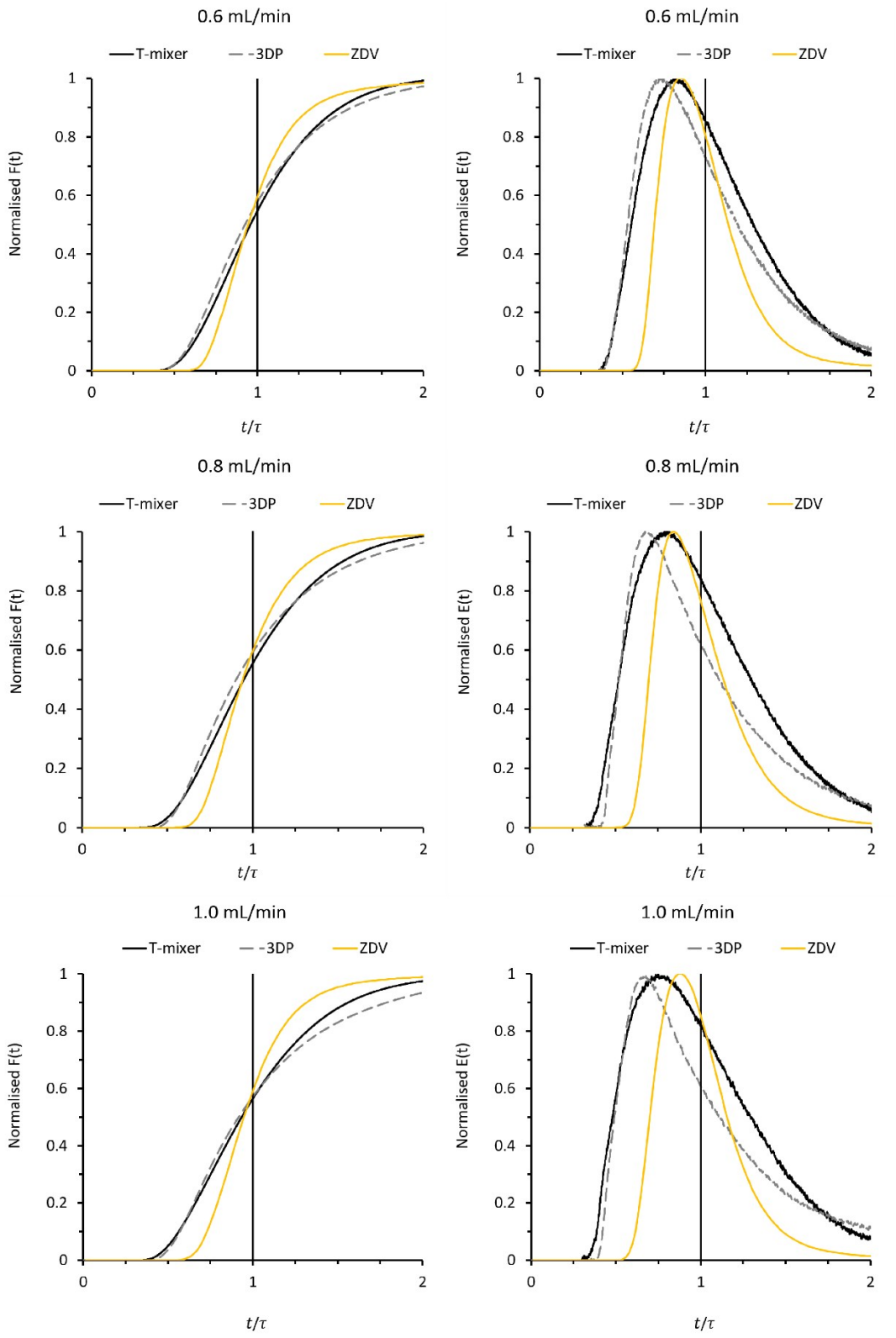

Figure 3. $E(t)$ curve (left) and $F(t)$ curve (right) comparison of 3DP mixer and simple T-mixing (top) 0.6 mL/min (middle) 0.8 mL/min (bottom) 1.0 mL/min. ZDV refers to an injection made with only the HPLC system volume.