Experimental Details

Samples were synthesised using the continuous-flow-reactor designed by the Lester group which uses a counter-current mixing reactor to induce rapid reaction and crystallisation of the dissolved precursors.

All chemicals were purchased from Sigma Aldrich and Fisher Scientific and used without further purification.

ZIF-8

A 0.06 M aqueous solution of $Zn(OAc)_2 \cdot 2H_2O$ was used in the upflow (room temperature, 10 mL min^{-1}) and a 0.06 M aqueous solution of 2-methylimidazole (2-HMeIm) was used in the downflow (room temperature- 400 °C, 20 mL min^{-1}). To improve the rate of deprotonation of the acid, ammonium hydroxide (NH_4OH) was also added to the organic solution in the ratio 1:8 (HMeIm:NH_4OH). Final ratio of reagents is 1:2:16 (Zn: HMeIm:NH_4OH).

X-ray Diffraction

Powder X-ray Diffraction (PXRD) was performed on a Bruker D8-Advance diffractometer using Cu K_α radiation, λ = 1.5415 Å over a 2θ range of 5 – 40°.

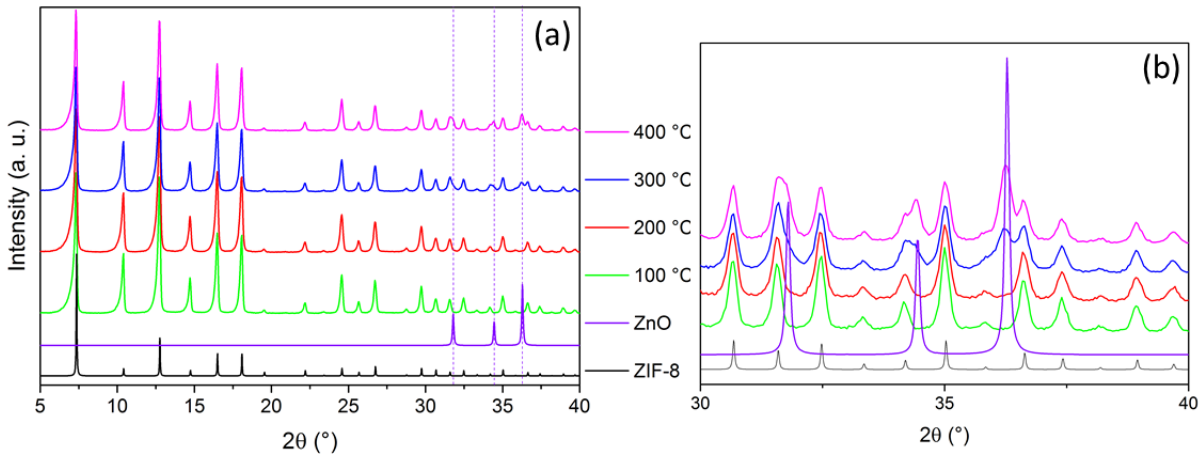

Figure A PXRD patterns for the ZIF-8 products synthesised using $N(Et)_3$ at RT, 100, 200, 300 and 400 °C. ZnO impurities can be seen in the product produced at 300 and 400 °C. The simulated patterns for ZIF-8 and ZnO are shown in black and purple respectively.

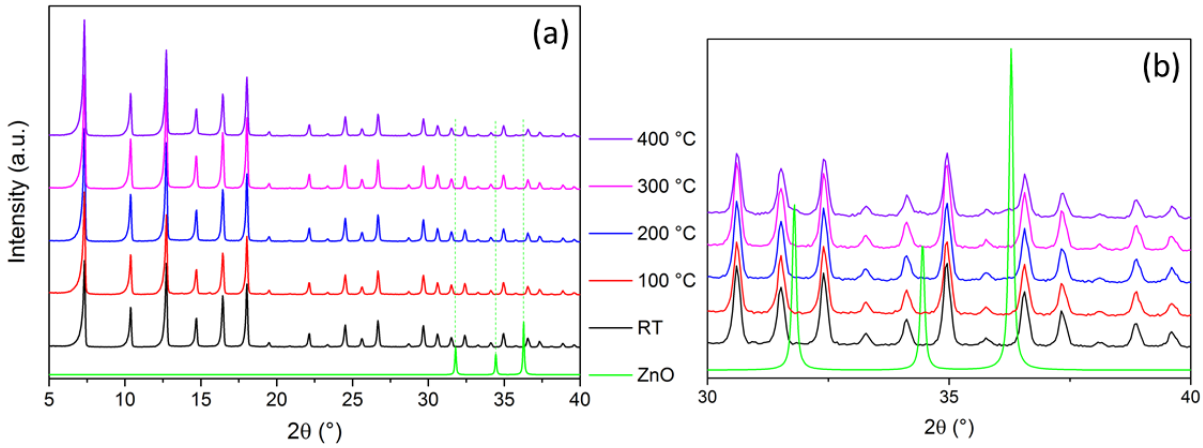

Figure B PXRD patterns for the ZIF-8 products synthesised using NH_4OH at RT, 100, 200, 300 and 400 °C. ZnO impurities can be seen in the product produced at 400 °C. The simulated patterns for ZIF-8 and ZnO are shown in black and green respectively.

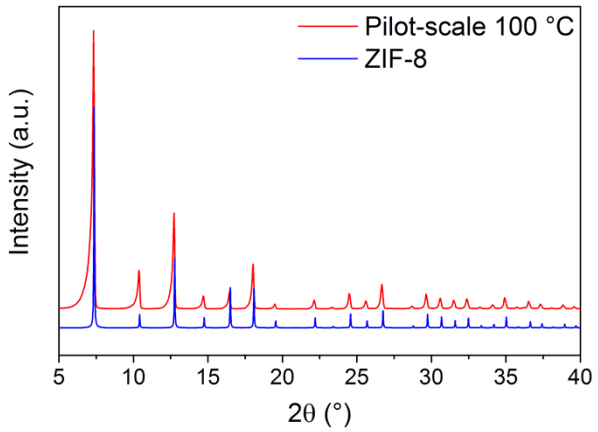

Figure C PXRD pattern for ZIF-8 synthesised at 100 °C, 0.06 M using the pilot-scale reactor. The simulated pattern for ZIF-8 is shown in blue.

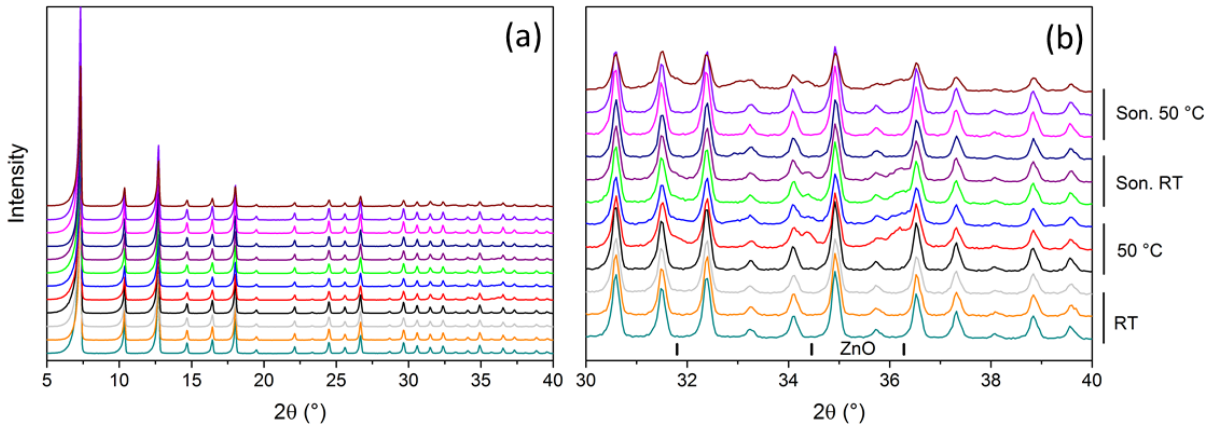

Figure D PXRD patterns for the ZIF-8 activated using the coil reactor. Sample method for activation, in ascending order, room temperature and dilutions of 1:1, 1:2 and 1:3, using a water bath at 50 °C and dilutions of 1:1, 1:2 and 1:3, sonicated water bath at room temperature and dilutions of 1:1, 1:2 and 1:3 and a sonicated water bath at 50 °C and dilutions of 1:1, 1:2 and 1:3. Synthesis conditions- Zn^{2+} 0.06 M, reagent ratio 1:2:16 (zinc acetate: 2-methylimidazole: ammonium hydroxide), 100 °C.

Thermogravimetric Analysis

Thermogravimetry data was recorded using a Q500 TA instruments thermogravimetric analyser. All material profiles were recorded between room temperature and 800 °C in air.

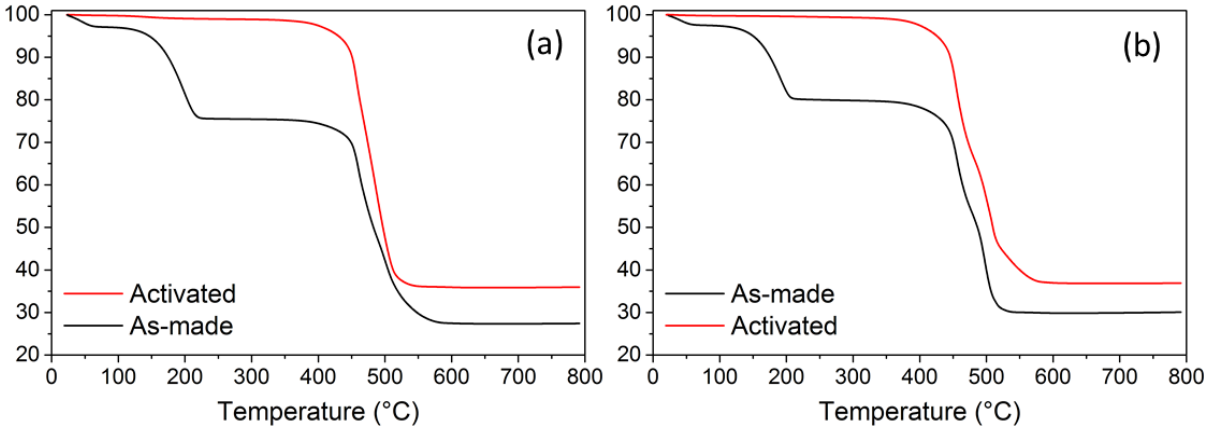

Figure E Thermogravimetric analysis of the as-made and activated products from the room temperature (a) and 400 °C (b) experiments.

Surface Area Analysis

Nitrogen isotherms were recorded using a Micromeritics Tristar II 3020 surface area analyser. Partial pressure range was 0.01 – 0.99. The Microactive software, which uses the Rouquerol method, was used for determining the BET range for each dataset independently.

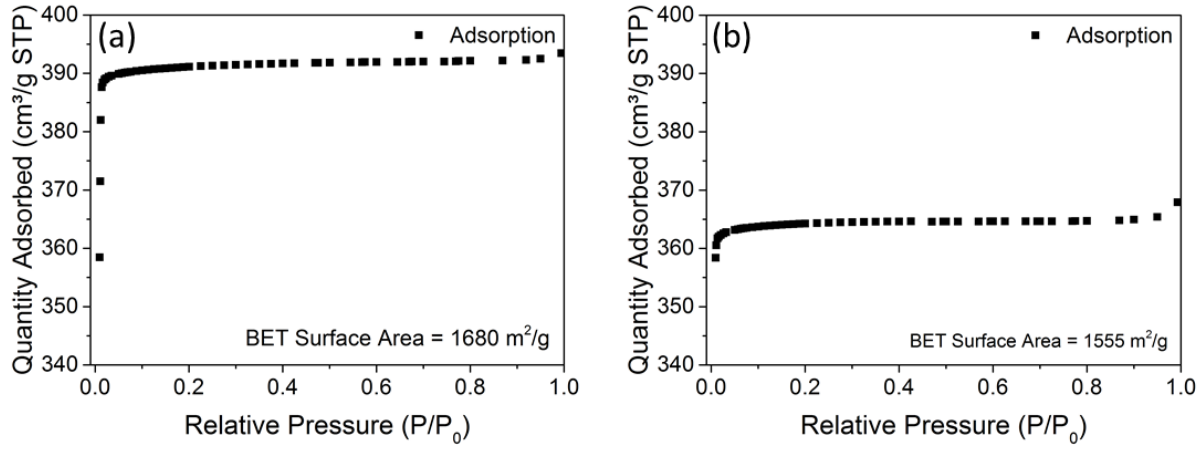

Figure F Nitrogen adsorption isotherms for the products produced at room temperature (a) and 400 °C (b). BET surface areas for each product are given.

*Table A synthesis conditions and corresponding surface areas for various ZIF-8 materials. All products were synthesised with the reagent ratio of 1:2:16 (Zn^{2+}:HMeIm:NH_4OH). ‡Bench batch-reaction performed for comparison, § reagent ratio was 1:4:16, * pilot-scale reactor used for synthesis, a = reaction was performed under autogenous pressure created internally within the equipment.*

Synthesis Conditions				Characterisation
Temperature (°C)	Pressure (bar)	Zn^{2+} concentration (M)	Product	BET Surface Area ($m^2\ g^{-1}$)
‡RT	(Bench)	0.06	ZIF-8	1654
RT	a	0.06	ZIF-8	1713
RT	240	0.06	ZIF-8	1680
100	a	0.06	ZIF-8	1806
100	240	0.06	ZIF-8	1741
100	240	0.24	Unknown impurity	938
100	240	0.015	ZIF-8	1805
400	240	0.06	ZIF-8	1555
§100	a	0.24	ZIF-8	1741
*100	a	0.06	ZIF-8	1780

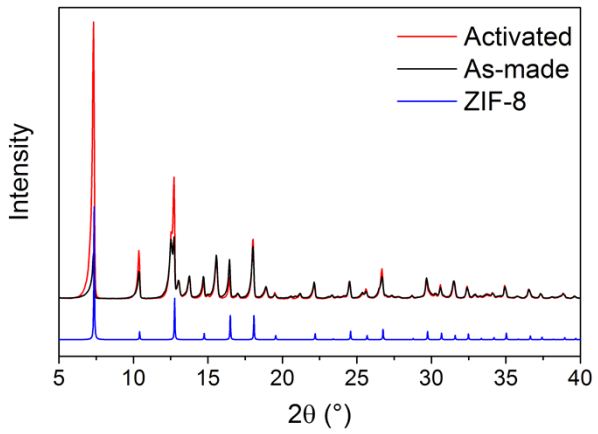

Figure G PXRD pattern of ZIF-8 before and after activation, synthesised at 100 °C and 0.24 M (Zn^{2+}), showing the presence of an unidentified impurity phase. The simulated pattern for ZIF-8 is shown in blue.

Space-Time Yield

Space-time yields were calculated based on the highest concentration reactions (Zn^{2+} = 0.24 M) using the product concentration and the total internal volume of the reactor.

$$\sigma_p = \frac{m_p}{Vt}$$

Metal salt concentration = 0.24 M

		units
Internal reactor volume (total pressurised pipework)	0.000055	m-3

	Total flow rate	30	mL min^{-1}
	Product concentration	0.0148	kg L^{-1}
	Production rate (per hr)	0.027	kg hr^{-1}
(σ_p)	Production rate (per day [8 hours])	0.213	kg d^{-1}
	Space-time yield (total pressurised pipework)	**3874.9**	**kg m^{-3} d^{-1}**