Electronic Supplementary Material

Continuous flow pyrolysis of virgin and waste polyolefins: a comparative study, process optimization and product characterization

Ecrin Ekici[1,2], Güray Yildiz **(✉)**[2,3], Magdalena Joka Yildiz[4], Monika Kalinowska[5], Erol Şeker[6], Jiawei Wang[7]

1 Karlsruhe Institute of Technology, Institute of Catalysis Research and Technology, 76344 Eggenstein-Leopoldshafen, Germany

2 Izmir Institute of Technology, Faculty of Engineering, Department of Energy Systems Engineering, 35430 Izmir, Türkiye

3 Department of Materials Engineering and Production, Faculty of Mechanical Engineering, Bialystok University of Technology, 15-351 Bialystok, Poland

4 Department of Agricultural and Food Engineering and Environmental Development, Institute of Civil Engineering and Energetics, Faculty of Civil Engineering and Environmental Sciences, Bialystok University of Technology, 15-351 Bialystok, Poland

5 Department of Chemistry, Biology and Biotechnology, Institute of Civil Engineering and Energetics, Faculty of Civil Engineering and Environmental Sciences, Bialystok University of Technology, 15-351 Bialystok, Poland

6 Izmir Institute of Technology, Faculty of Engineering, Department of Chemical Engineering, 35430 Izmir, Türkiye

7 Energy and Bioproducts Research Institute (EBRI), Aston University, Birmingham B4 7ET, United Kingdom

E-mails: guray.yildiz@pb.edu.pl, guryildiz@gmail.com

Table S1. The process parameters and product yields reported in the research articles analyzed for this work.

Plastic-type	Feed intake (g/min)	Reactor type	Pyrolysis temperature (°C)	Vapour residence time (s)	Liquid yield (wt.%)			Gas yield (wt.%)					Solid yield (*wt.*%)	Ref.
					C_5-C_{12} HCs	C_{13}-C_{20} HCs	C_{21+} HCs	C_1	C_2	C_3	C_4	Trace gases*		
HDPE	0.10	CSBR	500	0.01	6.0	26.0	67.0	0.02	0.10	0.38	0.50	0.00	0.00	[1]
HDPE	0.10	CSBR	550	0.01	8.0	28.0	61.0	0.02	0.37	1.23	1.38	0.00	0.00	
HDPE	0.10	CSBR	600	0.01	16.5	24.0	54.5	0.14	1.20	2.10	1.55	0.00	0.00	
HDPE	0.10	CSBR	650	0.01	27.0	22.0	37.0	0.98	4.04	4.78	4.20	0.00	0.00	
HDPE	0.10	CSBR	700	0.01	32.0	16.0	12.0	0.92	18.11	10.81	10.15	0.00	0.00	
LDPE	0.01	CSBR	500	0.02	0.0	0.0	69.0	15.79	4.59	3.16	7.46	0.00	0.00	[2]
LDPE	0.01	CSBR	550	0.02	0.0	0.0	57.0	6.41	15.32	10.95	10.32	0.00	0.00	
LDPE	0.01	CSBR	600	0.02	0.0	0.0	51.0	5.90	18.68	11.31	13.11	0.00	0.00	
HDPE	0.01	CSBR	500	0.02	0.0	0.0	68.0	13.88	6.59	4.71	6.82	0.00	0.00	
HDPE	0.01	CSBR	550	0.02	0.0	0.0	61.0	7.52	18.71	6.82	5.95	0.00	0.00	
HDPE	0.01	CSBR	600	0.02	0.0	0.0	49.0	7.02	25.92	9.03	9.03	0.00	0.00	
PP	0.01	CSBR	500	0.02	0.0	0.0	75.0	10.1	3.7	1.4	9.8	0.00	0.00	
PP	0.01	CSBR	550	0.02	0.0	0.0	67.0	6.3	10.4	7.8	8.5	0.00	0.00	
PP	0.01	CSBR	600	0.02	0.0	0.0	50.0	8.0	18.3	15.3	8.5	0.00	0.00	
PP	N/A	FFR	550	N/A	N/A	N/A	N/A	1.0	2.1	13.6	6.4	0.28	0.00	[3]
PP	N/A	FFR	575	N/A	N/A	N/A	N/A	2.8	4.4	13.9	6.8	0.40	0.00	
PP	N/A	FFR	600	N/A	N/A	N/A	N/A	6.0	6.8	14.3	6.0	0.93	0.00	
PP	N/A	FFR	625	N/A	N/A	N/A	N/A	11.4	11.2	15.7	6.3	1.93	0.00	
PP	0.45	BFBR	668	3.45	40.5	2.8	0.0	10.2	15.1	17.8	10.9	0.62	2.01	[4]
PP	0.45	BFBR	703	3.45	35.9	0.1	0.0	12.9	17.8	16.2	9.5	0.72	6.91	
PP	0.45	BFBR	727	3.45	34.9	0.0	0.0	17.0	20.9	14.7	8.8	0.61	3.12	
PP	0.45	BFBR	746	3.45	29.7	0.0	0.0	35.8	19.8	6.8	3.9	0.01	4.02	
PE	0.52	BFBR	660	3.45	49.2	12.8	0.0	7.0	16.7	9.4	4.0	0.21	0.71	
PE	0.52	BFBR	680	3.45	44.8	12.0	0.0	8.2	18.9	10.7	4.8	0.31	0.30	
PE	0.52	BFBR	704	3.45	38.4	5.9	0.0	10.6	24.5	13.4	6.4	0.42	0.30	

PE	0.52	BFBR	728	3.45	35.8	2.6	0.0	13.9	27.5	11.7	5.9	0.62	2.01	
PE	0.10	BFBR	550	3.45	N/A	N/A	N/A	3.5	10.4	7.9	1.0	5.95	68.97	[5]
PE	0.10	BFBR	600	3.45	N/A	N/A	N/A	8.1	15.8	10.1	0.0	6.87	57.14	
PE	0.10	BFBR	650	3.83	N/A	N/A	N/A	10.3	29.4	17.1	4.8	6.36	28.00	
PE	0.10	BFBR	700	3.89	N/A	N/A	N/A	7.3	18.6	7.5	2.8	2.78	56.00	
PE	0.10	BFBR	750	4.26	N/A	N/A	N/A	10.2	23.3	5.4	2.7	2.33	53.00	
PE	0.10	BFBR	550	2.02	N/A	N/A	N/A	2.9	8.7	2.9	0.0	5.76	78.57	
PE	0.10	BFBR	600	2.14	N/A	N/A	N/A	3.7	14.1	8.5	0.0	2.97	69.57	
PE	0.10	BFBR	650	2.26	N/A	N/A	N/A	8.8	31.4	18.1	7.1	0.00	32.49	
PE	0.10	BFBR	700	2.31	N/A	N/A	N/A	7.4	20.5	8.6	4.9	0.00	51.52	
HDPE	0.35	BFBR	645	0.82	N/A	N/A	N/A	1.5	6.0	5.7	4.8	0.00	0.00	[6]
HDPE	0.35	BFBR	640	0.99	N/A	N/A	N/A	1.1	5.1	4.3	2.1	0.00	0.00	
HDPE	0.35	BFBR	650	1.46	N/A	N/A	N/A	2.4	10.4	8.6	10.2	0.00	0.00	
HDPE	0.35	BFBR	650	2.57	N/A	N/A	N/A	1.8	7.8	6.9	6.9	0.00	0.00	
HDPE	0.35	BFBR	685	0.79	N/A	N/A	N/A	5.7	27.7	18.2	11.5	1.21	0.00	
HDPE	0.35	BFBR	685	1.3	N/A	N/A	N/A	4.8	20.2	17.5	17.2	0.40	0.00	
HDPE	0.35	BFBR	700	1.69	N/A	N/A	N/A	5.7	26.8	18.5	14.8	0.83	0.00	
HDPE	0.35	BFBR	685	2.12	N/A	N/A	N/A	5.7	23.2	16.7	11.6	0.68	0.00	
HDPE	0.35	BFBR	730	0.78	N/A	N/A	N/A	6.7	32.8	19.5	20.3	0.91	0.00	
HDPE	0.35	BFBR	725	1	N/A	N/A	N/A	6.6	33.8	20.9	17.0	0.56	0.00	
HDPE	0.35	BFBR	715	1.38	N/A	N/A	N/A	7.2	34.1	21.4	16.5	0.47	0.00	
HDPE	0.35	BFBR	730	2.27	N/A	N/A	N/A	7.9	30.6	26.5	19.2	0.60	0.00	
HDPE	0.35	BFBR	780	0.7	N/A	N/A	N/A	9.7	39.9	19.7	13.6	0.77	0.00	
HDPE	0.35	BFBR	780	0.81	N/A	N/A	N/A	10.4	43.8	21.2	13.8	0.64	0.00	
HDPE	0.35	BFBR	780	1.34	N/A	N/A	N/A	14.5	47.1	14.4	9.3	1.23	0.00	
HDPE	0.35	BFBR	800	1.55	N/A	N/A	N/A	14.4	46.5	16.1	7.9	0.95	0.00	
HDPE	0.35	BFBR	850	0.64	N/A	N/A	N/A	13.7	48.5	15.3	8.1	1.16	0.00	
HDPE	0.35	BFBR	850	0.86	N/A	N/A	N/A	17.7	50.5	6.3	5.6	1.74	0.00	
HDPE	0.35	BFBR	850	1.22	N/A	N/A	N/A	20.8	50.1	4.9	2.9	2.24	0.00	
HDPE	0.35	BFBR	850	1.71	N/A	N/A	N/A	28.4	46.6	2.3	2.2	4.60	0.00	
HDPE	0.35	BFBR	640	1.45	21.4	13.6	32.2	2.5	10.8	8.9	10.6	0.10	0.00	[7]

HDPE	0.35	BFBR	680	1.3	29.1	4.9	2.3	5.1	21.6	18.4	18.0	0.63	0.00	
HDPE	0.35	BFBR	730	1.3	13.8	1.6	1.0	8.2	31.8	25.0	17.9	0.63	0.00	
HDPE	0.35	BFBR	780	0.81	8.6	0.0	0.0	10.5	44.3	21.7	14.1	0.65	0.00	
HDPE	0.35	BFBR	850	0.85	15.4	0.0	0.0	18.5	52.0	6.5	5.8	1.81	0.00	
HDPE	0.01	FFR	500	1.58	5.8	21.2	70.3	0.0	0.3	0.7	0.8	0.00	0.80	
HDPE	0.01	FFR	500	1.55	5.7	10.0	81.0	0.1	0.3	0.8	0.8	0.00	1.20	[8]
HDPE	0.01	FFR	600	1.41	8.7	16.8	68.7	0.4	2.1	1.5	1.2	0.00	0.60	
HDPE	0.01	FFR	600	1.4	8.8	15.9	68.5	0.5	2.8	1.9	1.2	0.00	0.40	
HDPE	0.01	FFR	700	1.22	10.6	20.0	54.0	1.1	7.5	4.3	2.2	0.00	0.30	
HDPE	0.01	FFR	700	1.23	14.2	23.9	48.7	0.7	6.1	3.2	2.2	0.00	1.00	
HDPE	0.02	FFR	800	1.08	7.7	14.1	32.3	3.5	24.9	8.1	8.4	0.10	1.00	
HDPE	0.03	FFR	800	1.03	6.3	13.0	29.8	5.1	30.0	9.7	5.4	0.18	0.60	
HDPE	0.02	FFR	500	0.81	2.5	13.2	80.2	0.1	0.4	1.1	1.9	0.00	0.70	
HDPE	0.01	FFR	500	0.79	2.9	11.1	83.0	0.0	0.2	0.8	1.1	0.00	0.90	
HDPE	0.02	FFR	600	0.69	4.8	17.3	72.8	0.3	2.2	1.1	0.7	0.00	0.80	
HDPE	0.02	FFR	600	0.7	5.1	17.1	71.9	0.4	2.1	1.6	1.2	0.00	0.60	
HDPE	0.03	FFR	700	0.62	10.5	21.2	60.7	0.3	3.2	1.4	2.1	0.00	0.50	
HDPE	0.03	FFR	700	0.64	10.7	21.1	60.6	0.4	3.4	1.5	2.2	0.00	0.20	
HDPE	0.02	FFR	800	0.57	7.9	13.6	36.2	3.9	23.9	7.8	6.1	0.00	0.60	
HDPE	0.03	FFR	800	0.47	8.4	14.3	35.6	3.8	23.3	7.9	5.8	0.10	1.00	
HDPE	0.02	FFR	600	2.11	9.0	20.2	62.3	0.5	3.2	2.2	1.7	0.00	0.90	
HDPE	0.02	FFR	600	2.04	9.8	22.6	59.3	0.4	2.9	2.2	2.1	0.00	0.50	
HDPE	0.02	FFR	600	1.84	6.8	10.3	36.4	4.5	26.2	8.1	5.3	0.54	1.90	
HDPE	0.01	FFR	600	1.84	6.8	10.0	35.4	4.8	28.0	8.6	5.6	0.63	0.20	
HDPE	0.02	FFR	600	1.58	13.7	24.7	24.7	7.2	25.4	0.1	0.3	3.09	0.70	
HDPE	0.02	FFR	600	1.58	14.6	25.2	24.4	7.3	25.4	0.1	0.3	2.55	0.20	
HDPE	0.01	FFR	600	8.98	1.1	13.3	71.2	1.4	8.1	3.5	1.3	0.00	0.10	
HDPE	0.01	FFR	600	8.98	1.2	12.9	71.4	1.4	8.4	3.3	1.3	0.00	0.10	
HDPE	0.03	FFR	600	6.63	35.2	22.1	9.4	6.8	22.0	0.0	3.9	0.52	0.10	
HDPE	0.02	FFR	600	6.97	36.2	20.4	8.4	7.0	22.6	0.0	4.0	0.62	0.70	
HDPE	0.02	FFR	600	5.73	66.4	0.0	0.0	10.0	16.4	0.1	0.3	6.58	0.30	

HDPE	0.02	FFR	600	5.81	64.7	0.0	0.0	10.4	18.5	0.1	0.3	5.30	0.70	
LDPE	2.10	FBR	797	0.4	5.0	0.0	0.0	11.8	20.3	14.6	46.3	0.00	2.00	[9]
LDPE	2.10	FBR	825	0.4	5.0	0.0	0.0	11.6	24.8	14.5	42.2	0.00	2.00	
LDPE	2.10	FBR	780	0.6	7.9	0.0	0.0	22.7	28.7	18.1	18.7	0.00	4.00	
LDPE	2.10	FBR	805	0.6	7.9	0.0	0.0	23.8	33.0	17.4	15.9	0.00	2.00	
PP	0.50	BFBR	727	1.54	23.7	4.5	0.0	39.4	22.8	3.1	2.9	3.09	0.61	[10]
PP	0.50	BFBR	705.5	1.57	26.0	5.3	0.0	34.2	23.3	5.4	3.9	0.98	0.98	
PP	0.50	BFBR	717.6	1.54	16.8	3.0	0.0	42.9	22.7	4.8	4.0	5.76	0.06	
PP	0.50	BFBR	621	1.57	18.1	0.9	0.0	22.0	20.3	17.2	15.9	5.05	0.54	
PP	0.50	BFBR	683.3	1.53	17.6	2.3	0.0	37.8	21.2	9.0	7.4	4.39	0.41	
PP	0.50	BFBR	767.8	1.49	22.7	4.8	0.0	40.8	23.1	1.2	2.4	4.65	0.24	
PP	0.50	BFBR	718.2	1.58	31.2	3.8	0.0	20.3	24.5	9.8	7.5	1.14	1.67	
PP	0.50	BFBR	737.2	0.91	22.4	3.8	0.0	17.1	28.4	2.5	23.3	1.09	1.45	
PP	0.50	BFBR	712.6	1.54	18.0	0.6	0.0	22.1	15.6	20.9	17.7	4.81	0.25	
PE	0.33	BFBR	732.1	1.43	32.1	3.9	0.0	27.1	28.9	4.1	3.3	0.36	0.26	[11]
PE	0.33	BFBR	732.7	1.43	24.8	3.2	0.0	31.1	33.0	4.0	3.2	0.48	0.21	
PE	0.33	BFBR	731.7	1.43	22.7	2.6	0.0	29.6	34.9	4.8	3.9	0.43	1.09	
PE	0.33	BFBR	653.9	1.43	25.1	0.9	0.0	28.0	31.7	8.6	5.2	0.28	0.09	
PE	0.33	BFBR	736.1	1.43	19.5	3.1	0.0	13.6	36.4	12.3	12.0	0.32	2.65	
PE	0.33	BFBR	733.8	1.43	26.1	4.1	0.0	29.7	31.3	4.1	3.1	0.47	1.13	
PP	N/A	BFBR	510	5.6	29.3	6.5	57.1	0.4	1.2	3.9	1.2	0.01	0.26	[12]
PE	N/A	BFBR	510	4.6	6.7	4.0	86.5	0.2	0.8	0.9	0.7	0.03	0.17	
Mix	N/A	BFBR	510	4.3	14.5	5.0	75.9	0.3	1.1	2.2	0.9	0.01	0.11	
Mix	N/A	BFBR	510	4.1	17.1	5.0	72.6	0.3	1.1	2.7	1.0	0.03	0.18	
PP	N/A	BFBR	510	4.2	30.4	6.3	56.3	0.3	1.2	4.2	1.2	0.01	0.08	
PE	N/A	BFBR	510	3.9	6.8	4.3	86.3	0.2	0.7	0.9	0.6	0.02	0.18	
LDPE	18.00	BFBR	500	15	N/A	N/A	N/A	0.9	3.3	2.8	3.8	0.00	0.00	[13]
LDPE	18.00	BFBR	550	15	N/A	N/A	N/A	1.5	7.1	5.6	7.0	0.23	0.00	
LDPE	18.00	BFBR	600	15	N/A	N/A	N/A	3.0	9.4	6.5	5.1	0.22	0.00	
LDPE	18.00	BFBR	650	15	N/A	N/A	N/A	4.2	13.6	9.9	11.6	0.68	0.00	
LDPE	18.00	BFBR	700	15	N/A	N/A	N/A	11.8	31.5	19.8	7.6	0.66	0.00	

LDPE	0.20	BFBR	500	13.4	31.4	16.0	43.3	0.7	2.9	3.9	1.3	0.30	0.06	[14]
LDPE	0.20	BFBR	550	12.4	42.7	15.5	22.1	2.2	9.3	6.4	1.5	0.27	0.05	
LDPE	0.20	BFBR	550	13.9	47.5	11.1	15.5	2.8	11.1	7.7	1.5	0.82	2.14	
LDPE	0.20	BFBR	550	1.78	54.9	10.9	3.9	4.2	15.2	7.0	0.8	0.86	2.24	
LDPE	0.20	BFBR	550	20.4	54.8	10.6	3.0	4.8	16.4	6.2	0.4	1.01	2.85	
LDPE	0.20	BFBR	600	13.7	30.4	2.3	0.0	12.8	33.6	16.4	1.4	1.16	2.07	
HDPE	0.10	CSBR	500	0.265	5.9	25.6	67.0	0.0	0.1	0.6	0.7	0.00	0.00	[15]
HDPE	0.01	BFBR	500	1.5	8.6	15.6	24.2	0.7	2.8	5.1	6.7	0.00	36.50	[16]
HDPE	0.01	BFBR	600	1.5	14.0	15.8	13.3	1.0	4.4	12.5	14.5	0.00	24.60	
HDPE	0.01	BFBR	700	1.5	11.8	12.2	6.7	6.5	23.9	12.9	14.5	0.00	11.50	
HDPE	0.01	BFBR	800	1.5	10.2	9.2	0.0	6.8	27.7	16.0	15.9	0.00	14.30	
Mix	1.52	BFBR	650	3.25	N/A	N/A	N/A	8.4	13.6	9.4	4.9	0.65	15.00	[17]
Mix	0.40	BFBR	728	2.98	N/A	N/A	N/A	16.7	15.5	6.0	2.7	1.04	14.00	
HDPE	0.01	BFBR	500	1.5	N/A	N/A	N/A	0.6	2.8	5.1	6.7	0.00	36.50	[18]
HDPE	0.01	BFBR	600	1.5	N/A	N/A	N/A	1.0	4.6	12.3	14.5	0.00	24.60	
HDPE	0.01	BFBR	700	1.5	N/A	N/A	N/A	7.7	28.1	13.7	8.3	0.00	11.50	
HDPE	0.01	BFBR	800	1.5	N/A	N/A	N/A	7.7	31.6	18.4	8.6	0.00	14.30	
PP	8.00	MBR	500	N/A	N/A	N/A	N/A	0.9	2.0	5.7	3.8	0.14	0.00	[19]
PP	8.00	MBR	600	N/A	N/A	N/A	N/A	16.0	18.0	8.8	2.7	0.10	0.00	
PP	8.00	MBR	700	N/A	N/A	N/A	N/A	20.8	32.2	17.5	6.8	0.07	0.00	
HDPE	0.01	BFBR	500	3.45	N/A	N/A	N/A	1.1	3.2	11.5	17.4	0.00	0.00	[20]
LDPE	1.59	BFBR	515	1.5	97.4	0.0	0.0	0.2	0.7	0.9	0.6	0.02	0.20	[21]
HDPE	15.00	CFR	520	N/A	20.1	16.4	58.4	0.2	2.7	0.7	1.6	0.00	0.00	[22]
PP	15.00	CFR	520	N/A	28.9	18.0	48.9	0.2	0.8	2.3	0.9	0.00	0.00	
Mix	3.33	CFR	535	N/A	N/A	N/A	N/A	0.7	1.4	1.2	1.7	N/A	0.00	[23]
HDPE	2.08	CSTR	420	N/A	37.7	39.0	18.2	0.6	1.3	1.7	1.0	0.52	0.00	[24]
PP	2.08	CSTR	380	N/A	53.5	32.0	13.2	0.2	0.2	0.8	0.1	0.02	0.00	
LDPE	N/A	AR	450	15	25.4	31.6	42.0	0.0	0.3	0.4	0.3	N/A	0.00	[25]
LDPE	0.01	CFR	526	16	21.4	8.4	59.1	0.1	3.9	4.0	3.1	0.00	0.00	[26]
LDPE	0.10	RCR	700	2.51	N/A	N/A	N/A	9.1	23.9	21.1	14.1	N/A	0.00	[27]

LDPE	0.10	RCR	750	2.51	N/A	N/A	N/A	18.2	46.6	20.0	8.9	N/A	0.00	
LDPE	0.10	RCR	800	2.51	N/A	N/A	N/A	16.6	39.0	21.6	13.3	N/A	0.00	
LDPE	0.10	RCR	850	2.51	N/A	N/A	N/A	21.6	42.6	14.2	7.6	N/A	0.00	
PE	0.17	BFBR	740	3.45	33.3	5.9	0.0	16.1	30.7	9.3	3.3	0.50	0.90	[28]
PE	33.33	BFBR	740	3.45	31.1	8.6	0.0	23.6	26.5	5.6	2.1	0.75	1.75	
PE	41.67	BFBR	740	3.45	27.6	0.7	0.0	23.6	26.6	5.6	2.1	0.75	13.08	[29]
HDPE	N/A	CSTR	552	N/A	N/A	N/A	N/A	0.9	3.0	5.3	13.3	N/A	0.00	[30]
HDPE	N/A	CSTR	524	N/A	N/A	N/A	N/A	0.6	1.8	3.0	7.8	N/A	0.00	
LDPE	6.00	RCR	650	3.71	N/A	N/A	N/A	19.8	31.0	17.8	11.1	N/A	0.00	[31]
LDPE	6.00	RCR	700	3.71	N/A	N/A	N/A	23.5	29.3	13.9	9.5	N/A	0.00	
LDPE	6.00	RCR	750	3.71	N/A	N/A	N/A	32.1	31.4	11.5	6.9	N/A	0.00	
LDPE	6.00	RCR	800	3.71	N/A	N/A	N/A	39.1	31.7	9.8	6.5	N/A	0.00	
LDPE	6.00	RCR	850	3.71	N/A	N/A	N/A	38.0	30.7	9.9	6.1	N/A	0.00	
LDPE	3.54	RCR	725	0.5	N/A	N/A	N/A	53.1	29.0	12.0	6.0	N/A	0.00	
LDPE	5.88	RCR	725	0.5	N/A	N/A	N/A	44.0	35.7	11.3	7.1	N/A	0.00	
LDPE	9.90	RCR	725	0.5	N/A	N/A	N/A	45.5	25.4	17.3	9.9	N/A	0.00	
PP	6.00	RCR	625	2.51	N/A	N/A	N/A	45.5	25.4	17.3	9.9	N/A	0.00	
PP	6.00	RCR	625	2.51	N/A	N/A	N/A	20.2	14.6	27.5	17.8	N/A	0.00	
PP	6.00	RCR	675	2.51	N/A	N/A	N/A	28.3	18.9	20.5	11.0	N/A	0.00	
PP	6.00	RCR	720	2.51	N/A	N/A	N/A	43.9	25.3	15.2	7.6	N/A	0.00	
Mix	6.00	RCR	625	2.51	N/A	N/A	N/A	23.7	22.2	30.6	18.3	N/A	0.00	
Mix	6.00	RCR	625	2.51	N/A	N/A	N/A	24.5	32.2	27.3	12.9	N/A	0.00	
HDPE	0.01	BFBR	800	0	24.6	0.0	0.0	4.7	29.0	21.2	20.6	0.00	0.00	[32]
HDPE	0.01	BFBR	800	3.45	23.9	0.0	0.0	8.1	29.9	20.3	17.8	0.00	0.00	
HDPE	0.01	BFBR	800	3.45	23.5	0.0	0.0	7.9	32.0	18.4	18.3	0.00	0.00	
HDPE	0.01	BFBR	800	3.45	19.5	0.0	0.0	9.0	34.5	21.3	15.6	0.00	0.00	
HDPE	0.01	BFBR	800	3.45	19.3	0.0	0.0	17.0	38.5	15.7	9.4	0.00	0.00	
HDPE	8.33	BFBR	500	N/A	N/A	N/A	N/A	2.9	14.6	11.9	6.4	9.58	0.10	[33]
PE	3.33	CSTR	403	N/A	78.1	0.0	0.0	N/A	N/A	N/A	N/A	N/A	N/A	[34]
PP	3.33	CSTR	379	N/A	90.6	0.0	0.0	N/A	N/A	N/A	N/A	N/A	N/A	
Mix	3.33	CSTR	397	N/A	78.8	0.0	0.0	N/A	N/A	N/A	N/A	N/A	N/A	

Mix	3.33	CSTR	387	N/A	82.5	0.0	0.0	N/A	N/A	N/A	N/A	N/A	N/A
Mix	3.33	CSTR	384	N/A	91.3	0.0	0.0	N/A	N/A	N/A	N/A	N/A	N/A

*Trace gases contain CO, CO_2, SO_2, and H_2

Nomenclature: CSBR: continuously spouted bed reactor; FFR: free fall reactor; BFBR: bubbling fluidized bed reactor; MBR: moving bed reactor; CFR: continuous flow reactor; CSTR: continuously stirred tank reactor; AR: auger reactor; RCR: rotating cone reactor; HCs: hydrocarbons; N/A: not available.

Table S2. The results of proximate and ultimate analyses of waste plastics used in this work.

	W-HDPE	W-LDPE	W-PP
VM	97,07	93,28	94,75
Moisture	0,33	1,33	0,38
Ash	0,97	1,74	2,3
FC*	1,63	3,65	2,58
C	85,5	81,6	80,9
H	14,4	13,2	13,5
N	0	0	0
S	0	0	0
O*	0,1	5,2	5,6
HHV (MJ/kg)	45,35	43,23	43

Nomenclature: VM: volatile matter; FC: fixed carbon; HHV: high heating value; N/A: not available.

Table S3: ICP-OES results for waste polyolefins.

Elements, µg/g	Pb	Ba	Cd	Sr	Zn	Cu	Co	Fe	Mn	Cr	Ca	K	Al	Mg	Na
W-HDPE	76.7	11.2	0.01	0.80	12.4	0.42	0.92	28.7	0.52	2.00	191	48.5	35.8	28.1	797
W-LDPE	0.23	7.00	0.00	0.62	15.5	19.3	0.00	26.3	0.30	16.7	467	65.9	126	38.0	191
W-PP	0.18	28.6	0.00	5.00	15.6	81.7	0.00	37.7	0.00	1.00	62.7	68.3	281.3	42.3	78.7

Table S4. TGA and DTG results of waste POs.

Sample	**TGA results**			**DTG results**	
	Solid residue (*wt.*%)	Onset temperature (℃)	Weight loss (*wt.*%)	Peak temperature (℃)	Rate of degradation (% / min)
W-HDPE	0.76	458.4	94.63	477.4	35.97
W-LDPE	2.62	457.4	97.28	472.5	33.39
W-PP	8.76	420.0	95.52	456.3	18.11

Table S5. Experimental design using an L9 orthogonal array for virgin mixtures of POs.

Run	N_2 flow rate(A), L/min	Feed intake (B), g/min	Mixture type (C)
1	0.9	1.0	Mix 1
2	0.9	3.0	Mix 2
3	0.9	1.5	Mix 3
4	1.0	1.0	Mix 3
5	1.0	3.0	Mix 2
6	1.0	1.5	Mix 1
7	1.1	1.0	Mix 2
8	1.1	3.0	Mix 3
9	1.1	1.5	Mix 1

Table S6. Experimental design using an L9 orthogonal array for virgin mixtures of POs.

	Liquid yield (wt.%)					Gas yield (wt.%)				Solid yield (wt.%)			
RUN	Trial 1	Trial 2	Avg	STD	S/N	Trial 1	Trial 2	Avg	STD	Trial 1	Trial 2	Avg	STD
1	47.8	51.2	49.5	2.42	33.9	18.9	20.9	19.9	1.43	33.3	27.9	30.6	3.85
2	44.2	42.7	43.4	1.02	32.8	12.8	12.3	12.6	0.32	43.1	45.0	44.0	1.34
3	59.3	53.0	56.2	4.48	35.0	16. 9	17.3	17.1	0.31	23.8	29.7	26.7	4.17
4	69.0	67.8	68.4	0.83	36.7	26.7	23.0	24.7	2.59	4.33	9.16	6.74	3.41
5	40.0	40.9	40.4	0.63	32.1	12.8	11.4	12.1	0.98	47.2	47.7	47.5	0.35
6	60.7	57.3	59.0	2.40	35.4	20.6	20.0	20.3	0.40	18.7	22.7	20.7	2.80
7	68.3	68.7	68.5	0.25	36.7	26.5	22.6	24.7	2.60	5.17	8.50	6.83	2.36
8	55.8	57.2	56.5	1.02	35.0	15.0	12.9	13.9	1.46	29.3	29.9	29.6	0.43
9	71.2	72.4	71.8	0.83	37.1	22.3	18.6	20.5	2.57	6.55	9.00	7.78	1.73
CE^{exp}	77.4	72.9	73.3	3.91	37.3	20.1	25.1	21.6	3.06	2.44	2.00	2.22	0.31
CE^{the}	-	-	74.1	-	37.8	-	-	-	-	-	-	-	-

CEexp: Experimental results for the confirmation experiment
CEtheo: Theoretical results for the confirmation experiment

Table S7. Mixing ratio of pure POs.

	HDPE (wt.%)	LDPE (wt.%)	PP (wt.%)
Mix 1	50	25	25
Mix 2	25	50	25
Mix 3	25	25	50

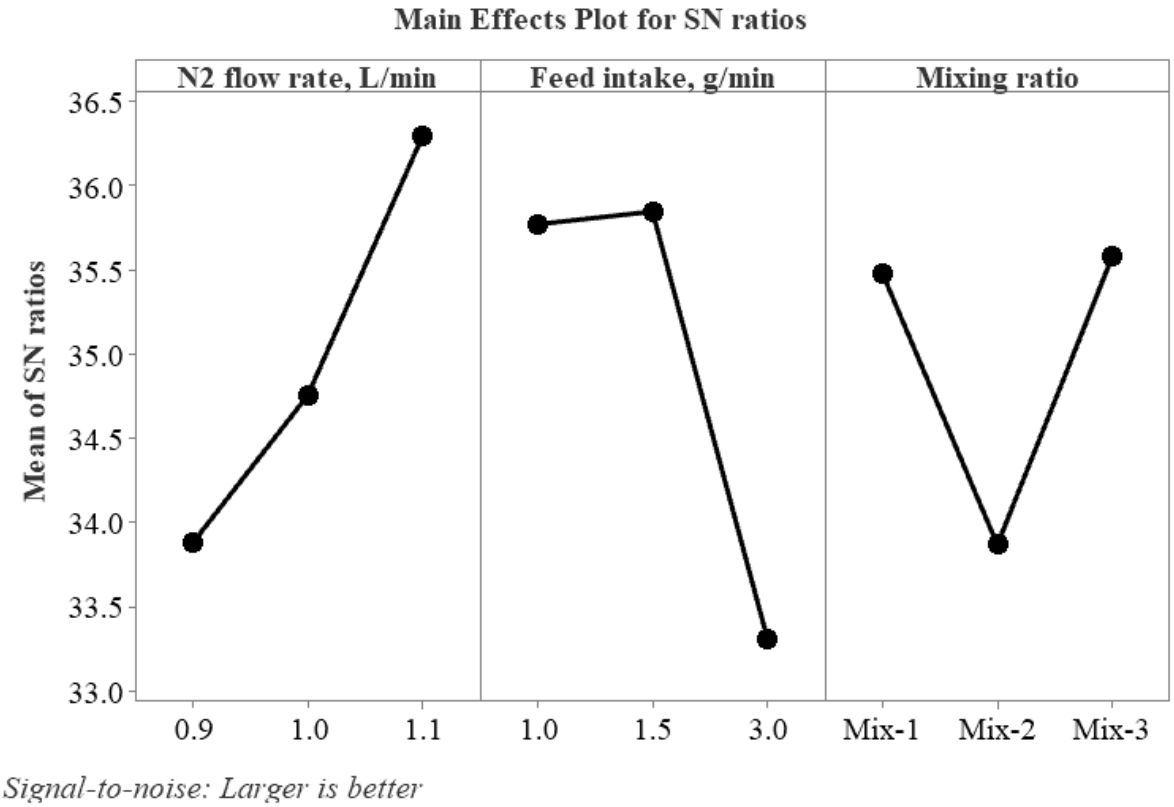

Figure S1. The optimum conditions of control factors for pyrolysis of mixed virgin plastics in the concept of "larger is better".

Table S8. The experimental conditions for pyrolysis of virgin and waste POs.

	Set 1				**Set 2**			
Mixing ratio, (HDPE: LDPE: PP, *wt.*%)	V-HDPE 100:0:0	V-LDPE 0:100:0	V-PP 0:0:100	V-Mix 25:25:50	W-HDPE 100:0:0	W-LDPE 0:100:0	W-PP 0:0:100	W-Mix 25:25:50
Feed intake, g/min	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Temperature, ° C	450	450	450	450	450	450	450	450
N_2 flow rate, L/min	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Process duration, min	60	60	60	60	60	60	60	60

Table S9. Liquid composition of V-HDPE obtained by GC-MS in area %

Paraffins (sum)	44.6
Decane	1.40
Undecane	1.88
Dodecane	1.89
Tridecane	1.78
Tetradecane	1.78
Pentadecane	1.79
Hexadecane	3.84
Heptadecane	3.94
Eicosane	6.49
Octadecane	10.7
Nonadecane	3.83
Tetracosane	1.74
Pentacosane	1.58
Octane	0.90
Nonane	1.14
Naphtenes (sum)	0.18
Cyclohexane, methyl-	0.18
Olefins (sum)	44.8
1-Decene	3.04
1-Undecene	3.25
1-Dodecene	3.01
1-Tridecene	2.91
1-Tetradecene	2.78
1-Pentadecene	2.72
3-Hexadecene, (Z)-	2.50
1-Octadecene	6.50
1-Nonadecene	6.96
5-Eicosene, (E)-	2.12
1-Docosene	2.54
1-Tricosene	3.03
1-Octene	1.22
2,4-Dimethyl-1-heptene	0.33
1-Nonene	1.87
Diolefins	4.03
1,12-Tridecadiene	0.23
1,13-Tetradecadiene	1.59
1,15-Hexadecadiene	0.85
1,19-Eicosadiene	1.36
Cyclic olefins (sum)	1.46
Cyclohexene, 1-methyl-	0.23
Cyclodecene	0.33
Cyclododecene	0.90
Undefined	4.92
Total	100

Table S10. Liquid composition of V-LDPE obtained by GC-MS in area %

Paraffins (sum)	41.6
Decane	1.21
Undecane	1.54
Dodecane	1.59
Tridecane	1.59
Tetradecane	1.70
Pentadecane	1.84
Hexadecane	4.01
Heptadecane	5.39
Octadecane	2.04
Octacosane	1.55
Octadecane	2.26
Nonadecane	3.76
Eicosane	7.44
Docosane	1.91
Tetracosane	1.79
Octane	0.92
Nonane	1.07
Naphtenes (sum)	4.46
1-Decene	2.08
Z-1,6-Tridecadiene	0.28
Cyclotetradecane	0.37
Cyclotetracosane	1.28
Cyclopentane, 1,2,4-trimethyl-	0.45
Other naphtenes	1.72
Isoparaffins (sum)	1.6
Heptane, 3-methylene-	0.18
Decane, 2,3,5-trimethyl-	0.07
Eicosane, 9-octyl-	1.35
Olefins (sum)	39.5
1-Undecene	2.48
2-Dodecene, (Z)-	2.60
1-Tridecene	4.68
1-Tetradecene	2.59
3-Heptadecene, (Z)-	2.85
1-Octadecene	4.70
1-Nonadecene	5.94
3-Eicosene, (E)-	5.48
1-Docosene	1.33
9-Tricosene, (Z)-	2.64
Pentacosane	2.87
1-Nonene	1.31
Other olefins	2.05
Diolefins	4.61
Z-1,6-Tridecadiene	0.79
1,13-Tetradecadiene	0.39

1,19-Eicosadiene	3.43
Other diolefins	0.24
Cyclic olefins (sum)	0.69
Cyclodecene, (Z)-	0.24
Cyclohexane, 1,4-dimethyl-, cis-	0.18
Cyclododecene	0.27
Other cyclic olefins	0.82
Undefined	2.73
Total	100

Table S11. Liquid composition of V-PP obtained by GC-MS in area %

Paraffins (sum)	0.46
Octane	0.28
Undecane	0.08
Dodecane	0.10
Naphtenes (sum)	51.3
Cyclohexane, 1,1,3,5-tetramethyl-,trans-	7.13
Cyclohexane, 1-ethyl-2,3-dimethyl-	4.24
Cyclooctane, ethyl-	4.07
Cyclohexane, 1-ethyl-2-propyl-	3.85
Cyclohexane, 2,4-diethyl-1-methyl-	3.29
Cyclooctane, (1-methylpropyl)-	6.79
1-Isopropyl-1,4,5-trimethylcyclohexane	4.48
Cyclohexane, 1,3,5-trimethyl-	17.4
Other naphtenes	3.62
Isoparaffins (sum)	2.05
Heptane, 4-methyl-	1.17
Heptane, 2,4-dimethyl-	0.58
Hexane, 2,4,4-trimethyl-	0.15
3-Ethyl-3-methylheptane	0.15
Other isoparaffins	1.25
Olefins (sum)	26.9
2-Undecene, 4-methyl-	6.36
2-Hexene, 2,3-dimethyl-	3.61
1-Hexene, 3,3,5-trimethyl-	1.65
2,4-Dimethyl-1-heptene	15.3
Other olefins	3.43
Diolefins	2.46
1,3-Heptadiene, 5,5-dimethyl-	1.68
Heptane, 2-methyl-3-methylene-	0.52
cis-2,6-Dimethyl-2,6-octadiene	0.26
Other diolefins	0.16
Cyclic olefins (sum)	1.09
Cyclohexene, 3,5-dimethyl-	0.24

Cyclopentene, 1,2,3-trimethyl-	0.30
1,2,4,4-Tetramethylcyclopentene	0.55
Undefined	7.32
Total	100

Table S12. Liquid composition of V-MIX obtained by GC-MS in area %

Paraffins (sum)	17.1
Hexadecane	2.45
Heptadecane	1.51
Octadecane	4.07
Nonadecane	1.57
Eicosane	1.01
Other paraffins	6.48
Isoparaffins (sum)	2.59
Heptane, 3,3,5-trimethyl-	0.89
Heptane, 4-methyl-	0.53
Dodecane, 2,6,10-trimethyl-	0.24
Heptane, 2,4-dimethyl-	0.25
Other isoparaffins	0.68
Naphtenes (sum)	24.0
Cyclohexane, 1,2-diethyl-1-methyl-	4.55
Cyclohexane, 1-ethyl-2-propyl-	1.83
Cyclooctane, 1-methyl-3-propyl-	4.53
Cyclooctacosane	3.36
Cyclopentane, propyl-	1.21
Cyclohexane, 1,3,5-trimethyl-	5.6
Other naphtenes	2.95
Olefins (sum)	44.6
1-Decene	1.90
2-Decene, 4-methyl-, (Z)-	1.73
5-Undecene, (E)-	1.77
1-Dodecene	1.42
3-Heptene, 2,2,3,5,6-pentamethyl-	1.12
1-Tridecene	1.28
2-Tetradecene, (E)-	1.50
1-Pentadecene	1.41
1-Heptadecene	2.37
1-Octadecene	1.30
1-Nonadecene	3.57
3-Eicosene, (E)-	3.10
9-Tricosene, (Z)-	1.13
1-Hexacosene	1.76
9-Tricosene, (Z)-	1.13
1-Hexacosene	1.76

2-Hexene, 2,5-dimethyl-	4.22
2,4-Dimethyl-1-heptene	8.40
Other olefins	3.73
Diolefins (sum)	6.40
1,13-Tetradecadiene	0.54
1,19-Eicosadiene	2.40
1,4-Hexadiene, 2,3-dimethyl-	0.15
Other diolefins	3.31
Cyclic olefins (sum)	1.04
Cyclohexene, 4-methyl-	0.14
1,2,4,4-Tetramethylcyclopentene	0.49
Other cyclic olefins	0.41
Unknowns	3.59
Total	100

Table S13. Liquid composition of W-HDPE obtained by GC-MS in area %

Paraffins (sum)	45.4
Dodecane	2.11
Tridecane	2.09
Tetradecane	2.21
Pentadecane	3.87
Hexadecane	2.60
Heptadecane	3.64
Octadecane	3.91
Nonadecane	6.17
Eicosane	8.30
Heneicosane	2.31
Other paraffins	8.21
Naphtenes (sum)	2.88
Cyclopropane, 1,2-dibutyl-	0.15
Cyclopentadecane	0.38
Cyclohexane, 1,1'-(1,4-butanediyl)bis-	0.12
Cyclotetracosane	0.26
Cyclooctacosane	0.65
Cyclohexane, methyl-	0.28
Cyclohexane, ethylidene-	0.11
Bicyclo[5.1.0]octane	0.38
Cyclohexane, ethyl-	0.19
Cyclohexane, 1,1-dimethyl-	0.15
Other naphtenes	0.20
Olefins (sum)	41.3
1-Decene	2.91
1-Undecene	2.98
1-Dodecene	3.09

6-Tridecene	6.00
1-Tetradecene	3.40
1-Heptadecene	3.11
1-Octadecene	5.54
1-Nonadecene	4.67
1-Eicosene	4.06
9-Tricosene, (Z)-	2.40
Other olefins	3.08
Diolefins	5.06
1,13-Tetradecadiene	1.59
1,19-Eicosadiene	2.13
Other diolefins	1.34
Cyclic olefins (sum)	1.27
Cyclopentene, 3-ethenyl-	0.21
1-Ethylcyclopentene	0.14
Cyclohexene, 1-methyl-	0.32
Cyclohexene, 1-ethyl-	0.52
Cyclopentene, 1-butyl-	0.08
Undefined	4.11
Total	100

Table S14. Liquid composition of W-LDPE obtained by GC-MS

Parrafins (sum)	36.0
Decane	1.46
Undecane	1.76
Dodecane	1.79
Tridecane	1.77
Tetradecane	1.81
Pentadecane	1.86
Hexadecane	2.13
Heptadecane	2.00
Octadecane	4.23
Nonadecane	4.56
Heneicosane	2.27
Docosane	1.85
Tricosane	1.70
Tetracosane	3.03
Other paraffins	3.84
Naphtenes (sum)	6.99
Cyclohexane, butyl-	0.38
Cyclotetradecane	0.25
Cyclotetracosane	2.36
Cyclooctacosane	0.72
Cyclohexane, methyl-	0.33

1-Methyl-2-methylenecyclohexane	0.28
Bicyclo[5.1.0]octane	0.35
Cyclohexane, (1-methylethyl)-	0.28
Other naphtenes	2.04
Olefins (sum)	54.5
1-Decene	3.11
1-Undecene	2.97
1-Dodecene	3.32
1,12-Tridecadiene	1.12
4-Tridecene, (Z)-	5.82
7-Tetradecene, (Z)-	5.57
1-Heptadecene	2.79
5-Octadecene, (E)-	2.81
1-Nonadecene	5.53
1,19-Eicosadiene	3.41
5-Eicosene, (E)-	9.20
9-Tricosene, (Z)-	1.56
1-Octene	1.84
1-Nonene	2.05
Other olefins	3.41
Cyclic olefins (sum)	2.00
Cyclodecene	0.30
Cyclododecene	0.34
Cyclohexene, 1-nonyl-	0.25
Bicyclo[4.1.0]hept-2-ene	0.26
Other cyclic olefins	0.83
Undefined	0.48
Total	100

Table S15. Liquid composition of W-PP obtained by GC-MS

Paraffins (sum)	0.60
Undecane	0.18
Dodecane	0.42
Isoparaffins	64.3
Heptane, 4-methyl-	1.38
Heptane, 3,3,5-trimethyl-	0.70
Octane, 3,3-dimethyl-	0.71
Heptane, 2-methyl-3-methylene-	0.75
Heptane, 2-methyl-3-methylene-	0.71
Other isoparaffins	1.55
Naphtenes (sum)	47.3
Cyclohexane, 1-ethyl-2,3-dimethyl-	6.83
Cyclohexane, 1,1,3,5-tetramethyl-,cis-	4.32
Cyclohexane, 1-ethyl-2,4-dimethyl-	3.51

Cyclohexane, 1-ethyl-2-propyl-	2.72
Cyclohexane, 1,2-diethyl-3-methyl-	8.52
Cyclohexane, 3-ethyl-5-methyl-1-propyl-	1.34
Cyclooctane, 1-methyl-3-propyl-	2.90
Cyclooctane	3.15
Cyclohexane, 1,1,3,5-tetramethyl-,trans-	2.05
Cyclohexane, 1,3,5-trimethyl-	4.37
Other naphtenes	7.59
Olefins (sum)	26.6
1-Hexene, 4-ethyl-	1.30
2,4-Dimethyl-1-heptene	16.3
3-Hexene, 2-methyl-, (E)-	1.09
1-Tetradecene	1.95
Other olefins	6.01
Diolefins	2.35
1,5-Heptadiene, 3,3-dimethyl-, (E)	1.57
Other diolefins	0.78
Cyclic olefins (sum)	0.96
1,2,4,4-Tetramethylcyclopentene	0.86
p-Terphenyl	0.10
Undefined	16.4
Total	100.00

Table S16. Liquid composition of W-MIX obtained by GC-MS in area %

Paraffins (sum)	17.09
Hexadecane	2.45
Heptadecane	1.51
Octadecane	4.07
Nonadecane	1.57
Eicosane	1.01
Other paraffins	6.48
Isoparaffins (sum)	2.59
Heptane, 3,3,5-trimethyl-	0.89
Heptane, 4-methyl-	0.53
Dodecane, 2,6,10-trimethyl-	0.24
Heptane, 2,4-dimethyl-	0.25
Other isoparaffins	0.68
Naphtenes (sum)	24.03
Cyclohexane, 1,2-diethyl-1-methyl-	4.55
Cyclohexane, 1-ethyl-2-propyl-	1.83
Cyclooctane, 1-methyl-3-propyl-	4.53
Cyclooctacosane	3.36
Cyclopentane, propyl-	1.21
Cyclohexane, 1,3,5-trimethyl-	5.6

Other naphtenes	2.95
Olefins (sum)	44.6
1-Decene	1.9
2-Decene, 4-methyl-, (Z)-	1.73
5-Undecene, (E)-	1.77
1-Dodecene	1.42
3-Heptene, 2,2,3,5,6-pentamethyl-	1.12
1-Tridecene	1.28
2-Tetradecene, (E)-	1.5
1-Pentadecene	1.41
1-Heptadecene	2.37
1-Octadecene	1.3
1-Nonadecene	3.57
3-Eicosene, (E)-	3.1
9-Tricosene, (Z)-	1.13
1-Hexacosene	1.76
9-Tricosene, (Z)-	1.13
1-Hexacosene	1.76
2-Hexene, 2,5-dimethyl-	4.22
2,4-Dimethyl-1-heptene	8.4
Other olefins	3.73
Diolefins (sum)	6.4
1,13-Tetradecadiene	0.54
1,19-Eicosadiene	2.4
1,4-Hexadiene, 2,3-dimethyl-	0.15
Other diolefins	3.31
Cyclic olefins (sum)	1.04
Cyclohexene, 4-methyl-	0.14
1,2,4,4-Tetramethylcyclopentene	0.49
Other cyclic olefins	0.41
Undefined	3.59
Total	100

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