Zeolite Catalyst from Agricultural Wastes for Aviation Fuel Production from Wastes: A review

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Abstract

Zeolite is a flexible and essential material for the climate that can be manufactured using inorganic wastes such as natural clay, fly ash, and ash of rice husk, Aviation fuel production derived environmental waste which includes the following major waste are covered in this review which are triglyceride-containing sources of biomass, Lignocellulosic sources of biomass and Starchy and Sugar sources of biomass. the different synthesis methods of Zeolite which include the Conventional methodology, Conventional Synthesis from Industrial Wastes, Synthesis in situ from Wastes of Industry, Synthesis of Industrial Wastes with the Aid of Microwaves, Synthesis of Agricultural Wastes in-Situ and, Synthesis of Agricultural Wastes with the Use of Microwaves are investigated also.

Keywords: Zeolite, Catalyst, Deoxygenation, biofuel

Introduction

Flying achieved the biggest request average in the transmission section in the last years. Guesses of international federation ITAT for air transport indicated the number of passengers may be getting high in the 2037 year for 8200 M. and this means the future two decades the flying will reach growth average of yearly as 3.5%[1].

as a result, CO2 rebirth and fuel using will be increased. Strategies, including the production of renewable fuels, have been suggested to ensure the Renewable development of the flying section. (ICAO) and (IATA) have agreed the renewable flying fuels are the main contributors to the flying section's long-term viability. Fuel extracted from fossil fuels consisting of hydrocarbons, including naphthenic, paraffinic, and aromatic compounds. Renewable flying fuels contain paraffinic and naphthenic compounds ,but still might not contain active oils, depending on the route of treatment.

The lack of organic hydrocarbons can lead to a leak in the tank as the aromatic compound needs to react with the polymers in the fuel tank. As a result, the use of renewable jet fuel in conjunction with fossil jet fuel is needed , with a maximum renewable fuel formation of 50%, in accordance with the ASTM standard[2].

Renewable flying fuel furthermore called bio-jet fuel, Organic glycerine jet fuel, or biokerosene; and it can be generated from triglyceride, lignocellulosic, sugar, and starchy feedstock. The feedstock is
transformed into bio-jet fuel through different pathways, which include hydroprocessing of triglyceride feedstock, thermochemical processing of biomass, and alcohol-to-jet[3]. The alternative is to use the raw materials of the waste available at a low cost; on the contrary, some of them cause environmental pollution problems due to the large quantities generated therein[4]. The process of biofuel production usually using zeolite catalyst. Therefore, the first focus of the present review based on use of raw products that have been discarded to create bio-jet fuel. Second objective is the utilizing inorganic waste, traditional, in-situ, and microwave methods to synthesize zeolites.

1. Zeolite Catalyst

Zeolite is molecular of aluminosilicate has a uniform pore, the structure is crystalline which contain silicon oxide, aluminium in their shape; water and cation are found in the pores. after the deposition of environments, Natural zeolites are crystallized For a while, from thousands to thousands, shore basins that are shallow for millions years. A few examples of environmental zeolites include stilbite, analcime, heulandite. In rare cases, natural zeolite is 100 per cent pure. Many industrial applications requiring purity avoid naturally occurring zeolites. Zeolites are made from silica and alumina-containing materials. All of this is beneficial to company zeolites.owe.their importance adsorption, ion exchange, and catalysis are only a few examples of properties are referred to as adsorption. Due to its structure the zeolite can absorb a variety of metallic materials, such as K⁺, Mg²⁺, Na⁺, etc. To decrease costs.

Low-cost raw materials of zeolite synthesis are the subject of researchers. Industrial residues, such as sludge of paper, flying ash, waste of porcelain, slag of Lithium, residues of waste metallic, agro waste from the rice industry, kaolin waste, etc, was working as the zeolite's starting materials manufacturing. These waste products produce a great deal of environmental hazard when deposited in garbage dumps and polluted waters, like lakes, as they contain harmful discharges from the manufacturing industry[5].

2. Sources of Waste Biomass

Three primary waste feedstocks exist:

1. Materials containing triglycerides.
2. lignocellulosic.
3. Starchy and sugar.

As shown in Figure (2.1):

Using various processing methods, Bio-jet fuel can be made from any of these feedstocks[4]. In addition, the key problems encountered in these development processes are analyzed and potential challenges are analyzed. Trends in research are discussed in the next subsections.
2.1 triglyceride-containing sources of biomass

Fats of animal, wastes of cooking oils, and oils derived from agricultural industries, among others, are among the most important waste materials for triglycerides. Due to the large quantities of generation from the residential sectors and food industries, which ultimately contribute to environmental contamination, fats are a major concern, and the greatest risk that exists is to remove them in incorrect ways[4]. Bio-jet fuel is made by removing oxygen from waste triglyceride feedstocks and cracking them.

The conversion of agricultural waste into liquid fuel has been studied by Charusiri et al. In 2006, using different catalysts such as HZSM-5 Hybrid, HZSM-5. Their experimentation were successful conducted under conditions represented by a temperature ranging between 380-430 °C and a pressure of 10-20 bars of hydrogen in the reactor of its type batch- microreactor, during a time duration varying from 45 to 90 minutes, the products were obtained, mostly liquids (represented by kerosene and benzene), gases and small quantities of solid material. Cooking oil waste has a high degree of acidity (28.7 mg KOH/g oil). Turns to diesel by hydrocracking using a ruthenium catalyst. The ability to crack diesel fuel and turn it into bio-jet fuel is one of its advantages[4].
I.H. Choi et al. have succeeded in streamlining the procedure and a reduction in energy and hydrogen consumption by conducting a study in which three processes (deoxygenation, isomerization, and cracking) are combined in one stage to obtain bio-jet fuel. As this process requires a quantity of waste oil with an estimated volume of 300-420 m3. This research includes a raw material in the form of a Pd catalyst, as well as B zeolite as a helper. Soybean waste and fatty acid distillate have been used to create zeolite[4].

In addition, the role suggested by Hanafi et al. relating to extraction of the hydrocarbons as well as naphtha and light gases since in one reactor, fatty acids are deoxygenated and broken, Jet fuel's boiling point spectrum is significant because it allows for smaller investment costs[4].

The study reported the advent of aeronautical fuel production in a single-stage process by Zhang et al. using animal fat as a starting point and a catalyst represented In a small reactor running at high pressure, Pt/SAPO-11 was used. The best choice, according to their findings, is operating conditions for the production of a larger quantity of C8-C16 hydrocarbons have a pressure of 4 MPa, 1000 mL/mL and 400 °C. Under these circumstances, There is a transformation of 96.6 per cent and a selectivity of 50.25 per cent to C8-C16 hydrocarbons with a selectivity of 35.68 per cent for their corresponding isomers[4].

To sum it up, Table 2.1 The study includes papers in which wasted triglyceride feedstock has been used to make bio-jet fuel.
| Raw material         | Pressure | Temperature (°C) | Reactor type | Catalyst                          | Yield                                                                 | Hydrogen requirement | References |
|----------------------|----------|------------------|--------------|-----------------------------------|-----------------------------------------------------------------------|----------------------|------------|
| Bio-oils             | 5 MPa    | 573              | Nantong Huaxing Petroleum | Ni/ZrO2                            | Hydrocarbon: 81.6; diesel-biojet fuel: 90; gasoline: 7                | Not mentioned        | [6]        |
| Waste Chicken        | 60 atm   | 400              | Fixed-bed    | NiW/SiO2-Al2O3                     | Total conversion: 94; selectivity to kerosene: 40                    | 450 v/v, H2/oil      | [7]        |
| Animal Fats          | 1 atm    | 500 (first stage); 520 (second stage) | TSRFCC*      | CORH LTB-2                        | LPG: 47; liquid total: 77.6                                          | Not mentioned        | [8]        |
| Waste cooking oil    | Not mentioned | 400–500       | Semi-batch   | Zirconia oxide (ZrO2)             | Liquid organic product: 83                                          | Not mentioned        | [9]        |
| Non used oil         | 13 789.5 kPa | 350–370        | Fixed bed    | DMDS** TBA***                     | Waste oil: 20.04; fresh                                             | 1068nm3/m3 H2/oil    | [10]       |
| Waste vegetable oil  | 10–20 bar | 380–430         | Batch micro-reactor | Sulfated Zirconia (HZSM-5); Hybrid catalyst (HZSM-5) | Gas oil: 6.5; gasoline: 26.57; kerosene: 10.65; light gases: 23.62; residues: 12.88 | Not mentioned        | [11]       |

Table 2.1 (Outline of using triglyceride waste for the production of biofuel).
| Animal Fat | 4MPa | 400 | Micro-reactor | Pt/SAPO-11 | Conversion: 96.6; selectivity C8-C16: 50.25; isomers: 35.68 | 1000 ml H2/ml oil | [12] |
|------------|------|----|--------------|------------|-------------------------------------------------|-----------------|-----|
| n-hexadecane | 500 psig; pressure drop 73 psig | 300–400 | Trickle bed continuous | Tungstated zirconia (8% w) | Iso-hexadecane: 87 | Not mentioned | [13] |
| n-dodecane | 6.0MPa | 480 | Not mentioned | Pt/ZSM-22 unmodified Pt/ZSM-22 modified | Unmodified ZSM-22 showed low activity. Modified ZSM-22: 88.0 | H2/n-C12 = 600:1 | [14] |
| n-heptane | 20 bar | 160 | Batch | Pt doped on gamma alumina | n-hexane: 85; | Not mentioned | [15] |
| n-hexatriacontane | 2–13.1 MPa | 345–380 | Stirred microautoclave | silica-alumina (MSA/E) | iso-hexatriacontane: 39–32 | Not mentioned | [16] |
| n-Hexadecane | 5MPa | 320–360 | Pressure fixed bed microreactor | AISBA-15 | Conversion to iso-C16: 61 | H2:CH = 350 NTP m3/m3 | [17] |
| n-octane | 2.0MPa | 548 | Not mentioned | Platinum | n-Hexane: 52; n-octane: 27 | 24 H2/n-C6 | [18] |
| Substance       | Pressure/Temp | Reaction Type | Catalyst/Reactor | Conversion/Selectivity | Conversion/Selectivity Details | Reference |
|-----------------|---------------|---------------|------------------|------------------------|--------------------------------|-----------|
| Non-edible oil  | 15 bar, 270   | Not mentioned| Pd/beta-zeolite  | Biojet fuel: 40%       | 300–420 m3H2/m3 oil             | [19]      |
| n-Hexadecane    | 160 psig, 218 | Trickle bed   | Pt/WO3/ZrO2      | Selectivity i-C16: 89.9; total conversion: 79.1 | H2/n-C16 mole ratio = 2 | [20]      |
| n-hexadecane    | 2–13.1 MPa, 345–380 | Stirred microreactor | 0.3% platinum | Iso-hexadecane: 58–62 | Not mentioned | [16]      |
| n-hexane        | 20 bar, 140   | Batch         | Pt doped on gamma alumina | At 180 °C n-hexane: 85 | Not mentioned | [15]      |
| Waste cooking oil | 3 MPa, 400   | Batch reactor | Meso-Y SAPO-34 HY | Aromatics: 13.4; jet fuel: 40.5 | 350 ml/min | [21]      |
| n-Hexadecane    | 50–100 bar, 260–320 | Micro-reactor of plug flow | Bifunctional Pt/alumina-beta | Conversion of n-C16: 50 | 500 NTP l/l H2/reactant | [22]      |
| Waste cooking oil | 2 MPa, 350   | Fixed-bed     | Ru supported on (Al13-Mont)† | Liquid hydrocarbons: 98.9 | 400 ml H2/ml oil | [23]      |
2.2 Waste Lignocellulosic sources of biomass

Biofuels are made from lignocellulosic biomass as a raw material, because of its wide availability and because it is renewable, it is present in agricultural waste such as textile waste and sawdust. In 2011, half of solid waste was recycled included waste food and organic unusable; Brazil produces a significant amount of biomass raw materials from sugar cane processing, and these residues can be used as primary materials in biofuel production[4].

The raw cellulose in the trash can be converted into ethanol. also, To remove the sugars already present, pretreatment is required. Cheng and Sun (2002) reviewed the hydrolysis for materials of lignocellulosic to produce ethanol. The materials studied include agricultural waste such as walnut shells, weeds and newspapers. Waste leaves in chemical pulp are a fascinating new raw material in this situation, which was not widely developed in order to acquire bioethanol and, eventually, biofuels. Bioethanol can be converted into biojet fuel after it is made[4]. The amount of lignin in the waste used to produce bioethanol is an important factor. Since it is hydrophobic in quality and closely related to hemicellulose and cellulose, the better raw material for Sugar-Bio-ethanol is made with a limited amount of lignin. The better processes were these in which carbonyl and butane were a stage between, conversion rates of 70-90 percent; As compared to direct alcohol to a jet operation with the conversion of 30-70% ethanol, as showed by Brooks et al. (2016) an idea of the alcohol-based biofuel production operations, considering the different media. Sakuneka et al.(2008) studied oligomerization for propene with solid phosphoric acid as a catalyst. processing conditions are 160\text{ - }240 ^\circ \text{C} and 3.8 MPa. In addition, Propane was used to investigate the alkylation of benzene and toluene. The findings revealed that the two reactions can be carried out on the same catalyst to generate synthetic jet fuel that meets Jet-A1 requirements[4].

All over the world, all studies Clarify the gained products want additional transformation, at least One more stage of distillation. Next, review the pyrolysis and hydrotherapy of cellulose raw materials for the production of bio-jet fuel. The jet is converted to jet fuel (Air TransportActionGroup 2011).

Jenkins et al. presented a detailed analysis of different pyrolysis techniques. The transformation technology was graded as slow (300\text{ – }700 ^\circ \text{C}; 5\text{ – }500 \text{mm}), fast (400\text{ – }800 ^\circ \text{C}; 3 \text{mm}), or flash (800 \text{ – }1000 ^\circ \text{C}; 0.2 \text{ mm}) based on the operating conditions and yields obtained from pyrolysis materials. pyrolysis in real-world conditions. In the case of rapid pyrolysis, the quantity of bio-oil produced increased, while the quantity of bio-oil produced decreased. Furthermore, there were various types of reactors, based on the size of the feed and the pureness of the bio oil needed, they were chosen[4].

There are various primary materials that can be treated during pyrolysis. Bio-jet fuel must be collected, hydproprocessing must be carried out after the pyrolysis stage. In addition, pyrolysis has been meant for the generation of electricity[6].

Table 2.2 Some of the recorded wasted raw resources studied for the production of bio-oil, which can then be converted to bio-jet fuel, are included in these works; however, conversion to bio-jet fuel is not included in these works.
Table 2.2 (Outline of the use of lignocellulosic waste in the pyrolysis process as an initial step towards the production of biojet fuel).

| Raw material       | Products          | Description                                      | Catalyst                        | Temperature (°C) | Yield                    | References |
|--------------------|-------------------|--------------------------------------------------|---------------------------------|------------------|--------------------------|------------|
| Waste pepper stems | Gas, Acids, Oxygenates, Phenolics, Aliphatics, Aromatics, PAHs, Nitrogen compounds | Fast pyrolysis, The raw material has hard texture, Large lignin content | HZSM-5 (23) and SiO2/Al2O3, HZSM-5 (280) with SiO2/Al2O3, Without catalyst | 550              | 15% by aromatics with HZSM-5(23) | [7]        |
| Wood waste         | Liquid products, Gas, Heavy metals, Coal | More than 99.925% of heavy metals and minerals are captured. | Not mentioned | 350              | Not mentioned             | [8]        |
| Waste rice husk    | Acids, Hydrocarbons, Oxygenates | The sample particles were 8–10mm long, | Meso-MFI, Pt-Meso-MFI, Non-catalytic | 500              | char (33.9%), liquid (32.0%), gas (42.3%) | [9]        |
| Waste pepper         | Char   | The reported yield is for the relation FCC:acetone 1:10 | Waste FCC HY zeolite | 500   | 58% Oil; 10% char; 35% gas | [10] |
|----------------------|--------|----------------------------------------------------------|----------------------|-------|---------------------------|------|
| Peanut shell         | Char   | None                                                     | Not mentioned        | 500   | 65% pine wood; 54% peanut shell; 45% maize stalk | [11] |
| Jatropha waste       | Acid   | The raw material was dried at 60 °C for 24 h, with particle size equal or less than 125 μm | HZSM-5               | 500   | The highest yield was 95% to aromatic and aliphatic hydrocarbons | [12] |
| Wood waste impregnated with CCA | Liquid products | Gas | Heavy metals | Coal | The raw material was dried in a conventional oven with air circulation, at a temperature of 120 °C for 90min | Not mentioned | 350 | Not mentioned | [8] |
| Textile residues | Char | Liquid | Gas | Composition of each product: Liquids: water, oxygenated compounds, heavy oil Gases: CO, CO2, | Not mentioned | 350–700 | liquid (32.0%), gas (42.3%) | Textile: char (31.6%), liquid (47.0%), gas (45.8%) | [13] |
| Material          | Char   | Bio-oil | Gas   | Catalyst Description                                                                 | Temperature | Notes                          |
|-------------------|--------|---------|-------|-------------------------------------------------------------------------------------|-------------|--------------------------------|
| Maize stalk       | Char   | None    |       | Not mentioned                                                                       | 500         | 65% pine wood; 54% peanut shell; 45% maize stalk [14] |
|                   | Coke   |         |       |                                                                                     |             |                                |
|                   | Gas    |         |       |                                                                                     |             |                                |
|                   | H2O    |         |       |                                                                                     |             |                                |
|                   | Bio-oil|         |       |                                                                                     |             |                                |
| Camelina straw    | Char   |         |       | The catalyst was pelletized with a particle size of 180–250 μm; the raw material was reduced to 0.5–1mm and dried at 105 °C for 48 h | 500         | 55 wt% toward bio-oil in sample partially de-ashed [15] |
|                   | Coke   |         |       |                                                                                     |             |                                |
|                   | Gas    |         |       |                                                                                     |             |                                |
|                   | H2O    |         |       |                                                                                     |             |                                |
|                   | Bio-oil|         |       |                                                                                     |             |                                |
| Waste wood | Cardboard |
|------------|-----------|
| (% w/w): | Composition of each product: |
| char (33.2%), liquid (44.7%), gas (33.1%) | char (33.9%), liquid (44.7%), gas (33.1%) |
| 350 - 700 | Liquids: water |
| Not mentioned | Char Liquid Gas Card-board |

[16]
2.3 Waste Starchy and Sugar sources of biomass

The majority of the starchy and waste sugar feedstocks come from the food industries, which generates the most of these materials annually. Agricultural activities all over the world produce huge quantities of fruit waste every day; many of these wastes are either discarded in landfill sites or deposited in the oceans.

Meyer-Pittroff and Russ researched how waste from the food and manufacturing sectors was used. Sugar production waste, as well as waste from the processing and planning of vegetables, fruit, grain and cocoa, as well as waste first from the processing of cakes, sweets, confectioners, and candy manufacturers, can all be used to create waste sugar catalyst. Fermentation can transform these residues to bioethanol. This bioethanol could be used to generate a significant amount of biojet fuel[4].

Another intriguing idea was to use corn cobs as raw materials for bioenergy, resulting in useful bio-products and biofuels. It produced bioethanol using Kluyveromyces marxianus yeast with biofuels. In addition, I.S. Choi et al. (2015) suggested a waypoint for the production of bioethanol through a mix between fruit and fruits that have been discarded. A high transformation rate, 90%, was achieved within 48 hours.

3. Zeolite synthesis

Zeolites can be produced from toxic waste by:

1. Conventional method, which includes fusion of alkali Inorganic wastes followed by hydrothermal treatment
2. In - Situs Synthesis
3. Microwave-aided synthesis[5].

3.1 Conventional methodology

The traditional approach entails treating inorganic waste with alkali, followed by thermal treatment. Fusion of alkali is performed at a perfect temperature and timing for the decomposition of materials Aluminum and silicon. Alkali that is widely used, NaOH, when added to the reaction, it serves as an activator during the fusion process, for the creation of dissolved sodium silicate and sodium aluminate, which is then used in the thermal process of zeolite [17]. The Na+ cation is important in increasing zeolite because it is known to equate sub - building groups of zeolite structures and is necessary for zeolite synthesis within hydrothermal conditions. The sodium soluble in water is proportional to the sodium content of the reagent mixture. As the amount of soluble sodium silicates produced increases, the performance of zeolite products obtained at the next step improves. To transfer the older content to a porous crystal form, The procedure is carried out at a particular temperature and over a specific amount of time[5].

3.2 Conventional Synthesis from Industrial Wastes

Fly ash containing SiO2:Al2O3::57.78:18.25 (wt percent) produced by the combustion of coal industry to make a variety of useful zeolite forms, like analcim, gismondine and
faujasite. Hydrothermal treatment was altering the experimental states, it can be used as a synthesis path such as alkali concentration, reaction time and temperature, This had a major impact on the formation sort of zeolite[18]. Izquierdo et al.18 examine the elimination of nitric oxide (NO) using zeolite - Y, LY-Cu, and LY-Fe (mineral group names) synthesized by alkali removal of carbon fly ash from the combustion of industry[19]. Alkali fusion was used to produce zeolite from carbon bottom ash Cd and Ni were removed from acidic wastewater using the resulting product[20]. To make zeolites from coal ash, they used an alkali hydrothermal process to generate zeolite, urban solid waste used flies ash in a cost-effective manner[21]. The hydrothermal melting process was chosen, and zeolites such as perialitis, zeolite A (sodalite group of zeolite linde A), and zeolite Y were formed[22].

Waste residues used containing manganese and SiO₂:Al₂O₃ ::66.4:15.8 (wt% percent) to make zeolites. To put it another way, to determine the consequences of the Si/Al ratio on various amounts of NaAlO₂ were used during the hydrothermal reaction process to produce Na-A-type zeolite[23].

Synthesized ash zeolites through hydrothermal treating prior to alkali melting. The fly ash utilized in their work included SiO₂:Al₂O₃ ::56.61:23.21 (%wt percent). Single Phase and high-crystalline zeolites X and A have been successfully synthesized.

3.3 Microwave Aided Synthesis from Industrial Wastes

Ojumu et al. In their work converted to a profit the disposed ash from flies into the precious zeolite. The ash from flies utilized in their function included SiO₂:Al₂O₃ ::55.44:31.51 (%wt percent). They used two separate methods to transform ash from a fly to zeolite A. In the first step, alkali ash was fused using traditional methods, then hydrothermally treated to produce zeolite A. Alkali reaction was achieved using ultra-sonic irradiation throughout the second step, and the obtained product was hydrothermally processed to create zeolite A. The use of ultrasound waves throughout a 10-minute alkali melting process efficiently transformed the content into zeolite by a subsequent hydrothermal technique, while conventional melting took 90 minutes to form zeolite[24].

Kim and Lee are a couple. To produce zeolite 4A, two-step fly ash heating with SiO₂:Al₂O₃ ::54.5:26.3 (percent wt percent) was used, which also included traditional heating and micro-oven heating. The primary outcomes of fly ash, Al and Si, where successfully converted into zeolite 4A using both conventional and microwave heating techniques[25]. The crystallinity of zeolite 4A was found to be 91 percent. It was discovered the first conventional heating has a major impact on the nucle formation and growth of small zeolite 4A seeds. The crystallization rate has grew from a small zeolite 4A nucle to a zeolite nucle crystal after the second microwave heating[25].

Tanaka et al. looked at a microwave two-step method for single phase synthesis. Amorphous carbon aluminosilicate ash containing SiO₂:Al₂O₃ ::64.2:23.3 Na-A zeolite (%wt percent). Fly ash was pre-treated in Sodium hydroxide and microwave irradiation for 1 hour. The residual fly ash was distilled out after pre-treatment, and a NaOH-NaAlO₂ solution was applied to the residual solution to regulate the silica/alumina ratio. In an air oven, the reaction mixture was aged for 24 hours at 358 K. During pre-treatment, the amorphous aluminosilicate in fly ash was dissolved at a rate that was much faster than the traditional process. Single phase Na-A zeolites were known as the
end products. When compared to traditional zeolite synthesis methods, synthetic zeolite showed greatly increased crystallite and cation exchange ability[26].

3.4 Microwave Aided Synthesis from Agricultural Wastes

Katsuki et al. used rice straw to create ZSM - 5 zeolite via microwave - hydrothermal and conventional - hydrothermal methods in their analysis. The rice husk ashes contained SiO2:Al2O3::90.69:0.14 (%wt percent). The microwave hydrothermal synthesis pathway was found to be more efficient than the traditional hydrothermal synthetic methods in transforming ash to zeolite, with a 3-4 times higher surface area and crystallinity[27].

3.5 Major Obstacles and Future Trends

Landfill raw materials is an intriguing recycled source of raw materials bio-jet fuel processing. Its key benefit is its high-volume, regular output, which ensures supply for the manufacturing process. Furthermore, these residues are seldom used to make valuation items[28].

Furthermore, they have had the ability to be environmentally toxic and are processed in vast quantities, creating a pollution problem; thus, using them as a raw material for the production of sustainable jet fuel helps to solve the problem of their eradication while providing a modern source of energy. Another advantage is the cheap of waste feedstock. Those materials are now available for free or at a lower cost, owing to transportation costs; although, if the marketing of value-added goods is effective, their price will rise over time[4].

The most significant drawback of waste feedstock is that it is typically distributed through various cultivation sites or manufacturing industries. As a result, the viability of manufacturing methods is heavily influenced by transportation costs. This emphasizes the significance of improving local and regional supply chains for production of renewable jet fuel, especially low density cellulose and lignin materials, in order to reduce transportation costs. As a result, it is important to optimize the production process for the production of bio-jet fuel[29].

The complexity of the recycled feedstock's composition is another drawback, which varies depending on the time span in which it is processed as the main commodity where the residual is produced. This problem could be solved by pre-treatment, which allows the composition of raw resources to be standardized; however, additives and the use of a custom-built control structure will be necessary, leading to an increase in cost of production[4].

As mentioned in the literature review, zeolites can be produced using conventional, in-situ, and microwave inorganic waste heating methods. Many of these approaches have advantages and disadvantages. When compared to the microwave synthesis path, traditional methods can easily produce zeolites with a narrow particle distribution, wide composition, and high purity. In addition, as compared to microwave synthesis, the time and temperature specifications are nearly 3 - 4 times higher. In comparison to the traditional approach, the in-situ method has an advantage in that it does not take as much ageing time. When comparing the in-situ and microwave heating paths, the purity and crystallinity of the synthetic zeolites is much lower on the in-situ route. Microwave synthesis has many advantages, including a fast heating time (due to fast and volumetric heating), precise and selective heating, and the ability to speed up the rate of
reaction rate by converting raw materials to zeolite at very low temperatures. In comparison to traditional and in-situ paths, the product has a high degree of crystallinity, purity, and restricted micro structural distribution, but processing is relatively costly.

4. Conclusion

Investigators have used waste materials that are rich in silica and alumina for the economic synthesis of precious zeolites. Clean and low temperature synthesis routes are adopted. Catalysts, ion exchangers, soil quality enhancers, and other uses for synthesized zeolites were discovered. The properties of zeolites made from such waste have demonstrated applications and benefits comparable to those of zeolites made from more costly precursors and chemicals. This study addresses use of environmental waste in the manufacture of renewable aviation fuels. Materials containing triglycerides, lignocellulose, sugar, and starch may be categorized as raw material waste by their design. Waste cooking oils, fats of animal and agriculture have all been used to make biofuel, which can then be processed to make bio-jet fuel. The use of waste feedstock to make renewable aviation fuel has the potential to minimize both operational and capital costs. To contribute to the long-term growth of the aviation industry, efforts in science should concentrate on the preparation of raw materials for the production of bio-jet fuel. Deoxygenation was primarily achieved by decarbonation and decarboxylation, yielding alkanes and terminal alkenes, with pyrolysis oil having a high structural modification capacity. In reality, it was flavored with zeolite ZSM-5, which raised the aromatic hydrocarbon and cyclic paraffin content of the biofuel to more than 60% by weight. The fuels obtained by distillation, including biodiesel and aeronautical biofuel, fully met the requirement for aviation fuel when the reaction was carried out under ideal conditions.

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