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Petroleum Refinery Feed Produce from Electronic-Waste Plastic (E-Waste) using Zinc Oxide (ZnO) Catalyst with Activated Carbon

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ABSTRACT

Electronic waste plastic problem are increasing day by day all over the world. One year 50 million tons of e-waste produce all over the world. Only 15-20% of e-waste is recycled, the rest of these electronics go directly into landfills and incinerators. Electronic waste plastic conversion into fuel experiment was performed with 10 % Zinc Oxide catalyst and 10% activated carbon. Thermal degradation process temperature range was 200-400 ºC. 75 gm of sample was use for this experiment by weight and 7.5 gm of ZnO and 7.5 gm of activated carbon used. Produced fuel density is 0.88 gm/ml and liquid fuel conversion rate is 74.26 %, light gas percentage is 3.34 %. Gas Chromatography and Mass Spectrometer (GC/MS) was use for liquid fuel analysis purpose and carbon chain compounds detected C_3H_6 to $C_{24}H_{18}$. Fuel can be use for petroleum feed stock refinery.

Keywords: e-waste plastic, thermal degradation, Electrical and electronic equipment, municipal, Fuel, conversion, GC/MS

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INTRODUCTION

Electronic waste, e-waste, e-scrap, or waste electrical and electronic equipment (WEEE) describes discarded electrical or electronic devices. There is a lack of consensus as to whether the term should apply to resale, reuse, and refurbishing industries, or only to product that cannot be used for its intended purpose. Informal processing of electronic waste in developing countries may cause serious health and pollution problems, though these countries are also most likely to reuse and repair electronics. Some electronic scrap components, such as CRTs, may contain contaminants such as lead, cadmium, beryllium, or brominated flame retardants. Even in developed countries recycling and disposal of e-waste may involve significant risk to workers and communities and great care must be taken to avoid unsafe exposure in recycling operations and leaching of material such as heavy metals from landfills and incinerator ashes. Scrap industry and USA EPA officials agree that materials should be managed with caution. Rapid changes in technology, changes in media (tapes, software, MP3), falling prices, and planned obsolescence have resulted in a fast-growing surplus of electronic waste around the globe [1]. An estimated 50 million tons of E-waste are produced each year. The USA discards 30 million computers each year and 100 million phones are disposed of in Europe each year. The Environmental Protection Agency estimates that only 15-20% of e-waste is recycled, the rest of these electronics go directly into landfills and incinerators [2].

According to a report by UNEP titled, "Recycling - from E-Waste to Resources," the amount of e-waste being produced - including mobile phones and computers - could rise by as much as 500 percent over the next decade in some countries, such as India [3]. The United States is the world leader in producing electronic waste, tossing away about 3 million tons each year [4]. China already produces about 2.3 million tons (2010 estimate) domestically, second only to the United States. And, despite having banned e-waste imports, China remains a major e-waste dumping ground for developed countries [4]. Electrical waste contains hazardous but also valuable and scarce materials. Up to 60 elements can be found in complex electronics. In the United States, an estimated 70% of heavy metals in landfills comes from discarded electronics [5,6].

While there is agreement that the number of discarded electronic devices is increasing, there is considerable disagreement about the relative risk (compared to automobile scrap, for example), and strong disagreement whether curtailing trade in used electronics will improve conditions, or make them worse. According to an article in Motherboard, attempts to restrict the trade have driven reputable companies out of the supply chain, with unintended consequences [7]. The EPA has just released its “2009 Facts and Figures” on Municipal Solid Waste generated in the U.S. This new report shows that in 2009, as in previous years, the vast majority (82.3%) of e-waste discarded in the U.S. Is still ending up in our landfills and incinerators, with only 17.7 percent going to recyclers. This is a slight increase from 2008, when 13.6 was diverted for recycling. But it’s far lower than the recycling rate reported for the whole municipal waste stream, which was 33.8%. Despite its name, this “municipal solid waste report” includes discards from consumers and businesses (but not industrial or hazardous waste). Residential waste accounts for 55-65% of the total wastes generated. This report groups

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electronics in with other “durable goods.” There’s not much more detail about e-waste volumes provided by the EPA – this is the only regular report issued that itemizes electronic waste [8]. Thermal degradation of polymer mixtures is more complex than the degradation of single polymers. Interactions can appear at high temperatures during decomposition in the polymer bulk, between the components of the mixture and the low molecular weight products and free radicals that are formed by the scission of the polymeric chains [9]. Some other researcher groups also try to convert e-waste to fuel [10, 11, 12, 13]. In present technology can convert all types of e-waste plastic into fuel by using ZnO and mixture of activated carbon at temperature range 200 to 400 ºC.

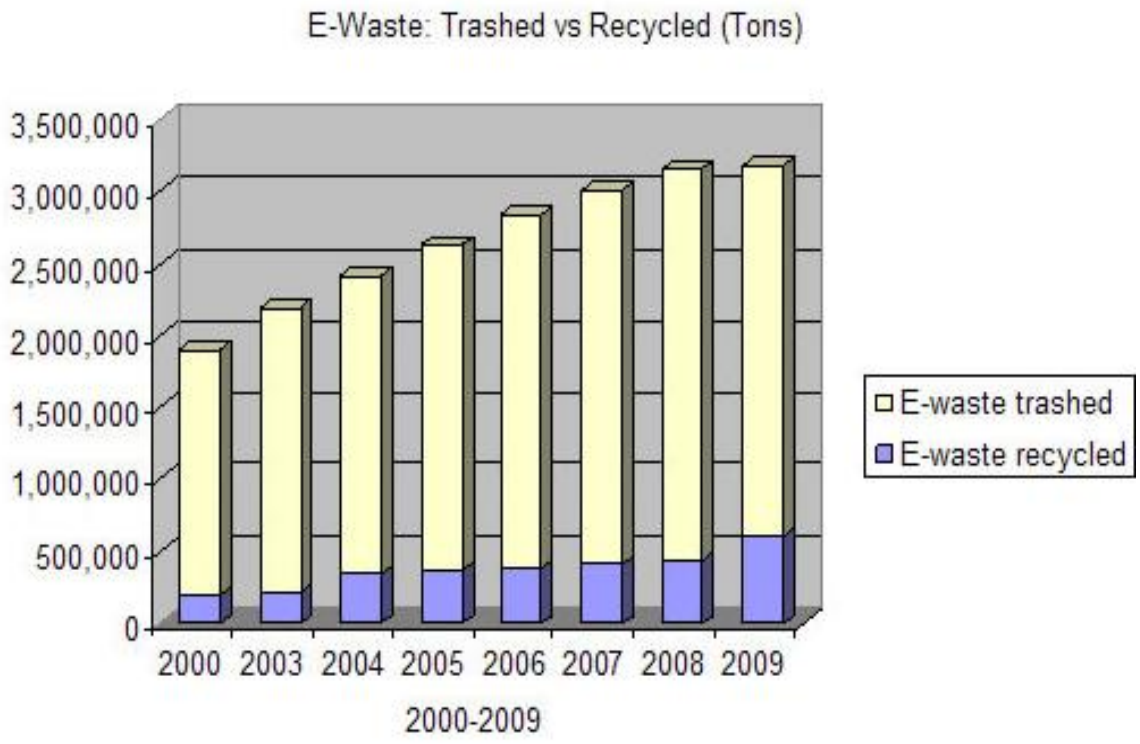

Figure 1: E- waste trashed and recycled tons per year in USA
(Source http://www.electronicstakeback.com/2011/01/26/epas-new)

MATERIALS AND METHODS

Electronic waste plastic collected from scrape computer and from scrape computer to collected only plastic part and cut in to small pieces using scissor. Computer has different type of metal part and metal was separated manually. Without wash computer body put into reactor with 10% ZnO catalyst and 10% activated carbon. ZnO catalyst and activated carbon was collected from VWR.com Company. Figure 1 showed e-waste trashed and recycled generation per year in the USA.

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Process Description

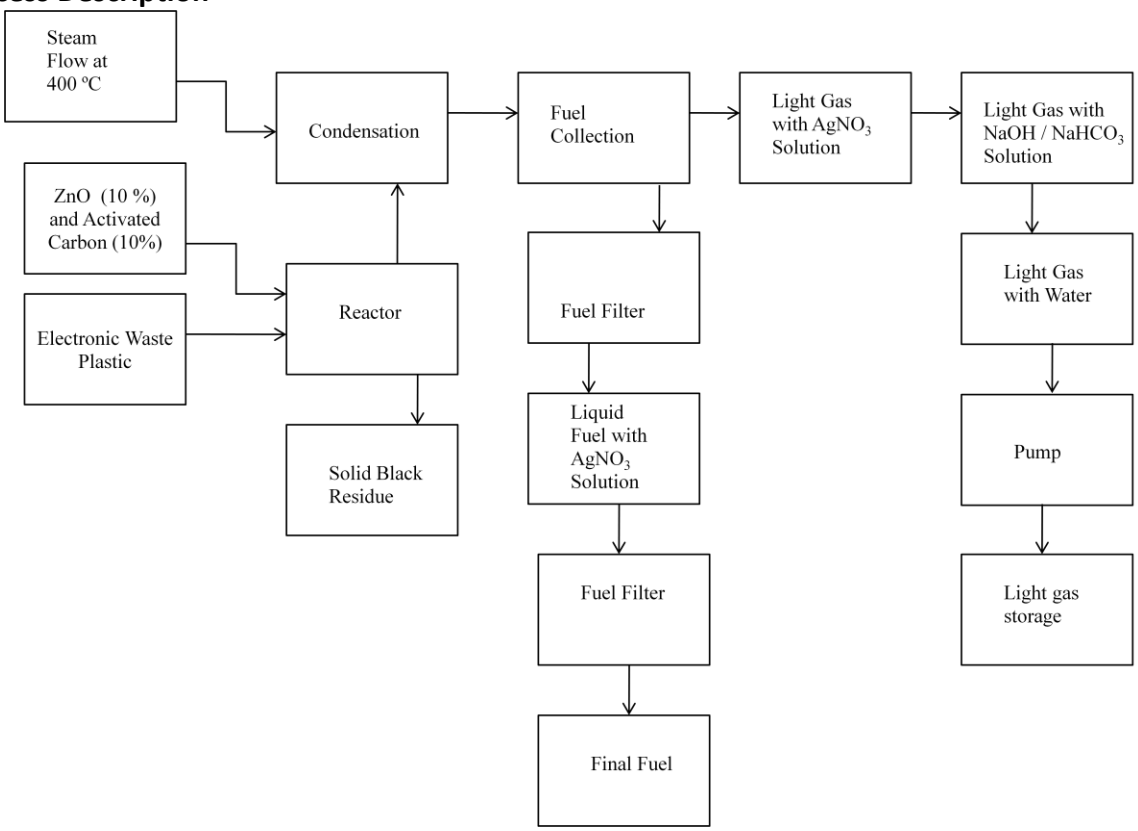

Figure 2: Electronic waste plastic to fuel production with ZnO and activated carbon

Electronic waste plastic to fuel production process was performed into laboratory scale in to batch process. Electronic waste plastic to fuel production thermal degradation process was applies with 10% ZnO catalyst and 10% activated carbon without vacuum system. In presence of oxygen under labconco fume hood experiment was performed. Small pieces electronic waste plastic and ZnO catalyst with activated carbon transferred into reactor chamber by manually. Then placed into heat mental and temperature was controlled with variac meter. Heat mental temperature raises capability up to 450 ºC. Experimental purpose electronic waste plastic sample was use only 75 gm, ZnO catalyst was use 7.5 gm and activated carbon was use 7.5 gm. Electronic waste plastic, ZnO and activated carbon was transferred into glass reactor chamber and glass chamber was pyrex glass. Reactor was connected into condensation unit one end with high temperature tolerable apezon vacuum grease to prevent gas loss. Condensation unit other end was connected with fuel collection tank unit one end, then fuel collection other neck was connected with light gas cleaning tank (0.25N $AgNO_3$ solution) one neck and light gas cleaning another neck was connected with .025 (N) NaOH solution tank one neck. NaOH solution tank another neck was connected with water filled up tank one neck and water filled up tank another neck was connected with small pump then pump was connected with Teflon bag. Steam flow was added with condensation unit at temperature 400 ºC to increase hydrocarbon compounds. After finished whole experimental setup (Figure 2) for electronic waste plastic to fuel production then start reactor temperature rise up from 200 - 400 ºC gradually. Electronic

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waste plastic start to melt and produce vapor, then vapor passed through condensation unit with steam flow then produce liquid fuel with some water. During production period some light gas was generated and light gas passed through with 0.25 (N) $AgNO_3$ solutions to removed chlorinated compounds then light gas passed through with 0.25 (N) NaOH solutions to removed other contamination. At the end light gas was passed through with water tank to removed alcoholic part then gas was transfer into Teflon bag using small pump. Collected fuel was filtered with micron filter system then passed through AgNO3 solution to removed chlorinated compounds from fuel then again fuel was filter with micro filter system. Electronic waste plastic to fuel production process was fully closed system. Whole process was finished 6-7 hours. Produce fuel density is 0.88 g/ml. Electronic waste plastic to fuel production process ZnO catalyst was use because chlorine compound mix with ZnO and produce $ZnCl_2$ and settle down with residue part. During electronic waste plastic to liquid fuel production conversion rate percentage is 74.26 %, light gas percentage rate is 3.34 % and solid residue percentage is 22.4%. In mass balance calculation showed 75 gm electronic waste plastic to liquid fuel weight is 55.7 gm, light gas conversion sample weight is 2.5gm and residue weight is 16.8gm. Light gas and solid black residue analysis under investigation. Electronic waste plastic to fuel production process input electricity was 0.592KWh.

RESULTS AND DISCUSSION

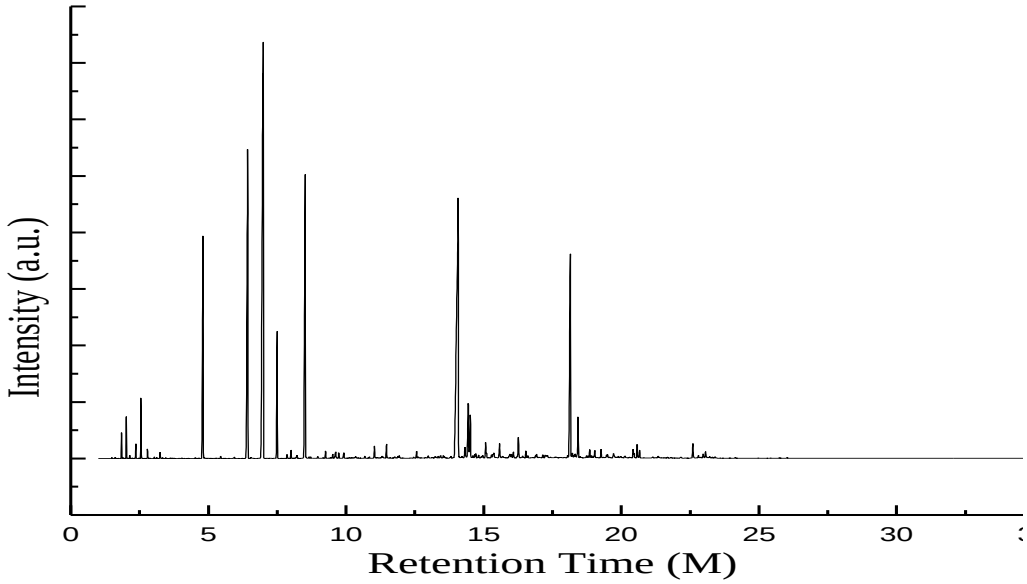

Figure 3: GC/MS chromatogram of electronic waste plastic to fuel

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Table 1: GC/MS chromatogram compounds list of electronic waste plastic to fuel

Number of Peak	Retention Time (min.)	Trace Mass (m/z)	Compound Name	Compound Formula	Molecular Weight	Probability %	NIST Library Number
1	1.49	41	Propene	C_3H_6	42	40.9	50
2	1.56	43	Isobutane	C_4H_{10}	58	43.5	61289
3	1.60	41	2-Butene, (E)-	C_4H_8	56	22.7	105
4	1.61	43	2-Methyl-2-vinyloxirane	C_5H_8O	84	22.3	291476
5	1.63	41	2-Butene, (E)-	C_4H_8	56	32.8	105
6	1.85	41	Methyl isocyanide	C_2H_3N	41	51.1	47
7	2.01	53	2-Propenenitrile	C_3H_3N	53	98.1	150247
8	2.36	54	Propanenitrile	C_3H_5N	55	96.2	40084
9	2.55	41	2-Propenenitrile, 2-methyl-	C_4H_5N	67	62.3	291472
10	2.79	42	Isobutyronitrile	C_4H_7N	69	96.4	227719
11	3.04	41	2-Butenenitrile	C_4H_5N	67	36.9	230526
12	3.12	67	Cyclopentene, 1-methyl-	C_6H_{10}	82	14.1	107747
13	3.24	78	Benzene	C_6H_6	78	65.6	291514
14	3.33	41	Butanenitrile	C_4H_7N	69	92.8	46212
15	3.45	41	2-Butenenitrile	C_4H_5N	67	38.9	230526
16	3.59	41	1-Heptene	C_7H_{14}	98	17.2	107734
17	3.63	54	Butanenitrile, 2-methylene-	C_5H_7N	81	46.9	26961
18	3.71	43	Heptane	C_7H_{16}	100	52.8	61276
19	3.75	81	2-Pentyne, 4,4-dimethyl-	C_7H_{12}	96	16.2	113656
20	3.80	41	2-Heptene, (E)-	C_7H_{14}	98	11.9	932
21	3.93	81	2,3-Dimethyl-1,4-pentadiene	C_7H_{12}	96	11.6	113670
22	4.00	54	2-Pentenenitrile	C_5H_7N	81	39.6	434
23	4.04	55	1,5-Heptadiene	C_7H_{12}	96	10.4	231488
24	4.13	55	Cyclohexane, methyl-	C_7H_{14}	98	17.8	118503
25	4.23	54	2-Pentenenitrile	C_5H_7N	81	50.4	434
26	4.28	69	Cyclopentane, ethyl-	C_7H_{14}	98	50.3	231044
27	4.36	81	1,4-Hexadiene, 4-methyl-	C_7H_{12}	96	12.6	113135
28	4.42	67	Cyclohexane, methylene-	C_7H_{12}	96	35.9	19641
29	4.45	52	5-Azabicyclo[2.2.0]hex-2-en-6-one	C_5H_5NO	95	76.8	288378
30	4.53	81	Cyclobutane, (1-methylethylidene)-	C_7H_{12}	96	15.8	150272
31	4.58	67	Cyclopentane, ethylidene-	C_7H_{12}	96	28.6	114403
32	4.65	41	Methallyl cyanide	C_5H_7N	81	56.2	158787
33	4.80	91	Toluene	C_7H_8	92	56.1	291301
34	5.01	54	trans-1-Methyl-2-(2'-propenyl)cyclopropane	C_7H_{12}	96	23.5	105774
35	5.07	67	Pyrazine, methyl-	$C_5H_6N_2$	94	16.1	34507
36	5.13	41	1-Octene	C_8H_{16}	112	15.4	1604
37	5.21	55	Cyclopentane, 1-ethyl-2-methyl-	C_8H_{16}	112	8.33	150594

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38	5.27	43	Octane	C_8H_{18}	114	47.1	229407
39	5.36	41	Dihydromyrcene	$C_{10}H_{18}$	138	7.89	292831
40	5.45	207	Cyclotrisiloxane, hexamethyl-	$C_6H_{18}O_3Si_3$	222	92.5	238029
41	5.55	55	Butane, 1-isocyano-	C_5H_9N	83	48.0	36736
42	5.63	81	1,4-Hexadiene, 3-ethyl-	C_8H_{14}	110	17.8	1483
43	5.74	41	1,6-Heptadiene, 3-methyl-	C_8H_{14}	110	7.59	61552
44	5.90	81	1,4-Hexadiene, 3-ethyl-	C_8H_{14}	110	19.6	1483
45	5.94	54	1,5-Cyclooctadiene, (E,Z)-	C_8H_{12}	108	23.4	1407
46	6.10	67	Cyclopentene, 1-propyl-	C_8H_{14}	110	44.7	142659
47	6.23	81	1,4-Octadiene	C_8H_{14}	110	18.9	231549
48	6.43	91	Ethylbenzene	C_8H_{10}	106	53.2	158804
49	6.98	103	Styrene	C_8H_8	104	44.7	291542
50	7.00	104	Styrene	C_8H_8	104	40.4	291542
51	7.50	105	Benzene, (1-methylethyl)-	C_9H_{12}	120	40.1	228742
52	7.86	117	Deltacyclene	C_9H_{10}	118	15.0	221906
53	8.00	91	Benzene, propyl-	C_9H_{12}	120	77.7	113930
54	8.12	105	Benzene, 1-ethyl-3-methyl-	C_9H_{12}	120	31.8	228743
55	8.22	53	Butanedinitrile	$C_4H_4N_2$	80	96.9	291263
56	8.26	281	Cyclotetrasiloxane, octamethyl-	$C_8H_{24}O_4Si_4$	296	60.0	313294
57	8.52	117	α-Methylstyrene	C_9H_{10}	118	32.8	229186
58	8.66	117	1,3-Methanopentalene, 1,2,3,5-tetrahydro-	C_9H_{10}	118	22.7	221371
59	8.71	105	Benzene, (1,3,3-trimethylnonyl)-	$C_{18}H_{30}$	246	23.9	11889
60	8.97	105	Benzene, (1-methylpropyl)-	$C_{10}H_{14}$	134	20.7	118593
61	9.17	117	Benzene, 1-methyl-4-(2-propenyl)-	$C_{10}H_{12}$	132	11.9	113549
62	9.25	117	Benzene, 2-propenyl-	C_9H_{10}	118	20.6	114744
63	9.45	117	Tetracyclo[3.3.1.0(2,8).0(4,6)]-non-2-ene	C_9H_{10}	118	15.7	191137
64	9.51	91	Benzene, 3-butenyl-	$C_{10}H_{12}$	132	79.7	232267
65	9.63	54	Pentanedinitrile	$C_5H_6N_2$	94	94.5	230325
66	9.73	91	Benzene, butyl-	$C_{10}H_{14}$	134	42.0	228741
67	9.92	68	Pentanedinitrile, 2-methyl-	$C_6H_8N_2$	108	69.6	290847
68	10.15	117	Benzene, (2-methyl-2-propenyl)-	$C_{10}H_{12}$	132	14.4	113536
69	10.21	41	Isopinocarveol	$C_{10}H_{16}O$	152	5.31	292836
70	10.35	57	Undecane	$C_{11}H_{24}$	156	5.26	114185
71	10.45	105	Benzene, (1-methylbutyl)-	$C_{11}H_{16}$	148	50.7	34703
72	10.52	117	1-Cyclohexene-1-methanol, 4-(1-methylethenyl)-	$C_{10}H_{16}O$	152	9.15	249385
73	10.68	117	Benzene, 4-ethenyl-1,2-dimethyl-	$C_{10}H_{12}$	132	11.0	2980
74	10.85	117	Benzene, (2-methyl-1-propenyl)-	$C_{10}H_{12}$	132	14.5	113562
75	11.03	117	Benzyl nitrile	C_8H_7N	117	39.0	290866
76	11.10	118	Benzene, (1-ethyl-2-propenyl)-	$C_{11}H_{14}$	146	46.0	113986
77	11.15	117	Benzene, 1-methyl-4-(2-propenyl)-	$C_{10}H_{12}$	132	9.86	113549

78	11.31	130	Benzene, (1-methylene-2-propenyl)-	$C_{10}H_{10}$	130	25.5	54280
79	11.47	116	Benzeneacetonitrile, α-methyl-	C_9H_9N	131	53.8	92315
80	11.60	41	Preg-4-en-3-one, 17α-hydroxy-17β-cyano-	$C_{20}H_{27}NO_2$	313	8.77	294644
81	11.76	41	3-Dodecene, (E)-	$C_{12}H_{24}$	168	6.64	113960
82	11.89	57	Dodecane	$C_{12}H_{26}$	170	5.60	291499
83	11.93	128	2-Naphthalenol, 1,2-dihydro-, acetate	$C_{12}H_{12}O_2$	188	33.6	162634
84	12.02	131	Benzene, (3-methyl-2-butenyl)-	$C_{11}H_{14}$	146	9.74	4232
85	12.08	94	Cyclohexene, 3,4-diethenyl-3-methyl-	$C_{11}H_{16}$	148	8.19	62471
86	12.37	117	Bicyclo[4.2.1]nona-2,4,7-triene, 7-ethyl-	$C_{11}H_{14}$	146	13.0	164426
87	12.44	117	Benzene, cyclopentyl-	$C_{11}H_{14}$	146	44.1	187011
88	12.57	91	Benzenepropanenitrile	C_9H_9N	131	61.8	231952
89	12.62	129	2-Propenenitrile, 3-phenyl-, (E)-	C_9H_7N	129	21.3	72101
90	12.73	117	1,2,4-Metheno-1H-cyclobuta[cd]pentalene-3,5-diol, octahydro-	$C_{10}H_{12}O_2$	164	10.9	188071
91	12.99	91	(1-Benzyl-cyclopropyl)-methanol	$C_{11}H_{14}O$	162	13.8	193386
92	13.35	57	Tridecane	$C_{13}H_{28}$	184	10.8	114282
93	13.43	143	Cyclopropanecarbonitrile, 2-phenyl-, trans-	$C_{10}H_9N$	143	18.1	52790
94	13.53	129	Benzene, 1-cyclopenten-1-yl-	$C_{11}H_{12}$	144	27.2	114813
95	13.57	142	Bicyclo[4.4.1]undeca-1,3,5,7,9-pentaene	$C_{11}H_{10}$	142	23.7	190616
96	14.07	91	Benzenebutanenitrile	$C_{10}H_{11}N$	145	94.2	236852
97	14.32	156	2,8-Dimethylquinoline	$C_{11}H_{11}N$	157	32.7	135976
98	14.43	91	Naphthalene-1,4-diol, 4-O-benzoyl(ether)	$C_{17}H_{14}O_2$	250	9.72	129683
99	14.52	105	Benzene, (2-iodoethyl)-	C_8H_9I	232	9.17	11166
100	14.62	41	7-Tetradecene	$C_{14}H_{28}$	196	11.6	70643
101	14.58	156	(7-Isopropylidenebicyclo[2.2.1]hept-5-en-2-ylidene)acetonitrile	$C_{12}H_{13}N$	171	32.2	211019
102	14.72	154	1,3-Cyclohexadien-5-ol, 1-phenyl-	$C_{12}H_{12}O$	172	70.0	159619
103	14.82	91	1H-Pyrrole, 1-(phenylmethyl)-	$C_{11}H_{11}N$	157	37.2	5406
104	14.92	115	Tetracyclo[5.2.1.0(2,6).0(3,5)]non-8-ene, 4-methyl-4-phenyl-, endo-	$C_{17}H_{18}$	222	15.4	154177
105	14.96	105	1-Penten-4-yn-3-ol, 1-phenyl-	$C_{11}H_{10}O$	158	12.0	188978
106	15.07	115	Bicyclo[4.2.0]octa-1,3,5-triene, 7-(3-butenyl)-	$C_{12}H_{14}$	158	10.5	161770
107	15.28	156	Sulfone, methyl 4-methylene-2-phenylcyclopentyl	$C_{13}H_{16}O_2S$	236	18.0	150803
108	15.37	167	Diphenylmethane	$C_{13}H_{12}$	168	57.5	114004
109	15.58	91	(2-Nitrocyclohexyl)-benzene	$C_{12}H_{15}NO_2$	205	47.9	192444

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110	15.68	117	Tricyclo[6.4.0.0(3,7)]dodeca-1,9,11-triene	$C_{12}H_{14}$	158	13.4	298964
111	15.94	91	(4-Methyl-1-methylenepent-4-enyl)benzene	$C_{13}H_{16}$	172	9.62	210729
112	16.01	57	Tetradecane	$C_{14}H_{30}$	198	12.8	113925
113	16.08	167	Benzene, 1,1'-ethylidenebis-	$C_{14}H_{14}$	182	28.9	22224
114	16.26	153	Naphthalene, 1-isocyano-	$C_{11}H_7N$	153	64.2	4954
115	16.42	117	5-Chloro-1-phenyl-1-pentene	$C_{11}H_{13}Cl$	180	15.1	217213
116	16.93	91	2-Pentenoic acid, 3-methyl-5-phenyl-, ethyl ester	$C_{14}H_{18}O_2$	218	34.0	188252
117	17.15	41	Trichloroacetic acid, hexadecyl ester	$C_{18}H_{33}Cl_3O_2$	386	2.98	280518
118	18.15	92	Benzene, 1,1'-(1,3-propanediyl)bis-	$C_{15}H_{16}$	196	93.3	133399
119	18.43	105	Benzene, 1,1'-(1-methyl-1,3-propanediyl)bis-	$C_{16}H_{18}$	210	92.1	149665
120	18.86	91	Naphthalene, 1,2,3,4-tetrahydro-2-phenyl-	$C_{16}H_{16}$	208	28.5	9510
121	19.04	194	1,2-Diphenylcyclopropane	$C_{15}H_{14}$	194	55.2	135351
122	19.26	91	Benzene, 1,1'-(1,4-butanediyl)bis-	$C_{16}H_{18}$	210	91.2	118778
123	19.72	115	Benzene, 1,1'-(3-methyl-1-propene-1,3-diyl)bis-	$C_{16}H_{16}$	208	48.6	9505
124	20.43	91	Benzene, 1,1'-(1-ethyl-1,3-propanediyl)bis-	$C_{17}H_{20}$	224	63.8	149667
125	20.57	41	Hexadecanenitrile	$C_{16}H_{31}N$	237	31.3	72104
126	20.66	105	Benzene, 1,1'-(1,4-dimethyl-1,4-butanediyl)bis-	$C_{18}H_{22}$	238	58.4	62594
127	22.59	57	Octadecanenitrile	$C_{18}H_{35}N$	265	32.9	12861
128	22.98	91	(1-Benzyl-2-O-tolyl-ethyl)-isonitrile	$C_{17}H_{17}N$	235	49.3	287385
129	24.98	44	Tricyclo[10.2.2.2(5,8)]octadeca-5,7,12,14,15,17-hexaene-6-carbonitrile	$C_{19}H_{19}N$	261	14.6	12671
130	26.03	255	Acridine, 9-phenyl-	$C_{19}H_{13}N$	255	42.8	271959
131	26.79	44	3-(4,8,12-Trimethyltridecyl) furan	$C_{20}H_{36}O$	292	58.6	245551
132	27.81	44	1,1':2',1'':4'',1'''-Quaterphenyl	$C_{24}H_{18}$	306	70.0	14545

Electronic waste plastic to liquid fuel was analysis (Figure 3 and Table 1) using Perkin Elmer Gas Chromatography and Mass Spectrometer (GC/MS). GC/MS chromatogram analysis result showed produce fuel has carbon chain range C_3H_6 to $C_{24}H_{18}$. From GC/MS chromatogram to all compounds was detected based on retention time and traces mass. Compounds was detected from chromatogram to hydrocarbon compounds, alcoholic compounds, oxygen containing compounds, nitrogen containing compounds, halogenated compounds and aromatic group compounds. In this section some compounds are elaborated from table 1 based on their retention time, trace mass, molecular weight and compounds probability percentage. Electronic waste plastic has chlorine compounds and different kind of metals which is harmful for human body. Electronics waste plastic to fuel initial compound

showed Propene (C_3H_6) (t=1.49, m/z=41) compound molecular weight is 42 and compound probability percentage is 40.9 %, final compound was 1, 1':2', 1'':4'', 1'''-Quaterphenyl ($C_{24}H_{18}$) (t=27.81, m/z=44) compound molecular weight is 306 and compound probability percentage is 70.0 %, then some compounds are detected based on retention time as followed such as 2-Methyl-2-vinyloxirane (C_5H_8O) (t=1.61, m/z=43) compound molecular weight is 84 and compound probability percentage is 22.3%, 2-Propenenitrile (C_3H_3N) (t=2.01, m/z=53) compound molecular weight is 53 and compound probability percentage is 98.1%, Benzene (C_6H_6) (t=3.24, m/z=78) compound molecular weight is 78 and compound probability percentage is 65.6%, 4,4-dimethyl-2-Pentyne (C_7H_{12}) (t=3.75, m/z=81) compound molecular weight is 96 and compound probability percentage is 16.2%, 2-Pentenenitrile (C_5H_7N) (t=4.23, m/z=54) compound molecular weight is 81 and compound probability percentage is 50.4%, ethylidene-Cyclopentane (C_7H_{12}) (t=4.58, m/z=67) compound molecular weight is 96 and compound probability percentage is 28.6%, Toluene (C_7H_8) (t=4.80, m/z=91) compound molecular weight is 92 and compound probability percentage is 56.1%, Octane (C_8H_{18}) (t=5.27, m/z=43) compound molecular weight is 114 and compound probability percentage is 47.1%, hexamethyl-Cyclotrisiloxane ($C_6H_{18}O_3Si_3$) (t=5.45, m/z=207) compound molecular weight is 222 and compound probability percentage is 92.5%, 3-ethyl-1,4-Hexadiene (C_8H_{14}) (t=5.90, m/z=81) compound molecular weight is 110 and compound probability percentage is 19.6 %, Ethylbenzene (C_8H_{10}) (t=6.43, m/z=91) compound molecular weight is 106 and compound probability percentage is 53.2%, Styrene (C_8H_8) (t=7.00, m/z=104) compound molecular weight is 104 and compound probability percentage is 40.4%, Deltacyclene (C_9H_{10}) (t=7.86, m/z=117) compound molecular weight is 118 and compound probability percentage is 15.0 %, Butanedinitrile ($C_4H_4N_2$) (t=8.22, m/z=53) compound molecular weight is 80 and compound probability percentage is 96.9%, α-Methylstyrene (C_9H_{10}) (t=8.52, m/z=117) compound molecular weight is 118 and compound probability percentage is 32.8 %, 2-propenyl- Benzene (C_9H_{10}) (t=9.25, m/z=117) compound molecular weight is 118 and compound probability percentage is 20.6%, 2-methyl- Pentanedinitrile ($C_6H_8N_2$) (t=9.92, m/z=68) compound molecular weight is 108 and compound probability percentage is 69.6%, Undecane ($C_{11}H_{24}$) (t=10.35, m/z=57) compound molecular weight is 156 and compound probability percentage is 5.26%, 4-(1-methylethenyl)- 1-Cyclohexene-1-methanol ($C_{10}H_{16}O$) (t=10.52, m/z=117) compound molecular weight is 152 and compound probability percentage is 9.15%, 1-ethyl-2-propenyl- Benzene ($C_{11}H_{14}$) (t=11.10, m/z=118) compound molecular weight is 146 and compound probability percentage is 46.0%, 17α-hydroxy-17β-cyano- Preg-4-en-3-one ($C_{20}H_{27}NO_2$) (t=11.60, m/z=41) compound molecular weight is 313 and compound probability percentage is 8.77%, 2-Naphthalenol, 1,2-dihydro-, acetate ($C_{12}H_{12}O_2$) (t=11.93, m/z=128) compound molecular weight is 188 and compound probability percentage is 33.6%, cyclopentyl- Benzene ($C_{11}H_{14}$) (t=12.44, m/z=117) compound molecular weight is 146 and compound probability percentage is 44.1%, 1-Benzyl-cyclopropyl-methanol ($C_{11}H_{14}O$) (t=12.99, m/z=91) compound molecular weight is 162 and compound probability percentage is 13.8%, Benzenebutanenitrile ($C_{10}H_{11}N$) (t=14.07, m/z=91) compound molecular weight is 145

and compound probability percentage is 94.2%, 1-(phenylmethyl)-1H-Pyrrole ($C_{11}H_{11}N$) (t=14.82, m/z=91) compound molecular weight is 157 and compound probability percentage is 37.2 %, methyl 4-methylene-2-phenylcyclopentyl Sulfone ($C_{13}H_{16}O_2S$) (t=15.28, m/z=156) compound molecular weight is 236 and compound probability percentage is 18.0%, Tetradecane ($C_{14}H_{30}$) (t=16.01, m/z=57) compound molecular weight is 198 and compound probability percentage is 12.8 %, bis-1,1'-(1,3-propanediyl) Benzene ($C_{15}H_{16}$) (t=18.15, m/z=92) compound molecular weight is 196 and compound probability percentage is 93.3%, bis-1,1'-(1,4-butanediyl) Benzene ($C_{16}H_{18}$) (t=19.26, m/z=91) compound molecular weight is 210 and compound probability percentage is 91.2%, Hexadecanenitrile ($C_{16}H_{31}N$) (t=20.57, m/z=41) compound molecular weight is 237 and compound probability percentage is 31.3%, (1-Benzyl-2-O-tolyl-ethyl)-isonitrile ($C_{17}H_{17}N$) (t=22.98, m/z=91) compound molecular weight is 235 and compound probability percentage is 49.3 %, 9-phenyl- Acridine ($C_{19}H_{13}N$) (t=26.03, m/z=255) compound molecular weight is 255 and compound probability percentage is 42.8%, 3-(4,8,12-Trimethyltridecyl) furan ($C_{20}H_{36}O$) (t=26.79, m/z=44) compound molecular weight is 292 and compound probability percentage is 58.6 % respectively. In this analysis result showed furan compound has present fuel which is very harmful for human body for that reason fuel need to be more modification by using feed stock refinery process. During fuel production process also generated hydrochloric acid and HBr etc. Although ZnO catalyst was use for experiment and reduce chlorine content from electron9ic waste plastic to fuel production process. This can use only for petroleum refinery for feed stock and produce potential energy for internal combustion engines.

CONCLUSION

Electronic waste plastic to fuel production process 10% ZnO catalyst and 10%activated carbon was use. Fuel production temperature range was 200-400 ºC and an initial raw material was computer body plastic part. Fuel density is 0.88 gm/ ml and fuel color was light yellow and fuel was little thick. Electronic waste plastic to fuel production conversion rate was 77.6% including light gas and solid black residue was 22.4%. Produce fuel analysis result showed aromatic group compounds and nitrogen containing compounds percentage higher than other compounds. Aromatic group compounds are Benzene, Toluene, Ethylbenzene, Styrene, α-Methylstyrene, Benzene, 2-propenyl-, Benzene, (2-methyl-2-propenyl)-, Benzene, 1-methyl-4-(2-propenyl)-, Benzene, cyclopentyl-, Benzene, 1-cyclopenten-1-yl-, Naphthalene-1,4-diol, 4-O-benzoyl(ether), Benzene, 1,1'-ethylidenebis-, Naphthalene, 1,2,3,4-tetrahydro-2-phenyl-, Benzene, 1,1'-(1,4-dimethyl-1,4-butanediyl)bis- etc., and nitrogen containing compounds are Methyl isocyanide, 2-Propenenitrile, Propanenitrile, Isobutyronitrile, 2-Butenenitrile, Butanenitrile, 2-methylene-, 2-Pentenenitrile, Methallyl cyanide, Pentanedinitrile, 2-methyl-, Benzeneacetonitrile, α-methyl-, Benzenepropanenitrile, 2-Propenenitrile, 3-phenyl-, (E)-, Benzenebutanenitrile, 1H-Pyrrole, 1-(phenylmethyl)-, Naphthalene, 1-isocyano-, Tricyclo[10.2.2.2(5,8)]octadeca-5,7,12,14,15,17-hexaene-6-carbonitrile and so on. Electronic waste plastic to fuel production process can convert all e-waste to liquid fuel using ZnO catalyst with activated carbon. By using this technology e-waste problem can be solved and save the

environmental e-waste problem and create potential energy for next generation. Fuel can be use for electricity generation or feed stock for petroleum refinery process.

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