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Research article

Dirty Waste Plastics to Crude Oil Production for Refinery

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Abstract

A waste plastic is a big problem all over the World. Waste plastic can remain landfill long time because is not biodegradable within short time. Plastic made by crude oil and in this experiment our goal is dirty waste plastic to crude oil production by using thermal degradation process. Dirty waste plastic mixture was LDPE, HDPE, PP, PS, tire, rubber, PVC, PETE, OTHER-7 and etc. 100 gm sample was use for experiment and temperature was use 400-420 ºC. Glass reactor was use for in this experiment. Liquid fuel was recovered only 60 % because raw materials were dirty and during production period it was clean by water. During production period some percentage of light gas (15%) generated and it was C1-C4. Rest of percentage (25%) was solid black reside. Liquid crude oil was analysis by using GC/MS, FTIR to check for compound quality. Fuel density was 0.78 g/ml.

Keywords: crude oil, mixed plastic, fuel, thermal, GC/MS

Introduction

In modern life, the application of polymers is common. This kind of material is present in packaging, the electrical industry, in toys, etc. The increase in application leads to a higher per capita consumption of virgin plastics. Thus, this increment rose 96.6 kg in 2002 and 98.1 kg in 2003.[1,2] Although significant amounts of thermoplastics are utilized in products with a long life span, the majority are used in short term applications. Because of this, the quantity of thermoplastics found in waste is increasing correspondingly. High-density polyethylene (HDPE), low-density polyethylene (LDPE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), and polyethylene terephtalate (PET) are the most extensively used plastics. The polyethylene plastics (HDPE and LDPE) are the major components of the total plastic content of municipal solid waste.[3-6] Plastics have a high calorific value (i.e., polyethylene 43 MJ/ kg, polypropylene 44 MJ/kg, polyvinyl chloride 20 MJ/kg), and their combustion can be an alternative to removing them.[7]This alternative must, however, be subjected to severe environmental controls in order to fulfill the legal restrictions concerning the emission of solid particles and gaseous effluents.[7,8,9]Landfills have also been used for plastic disposal, but these can pose a danger through the environment product degradation and the subsequent pollutant generation.[8,9,10]

Polyolefins (low-density polyethylene (LDPE), high-density polyethylene (HDPE), and polypropylene (PP)) are plastic materials used extensively in containers and packaging. They represent 60% of the total amount of plastics in municipal solid waste.[11] In western Europe (the European Union (EU), Norway, and Switzerland), the current strategies that involve these wastes are still based in landfilling to a great extent (53% of the total available plastic waste collectable in 2004).[12] In this context, the EU launched the 94/62/CE directive on packaging and packaging waste in 1994, which has been recently amended through Directive 2004/12/CE. According to the new directive, between 55% w/w, as a minimum, and 80% w/w, as a maximum, of packaging waste must be recycled no later than 2009.[13] The thermal pyrolysis of plastic wastes produces a broad distribution of hydrocarbons, from methane to waxy products. This process takes place at high temperatures. The gaseous compounds generated can be burned out to provide the process heat requirements, but the overall yield of valuable gasoline range hydrocarbons is poor, so that the pyrolysis process as a means for feedstock recycling of the plastic waste stream is rarely practiced on an industrial scale at present.[14,15] In contrast, thermal cracking at low temperatures is usually aimed at the production of waxy oil fractions, which may be used in industrial units for steam cracking and in fluid catalytic cracking units.[16] An alternative to improve gasoline yield from plastics pyrolysis is to introduce suitable catalysts. High conversions and interesting product distributions are obtained when plastics are cracked over zeolites.[17-19] Moreover the catalytic cracking of polymers has proven itself to be a very versatile process, since a variety of products can be obtained depending on the catalyst,[20-23] the polymer,[24-25] the reactor type,[26,27] and the experimental conditions used,[28,29] among other variables.[30] In this experiment main goal was dirty waste plastic mixture to crude fuel production without using any kind of catalyst or chemical adding.

Materials and Method

Figure 1: Mixed dirty waste plastics sample

Materials

Dirty mixed waste plastic was collected from Canada. Canadian one investment group send us this type of plastic for check it is possible or not to produce fuel or crude oil. It was mixture of tire, rubber, LDPE, HDPE, PP, PS, PVC, Other-7, PETE, and etc. Provided plastic was too much dirty and we did not clean or was during production period. 100 gm sample was use for experiment. Dirty mixture waste plastic picture are shown figure 1 for visual understanding.

Method

Experimental set is shown figure 2 for visual understanding. Dirty waste plastic was placed in to reactor and reactor was made by pyrex glass. In this experiment sample was used 100 gm of dirty plastics. Dirty plastic content was LDPE, HDPE, PP, PS, PVC, PETE, Other -7, tire, rubber and etc. temperature range was 400 -420 º C for plastic melting. Glass reactor was connected in to condenser unit, condenser unit was connected in to liquid crude fuel collection unit, crude fuel unit were connected light gas device and crude fuel storage unit. Light gas device was connected light gas cleaning system and after that light gas was collected in Teflon bag. Dirty waste plastic was heated up by using electrical coil system reactor. Starting temperature was use 25 ºC and temperature was increased slowly up to 400 ºC. At the end time temperature was increased 420 ºC for finished the whole process. During production process liquid fuel or crude oil was condensed by condensing unit and this experiment cooling water was not use for condensing purpose. Experimental period produce light gas was collected by using Teflon bag and gas was treated by alkali wash. Crude oil was cleaned by using RCI purification system and keep in separate container shown figure 3. Residue takes after experiment and keeps in to different container for future analysis purpose.

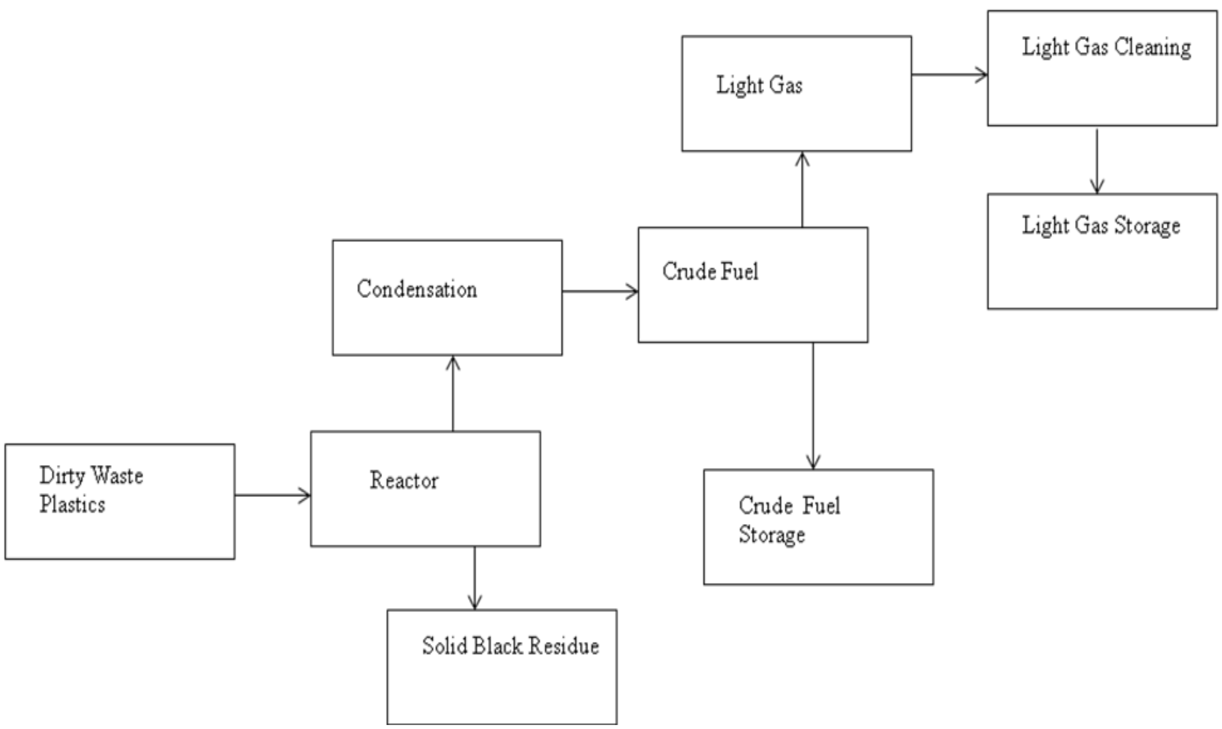

Figure 2: Dirty waste mixed plastic to crude oil production process

Figure 3: crude oil from dirty waste plastics

Result and Discussion

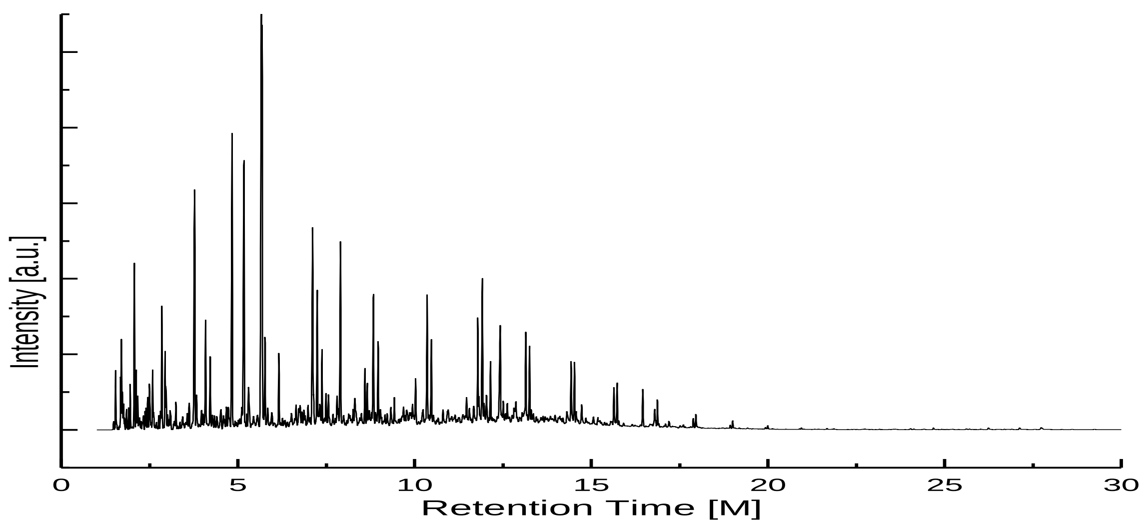

Figure 4: GC/MS chromatogram of dirty waste mixed plastic to crude oil

Table 1: GC/MS chromatogram compounds list of dirty waste mixed plastic to crude oil

Peak Number	Retention Time (M.)	Trace Mass (m/z)	Compounds Name	Compounds Formula	Molecular weight	Probability Percentage	NIST Library Number
1	1.48	41	Cyclopropane	C_3H_6	42	41.9	18854
2	1.53	41	2-Butene	C_4H_8	56	27.7	61292
3	1.68	42	1-Pentene	C_5H_{10}	70	23.6	19081
4	1.71	43	Pentane	C_5H_{12}	72	77.5	114462
5	1.73	67	1,3-Pentadiene, (Z)-	C_5H_8	68	17.8	160480

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6	1.77	55	Cyclopropane, 1,2-dimethyl-, cis-	C_5H_{10}	70	16.6	19070
7	1.79	67	1,3-Pentadiene	C_5H_8	68	21.8	291890
8	1.95	43	Pentane, 2-methyl-	C_6H_{14}	86	45.6	61279
9	2.07	56	1-Pentene, 2-methyl-	C_6H_{12}	84	17.2	61283
10	2.12	41	Hexane	C_6H_{14}	86	72.5	61280
11	2.16	41	2-Pentene, 3-methyl-, (E)-	C_6H_{12}	84	19.7	19321
12	2.22	67	Isopropenylcyclopropane	C_6H_{10}	82	5.88	445
13	2.33	56	Cyclopentane, methyl-	C_6H_{12}	84	57.1	114428
14	2.38	67	2,4-Hexadiene, (Z,Z)-	C_6H_{10}	82	11.8	113646
15	2.45	56	1-Pentene, 2,4-dimethyl-	C_7H_{14}	98	55.5	114435
16	2.50	67	Cyclopentene, 1-methyl-	C_6H_{10}	82	8.03	107747
17	2.58	78	Benzene	C_6H_6	78	69.5	114388
18	2.61	41	1-Hexene, 3,4-dimethyl-	C_8H_{16}	112	15.1	113920
19	2.70	43	Hexane, 3-methyl-	C_7H_{16}	100	64.3	113081
20	2.76	67	Cyclohexene	C_6H_{10}	82	25.7	114431
21	2.81	56	1-Hexene, 2-methyl-	C_7H_{14}	98	29.3	114433
22	2.85	41	1-Heptene	C_7H_{14}	98	41.3	107734
23	2.94	43	Heptane	C_7H_{16}	100	68.6	61276
24	2.96	81	1,3-Pentadiene, 2,4-dimethyl-	C_7H_{12}	96	17.1	114450
25	3.02	41	2-Heptene	C_7H_{14}	98	18.7	113119
26	3.05	41	2-Propenoic acid, 2-methyl-, methyl ester	$C_5H_8O_2$	100	38.3	34560
27	3.08	57	1-Pentene, 2,4,4-trimethyl-	C_8H_{16}	112	50.0	114321
28	3.24	55	Cyclohexane, 1,2-dimethyl-, trans-	C_8H_{16}	112	8.30	228785
29	3.44	79	1-Cyclohexene-1-methanol	$C_7H_{12}O$	112	7.71	52048
30	3.56	81	Cyclopentene, 4,4-dimethyl-	C_7H_{12}	96	17.1	38642
31	3.78	91	Toluene	C_7H_8	92	66.1	291301
32	3.83	57	1-Hexyne, 5-methyl-	C_7H_{12}	96	10.1	231051
33	3.97	87	4-Methyl-1-hepten-4-ol acetate	$C_{10}H_{18}O_2$	170	9.78	114571
34	4.01	56	1-Heptene, 2-methyl-	C_8H_{16}	112	52.6	113675
35	4.09	55	1-Octene	C_8H_{16}	112	29.3	227923
36	4.21	43	Octane	C_8H_{18}	114	35.9	229407
37	4.27	42	1,4-Dioxane, 2,5-dimethyl-	$C_6H_{12}O_2$	116	15.7	1958
38	4.34	95	Cyclopropane, (2,2-dimethylpropylidene)-	C_8H_{14}	110	13.1	60981
39	4.41	83	2,3-Dimethyl-3-heptene, (Z)-	C_9H_{18}	126	5.10	232149
40	4.52	43	Hexane, 3-ethyl-	C_8H_{18}	114	23.8	113940

41	4.59	95	1-Methyl-2-methylenecyclohexane	C_8H_{14}	110	16.8	113437
42	4.68	83	2-Hexene, 4,4,5-trimethyl-	C_9H_{18}	126	18.1	26930
43	4.73	69	Cyclohexane, 1,3,5-trimethyl-, (1α,3α,5α)-	C_9H_{18}	126	15.1	2479
44	4.84	70	2,4-Dimethyl-1-heptene	C_9H_{18}	126	58.7	113516
45	5.17	91	Ethylbenzene	C_8H_{10}	106	54.6	114918
46	5.25	95	1,3-Hexadiene, 2,5-dimethyl-	C_8H_{14}	110	11.1	61715
47	5.30	91	p-Xylene	C_8H_{10}	106	23.9	113952
48	5.67	104	Styrene	C_8H_8	104	34.8	291542
49	5.77	43	Nonane	C_9H_{20}	128	36.1	228006
50	5.85	55	cis-2-Nonene	C_9H_{18}	126	14.7	113508
51	5.95	55	Bicyclo[3.1.1]heptane, 2,6,6-trimethyl-, [1R-(1α,2α,5α)]-	$C_{10}H_{18}$	138	7.81	140998
52	6.16	105	Benzene, (1-methylethyl)-	C_9H_{12}	120	50.1	228742
53	6.26	43	Ethanone, 1-(1,2,2,3-tetramethylcyclopentyl)-, (1R-cis)-	$C_{11}H_{20}O$	168	14.0	186082
54	6.30	55	2,4-Pentadien-1-ol, 3-propyl-, (2Z)-	$C_8H_{14}O$	126	5.58	142179
55	6.34	41	2,4-Undecadien-1-ol	$C_{11}H_{20}O$	168	6.94	136410
56	6.40	41	3,6-Nonadien-1-ol, (E,Z)-	$C_9H_{16}O$	140	7.29	39208
57	6.52	117	1,3-Methanopentalene, 1,2,3,5-tetrahydro-	C_9H_{10}	118	12.0	221371
58	6.64	91	Benzene, propyl-	C_9H_{12}	120	58.5	113930
59	6.73	68	Bicyclo[4.1.0]heptane, 7-(1-methylethylidene)-	$C_{10}H_{16}$	136	7.51	3316
60	6.76	105	Benzene, 1-ethyl-3-methyl-	C_9H_{12}	120	21.4	228743
61	6.87	41	1-Heptanol	$C_7H_{16}O$	116	10.1	190036
62	6.98	94	Phenol	C_6H_6O	94	56.7	221160
63	7.12	117	α-Methylstyrene	C_9H_{10}	118	29.7	30236
64	7.24	41	1-Decene	$C_{10}H_{20}$	140	14.7	118883
65	7.32	105	Valeric acid, 4-phenyl-	$C_{11}H_{14}O_2$	178	13.2	99257
66	7.38	43	Decane	$C_{10}H_{22}$	142	39.7	114147
67	7.49	43	Decane, 4-methyl-	$C_{11}H_{24}$	156	8.85	5261
68	7.69	121	1,5,5-Trimethyl-6-methylene-cyclohexene	$C_{10}H_{16}$	136	9.43	190588
69	7.80	119	2,3-Epoxycarane, (E)-	$C_{10}H_{16}O$	152	34.1	156146
70	7.84	117	Benzene, 2-propenyl-	C_9H_{10}	118	10.3	114744
71	7.90	68	Limonene	$C_{10}H_{16}$	136	14.7	64032
72	7.99	117	Phenprobamate	$C_{10}H_{13}NO_2$	179	9.46	187336
73	8.14	116	Benzene, 1-ethynyl-4-	C_9H_8	116	18.6	43759

			methyl-				
74	8.26	43	2-Undecanethiol, 2-methyl-	$C_{12}H_{26}S$	202	6.56	9094
75	8.31	57	Bicyclo[3.1.0]hex-3-en-2-ol, 2-methyl-5-(1-methylethyl)-, (1α,2α,5α)-	$C_{10}H_{16}O$	152	18.1	250249
76	8.50	107	2-Naphthol, 1,2,3,4,4a,5,6,7-octahydro-4a-methyl-	$C_{11}H_{18}O$	166	6.70	186122
77	8.72	56	3-Undecene, (E)-	$C_{11}H_{22}$	154	7.42	60565
78	8.79	117	Cyclohexene, 1-methyl-4-(1-methylethylidene)-	$C_{10}H_{16}$	136	9.72	21016
79	8.84	41	2-Undecene, (E)-	$C_{11}H_{22}$	154	7.50	142597
80	8.97	57	Undecane	$C_{11}H_{24}$	156	32.8	114185
81	9.03	55	2-Undecene, (Z)-	$C_{11}H_{22}$	154	10.4	60564
82	9.17	41	5-Undecene, (Z)-	$C_{11}H_{22}$	154	9.50	60554
83	9.23	83	1,12-Tridecadiene	$C_{13}H_{24}$	180	10.2	7380
84	9.68	69	1,12-Tridecadiene	$C_{13}H_{24}$	180	6.41	7380
85	9.73	41	1b,5,5,6a-Tetramethyl-octahydro-1-oxa-cyclopropa[a]inden-6-one	$C_{13}H_{20}O_2$	208	11.8	194131
86	9.78	115	1H-Indene, 3-methyl-	$C_{10}H_{10}$	130	18.0	190595
87	9.87	91	5,7-Dodecadiyn-1,12-diol	$C_{12}H_{18}O_2$	194	24.1	136921
88	9.94	43	Decane, 1-chloro-	$C_{10}H_{21}Cl$	176	16.6	133277
89	10.03	41	1-Nonanol	$C_9H_{20}O$	144	13.4	21281
90	10.24	56	3-Dodecene, (E)-	$C_{12}H_{24}$	168	6.93	70642
91	10.36	41	1-Dodecene	$C_{12}H_{24}$	168	5.77	107688
92	10.48	57	Dodecane	$C_{12}H_{26}$	170	29.5	291499
93	10.67	41	9-Octadecenal	$C_{18}H_{34}O$	266	6.76	35819
94	11.15	43	Tetradecane, 2,6,10-trimethyl-	$C_{17}H_{36}$	240	10.1	11556
95	11.26	91	2,5-Octadecadiynoic acid, methyl ester	$C_{19}H_{30}O_2$	290	32.1	35988
96	11.48	83	Cyclohexanecarboxylic acid, 4-pentadecyl ester	$C_{22}H_{42}O_2$	338	5.37	280601
97	11.55	97	7-(1-Hydroxy-cyclohex-2-enyl)-2,2-dimethyl-hept-5-en-3-one	$C_{15}H_{24}O_2$	236	9.16	193200
98	11.67	41	1,12-Tridecadiene	$C_{13}H_{24}$	180	19.2	7380
99	11.79	41	1-Tridecene	$C_{13}H_{26}$	182	11.2	107768
100	11.92	43	1-Octanol, 2-butyl-	$C_{12}H_{26}O$	186	4.56	62231
101	11.96	142	2H-Pyran, tetrahydro-2-[(1-methyl-4-phenyl-2-butynyl)oxy]-	$C_{16}H_{20}O_2$	244	14.5	47699
102	12.03	43	2-Piperidinone, N-[4-bromo-n-butyl]-	$C_9H_{16}BrNO$	233	3.72	251632
103	12.43	91	Benzenebutanenitrile	$C_{10}H_{11}N$	145	74.8	236852

104	12.51	43	Trichloroacetic acid, hexadecyl ester	$C_{18}H_{33}Cl_3O_2$	386	5.13	280518
105	12.76	41	1-Heptatriacotanol	$C_{37}H_{76}O$	536	13.9	127968
106	12.81	43	Hexadecane, 1,16-dichloro-	$C_{16}H_{32}Cl_2$	294	5.30	154062
107	12.87	55	1-Tetradecanol, 14-chloro-	$C_{14}H_{29}ClO$	248	7.66	156095
108	12.97	55	Longipinocarveol, trans-	$C_{15}H_{24}O$	220	14.7	159365
109	13.05	41	9,12-Octadecadienoyl chloride, (Z,Z)-	$C_{18}H_{31}ClO$	298	9.09	76312
110	13.15	41	3-Tetradecene, (E)-	$C_{14}H_{28}$	196	6.58	139981
111	13.25	57	Tetradecane	$C_{14}H_{30}$	198	33.7	113925
112	13.30	55	Dodecylsuccinic anhydride	$C_{16}H_{28}O_3$	268	5.48	233097
113	13.36	170	Bicyclo[4.1.0]heptan-2-ol, 1-phenyl-, endo-	$C_{13}H_{16}O$	188	14.0	142777
114	14.11	94	2,5-Octadecadiynoic acid, methyl ester	$C_{19}H_{30}O_2$	290	25.5	35988
115	14.20	43	Murolan-3,9(11)-diene-10-peroxy	$C_{15}H_{24}O_2$	236	14.5	140333
116	14.31	83	1-Dodecanol, 3,7,11-trimethyl-	$C_{15}H_{32}O$	228	4.06	22776
117	14.43	41	1-Pentadecene	$C_{15}H_{30}$	210	8.73	232902
118	14.53	57	Pentadecane	$C_{15}H_{32}$	212	17.7	107761
119	14.58	55	7-Heptadecene, 17-chloro-	$C_{17}H_{33}Cl$	272	4.72	36338
120	15.18	83	Ethanol, 2-(9-octadecenyloxy)-, (Z)-	$C_{20}H_{40}O_2$	312	4.58	36235
121	15.55	41	7-Heptadecene, 17-chloro-	$C_{17}H_{33}Cl$	272	3.72	36338
122	15.64	41	1-Hexadecene	$C_{16}H_{32}$	224	8.23	118882
123	15.73	57	Hexadecane	$C_{16}H_{34}$	226	29.1	114191
124	16.39	43	7-Methyl-Z-tetradecen-1-ol acetate	$C_{17}H_{32}O_2$	268	22.0	130996
125	16.46	92	Benzene, 1,1'-(1,3-propanediyl)bis-	$C_{15}H_{16}$	196	92.4	133399
126	16.67	97	Pentadec-7-ene, 7-bromomethyl-	$C_{16}H_{31}Br$	302	3.88	259585
127	16.79	41	8-Heptadecene	$C_{17}H_{34}$	238	6.22	113620
128	16.87	57	Heptadecane	$C_{17}H_{36}$	240	16.6	107308
129	16.91	55	1-Hexadecanol, 2-methyl-	$C_{17}H_{36}O$	256	7.29	36540
130	17.10	83	tert-Hexadecanethiol	$C_{16}H_{34}S$	258	6.84	234966
131	17.61	83	3-Chloropropionic acid, 3-pentadecyl ester	$C_{18}H_{35}ClO_2$	318	6.87	282044
132	17.76	41	5,8,11,14-Eicosatetraynoic acid	$C_{20}H_{24}O_2$	296	11.4	194499
133	17.81	41	9-Hexadecenoic acid	$C_{16}H_{30}O_2$	254	6.71	43703

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134	17.89	43	1-Nonadecene	$C_{19}H_{38}$	266	4.48	113626
135	17.96	57	Octadecane	$C_{18}H_{38}$	254	11.5	57273
136	18.15	41	1-Docosanol	$C_{22}H_{46}O$	326	6.26	23377
137	19.00	43	Nonadecane	$C_{19}H_{40}$	268	13.3	114098
138	19.19	41	Cholestan-3-ol, 2-methylene-, (3β,5α)-	$C_{28}H_{48}O$	400	20.3	48741
139	19.94	43	1-Eicosene	$C_{20}H_{40}$	280	4.73	13488
140	20.00	57	Eicosane	$C_{20}H_{42}$	282	14.5	34730
141	20.89	43	1-Docosene	$C_{22}H_{44}$	308	5.50	113878
142	20.95	57	Heptadecane, 2,6,10,15-tetramethyl-	$C_{21}H_{44}$	296	7.88	14103

Liquid oil was analysis by using GC/MS and crude oil chromatogram shown figure 4 and compound table showed table 1. In this oil GC/MS analysis shown hydrocarbon compounds range C_3 –C_{37} including halogen compounds, oxygenated and nitrogen compounds. This type of mixture compounds was appeared because initial material was mixture of different type of plastics. Crude oil GC/MS analysis was based on compounds name and structure, trace mass, compounds retention time, compounds molecular weight and NIST library number. Compounds are appeared 1st Cyclopropane (C_3H_6) , (t=1.48, m/z=42) and NIST # 18854 and last compounds Heptadecane, 2,6,10,15-tetramethyl- ($C_{21}H_{44}$), (t=20.95, m/z=296) and NIST # 14103, In this analysis between 1st compounds and last compounds also determine lots of different types of compounds from GC/MS analysis. Some of hydrocarbon compounds are shown in this analysis section and rest of other compounds also shown in data table. In this analysis shown most of the compounds are hydrocarbon and some percentage of alcoholic, halogenated and nitrogen mixture. Liquid was burn in ignition test and produce some residual after burn. Liquid oil has chlorine content mixture for that reason before use this liquid to be retreat with silver nitrate solution. This liquid oil can be use for refinery process because this liquid has chlorine mixture.

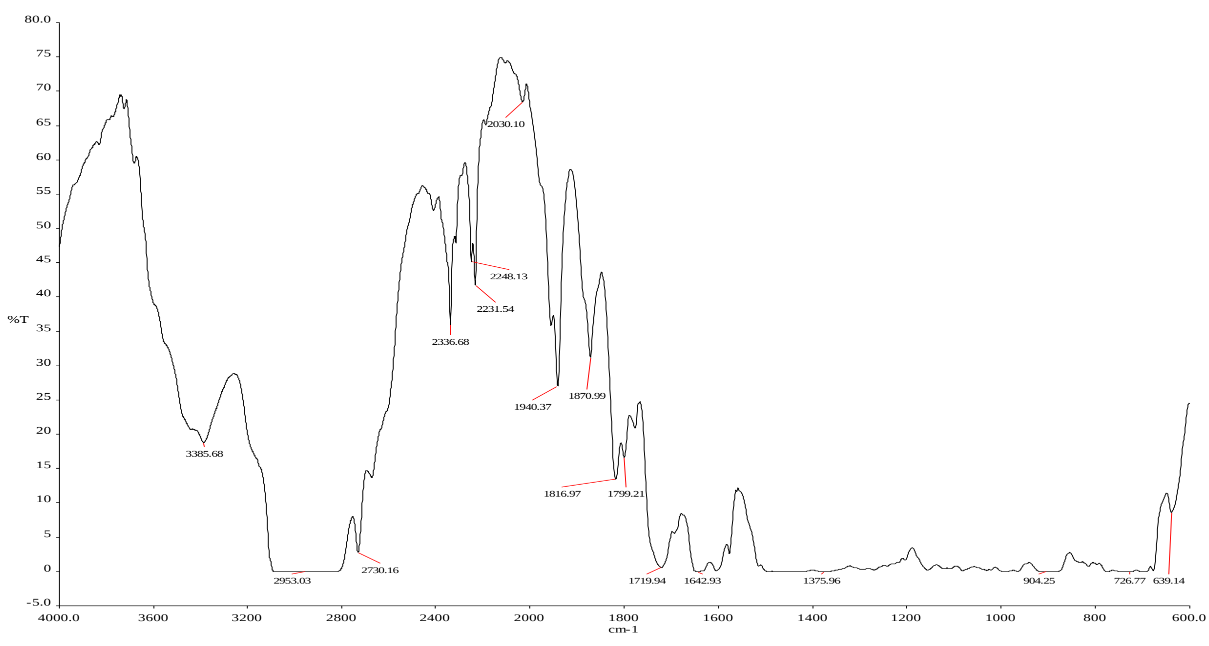

Figure 5: FTIR graph of dirty plastic to fuel

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Table 2: FTIR functional group of dirty plastic to fuel

No.	IR Band Number	Functional Group	No.	IR Band Number	Functional Group
1	3385.68	N-H stretch (1°, 2° amines, amides)	10	1816.97	
2	2953.03	C-H stretch (aromatics)	11	1799.21	
3	2730.16	C-H=O: C-H stretch (aldehydes)	12	1719.94	C=O stretch
4	2336.68	C-H=O: C-H stretch (aldehydes)	13	1642.93	-C=C- stretch (alkenes)
5	2231.54	Nitriles	14	1375.96	C-H bend (alkanes)
6	2248.13	Alkynes	15	904.25	N-H
7	2030.10		16	726.77	C-Cl
8	1940.37		17	639.14	C-Br
9	1870.99				

FT-IR analysis result showed figure 5 and table 2. Table 2 showed band number and functional group. In this liquid fuel has a mixture compound s including nitrogen, halogen, benzene or aromatics, alkane, alkenes and alkyl group. IR represent every band has energy value.

Conclusion

Dirty waste plastic can make liquid fuel by using NSR technology process. If waste plastics too old and was seated long time land fill it will not any problem to produce liquid oil or fuel. Mixture dirty waste plastic was combination of LDPE, HDPE, PP, PS, PETE, PLA (Other-7), Tire, rubber and etc. for that reason liquid oil was mixture of aromatic, aliphatic, nitrogen, alcoholic, halogenated and etc. Liquid was burn by ignition test and density was 0.78 g/ml. In this experiment conclusion that any kind of dirty waste plastic material can made oil by using NSR technology process without using any kind of chemical or catalysis. In the land fill long time setting waste plastics can be use for liquid fuel or oil production and same time its can save environment.

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References

[1] Association of Plastics Manufactures in Europe (APME). An analysis of Plastics Consumption and Recovery in Europe, 2002-2003.

[2] Williams, E. A.; Williams, P. T. Analysis of products derived from the fast pyrolysis of plastic waste. J. Anal. Appl. Pyrolysis 1997, 40-41, 347.

[3] Mastral, J. F.; Esperanza, E.; Garcı´a, P.; Juste, M. Pyrolysis of HDPE in a fluidised bed reactor. Influence of the temperature and residence time. J. Anal. Appl Pyrolysis 2002, 63, 1.

[4] Williams, P. T.; Williams, E. A. Fluidised bed pyrolysis of low density PE to produce petrochemical feedstock. J. Anal. Appl. Pyrolysis 1999, 51, 107.

[5] Kaminsky, W.; Schmidt, H.; Simon, C. M. Recycling of mixed plastics by pyrolysis in a fluidised bed. Macromol. Symp. 2000, 152, 191.

[6] Onu, P.; Vasile, C.; Ciocıˆlteu, S.; Iojoiu, E.; Darie, H. Thermal and catalytic decomposition of PE and PP. J. Anal. Appl. Pyrolysis 1999, 49, 145.

[7] Arandes, J. M.; Abajo, I.; Lo´pez-Valerio, D.; Fernandez, I.; Azkoiti, M. J.; Olazar, M.; Bilbao, J. Transformation of several plastic wastes into fuels by catalytic cracking. Ind. Eng. Chem. Res. 1997, 36, 4523.

[8] Aguado, J.; Serrano, D. P.; Escola, J. M.; Garagorri, E.; Ferna´ndez, J. A. Catalytic conversion of polyolefins into fuels over zeolite beta. Polym. Degrad. Stab. 2000, 69, 11.

[9] San You, Y.; Kim, J-H.; Seo, G. Liquid-phase catalytic degradation of polyethylene wax over MFI zeolites with different particle size. Polym. Degrad. Stab. 2000, 70, 365.

[10] Ma del Remedio Herna´ndez, AÄ ngela N. Garcı´a, Amparo Go´mez, Javier Agullo´, and Antonio Marcilla, Effect of Residence Time on Volatile Products Obtained in the HDPE Pyrolysis in the Presence and Absence of HZSM-5, Ind. Eng. Chem. Res. 2006, 45, 8770-8778

[11] Aguado, J.; Serrano, D. P. Feedstock Recycling of Plastic Wastes; Royal Society of Chemistry: Cambridge, U.K., 1999.

[12] An Analysis of Plastics Production, Demand and RecoVery in Europe 2004; Association of Plastics Manufactures in Europe (APME): Brussels, Belgium, 2006.

[13] J. Aguado,* D. P. Serrano, G. Vicente, and N. Sa´nchez, Enhanced Production of r-Olefins by Thermal Degradation of High-Density Polyethylene (HDPE) in Decalin Solvent: Effect of the Reaction Time and Temperature, Ind. Eng. Chem. Res. 2007, 46, 3497-3504

[14] Kaminsky, W.; Nun˜ez Zorriqueta, I. J. Catalytical and thermal pyrolysis of polyolefins. J. Anal. Appl. Pyrol. 2007, 79, 368.

[15] Predel, M.; Kaminsky, W. Pyrolysis of mixed polyolefins in a fluidised-bed reactor and on a pyro-GC/MS to yield aliphatic waxes. Polym. Degrad. Stab. 2000, 70, 373.

[16] Aguado, R.; Olazar, M.; San Jose´, M. J.; Gaisa´n, B.; Bilbao, J. Wax formation in the pyrolysis of polyolefins in a conical spouted bed reactor. Energy Fuels 2002, 16, 1429.

[17] Marcilla, A.; Beltra´n, M. I.; Navarro, R. Study of the deactivation process of HZSM5 zeolite during polyethylene pyrolysis. Appl. Catal., A 2007, 333, 57.

[18] Marcilla, A.; Go´mez, A.; Menargues, S. TGA/FTIR study of the evolution of the gases evolved in the catalytic pyrolysis of ethylene-vinyl acetate copolymers. Comparison among different catalysts. Polym. Degrad. Stab. 2005, 89, 454.

[19] Herna´ndez, M. R.; Garcı´a, A. N.; Marcilla, A. Catalytic flash pyrolysis of HDPE in a fluidized bed reactor for recovery of fuel-like hydrocarbons. J. Anal. Appl. Pyrol. 2007, 78, 272.

[20] Marcilla, A.; Go´mez-Siurana, A.; Berenguer, D. Study of the early deactivation in pyrolysis of polymers in the presence of catalysts. J. Anal. Appl. Pyrol. 2007, 79, 443.

[21] Cardona, S. C.; Corma, A. Tertiary recycling of polypropylene by catalytic cracking in a semibatch stirred reactor: Use of spent equilibrium FCC commercial catalyst. Appl. Catal., B 2000, 25, 151.

[22] Chaianansutcharit, S.; Katsutath, R.; Chaisuwan, A.; Bhaskar, T.; Nigo, A.; Muto, A.; Sakata, Y. Catalytic degradation of polyolefins over hexagonal mesoporous silica: Effect of aluminum addition. J. Anal. Appl. Pyrol. 2007, 80, 360.

[23] Ali, S.; Garforth, A. A.; Harris, D. H.; Rawlence, D. J.; Uemichi, Y. Polymer waste recycling over “used” catalysts. Catal. Today 2002, 75, 247.

[24] Marcilla, A.; Beltra´n, M. I.; Navarro, R. Thermal and catalytic pyrolysis of polyethylene over HZSM5 and HUSY zeolites in a batch reactor under dynamic conditions. Appl. Catal., B 2008, in press.

[25] Mertinkat, J.; Kirsten, A.; Predel, M.; Kaminsky, W. Cracking catalysts used as fluidized bed material in the Hamburg pyrolysis process. J. Anal. Appl. Pyrol. 1999, 49, 87.

[26] Herna´ndez, M. R.; Go´mez, A.; Garcı´a, A. N.; Agullo´, J.; Marcilla, A. Effect of the temperature in the nature and extension of the primary and secondary reactions in the thermal and HZSM-5 catalytic pyrolysis of HDPE. Appl. Catal., A 2007, 317, 183.

[27] Scheirs, J.; Kaminsky, W. Feedstock Recycling and Pyrolysis of Waste Plastics; Wiley Series; Wiley: Chichester, U.K., 2006.

[28] Arandes, J. M.; Azkoiti, M. J.; Torre, I.; Olazar, M.; Castan˜o, P. Effect of HZSM-5 catalyst addition on the cracking of polyolefin pyrolysis waxes under FCC conditions. Chem. Eng. J. 2007, 132, 17.

[29] Aguado, J.; Serrano, D. Feedstock Recycling of Plastic Wastes; Royal Society of Chemistry: Cambridge, U.K., 1999.

[30] A. Marcilla,* M. I. Beltra´n, and R. Navarro, Evolution with the Temperature of the Compounds Obtained in the Catalytic Pyrolysis of Polyethylene over HUSY, Ind. Eng. Chem. Res. 2008, 47, 6896–6903