

# A REVIEW ON PRODUCTION OF THE FUEL BY CATALYTIC CONVERSION OF WASTE PLASTIC

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## Abstract:

The modern world has shaped through materials but its far-reaching negative impact on our environment cannot be disregarded. There have been many moves and methods taken to minimize the negative impact of plastic waste. One appropriate way among these is to minimize the impact of plastic waste by keeping in mind the continued depletion of fossil fuel. Waste plastic has been turned successfully into jet fuel and hydrogen-enriched gases. Different types of catalysts such as Zeolite, HZSM-5, magnesium carbonate, copper carbonate have been reviewed. For the production of fuel through various types of plastic pyrolysis and currently activated carbon has produced very good quality jet fuel from LDPE plastic. It has been reviewed in this paper that the highest and best quality fuel is obtained by selecting the reactor of the catalyst by proximate analysis of plastics. We have done a comprehensive study of several reactor performance for LDPE plastic pyrolysis. From the literature thermal pyrolysis catalytic temperature and reactor type to simulate the use of a good reactor model to achieve maximum jet fuel and hydrogen gas efficiency with activated carbon catalyst.

*Keywords: Plastic waste, Catalyst, Activated carbon, Reactor, Pyrolysis, Jet fuel, Hydrogen gas*

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## 1. Introduction

Plastic is an exceptionally fast-lasting, long lasting, molecular weight material, with a lot of tensile strength that was discovered in 1862 by Alexander Parkes [1]. Every year plastic is evolved worldwide about 280 million tonnes, of which more than half are not recycled or buried in landfill, exposing that over 100 million tonnes per annum remain to litter continents and ocean. One of the major concerns use for extensive of the plastics is the disposal of the waste plastic. The first in Bangladesh plastic

industry begins with a small industry 1960's. There are currently 3000 plastic production units, 98% of them Small-Medium Enterprises (SMEs) [2]. The total current consumption in FY 2010-2011 of polymers and recycled plastic residues including imported polymers is 750,000 tons [3]. Around 34–40 million tons of sewage sludge was produced in China, for example, in 2015 [4,5] and it is predicted that in 2020 it will reach more than 60 million tons [6,7]. In particular, recurring sludge treatment expenses account for almost 50 % of the overall wastewater treatment process cost [8,9]. Just 24% of

urban waste is recycled and 9% composted, with a total of just 33% of recovered waste [2].

Plastic waste can be classified as industrial and municipal plastic waste by source depending on different properties and characteristics and different management strategies [10,11]. PP, PET, PS, PVC, LDPE and HDPE are the six types of plastics available worldwide. Environmental pollution mainly due to plastics must prevent water and land pollution. Plastic pollution exists all over the world. Even most of the waste floating in seawater is plastic waste and these are spread over many square miles. These plastic wastes floating in seawater need to be removed immediately or they could cause serious damage to the ecosystem. A lot of space is needed to store reusable plastics so vast lands are being depleted very quickly. Converting reusable plastics into new plastics is a landmark step, as it saves 85% of the total cost of producing new plastics. Petroleum and other fossil fuels are also available from this plastic. It is not only the plastic that is transformed but also to protect the environment and the organism from deadly damage. But it will be possible to protect the environment if there is a need for efficient conversion methods and thermal systems.

The chemical recycling process is the most important for the use of plastic serotonin. Other polymers, such as polymethyl methacrylate (PMMA), cannot be recycled into monomers by simple chemical methods (e.g. poly (ethylene terephthalate) (PET)) as compared to condensation polymer [12]. Various mechanisms have been identified in the literature for the depolymerization of PMMA and thermal-chemical methods of recycling, such as pyrolysis, are also used [13-19]. According to the previous studies [20-23], catalytic pyrolysis can be a promising method for converting plastics into high quality biofuels. Thus diesel, petrol, or jet fuel can be produced according to the target by selecting a suitable catalyst accordingly.

Catalyst pyrolysis can lower the reaction temperature, thus reducing the energy consumption of the whole process [24,25]. Thus, the use of suitable catalysts for plastic catalyst pyrolysis is indispensable, which not only maximizes the production of target products, but also reduces energy consumption and contributes to

environmental protection. Many catalytic converter and base catalysts, including solid acid catalysts (zeolites, activated carbon, etc.) have recently been used and studied in the catalytic transformation of waste plastic catalysts [26]. Plastic are recycle by pyrolysis method by using better catalyst and initiator and getting pure gas and oil. Simple pyrolysis product fuel has a lot of problem. Because product has lot of impurity such as; Wax, acidic compound, aluminum, aromatic and different aromatic compound. This impurity creating knocking in a machine and decreasing efficiency of fuel. Many catalytic converters, including solid acid catalysts (zeolites, activated carbon etc.) and base catalysts have recently been used and studied in the catalytic conversion of waste plastics [27].

Many research papers have been published regarding the potential of various types of plastics in pyrolysis process for liquid fuel production. The product yield and quality depends heavily on the parameters set up [2]. Identify and choosing the better catalyst and reactor for producing oil and gaseous products from waste plastic. The four tray distillations including the Bubble cap plate column provide better separating for such liquid fuel [19]. Recent research for applying fixed bed reactor with activated carbon getting a better quality liquid fuel (jet fuel) and hydrogen gas (cannot modify) [28]. Also choosing a better reactor for production of jet fuel and hydrogen gas which getting maximum production of fuel and environment friendly.

## 2. Materials and methods

### *Pyrolysis of plastics*

Fundamentally, different type of plastics have different compositions that normally reported in terms of their proximate analysis. Proximate analysis can be characterized as a technique for measuring the plastic compound's chemical properties based on four specific elements: moisture content, fixed carbon, volatile matter and ash content [3]. The high carbon content of char makes it suitable as solid fuel or as an adsorbent for many applications [29]. A reasonably high ash content and a low volatile feedstock content often produce a high char content when pyrolyzed [20]. Table 1 summarized the

proximate analysis of different plastic. Based on table 1, the volatile material was found to be very high for all plastics, while the ash content was considered low [2]. These characteristics indicate that plastics have high potential to produce large amount of liquid oil through pyrolysis process.

Table 1

Proximate analysis of plastic [30]

Type of plastic (wt. %) Ref.	Moisture (wt. %)	Fixed carbon (wt. %)	Volatile (wt. %)	Ash
PP [30]	0.15	1.22	95.08	3.55
[12]	0.18	0.16	97.85	1.99
PE [30]	0.10	0.04	98.87	0.99
PET [13]	0.46	7.77	91.75	0.02
[12]	0.61	13.71	86.83	0.00
HDPE [14]	0.00	0.01	99.81	0.81
[12]	0.00	0.03	98.57	1.40
LDPE [15]	0.30	0.00	99.70	0.00
[16]	-	-	99.60	0.40
PVC [17]	0.80	6.30	93.70	0.00
[14]	0.74	5.19	94.82	0.00

The processing of LDPE waste plastic from daily waste, consisting primarily of water containers, milk bottles and plastic bags. Such waste plastics contain mainly polystyrene (PS) and polyethylene (PE), polypropylene (PP) and polyethylene terephthalate (PET) as their composition was estimated.

Physical separation of the thermal degradation and catalyst cracking stages supports the cracking reactions of pyrolytic volatiles and the subsequent splitting between catalysts and solid residues pyrolysis, the ex-situ catalytic pyrolysis of the reactant with activated carbon catalysts was performed in a common fixed-bed tube reactor [28].

Fixed loading of feedstock (2g) was placed in the quartz tube with the quartz wool at both ends of the sample. Activated carbon catalyst was also loaded in the same way in the tube. The catalyst to feedstock ratio was set to 0.6, 1.3, 1.5, 2, 2.5, and 2.71. Followed by the nitrogen gas flow direction, the sample came first then followed with activated carbon. The tube furnace (Thermal Scientific) was heated to the target temperature (430, 450, 500, 550 and 571°C, respectively) and then the quartz tube was transferred to the furnace [28].

### 3. Thermal pyrolysis characterization

A high energy, endothermic cycle that needs at least 350–500 8C temperature is the non-catalytic or thermal pyrolysis of polyolefins [31–33]. Temperatures up to 700–900 8C are indispensable to decent product output in some studies [22,34,35]. Thermal pyrolysis of both virgin and waste plastics as well as other hydro-carbonaceous sources has been studied extensively in the past. Many of the thermal cracking studies have involved polyethylene [31,36–44,45–50], polystyrene [33,36–40] and polypropylene [32,37,38,41–55]. On the contrary, only a few have been working with thermal decomposition of other common plastics, for example polyvinylchloride [56,57], polymethyl methacrylate [45], polyurethane [58] and polyethylene terephthalate [57]. Thermal cracking typically results in low octane value fluids and a higher degree of residues contents at medium temperatures, rendering the manufacture of gasoline fuel efficient [39,52]. Thermal pyrolysis gaseous products are not appropriate for use as fuel products, which require further processing to become fuel products [59], [60]. Several scientists have been working to improve the thermal pyrolysis without using catalysts, but these changes have either led to minor improvements or have added a new level of complexity and costs [52,61].

### 4. Catalytic characterization

Two types of catalysts (only one phase) are homogeneous and heterogeneous (more than one phase). Usually classical Lewis acid such as AlCl<sub>3</sub> was a homogeneous catalyst used for polyolefin

pyrolysis [62,63]. However the most common type of catalyst used is heterogeneous as the mixture of fluid products can be easily separated from the solid catalyst. Hence, heterogeneous catalyst is economically preferable because various catalysts are quite costly and their reuse is demanded. It is possible to classify heterogeneous catalyst as nano-crystalline zeolites, traditional solid acid, meso-structured catalyst, carbon-supported metal and basic oxides [64]. Some examples of nano-crystalline zeolites are HZSM-5, HUSY, Hb and HMOR which are extensively used in the researches of plastic pyrolysis. Besides, the non-zeolites catalysts such as silica–alumina, MCM-41 and silicalite have also received much attention in current researches.

Activated carbon characterization is generally driven by the need for qualitative and quantitative facts, which serve as the basis for parallelism and activated carbon selection for a precise application. It is commonly understood that certain role groups like –C=O and –OH are typically for med in the time of activated carbon processing and are stated to have a ticklish effect on catalytic efficiency in wastewater treatment and adsorption of gases.

Applying activated carbon are mainly four type for catalytic pyrolysis of plastic. Here mainly two type activated carbon (CAC2 and CAC5) performance showing for pyrolysis of LDPE type plastic. At 500 °C, CAC5 with fixed-bed reactor output is the maximum production of hydrogen than CAC2, produced by 500 °C CAC2 catalyst with a high volume of jet fuel hydrocarbon [28].

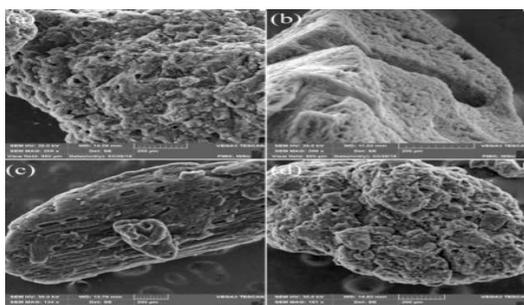


Fig: 1. SEM images of selected commercial activated carbons; (a) CAC2, (b) CAC4, (c) CAC5, and (d) CAC6 [28].

### 5. Performance of Activated Carbon

ACs can be produced extensively from renewable biomass, and a small number of chemical products are needed during activation processes to generate inexpensive, environmentally friendly and effective catalysts for the generation of hydrocarbon fuels from commercially available catalyst pyrolysis [28]. Mainly four type of activated carbon performed for catalytic pyrolysis of waste plastics. AC2 are getting better performed for liquid oil production because of the pore size of AC2 are different from other AC. Also advantage of this catalyst is converted of liquid fuel at a low temperature from other activated carbon. AC2 showed an average performance for producing oil and gas at a 600 °C. But high amount of hydrogen gas production using AC2 catalyst at 600 °C similar with AC5.

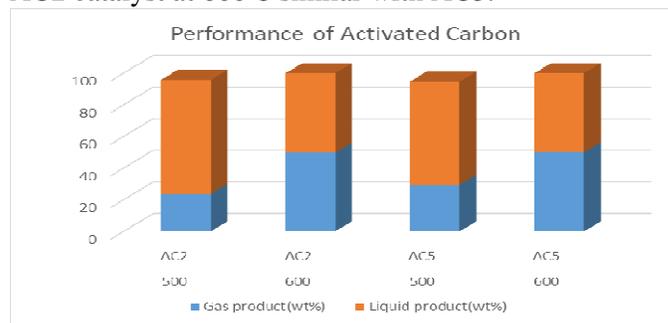


Fig: 2. Performance of Activated Carbon for LDPE plastic

### 6. Performance of different type reactor with LDPE plastic

Catalytic pyrolysis of waste plastic in occurred a reactor and produced different amount of liquid and gaseous products. Different fraction of those products depend on the basis of reactor design. But reactor design for a fixed type of plastic for depend of catalyst for pyrolysis products. The most favorable catalyst choice that is activated carbon but for this type of catalyst using a better design of reactor. Below a graph chart which formed the base of table 2 and getting the help of described that

micro-auto, fluidized bed and fixed bed reactor performance for producing of liquid fuel almost same. The maximum output of jet fuel and even the pure liquid fuel which is no problem in a combustion engine was demonstrated in the use of a fixed bed reactor with activated carbon catalyst [28]. On the other hand of gaseous products are comparatively low percentage produced by using this reactor but getting gaseous products is high expensive as a hydrogen gas.

### **Fixed beds**

Batch mode waste plastic pyrolysis these reactors usually work [65,66]. Once the plastic sample has been loaded, it is heated with a rate between 5 and 25°C min<sup>-1</sup> to a previously defined final temperature. Once the final temperature has been reached the reactor is maintained at this temperature for the required period of time to ensure full degradation of the sample. The quantity of plastic used in each run varies from a few grams to loads greater than 100 g [23,67], or even less than 1 g [68-71]. The operation with higher plastic amounts is severely limited due to the poor heat transfer rates attained in such a large melted plastic masses. The products made from pyrolysis in plastic degradation are typically purged by continuous inert gas flow, so their gas residence time is between a couple of seconds and one minute [68,72-74]. However, other fixed bed reactors are closed vessels throughout the pyrolysis process and the volatiles formed remain in the reactor until reaction end. Products are discharged once the processes have been completed [75-77].

This operating technique leads to a significant amount of secondary reactions due to high occupancy time and partial pressure to the pyrolysis products. Several authors studied catalytic pyrolysis in situ bedding. In fixed beds several authors studied catalytic pyrolysis in situ [23,72,78,79]. The pyrolysis in fixed beds is followed by the in-line cracking of the volatiles provided by plastic in another fixed-bed reactor to improve the efficiency of the catalytic step [65,80,81].

### **Fluidized bed reactors**

In spite of their more complex design and operation, fluidized bed reactors have clear advantages in relation to fixed beds. Fluidized beds are characterized by their high heat and mass transfer rates and solid mixing regime. Moreover, these reactors provide a significant versatility on gas residence time, which is a point of great interest to modify product distribution in the case of pyrolysis, or promote tar cracking in gasification processes by increasing this parameter. Furthermore, fluidized beds may conduct with continuous plastic feed which is important for process scaling up [82]. The mixing regime of the particles and bed isothermicity make fluidized beds a suitable alternative for use of cracking catalysts in situ. Accordingly, fluidized bed reactors have been widely used in the pyrolysis of waste plastics. The pioneering studies applying fluidized beds to the pyrolysis of plastics were carried out by the group headed by Kaminsky in the 1970s. This became effective in the scaling up of many plastics, mixture plastics and other polymeric materials including waste tyres at a level of 30 kg h<sup>-1</sup> [45,83-85]. For the study of thermal pyrolysis of polyolefines Mastral et al. used a fluidized bed reactor on a laboratory scale working under continued regime [34,86]. The method proposed by Jung et al. was to produce BTX in a continuous fluidized bed reactor by high-temperature pyrolysis (650–750°C) [30]. In order to minimize the time of residence and improve light olefins production at high temperatures, Milne et al. used a fluidized circulating bed [87]. Conventional fluidized beds have also been widely used in the catalytic pyrolysis of plastics operating in both continuous [88] and batch regime [89-91]. Notwithstanding the interesting characteristics of fluidised bed reactor, bed defluidization due to the agglomeration of fused plastic-coated particles occurs when the pyrolysis operating conditions are out of limited range [92,93].

### **Spouted beds**

Spouted beds are an alternative to fluidized beds for handling particles of irregular texture, fine particles, and those with a broad size distribution and sticky

solids, whose treatment is difficult using other gas-solid contact regimes.

In addition, spouted beds are distinguished by its vigorous gas-solid contact which increases heat and mass transfer between phases [94], improves solid heating rate and enables bed isothermicity to be achieved. These features enhance the uniform coating of sand particles with fused plastics and the vigorous solid movement of the particles. Accordingly, bed defluidization by agglomeration of particles is avoided even under severe conditions involving very sticky particles. The short gas reactor residence time, reducing secondary reaction, is another important aspect of spout beds for plastic pyrolysis [95,96]. The application of the spouted bed reactor for solid waste pyrolysis has been developed by the research group headed by Olazar. A continuous mode of thermal pyrolysis was investigated in a bench scale plant for various plastics and polymeric materials [95,97-100].

This process has been successfully measured up to 25 kg<sup>h</sup><sup>-1</sup> to achieve biomass pyrolysis [101,102]. The vigorous mixing regime of the solid in spouted beds allows operating with catalysts in situ and, in fact, different catalyst have been tested in the pyrolysis of polyolefins and other polymeric materials [103-106] in a fixed bed reactor downstream the screw kiln. Kodera et al. suggested the method [107] to produce the desired product, which was the gas fuel, at temperatures up to 700°C. An alternative to screw kilns is the simpler rotary kiln, which has been widely used in the pyrolysis of biomass, but scarcely in the pyrolysis of waste plastics [108,109] due to the problems involved in the handling of fused polymers.

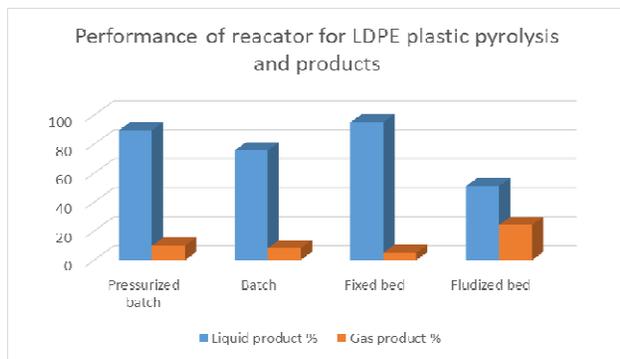
### *Microwave reactors*

Pyrolysis with microwaves is a promising method for achieving an efficient heat transfer in plastic waste across thermal degradation. In addition, this strategy provides quick and selective heating and easy response condition control [110]. Ludlow Palafox and Chase initially examined the microwave assisted plastic pyrolysis [111] in the range from 500 to 700°C. Recently, these authors studied the effect of activated carbon as catalyst in the pyrolysis of HDPE [112]. Zhang et al. [110] researched LDPE

microwave supported pyrolysis, with the pyrolysis vapors cracked on a HZSM-5 zeolite in a fixed bed reactor. Undri et al. [113-115] recently examined the pyrolysis of various polymeric waste aided by the microwave.

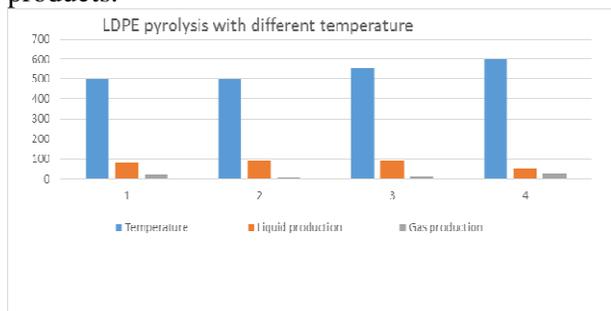
### *Two-stage pyrolysis system*

Despite of the advantages mentioned in the CSBR pyrolysis, the process tends to produce more wax rather than liquid and gaseous products. In order to improve the pyrolysis performance associated with CSBR, a second reactor had been added to the existing reactor by Artetxe et.al. for further cracking of waxes from CSBR. This allowed gases and liquids to be produced with the reported output of other systems [116,117]. In such design, the plastic waste was firstly melted and thermally cracked in the reactor at the bottom, and the vapor formed was then flown upwards and reacted with the catalyst on the fixed bed reactor [118]. Such design avoided the direct contact of the catalysts with melted plastic, which causes several problems: difficulty in catalyst recovery after pyrolysis process, and rapid deactivation of catalyst when contacted with melted plastic, as well as impurities that are present. Conversion of the polymer in such device was based only on the thermal reactor temperature. Complete conversion of LDPE in such system was achieved in 475 °C, together with high liquid yield, with 16% of the product being grouped in light species, while 41% in gasoline fraction, and 40% in diesel fraction [118]. The use of HZSM-5 zeolites in the reactor was able to increase the cracking of gasoline to form more light species, due to the strong acidic sites that caused high rate of cracking. Similar result was also obtained by the work of San et al. [119], which investigated on the sequential pyrolysis and catalytic hydroreforming of waste agricultural films, as well as work by Miskolczi and Buyong [120], who studied on the thermal-catalytic pyrolysis system for refuse-derived-fuel (RDF). These studies demonstrated the feasibility of the two-stage thermo-catalytic reactors for the purpose of polymer pyrolysis to produce liquid products with the desired quality.



### 7. Pyrolysis process with different temperature for LDPE plastic

Mainly pyrolysis process occurred by two way one is temperature base and other is catalyst base. Below this chart expressed that the temperature basis pyrolysis process which is mainly use for LDPE plastics. But this type of method for producing liquid and gaseous products are not pure and not directly use in a combustion engine. Also those products including a huge amount of impurity which are created knocking problem in an engine. In modern method for applying waste plastic pyrolysis considerable mainly temperature, catalyst, quality of products.

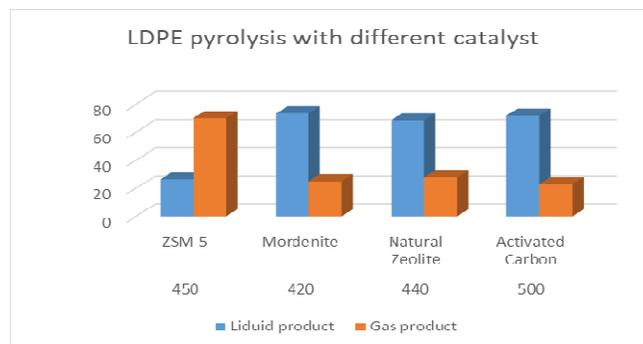


In present one atmosphere applying the heating rate 6 (°C/min), LDPE plastic pyrolysis at 500 °C and the pyrolysis products are 80.4 percent oil and 19.4 percent gas [123]. In a fixed bed reactor as a result (95 percent oil and 5 percent gas) apply heating rate 10 (°C/min) in plastic at the same temperature [81]. The heating rate 5 (°C/min) and result (93.1

percent oil and 14.6 percent gas) apply to a batch reactor of 550 °C [69]. In one atmosphere of pyrolysis state and result (51 percent oil and 24.2 percent gas) in fluidized bed reactor at 600 °C [121].

### 8. Catalytic pyrolysis with different temperature for LDPE plastic

Catalytic pyrolysis for LDPE plastic pyrolysis method are using different temperature for the basis of catalyst getting high quality of fuel products. The graph chart below shows that the mordenite and activated carbon catalyst received the highest amount of liquid products but the performance of mordenite is better than that of activated carbon in terms of temperature. However, due to the development of jet fuel like kerosene, the consistency of the liquid products of the activated carbon catalyst is higher than the mordenite catalyst.



Activated carbon catalyst also help that the improving of fuel quality because almost zero impurity included this products. Applying this catalyst at 600 °C producing gaseous fuel like hydrogen gas which is most effective fuel in energy sector.

### 9. Result and Discussion

The catalytic effect in different type of plastics are totally different and the result of gas and oil production at different temperature. Gaseous fuel are most important role in run an engine. Different type of gaseous fuel conversion by a catalytic pyrolysis method of plastic but most important and effective gaseous product is hydrogen gas. Hydrogen gas are

most expensive gas which is produced by alternative source of waste plastic. Using red mud or ZSM-5 for pyrolysis of waste plastic getting maximum amount of gaseous product but not hydrogen gas. Every catalyst getting a better role for producing gas and liquid product but at economical issue that low temperature and high efficiency fuel producing catalyst selected. Using activated carbon with fixed bed reactor showed better quality of gas and liquid. Here, gaseous product is hydrogen gas which are effective fuel from other gaseous fuel. On the other hand liquid fuel from the catalytic pyrolysis such as, kerosene, gasoline, C8-C16, liquid oil etc. The best role of liquid fuel in combustion engine is kerosene which is mainly use a jet engine as a jet fuel. Using activated carbon as a catalyst for pyrolysis of waste plastic and a result getting jet fuel effectively. AC2 are better catalytic performance of producing jet fuel from other type of activated carbon.

Table: 2

Plastic	Reactor	Catalyst	Temperature (°C)	Gas product Wt (%)	Liquid product wt (%)	Reference
HDP E	FCC	Natural Zeolite	(500 - 800)	(C1-C4) - 30	55	[122]
HDP E,PP	Tube reactor	ZSM-5	520	Paraffin- 40.6	Gasoline- (20-48) Liquid oil- (17-36)	[123]

PE	Scheme of cracking reactor	MgCO <sub>3</sub>	(414 - 480)		53	[124]
Plastic waste	FCC two step pyrolysis	Red mud, ZSM-5	325	70.7	13	[27]
HDP E/LD PE/PP	Micro-auto-clave reactor	AIBN - initiator	440		95	[125]
PP	Fixed bed reactor with distillation bubble cap column refiner	Pyrolysis process at present oxygen	(500 - 650)	(12-15)	(63-83)	[19]
LDPE /HD PE	Fluidized bed	TiCl <sub>4</sub> /MgC <sub>2</sub>	650	6.5	89	[88]

HDP E	Fixe d bed	CuC O3	390	14.7	85	[126 ]
PE	Fixe d bed	USY Zeoli te	450	26.8	71.0	[127 ]
LDPE	Stirr ed react or	mor deni te	420	25.8	31.3	[128 ]
LDPE /HD PE	Spou ted bed	HZS M-5	500	74	25	[129 ]
LDPE	Fixe d bed	AC2	500	23.7 H2- 23.7 vol%	72 (C8- C16)	[28]
LDPE	Fixe d bed	AC5	500	29.5 H2- 71.2 vol%	65.1 (C8- C16)	[28]
WPs	Fixe d bed	AC2	600	47.7 H2- 51.7 Vol%	50.1 7 (C8- C16)	[28]

plastic waste is constantly increasing which is highly harmful and has been converted into very useful biojet fuel by reducing the amount of damage. As evidenced by this, the International Air Transport Association (IATA) has identified the development of renewable aviation fuels known as biojet fuel as the most effective measure to reduce the environmental problems of airports. As plastics pose a serious threat to the environment, in the future these are biojet fuel foresight plans to eliminate plastic waste. In the context of the future where petroleum is no longer available, conventional refineries could convert biojet fuel from plastic waste and reduce investment costs using existing infrastructure. Thermochemical system that converts biomass as pyrolysis and gasification operations are used is a big challenge to reduce energy consumption. This requires removing restrictions on the use of vegetable oils to reduce management and capital costs. The efficiency of fixed bed reactors needs to be increased so as to increase the comparative percentage production of gaseous products as it is imperative to improve the efficiency of high cost and catalytic measures such as hydrogen gas found in gaseous products. Improving the interaction of feedstock and catalysts in converting plastic waste into biojet fuel and the correct selection of catalysts require vital improvements as in most cases catalyst pyrolysis increases production costs due to temperature. One issue is that if plastic waste is used to produce raw materials for any, the issue of response to climate is under consideration. To directly produce biojet fuel the energy cost of the oil extraction process must be reduced as at present the total processing cost represents the most important of the biojet fuel. Further efforts will need to focus mainly on developing more efficient catalysts to perform plastic catalysts in jet fuel production. In the case of making good quality fuel, just as it is necessary to select a good catalyst, it is also necessary to use a good reactor supported by that catalyst. Selection of reactors is very important for production cost and good quality fuel. Efforts to develop advanced photocatalysts to produce long-chain hydrocarbons should be given more importance so that it can ultimately directly contribute to the production of biojet fuel. Finally,

**10. Future prospects and outlook**

As the world continues to run out of energy sources, the source of any alternative fuels carries future considerations and significance. And if it is a profitable, sustainable and used source, the long-term impact will be widespread in the future. The conversion of biojet fuel from plastic waste can be such a source because, in the environment, unused

the environmental impact can be minimized by addressing the full use of raw materials to produce biojet fuel with existing technologies. From the overall review, it is available that biojet fuel from plastic waste will be a potential source of future energy, fuel means safety, environmentally friendly, accessibility and profitable partner.

### Conclusion

In this study, catalytic cracking of the hydrocarbon polymers like LDPE was investigated both theoretically and experimentally in a lab-scale reactor for maximizing the diesel, gasoline, jet fuel and hydrogen products. More competitive biofuels require both technological and economic goals to meet and ensure the sustainable development of the aviation sector and the production process of saturated biojet fuel. We show that different types of plastic pyrolysis process are happened by different catalyst and reactor produced various grate product of fuel and oils. But the applying activated carbon which given maximum liquid fuel like jet fuel and hydrogen gas using fixed bed reactor. This catalyst produced liquid and gas is pure and getting different type products also the help of four tray distillation including Bubble cap plate column which is separated different fuel about their related boiling point and absorb acidic and toxic compound in vacuum condition. Using this method we get higher quality of liquid and hydrogen fuel which contributed plastic must be recycle and reduced pollution in environment.

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