Supplementary Information (SI) for RSC Sustainability.
This journal is © The Royal Society of Chemistry 2026

Supporting Information

Cracking Behavior of Upgraded Waste Plastic Pyrolysis oil to lighter olefins (C_2–C_3): A study on Performance, Product Distribution and Outlook for a Circular Hydrocarbon Economy

Abhishek G. Sarang [a, 1], Aditya Bora [a, 1], Syed Mohammed Razak [a, b], Karan Sharma [a], Chandan Kumar Munagala [a, b], Pratik Mali [a], Nettem V. Choudary [b], Vineet Aniya [a, b*]

[a] Process and Polymer Engineering Lab, Chemical Engineering and Process Technology Department, CSIR-Indian Institute of Chemical Technology, Hyderabad, 500007, India

[b] Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, 201002, India

[1] These authors contributed equally to the present study.

Table of Contents

Figure S1. Spent FCC catalyst

Figure S2. Waste and Upgraded Plastic Pyrolysis Oil

Figure S3. FTIR of E-CAT and Spent E-CAT

Figure S4. Distillation curve of three oils

Table S1. Effect of space velocity on product distribution

Table S2. Effect of Temperature on DPO carried out at WSHV of 2 h^{-1}

Table S3. Effect of Oil type on product distribution

Table S4. Effect of reaction time on CPO

Table S5. Effect of reaction time on DPO

Figure S1. E-CAT

Figure S2. Waste and Upgraded Plastic Pyrolysis Oil

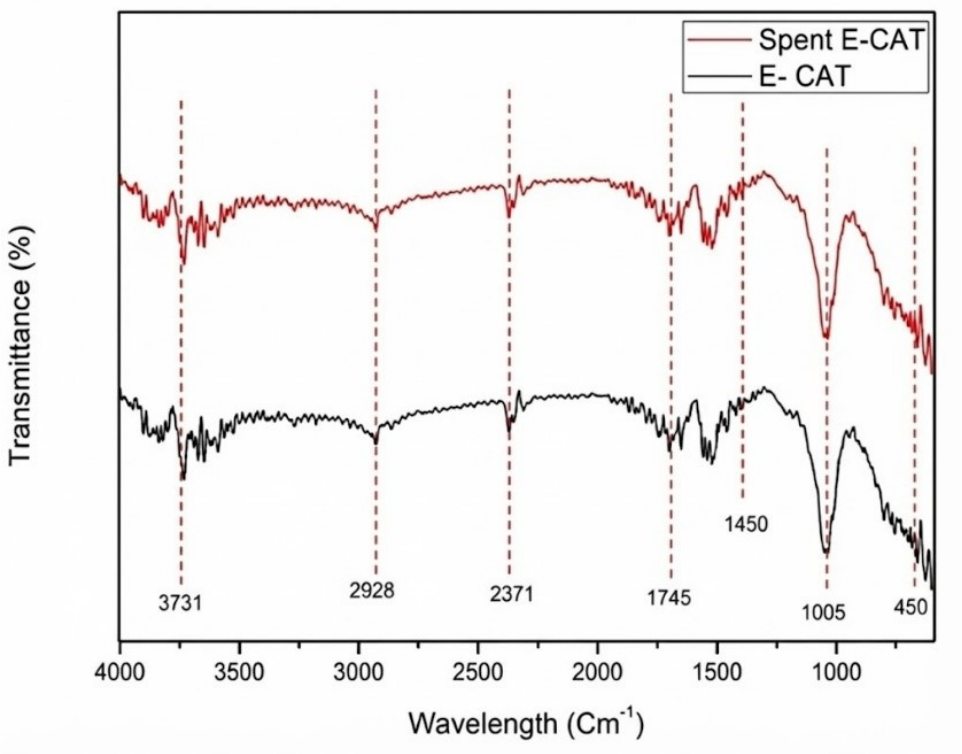

Figure S3. FTIR of E-CAT and Spent E-CAT

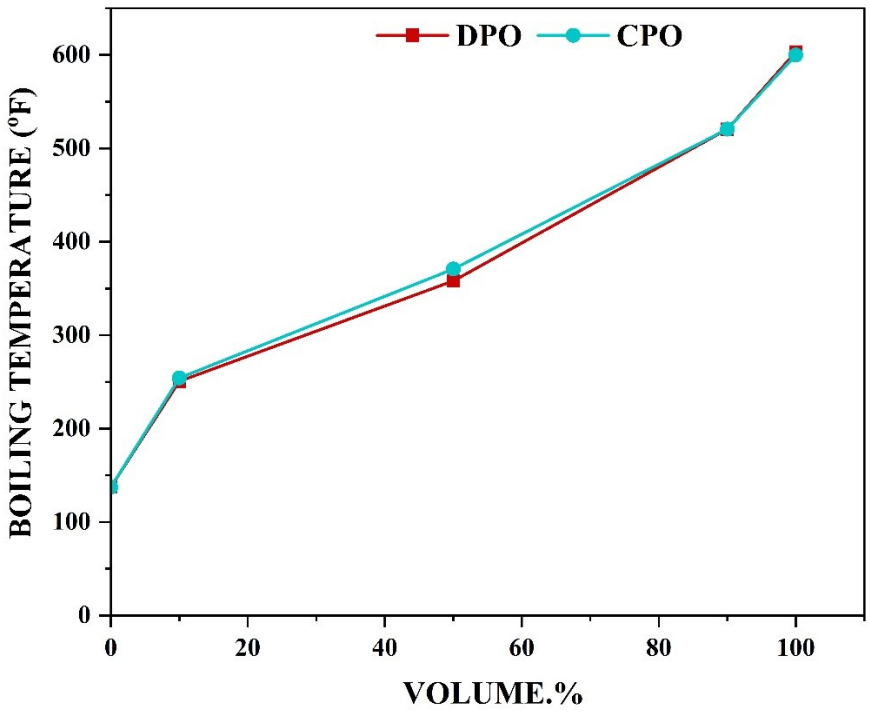

Figure S4. TBP curve of upgraded oils

Table S1. Effect of space velocity on product distribution of DPO carried out at 550 °C

Mol. (%)	**0.2 h^{-1}**	**0.5 h^{-1}**	**1 h^{-1}**	**2 h^{-1}**
Hydrogen	2.27	4.4	-	-
Methane	25.09	40.02	37.41	17
Ethane	22.34	21.43	19.8	11.87
Ethylene	23.67	22.58	31.06	31.09
Propane	12.76	7.68	3.82	6.4
Propylene	11.07	3.13	6.52	29.19
Propadiene	0.78	0.75	0.73	0.84
Butane	0.71	-	0.37	1.04
1-Butene	0.16	-	0.3	0.97
Transbutene	0.02	-	-	0.29
Isobutene	0.85	-	-	0.98
Cisbutene	0.17	-	-	0.21
Propyne	0.01	-	-	0.01
Butadiene	0.08	-	-	0.11

Table S2. Effect of Temperature on DPO carried out at WSHV of 2 h^{-1}

Mol. (%)	500 °C	550 °C	600 °C
Hydrogen	-	-	1.05
Methane	16.46	17.00	34.12
Ethane	13.62	11.87	16.27
Ethylene	24.05	31.09	29.35
Propane	6.71	6.40	2.26
Propylene	27.63	29.19	15.04
Propadiene	0.84	0.84	0.74
Butane	0.90	1.04	0.38
1-Butene	1.76	0.97	0.23
Transbutene	1.96	0.29	-
Isobutene	3.77	0.98	0.56
Cisbutene	1.43	0.21	-
Propyne	0.01	0.01	-
Butadiene	0.86	0.11	-

Table S3. Effect of oil type on product distribution carried out at 2 h^{-1}

Mol (%)	PPO	CPO	DPO
Methane	25.7	26.4	17
Ethane	16.2	14.9	11.87
Ethylene	20.4	22.9	31.09
Propane	8.4	7.3	6.4
Propylene	20.6	20.5	29.19
Propadiene	1.3	1.0	0.84
Butane	0.8	0.6	1.04
1-Butene	1.3	1.2	0.97
Transbutene	1.2	1.1	0.29
Isobutene	2.5	2.5	0.98
Cisbutene	0.1	0.9	0.21
Propyne	1.0	0.4	0.01
Butadiene	0.4	0.3	0.11

Table S4. Effect of reaction time on CPO carried out at 550 ^{o}C, 2 h^{-1}

Mol. %	1	2	4	10	16	24
Methane	25.7	18.71	22.58	27.65	21.51	22.14
Ethylene	20.4	16.88	19	23.5	18.46	19.75
Propylene	20.6	28.53	26.34	22.74	27.21	25.75

Table S5. Effect of reaction time on DPO carried out at 550 ^{o}C, 2 h^{-1}

Mol. %	1	2	4	10	16	24
Methane	17.00	18.79	15.67	13.9	12.6	12.22
Ethylene	31.09	16.35	12.13	14.14	13.11	12.93
Propylene	29.19	29.42	27.08	28.78	28.57	28.7

Table S6. GC-MS data of DPO

#Peak	Total %	Name (DPO)	CAS#
1	0.05%	4-Methyl-1,3-pentadiene	000926-56-7
2	0.34%	1-Pentene, 2,4-dimethyl-	002213-32-3
3	0.16%	2-Pentene, 4,4-dimethyl-, (E)-	000690-08-4
4	0.14%	Benzene	000071-43-2
5	0.17%	1,3-Pentadiene, 2,4-dimethyl-	001000-86-8
6	0.37%	2-Heptene, 4-methyl-, (E)-	066225-17-0
7	1.82%	Heptane, 4-methyl-	000589-53-7
8	0.19%	3-Octene, (E)-	014919-01-8
9	1.35%	1,2,4,4-Tetramethylcyclopentene	065378-76-9
10	0.09%	2-Pentene, 4,4-dimethyl-	026232-98-4
11	0.42%	2,2-Dimethyl-3-heptene trans	019550-75-5
12	0.92%	Heptane, 2,4-dimethyl-	002213-23-2
13	1.23%	3-Amino-2-cyclohexenone	005220-49-5
14	7.28%	2,4-Dimethyl-1-heptene	019549-87-2
15	0.80%	Cyclohexane, 1,3,5-trimethyl-, (…	001795-26-2
16	0.69%	Ethylbenzene	000100-41-4
17	1.20%	o-Xylene	000095-47-6
18	4.11%	Cyclopentane, 1,2,3,4,5-pentamet...	1000152-79-7
19	0.33%	Phenol, 3-ethyl-	000620-17-7
20	0.27%	3,4-Decadiene	037050-04-7
21	0.43%	Benzene, (1-methylethyl)-	000098-82-8
22	0.23%	2-Heptanone, 4-methyl-	006137-06-0
23	0.20%	Benzene, propyl-	000103-65-1
24	0.13%	Nonane, 4-methyl-	017301-94-9
25	0.20%	Benzene, 1-ethyl-3-methyl-	000620-14-4
26	0.87%	Benzene, 1,3,5-trimethyl-	000108-67-8
27	0.54%	alpha-Methylstyrene	000098-83-9
28	0.12%	Benzonitrile	000100-47-0
29	0.27%	1-Decene	000872-05-9
30	0.86%	Benzene, 1,2,3-trimethyl-	000526-73-8
31	0.44%	1-Hexene, 3,3-dimethyl-	003404-77-1

32	0.30%	1,1'-Bicyclooctyl	006708-17-4
33	1.53%	Octane, 3,3-dimethyl-	004110-44-5
34	1.46%	Heptane, 3,3,5-trimethyl-	007154-80-5
35	1.20%	1-Undecene	000821-95-4
36	0.23%	Benzene, 1-ethenyl-2-methyl-	000611-15-4
37	1.15%	Cyclopentane, (2-methylbutyl)-	053366-38-4
38	0.72%	Benzene, 2-propenyl-	000300-57-2
39	0.25%	2-Undecene, 4-methyl-	091695-32-8
40	0.34%	Cyclopentane, 1-butyl-2-propyl-	062199-50-2
41	0.78%	Cyclohexane, 1,2-diethyl-, cis-	000824-43-1
42	0.83%	Decane, 3,6-dimethyl-	017312-53-7
43	1.48%	Sulfurous acid, hexyl octyl ester	1000309-13-0
44	0.63%	2-Dodecene, (E)-	007206-13-5
45	0.67%	Bicyclo[2.2.1]heptane-2,5-dione,...	004230-32-4
46	2.33%	Ethanone, 1-cyclopentyl-	006004-60-0
47	1.93%	5-Dodecene, (E)-	007206-16-8
48	0.23%	Cyclohexene, 1,4,6,6-tetramethyl-	070092-37-4
49	0.33%	Undecane	001120-21-4
50	0.36%	E-2-Octenyl tiglate	084271-97-6
51	2.18%	3-Methyl-2-butenoic acid, 6-ethy...	1000279-22-7
52	0.14%	Naphthalene, decahydro-1,2-dimet...	003604-14-6
53	0.25%	Benzene, 4-ethyl-1,2-dimethyl-	000934-80-5
54	1.92%	Cyclohexane, 1,1,4,4-tetramethyl-	002223-52-1
55	1.13%	2,3-Dimethyl-3-heptene, (Z)-	059643-73-1
56	0.20%	3a,6-Methano-3aH-indene, 2,3,6,7...	098640-29-0
57	0.51%	Benzene, 1-methyl-4-(1-methylpro...	001595-16-0
58	0.53%	Cyclohexane, 1,1'-(1-methylethyl...	054934-90-6
59	0.52%	Cyclopropanemethanol, 2-methyl-2...	098678-70-7
60	0.23%	1,3-Diisopropyl cyclohexane	007045-70-7
61	0.40%	4-Methyl-2-heptene	003404-56-6
62	0.71%	Naphthalene	000091-20-3
63	0.33%	Dodecane	000112-40-3
64	0.18%	1H-Indene, 2,3-dihydro-4,7-dimet...	006682-71-9
65	0.24%	Methanesulfenyl chloride, triflu...	000421-17-0

66	0.16%	Cyclohexane, 1-ethyl-2,3-dimethyl-	007058-05-1
67	0.50%	Phenol, 2-(1-methylethyl)-, meth...	002631-40-5
68	3.72%	Cyclohexane, 1,2,4-trimethyl-	002234-75-5
69	0.76%	Dodecane, 4,6-dimethyl-	061141-72-8
70	1.44%	Hexane, 3,3-dimethyl-	000563-16-6
71	0.19%	Dodecane, 4-methyl-	006117-97-1
72	0.19%	3-Hexene, 2,3-dimethyl-	007145-23-5
73	0.36%	n-Nonylcyclohexane	002883-02-5
74	0.65%	3-Ethyl-3-methylheptane	017302-01-1
75	0.97%	Dodecane, 2,6,11-trimethyl-	031295-56-4
76	0.29%	Tridecane	000629-50-5
77	0.99%	Bis(2-ethylhexyl) hydrogen phosp...	003658-48-8
78	2.27%	4-Isopropyl-1,3-cyclohexanedione	062831-62-3
79	3.46%	Cyclohexane, 1,2-diethyl-1-methy...	061141-79-5
80	0.56%	2,6-Dodecadien-1-ol, 3,7,11-trim...	020576-56-1
81	0.27%	Benzenebutanenitrile	002046-18-6
82	0.17%	Cyclohexane, 1,1,3,5-tetramethyl...	050876-32-9
83	0.21%	Cyclohexane, 1,1'-(1,4-butanediy...	006165-44-2
84	3.29%	3-Decene, 2,2-dimethyl-, (E)-	055499-02-0
85	2.13%	3-Heptene, 2,2,3,5,6-pentamethyl-	116164-06-8
86	0.43%	Oleyl alcohol , acetate	998492-92-1
87	0.43%	Cyclopentane, 1-butyl-2-ethyl-	072993-32-9
88	0.38%	2-Tetradecene, (E)-	035953-54-9
89	0.56%	Tetradecane	000629-59-4
90	0.29%	Naphthalene, 1,2-dimethyl-	000573-98-8
91	0.57%	Neopentylidenecyclohexane	039546-80-0
92	5.55%	Cyclohexane, 1-ethyl-2-propyl-	062238-33-9
93	0.16%	1-Cyclohexyl-2-methyl-prop-2-en-...	025183-82-8
94	0.75%	Hexadecane, 3-methyl-	006418-43-5
95	2.49%	Tetradecane, 2,6,10-trimethyl-	014905-56-7
96	0.37%	Cyclopentane, 1-pentyl-2-propyl-	062199-51-3
97	0.85%	Nonane, 2,6-dimethyl-	017302-28-2
98	0.47%	1-Heptadecanol	001454-85-9
99	1.07%	Pentadecane	000629-62-9

100	1.92%	Cyclohexane, 1,2,4-trimethyl-	002234-75-5
101	0.40%	Decane, 3,8-dimethyl-	017312-55-9
102	0.81%	Heptadecane, 8-methyl-	013287-23-5
103	0.36%	Cyclohexane, 1,2,3,4,5,6-hexaethyl-	001795-14-8
104	0.66%	Hexadecane	000544-76-3
105	0.35%	2-Methyl-Z-4-tetradecene	1000130-78-3
106	0.50%	Cyclohexane, 1,1,2-trimethyl-	007094-26-0
107	0.27%	Bicyclo[3.1.1]heptan-3-one, 2,6,...	000547-60-4
108	0.45%	Pentadecane, 2,6,10-trimethyl-	003892-00-0
109	0.29%	1-Iodoundecane	004282-44-4
110	0.18%	Cyclopentane, propyl-	002040-96-2
111	0.96%	Heptadecane	000629-78-7
112	0.42%	1,2,4-Triazole, 5-cyclohexanecar...	021051-17-2
113	0.25%	Cyclohexanecarboxylic acid, 2-et...	016397-74-3
114	0.85%	Cyclohexane, 1-ethyl-2,4-dimethyl-	061142-69-6
115	0.68%	Triallylsilane	001116-62-7
116	0.29%	2,3-Dimethyldodecane	006117-98-
117	0.19%	Cycloundecanone	000878-13-7
118	0.11%	Octadecane	000593-45-3
119	0.34%	2-Pentene-1,4-dione, 1-(1,2,2-tr...	1000196-77-9
120	0.12%	Cyclopentane, 1,2-dibutyl-	062199-52-4
121	0.07%	Eicosane	000112-95-8
122	0.13%	2-sec-Butyl-3-methyl-1-pentene	075144-24-0