Electronic Supplementary information (ESI)

Supplementary information related to Figure 1.

The energy consumption of our 100 tons per year pilot line displayed on Figure 1 was measured by the Carbon Nexus production facility. The carbon fibre production line was loaded with 30 spools of 24000 filaments polyacrylonitrile precursors. The line speed was set up at 120 m/h. The carbon fibre produced from this trial had a tensile strength of 5.16 Gpa, a tensile modulus of 275.39 Gpa and an elongation of 2 %. The density of the stabilized and the carbon fibre was 1,365 g/cm^3 and 1,790 g/cm^3 respectively. The energy consumption per stage of the manufacturing process is shown on Table 1.

Table 1. Energy consumption of our carbon fibre line.

Stage of the carbon fibre process	Energy consumption (Kw)
Stabilisation	134
Low temperature carbonisation	15
High temperature carbonisation	45
Abatement system	25
Material handling	5
Surface treatment, handling, drying	43
Winding	10
Total	277

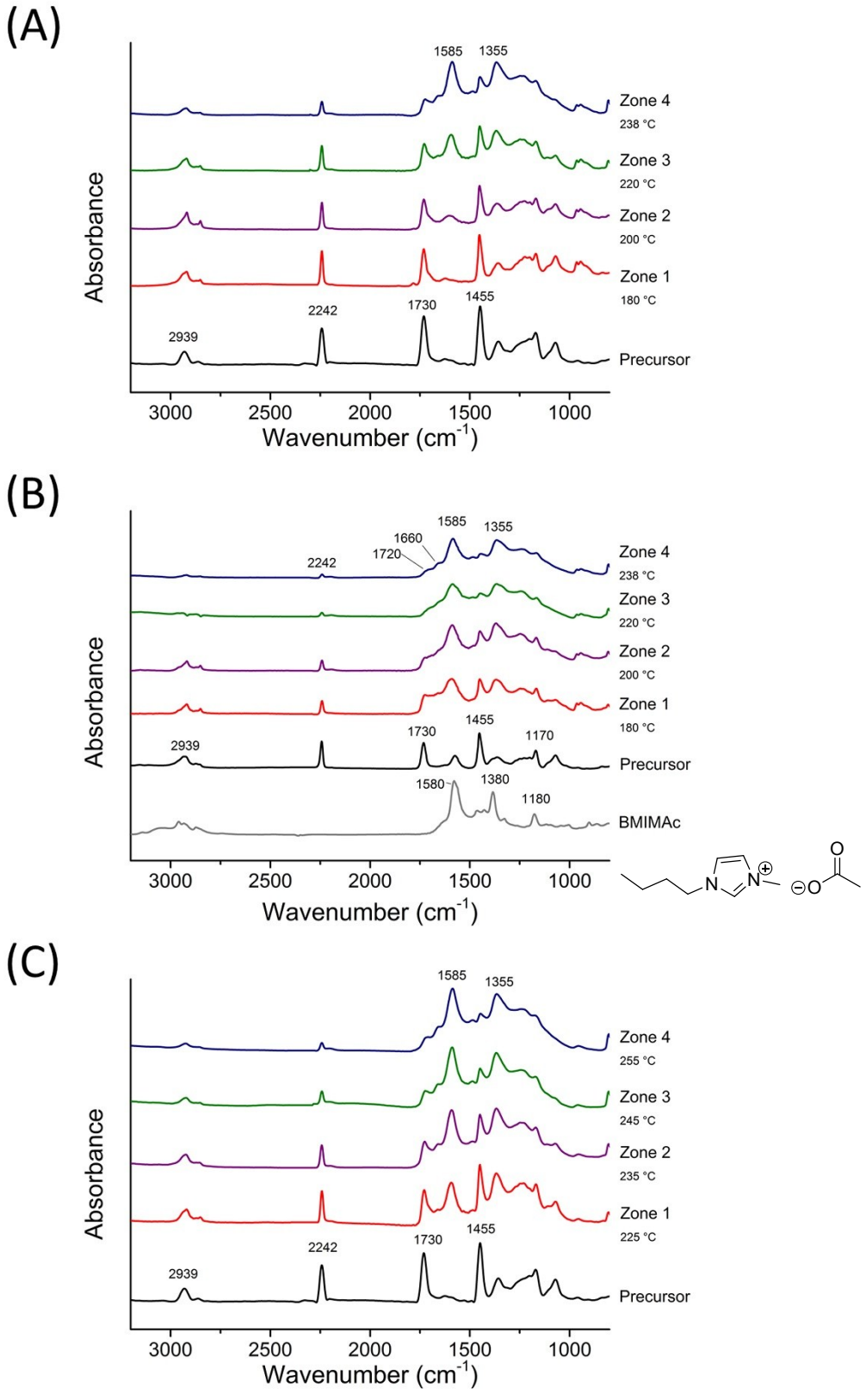
Supplementary information related to the paragraph 'stabilisation of fibres'.

Table 2. Process parameters used for the manufacture of Control, Impregnated and Standard fibres.

Products	Process parameters			
Control and Impregnated fibres	Zone	Temperature (°C)	Residence time per zone (min)	
	1	180	24	
	2	200		
	3	220		
	4	238		
	Material handling (drive system)			
	Drive number	1	2	3
	Draw (%)	-	-10.8	0
	Speed (m/h)	30	26.8	25.8
	Tension (cN) (Untreated -/Treated)	400/400 (±100)	1000/1000 (±100)	500/500 (±100)
Standard fibres	Zone	Temperature (°C)	Residence time per zone (min)	
	1	225	24	
	2	235		
	3	245		
	4	255		
	Material handling (drive system)			
	Drive number	1	2	3
	Draw (%)	-	3.0	4.0
	Speed (m/h)	30	30.9	32.1
	Tension (cN)	730 (±100)	1650 (±100)	1570 (±100)

Supplementary information related to the paragraph 'Fibre stabilisation – infrared study'

Figure 1. FT-IR spectra of (A) Control, (B) Impregnated, (c) Standard fibres along the stabilisation



Supplementary information related to the paragraph 'Fibre stabilisation – Calorimetric study'

Table 3. Recorded DSC data (mean and standard deviation) for the Control, Impregnated and Standard fibres.

Samples		ΔH (J/g)		Conversion index (%)	
		Mean	*Dev.*	***Mean***	*Dev.*
Control	Precursor	552.8	± 5.8	-	
	Zone 1	547.8	± 1.1	0.8	± 0.2
	Zone 2	520.0	± 3.3	5.9	± 0.6
	Zone 3	490.9	± 2.6	11.1	± 0.5
	Zone 4	425.4	± 6.3	23.0	± 1.1
Impregnated	Precursor	585.1	± 7.8	-	
	Zone 1	439.0	± 8.2	25.0	± 1.4
	Zone 2	388.8	± 8.9	33.6	± 1.5
	Zone 3	339.7	± 2.1	41.9	± 0.4
	Zone 4	243.0	± 6.9	58.5	± 1.2
Standard	Precursor	552.8	± 5.8	-	
	Zone 1	427.8	± 4.6	22.5	± 0.8
	Zone 2	393.1	± 5.4	28.8	± 1.0
	Zone 3	351.1	± 2.3	36.4	± 0.4
	Zone 4	256.7	± 4.6	53.5	± 0.8

Supplementary information related to the paragraph 'Fibre stabilisation – thermogravimetric study'

Figure 2. TGA (top) and (bottom) DTG curves of (A) Control and (B) Standard fibres.