Supplementary Information (SI) for RSC Sustainability.
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SUPPLEMENTARY MATERIAL

From additive analysis to process monitoring: characterization of polypropylene solvent-based recycling from plastic feedstocks representative of sorting centers

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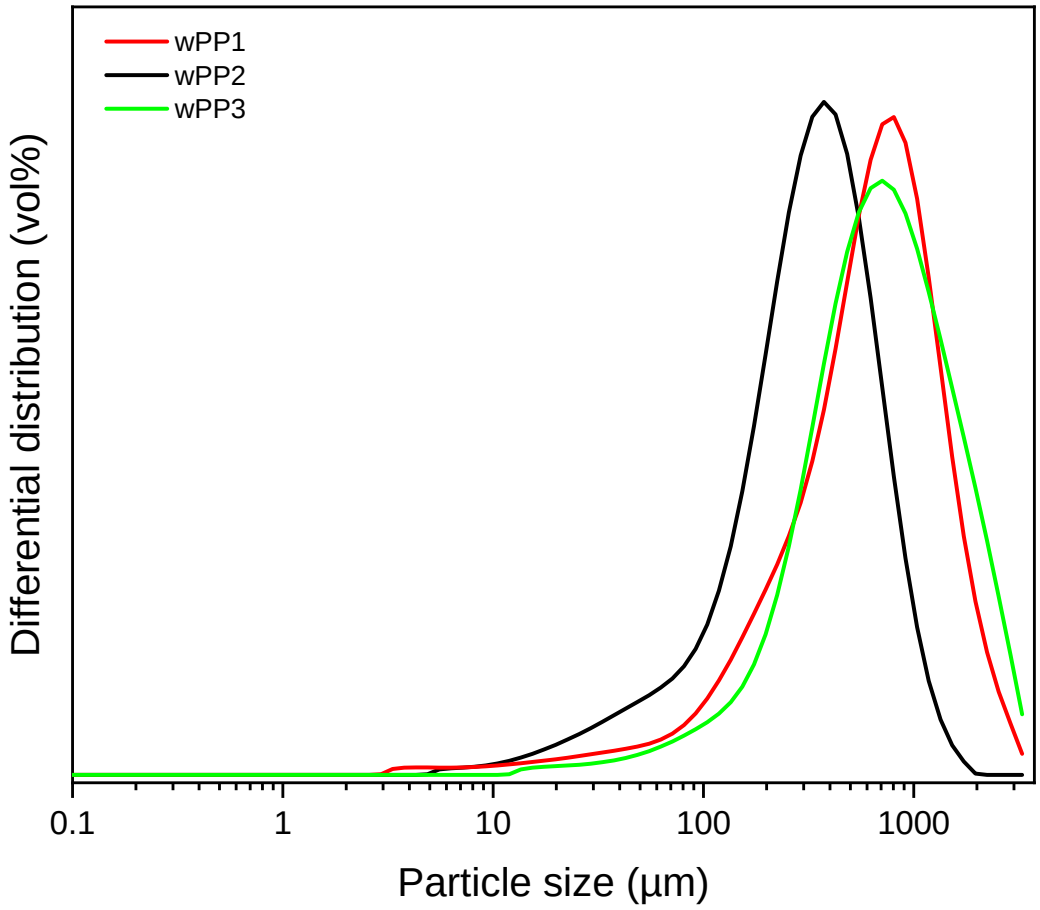

Fig. S1 Particle size distribution of the cryogenic grinded polymer particles by dry mode Mastersizer.

Table S1 Associated data of the particle size distribution of the cryogenic grinded polymer particles

	wPP1	wPP2	wPP3
D [3,2]	391 µm	212 µm	159 µm
D [4,3]	875 µm	752 µm	382 µm
Dx (50)	693 µm	643 µm	327 µm

Table. S2 Thermal and structural properties of the plastic feedstock polymers used in this study.

Sample	T_m (°C)		T_c (°C)		Crystallinity (%)	M_n (kg.mol^{-1})	M_w (kg.mol^{-1})	*Đ*
	T_{m1}	T_{m2}	T_{c1}	T_{c2}				
wPP1	129.7	164.3	130.8	119.9	34.9	54.1	248.1	4.1
wPP2	126.4	164.1	128.1	117.8	27.5	17.8	249.3	13.9
wPP3	132.7	164.2	130.5	117.3	27.5	18.1	245.4	13.5

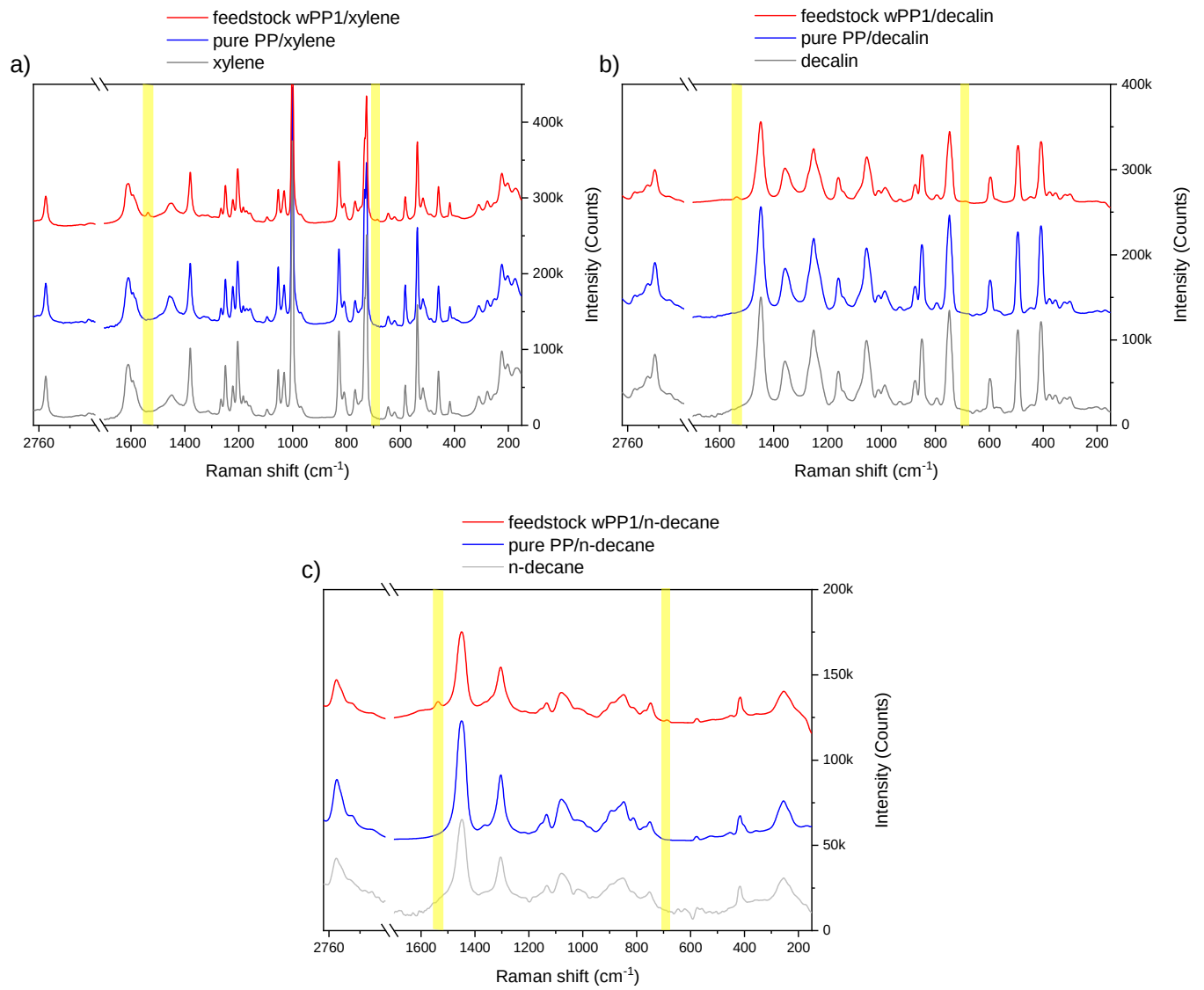

Fig. S2 Raman spectra of the solvent, pure polymer/solvent, and plastic feedstock polymer/solvent systems in a) xylene, b) decalin and c) n-decane. The highlighted regions show the new bands in the dissolved plastic feedstock.

Table S3 Operating conditions of the plastic feedstock polypropylene dissolutions

Run	Polymer	Solvent	Temperature (°C)	Stirring speed (rpm)	Polymer content (% w/v)	Form introduced
1	wPP1	TCB	150	800	5	Flakes
2	wPP1	Decane	150	800	10	Flakes
3	wPP1	TCB	150	800	5	Flakes
4	wPP1	TCB	150	800	5	Powder
5	wPP1	Decane	150	800	10	Powder
6	wPP1	TCB	150	800	5	Powder
7	wPP1	Decalin	130	800	5	Powder
8	wPP1	Amyl acetate	145	800	5	Powder
9	wPP2	Xylene	130	800	5	Powder
10	wPP3	Xylene	130	800	5	Powder

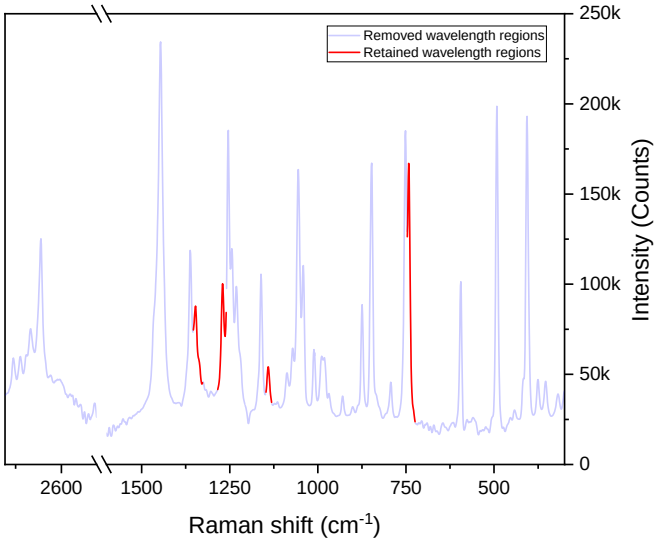

Fig. S3 Raman spectra of the wPP3 dissolved in decalin. The light blue regions are removed from the PCA while the red regions are used.

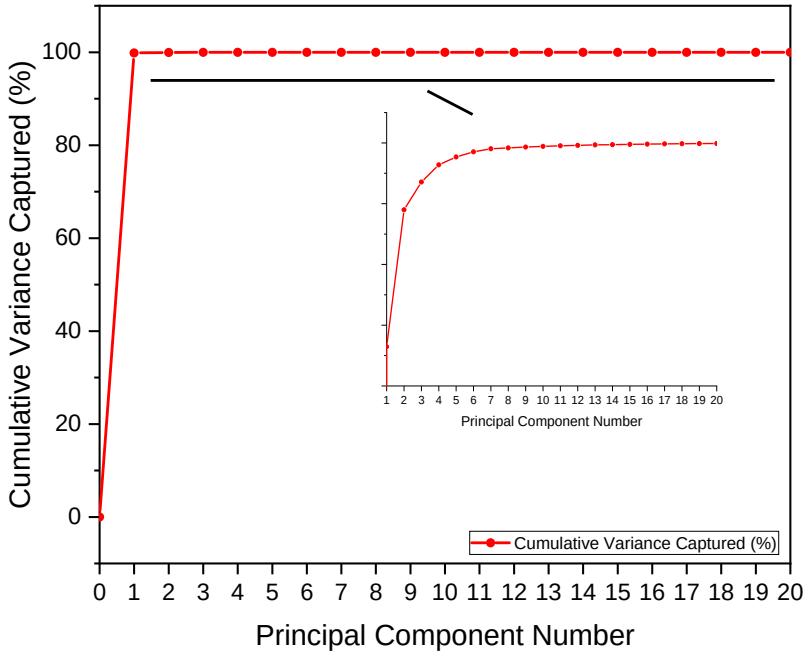

Fig. S4 Percentage of variance captured as a function of the principal component number of the retained regions PCA.

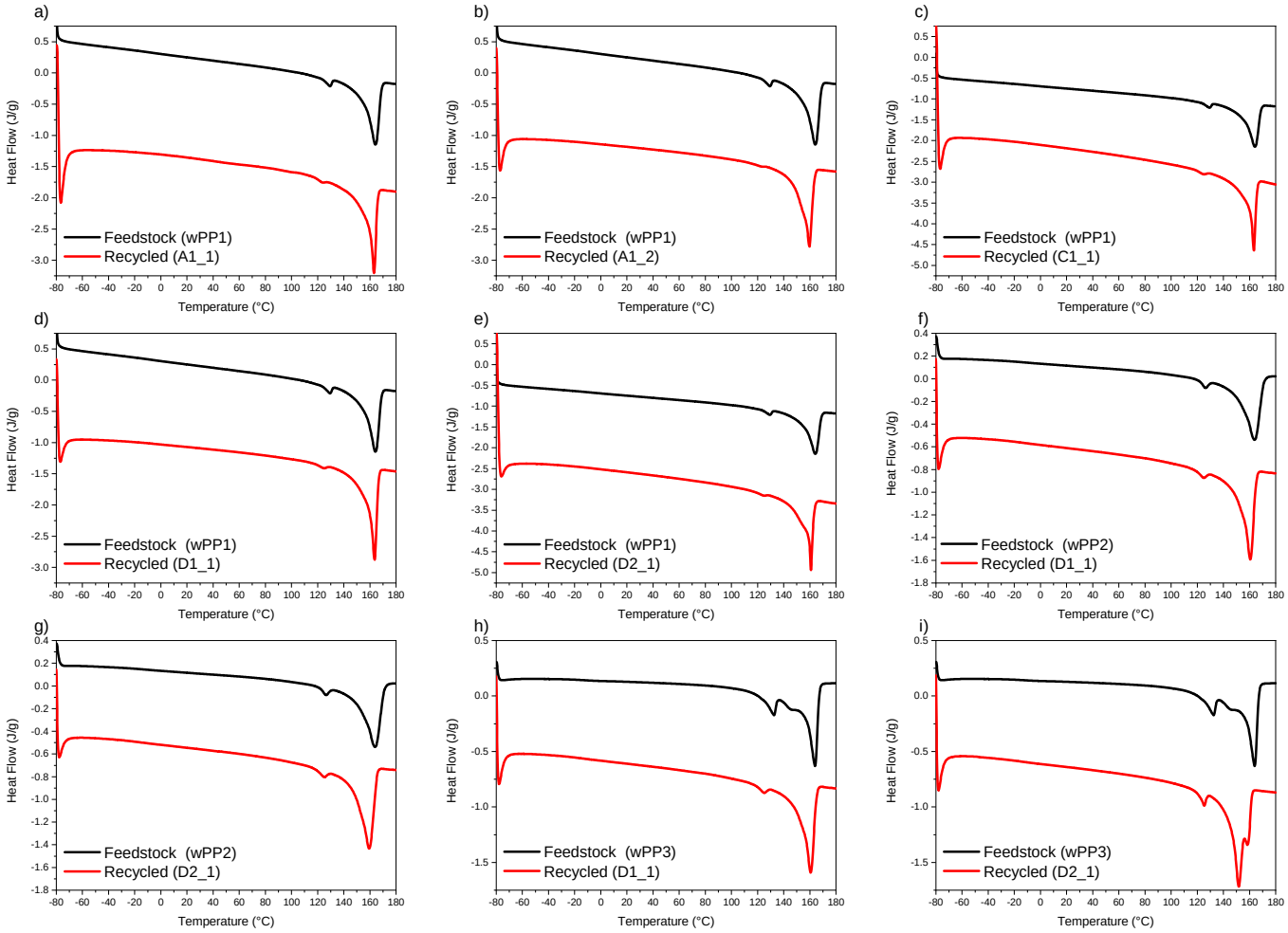

Fig. S5 DSC heating curves, in black of the plastic feedstock material and in red of the recycled material (a) wPP1 in the A1_1 condition, (b) wPP1 in the A1_2 condition, (c) wPP1 in the C1_1 condition, (d) wPP1 in the D1_1 condition, (e) wPP1 in the D2_1 condition (f) wPP2 in the D1_1 condition, (g) wPP2 in the D2_1 condition (h) wPP3 in the D1_1 condition (i) wPP2 in the D2_1 condition.

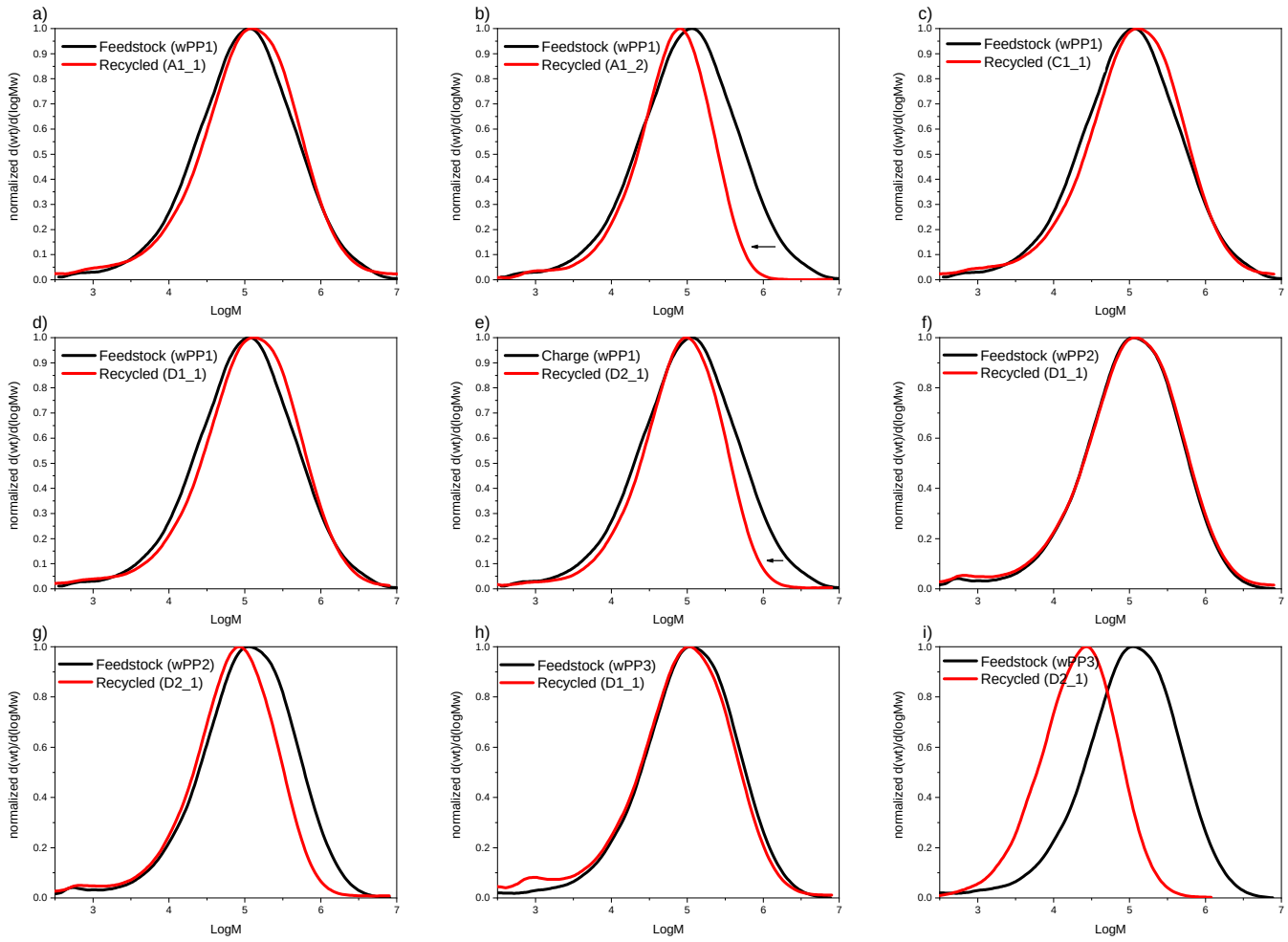

Fig. S6 Normalized molar mass distributions curves, in black of the plastic feedstock material and in red of the recycled material (a) wPP1 in the A1_1 condition, (b) wPP1 in the A1_2 condition, (c) wPP1 in the C1_1 condition, (d) wPP1 in the D1_1 condition, (e) wPP1 in the D2_1 condition (f) wPP2 in the D1_1 condition, (g) wPP2 in the D2_1 condition (h) wPP3 in the D1_1 condition (i) wPP2 in the D2_1 condition.

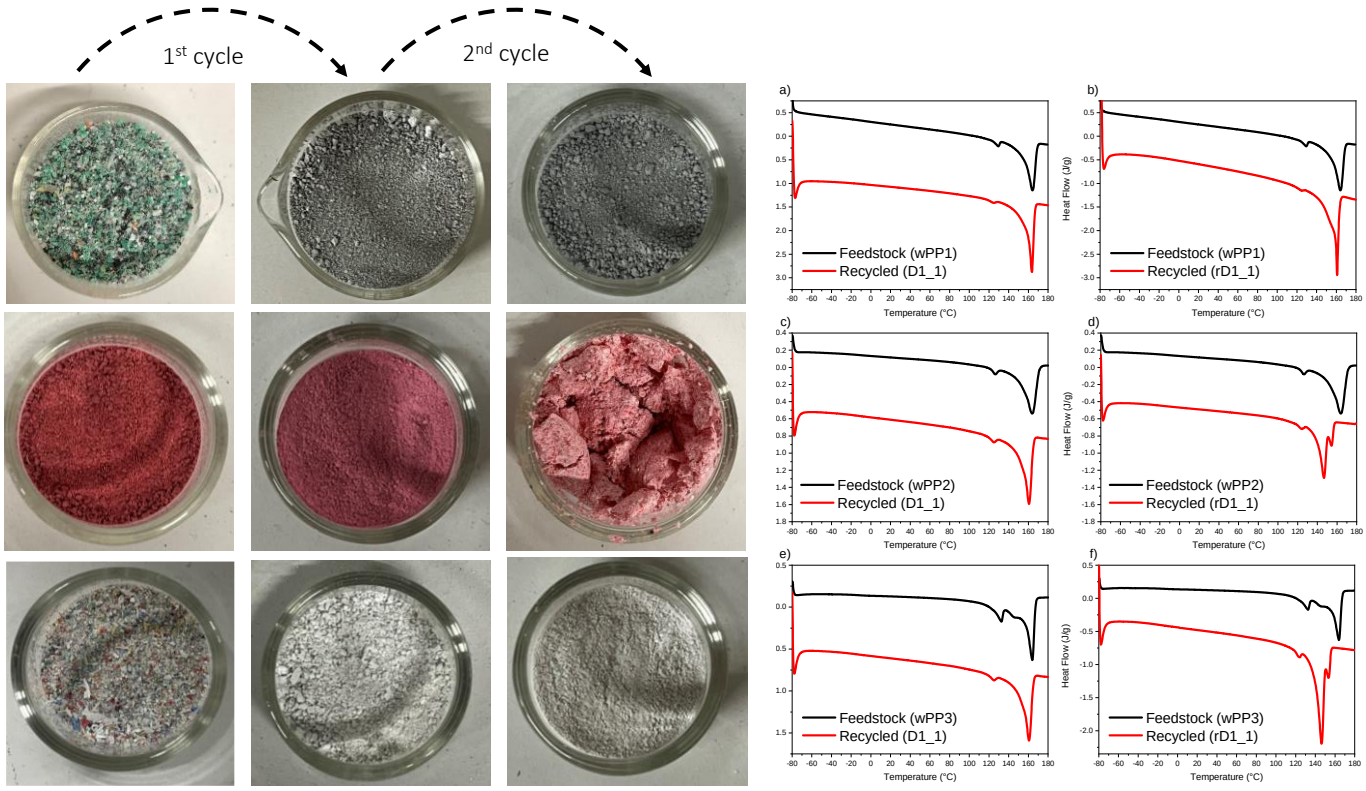

Fig. S7 Pictures of the plastic feedstock material wPP1, wPP2 and wPP3 and the according recycled material under the D1_1 condition (1st cycle and 2nd cycle). DSC heating thermogram, in black of the plastic feedstock material and in red of the recycled material for (a) wPP1 after 1 cycle, (b) wPP1 after 2 cycles, (c) wPP2 after 1 cycle, (d) wPP2 after 2 cycles, (e) wPP3 after 1 cycle, (f) wPP3 after 2 cycles

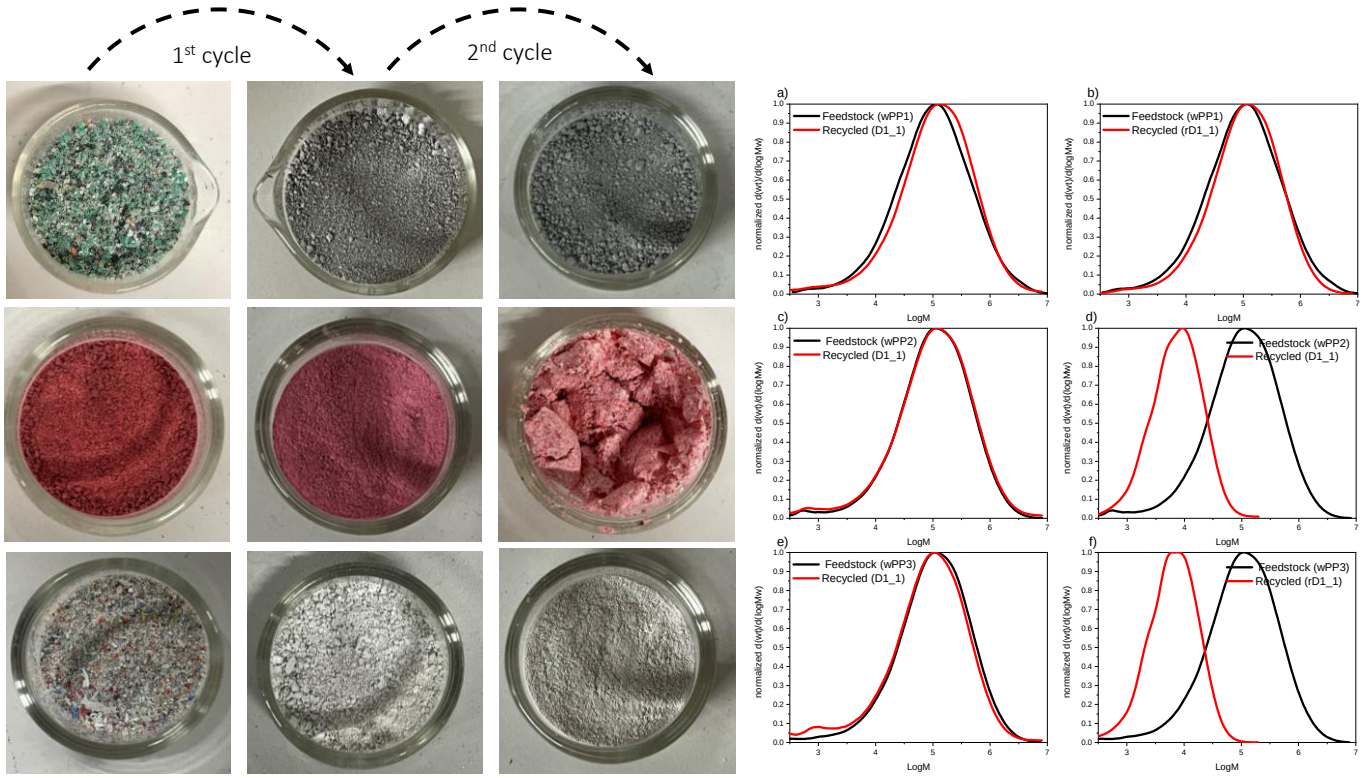

Fig. S8 Pictures of the plastic feedstock material wPP1, wPP2 and wPP3 and the according recycled material under the D1_1 condition (1st cycle and 2nd cycle). Normalized molar mass distributions curves, in black of the plastic feedstock material and in red of the recycled material for (a) wPP1 after 1 cycle, (b) wPP1 after 2 cycles, (c) wPP2 after 1 cycle, (d) wPP2 after 2 cycles, (e) wPP3 after 1 cycle, (f) wPP3 after 2 cycles

Table S4 Detail of the HT-SEC measurement of the recycled polymers

Sample	Mn (kg.mol^{-1})	Mw (kg.mol^{-1})	*Đ*
wPP1	54.1	248.1	4.1
wPP1_A1_1[(a)]	34.4	265.8	7.7
wPP1_A1_2[(b)]	19.4	108.8	5.6
wPP1_C1_1[(c)]	31.0	268.8	8.6
wPP1_D1_1[(d)]	24.4	276.6	11.3
wPP1_D2_1[(e)]	19.5	152.4	7.8
rwPP1_D1_1[(f)]	20.2	241.2	12.3
wPP2	17.8	249.3	13.9
wPP2_D1_1[(d)]	15.7	250.2	8.2
wPP2_D2_1[(e)]	12.3	128.3	16.5
rwPP2_D1_1[(f)]	9.4	11.4	4.1
wPP3	18.1	245.4	13.5
wPP3_D1_1[(d)]	29.2	203.1	8.2
wPP3_D2_1[(e)]	4.3	38.1	2.6
rwPP3_D1_1[(f)]	3.7	9.9	2.7

(a) Amyl acetate, 130°C, 30min
(b) Amyl acetate, 130°C, 120min
(c) Cyclohexanone, 130°C, 30min
(d) n-decane, 130°C, 30min
(e) n-decane, 170°C, 30min
(f) 2nd recycling in n-decane, 130°C, 30min

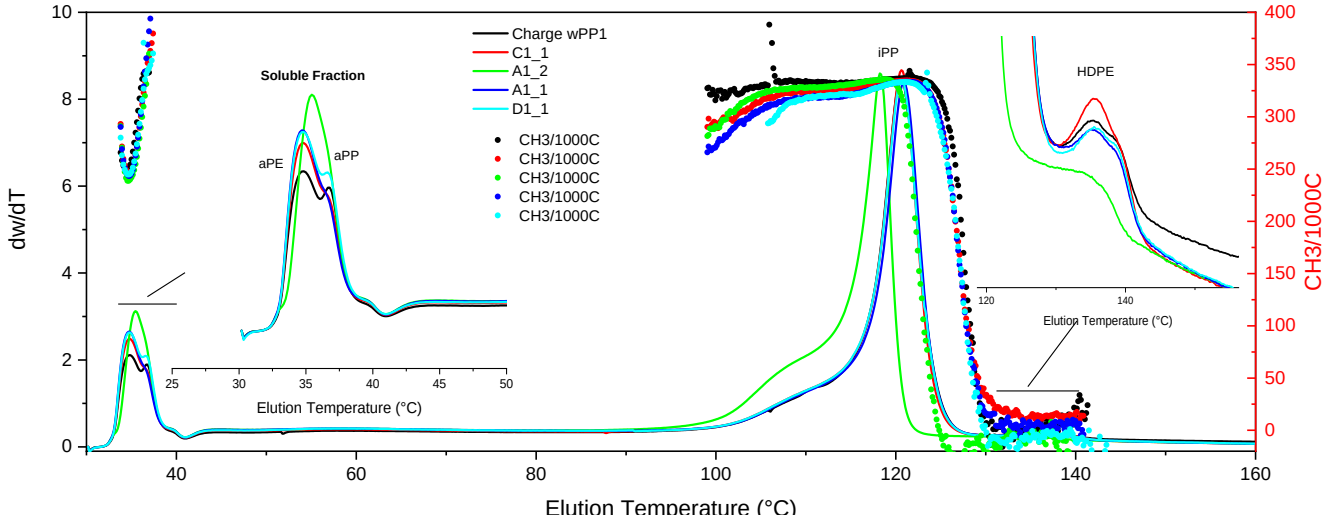

Fig. S9 TGIC profiles, of the plastic feedstock wPP1 and of the recycled material

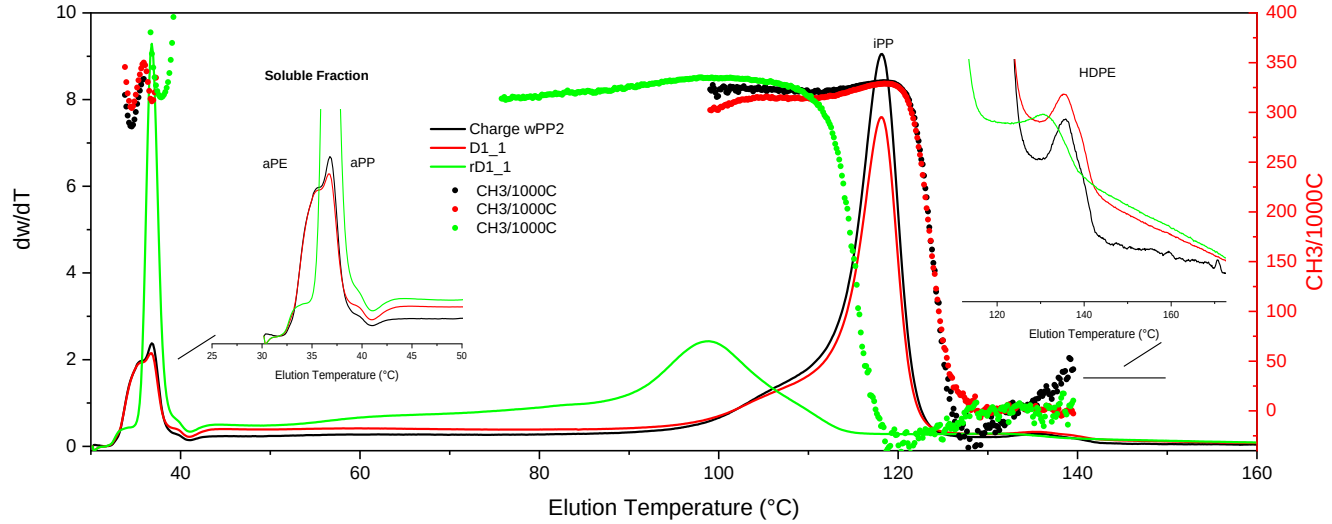

Fig. S10 TGIC profiles, of the feedstock charge wPP2 and of the recycled material

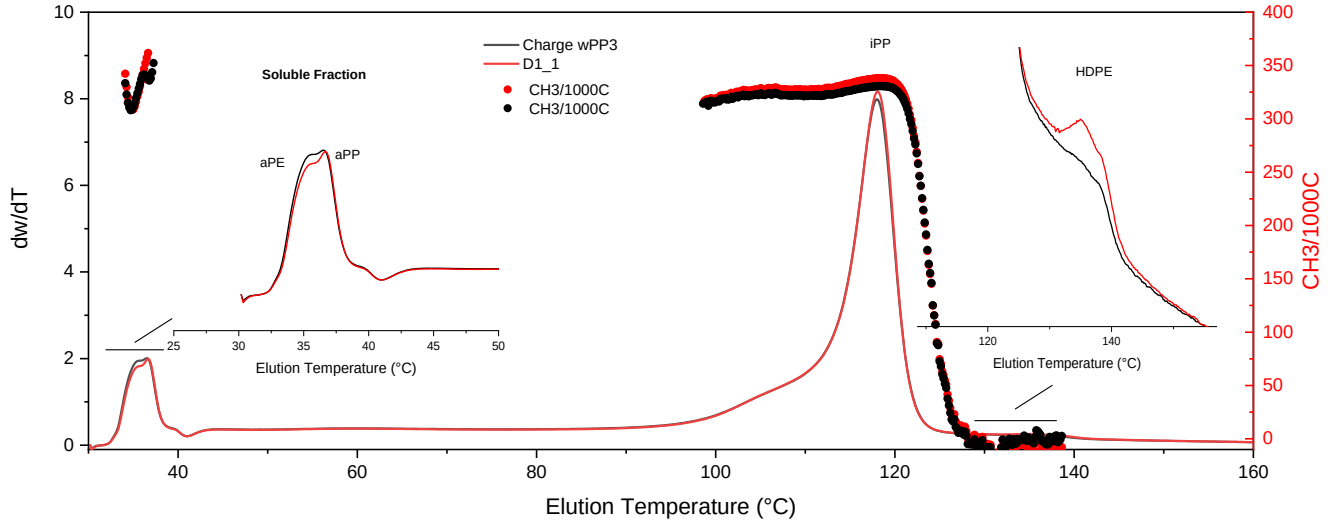

Fig. S11 TGIC profiles, of the feedstock charge wPP3 and of the recycled material