

Supplementary Materials

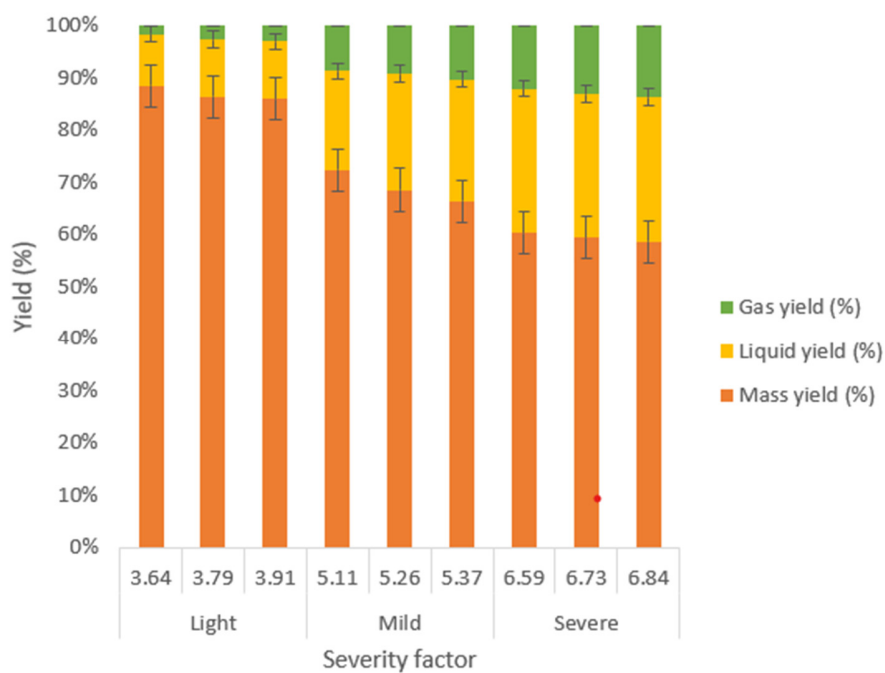


Figure S1. Product yields of torrefied white spruce sawdust (WSS).

Table S1. Elemental and proximate composition of untreated and torrefied WSS.

Temp (°C)	RT (min)	SF	M.C (%)	C (%)	H (%)	N (%)	S (%)	O ^a (%)	Ash ^b (%)	VM ^b (%)	FC ^b (%)
NT	NT	NT	8.69	47.47	6.66	0.11	0.21	45.41	0.14	86.42	13.44
200	5	3.64	8.62	48.80	5.64	0.38	0.20	44.69	0.29	83.56	16.15
200	7	3.79	8.60	49.85	5.52	0.40	0.18	43.76	0.29	81.22	18.49
200	9	3.91	8.55	50.17	5.48	0.40	0.15	43.50	0.30	79.59	20.11
250	5	5.11	8.51	50.27	5.44	0.41	0.13	43.43	0.32	78.02	21.66
250	7	5.26	8.49	51.22	5.41	0.43	0.13	42.43	0.38	76.50	23.12
250	9	5.37	8.41	51.87	5.39	0.43	0.15	41.74	0.42	75.44	24.14
300	5	6.59	8.33	52.06	5.32	0.44	0.12	41.52	0.54	70.43	29.03
300	7	6.73	8.27	52.69	5.27	0.44	0.12	40.92	0.58	68.89	30.53
300	9	6.84	8.24	54.25	5.22	0.44	0.11	39.34	0.61	67.66	31.73

Temp = temperature; RT = residence time; SF = severity factor (which is a function of temperature and time); M.C = moisture content; C = carbon; H = hydrogen; N = nitrogen; S = sulfur; O = oxygen; VM = volatile matter; FC = fixed carbon; ^a= calculated by difference; ^b= dry basis; and NT = non-treated.

Table S2. Pellet properties of torrefied WSS.

Temp (°C)	RT (min)	SF	Pellet Density (kg/m ³)	Dimensional Stability (%)	Tensile Strength (MPa)
NT	NT	NT	1048.56	2.87	1.68
200	5	3.64	1022.34	2.12	1.82
200	7	3.79	1017.67	1.61	1.86
200	9	3.91	1001.89	1.22	1.84
250	5	5.11	997.31	1.06	1.34
250	7	5.26	992.00	0.82	1.26
250	9	5.37	973.08	0.94	1.23
300	5	6.59	934.84	0.67	0.85
300	7	6.73	930.61	0.54	0.81
300	9	6.84	915.42	0.66	0.78

Temp = temperature; RT = residence time; SF = severity factor; NT = untreated.

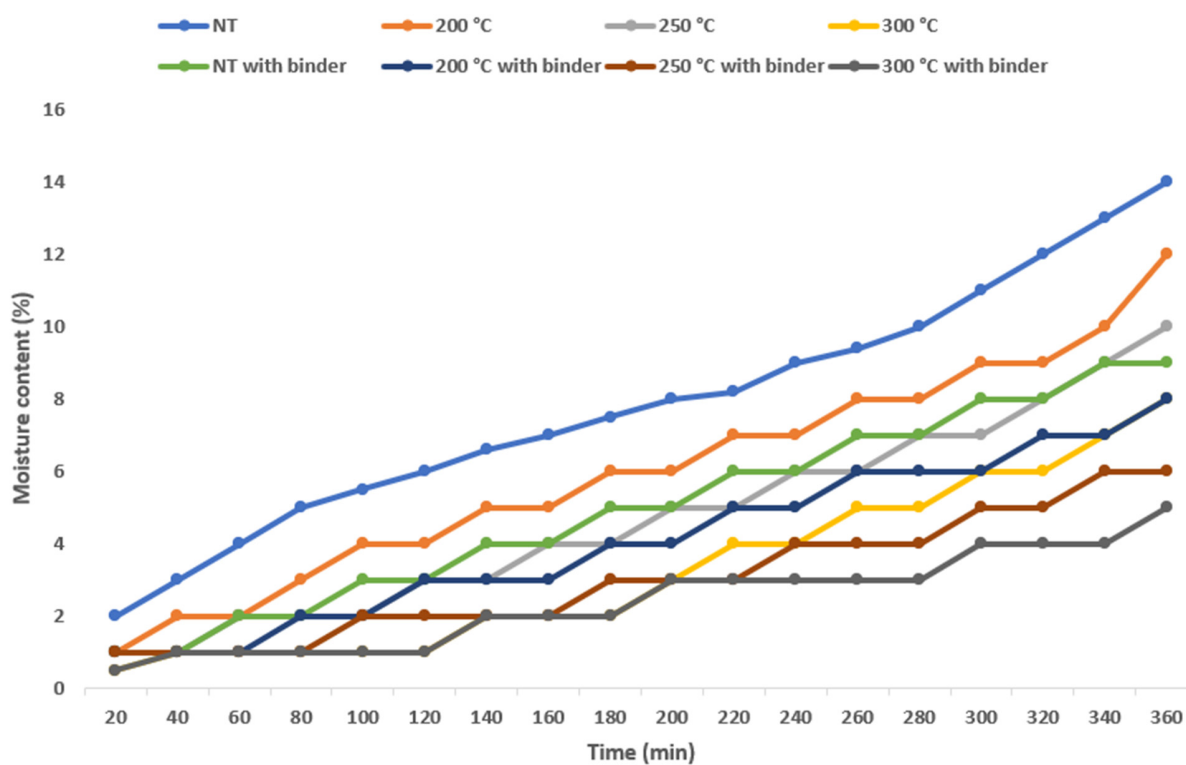


Figure S2. Effect of the binders on the moisture absorption rate of the pellets.

NB: NT = Untreated.

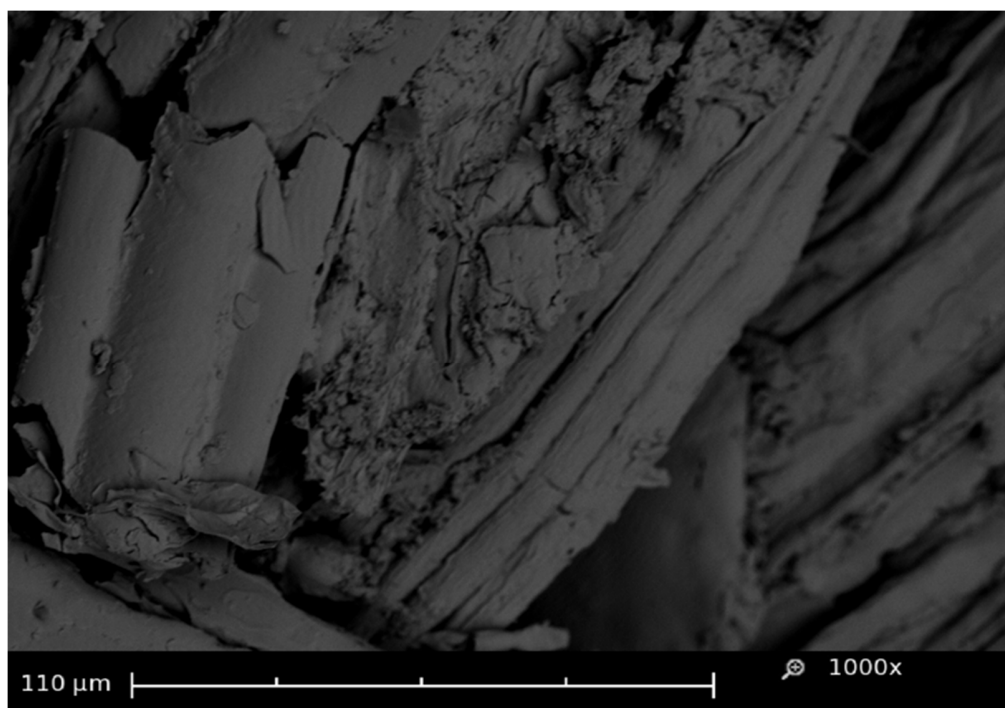


Figure S3. Higher magnification of scanning electron microscope image of the longitudinal cross-section of the untreated pellet.

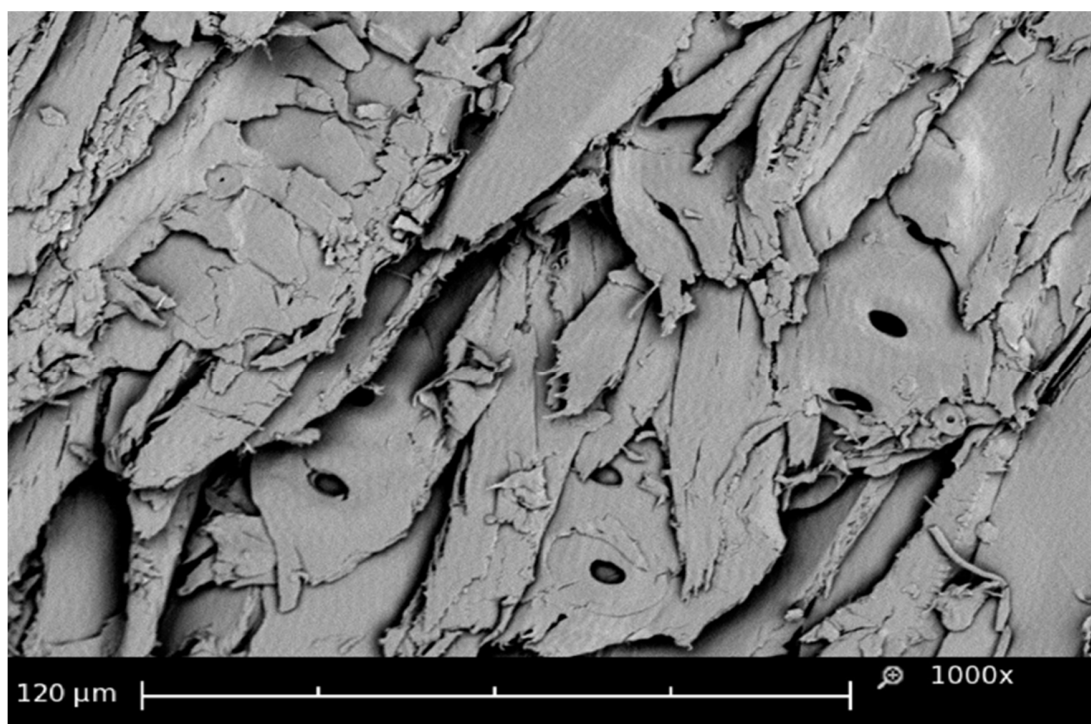


Figure S4. Higher magnification of Scanning electron microscope images of the longitudinal cross-section of WSS torrefied at 200 °C.

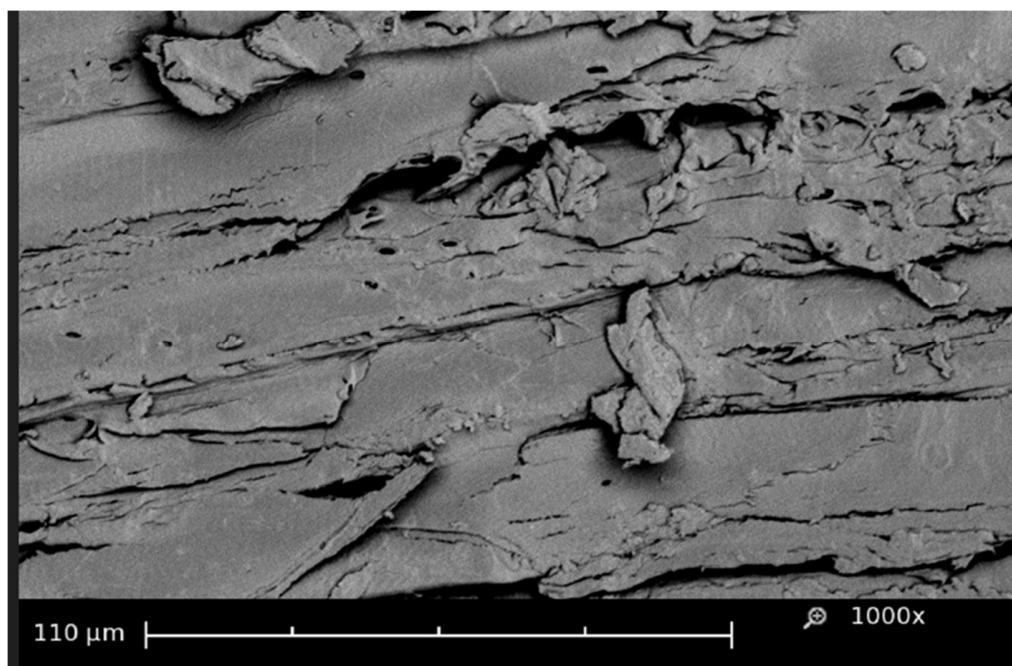


Figure S5. Higher magnification of Scanning electron microscope images of the longitudinal cross-section of WSS torrefied at 250 °C.

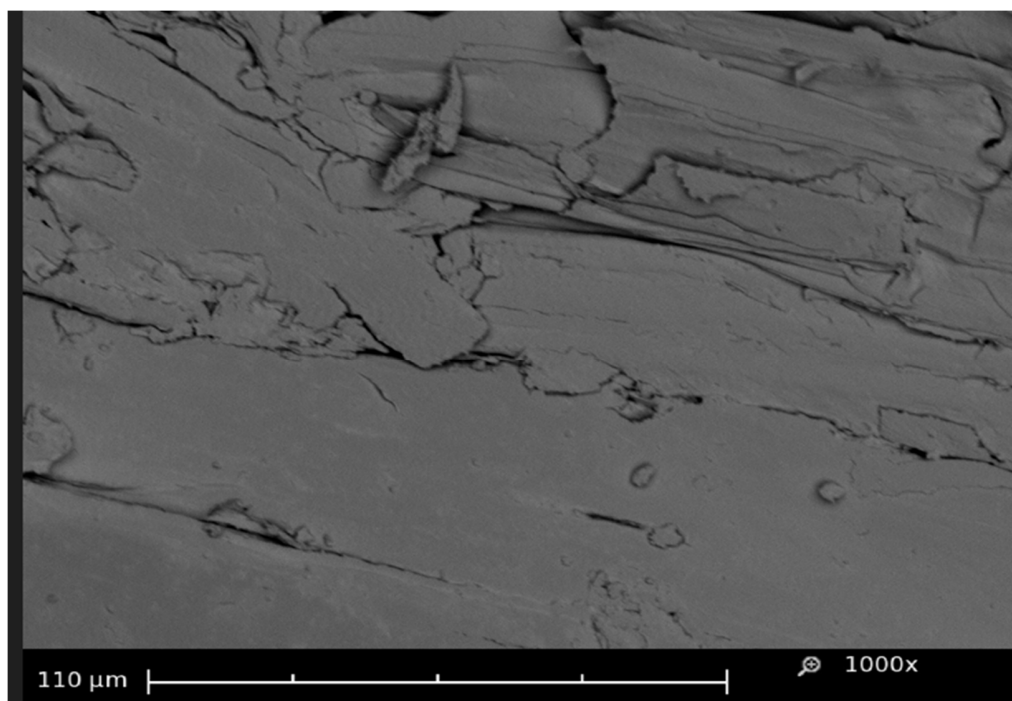


Figure S6. Higher magnification of Scanning electron microscope images of the longitudinal cross-section of WSS torrefied at 300 °C.