*Review Article*

Chemical Review and Letters
journal homepage: www.chemrevlett.com
ISSN (online): 2645-4947 (print) 2676-7279

# An overview on the green petroleum production

Nima Norouzi [a], Saeed Talebi [b], ⁎

[a]*Department of Energy, Amirkabir university of technology, Tehran, Iran*
[b]*Assistant Professor, Department of Energy, Amirkabir university of technology, Tehran, Iran*

ARTICLE INFO

*Article history:*
Received 6 March 2020
Received in revised form 7 March 2020
Accepted 8 March 2020
Available online 15 April 2020

*Keywords:*
Green Petroleum
Biofuel
Hydroprocessing
Hydrocracking
Biodiesel
Bioenergy

ABSTRACT

Given the greenhouse gas emissions and future biofuels control, it is encouraged to look for alternatives to raw materials and green granular processes in the crop to produce these biodegradable chemicals. In addition, bio-oil or disinfectant crop oil for the production of second-generation biofuels, bio-oil can be processed in various refining units and may also result in green diesel production, which is not only an opportunity but also an opportunity. It's a challenge for the oil industry. Green Oil or Diesel Green can be produced by renewable diesel processing with petroleum oil in the current hydroprocessing unit. Hoping to discover the mechanism and optimization of processing technology by adding quantities of oils and animal fats to the traditional oil refining process, much research and work has been done on the processing process and simultaneous processing processes. Green Oil This is a literature review of green oil production using hydroprocessing and concurrent processing.

## 1. Introduction

It is clear that fossil resources are not sustainable for long-term social development due to the problem of non-renewability, environment, and environmental protection [1]. Therefore, the oil refining industry must face serious challenges regarding uncertainty about future raw materials and properties of petroleum products around the world. On the one hand, the oil industry must consider increasing the refinery's versatility and integrate the refining and petrochemical industries. On the other hand, reducing carbon footprint and greenhouse gas (GHG) emissions not only puts pressure on the oil industry but also opens up new opportunities for refineries. According to their actions based on photosynthesis, biofuels, and biomass-derived from biomass do not increase pure CO2 in the atmosphere and thus do not reduce global warming. It is encouraged to look for shifts in the inventory of industrial food sources and green processes to produce these chemicals from renewable biomass sources [2]. The environment, economy, and consumers have many advantages over using biofuels because they are biodegradable and sustainable [3].

Biofuels are generally liquid or gaseous fuels made from biomass, including agricultural products, monthly waste, and agricultural and forestry products through biochemical or heat processes. While biodiesel reduces pure carbon dioxide emissions by 78% on a life cycle basis, compared to conventional diesel fuel [4], it also improves dramatically

Greenhouse gas emissions, which reduce carbon monoxide (CO) emissions by 46.7%, particulate matter emissions by 66.7%, and unburned hydrocarbons by 45.2%, are regulated in biodiesel combustion [5]. Thus, biofuels prevention, along with biofuels, could provide new perspectives for energy in the 21st century. Meanwhile, the growth of alternative fuels will have a major impact on oil refining. Forecasting energy demand at 2.1% CAGR, fossil fuels meet 83% of energy and 95% of liquid transportation needs while biofuels are projected to grow at 8% - 12% annually [6 ]. Therefore, given the worldwide reduction in GHG emissions as well as fuel consumption, it is recommended to have more efficient alternatives based on renewable and conventional technologies [7]. The conversion of vegetable oils and animal fats to biodiesel has been going on for many years. Biofuels can replace conventional fuels in vehicle gases on a full or partial basis in a mixture [8].

---

⁎ Corresponding author. Tel.: +989127268203; e-mail: Sa.talebi@aut.ac.ir

Compared to gasoline-powered vehicles, diesel vehicles are naturally 20% -40% more energy-efficient, resulting in a 10% -20% reduction in greenhouse gas emissions. In addition, the use of biodiesel and renewable diesel fuels can increase carbon dioxide emissions anywhere from 20% to 60% [9]. In particular, with the increasing number of vehicles based on leum fuels worldwide, efforts and research continue to be hot on new energy and renewable engine fuels, focusing on the development of renewable and sustainable resources, green energy, the environmentally friendly process. Etc. In the shipping sector. Simultaneous processing under normal processing conditions in refineries is a good option for refineries. Hydrogenation for bio-oils may cause a mass loss for green oil production, whereby the efficiency of biodiesel production by hydrogenation is approximately 81% by weight and 92% by volume of biodiesel by approximately 15% - 20%; methyl ester in (weight by weight) [10]. However, this mass loss can be tolerated or compensated because the predominant n-alkane HDO products are renewable in terms of higher energy consumption in diesel than precursors of methyl esters. In addition, green oil from the hydrogenation process of bio-oils can significantly increase the number of cyanides for renewable diesel oil alone with an alternative energy source. Thus, it seems that the advantages of refineries for the simultaneous processing of conventional oils and oils.

Renewable diesel with simultaneous processing can be produced and used when an oil company adds small amounts of vegetable oils or animal fats to the traditional oil refining process. This bio-oil can be used in various refining units, which may lead to generation biofuels. In particular, the hydration process plays an important role in the production of so-called green oil and is commonly used to process bio-oils mixed with various oils. Common catalysts commonly discussed in the literature are NiMo / γ-Al2O3 or CoMo / γ-Al2O3 [11], while catalysts with various drugs and / or support such as CoMo / C [16], Ni / SiO2 The reducing [19], Pd / SiO2 [20], Pd / C [21], Pt / C [23], Rh / C [23], Rh / Al2O3 [25] and others were investigated.

In addition, since alternative feeds are biodegradable and potentially cheaper than mineral oil, where it is involved, the application of processing techniques to oil refineries can lead to competitive development for both refineries to become a community. Undoubtedly, co-operation can make use of existing production and distribution systems for petroleum-based products and prevent the creation of parallel systems that reduce production costs. However, some problems need to be resolved, and some features must be taken to ensure that the normal processing performance is performed when used in conventional refineries. Most importantly, the oxygen characteristic of bio-oil is remarkable. Water accumulates under hydrogenation conditions. The effect of water on simultaneous processing should be taken into account because the water created during the hydration process may reduce the reaction activity [26], although it has been poorly described during the body's desorption period. In addition to water, NH3 and H2S produced during the hydrogenation process are likely to have effects on HDO or even co-processing.

## 2. Literature Review

The rapid liquidity of biomass emissions has been a crucial research and development area for biofuels [27]. Biofuel is a complex oil derived from biomass and vegetable oil. In general, biodiesel is an edible raw material obtained by rapid gas decomposition and proper upgrading of liquids, which can replace crude oil in conventional refinery units and have significant CO2 emissions. The name biodiesel is generally given to transesterified vegetable oil to describe its use as diesel fuel because it has properties similar to diesel produced from crude oil [28]. Acceptable biodiesel feedstocks typically include soybean oil, rapeseed, corn, rapeseed, and palm oils, while new vegetable oils such as mustard seed, peanut, sunflower, and cotton are used. The most widely used animal fats include those derived from chicken, beef, and pork [29].

Biofuel is a highly oxygenated mixture of large amounts of macromolecules, which contains almost all the characteristics of the oxygenated organism, such as esters, esters, aldehydes, ketones, phenols, organic acids, etc. for pyrolysis crude oil. The compounds comprise 50% - 65% of the organic components, 15% - 30% of the water, and 20% of the colloidal lignin fraction, in which more than 400 different organic substances have been identified that can be classified into several groups: organic acids, Aldehydes. , Ketones, eruptions, phenolic compounds, guaiacol (methoxyphenyl), seringulols, and sugar compounds [30].

Chemically, this is a combination of mono-alkaline fatty acids, often derived from vegetable oils or animal fats collected. In order to make biodiesel from biomass or vegetable oils and convert them to substitutes for petroleum-based diesel fuel, transesterification is necessary to convert trioline to methyl oleate and hydroxylation (HDO) to convert them to instant heptad. For the production of green oils, hydrogenation is a basic process by which a raw material containing double bonds and oxygen bonds is converted to hydrocarbons by saturating the double bonds and removing the oxygen through the decarboxylation, decarbonylation, dehydration reaction.

Ulcer et al. [1] studied the moisture content of FT waxes based on coal and the fraction of paraffinic wax from crude oil to diesel with base metal catalysts available at various process parameters for feed temperature, pressure and feed speed under soft conditions. Calemma et al. [2, 3, 5] analyzed the hydrocracking behavior of platinum on amorphous silica-alumina catalysts and confirmed the high potential of wax hydroperoxide for high-quality biofuels in the diesel range. Calemma et al. describe the application of FT biofuels as feedstock in pilot-scale hydroproduction units in operation conditions very similar to an industrial-sized hydroelectric plant for fossil gas. These experiments were performed with a commercially available mild catalyst. Various experiments were performed with changes in reactor temperature and feed rate, based on the mass of the catalyst defined as the hourly space velocity (WHSV). The target of this paper was to produce fuel in the range of diesel, kerosene, and gasoline as well as light hydrocarbons and to determine its effect on catalyst behavior and product distribution. The results of the paper support the implementation of cohydroprocessing production in refineries aimed at reducing fossil CO2 emissions. Yates et al. [7] investigated high-impact diesel fuels and hypothesized an equation to calculate the number of cyanide derivatives (DCNs) from the ignition delay measured by the combustion quality tester (IQT). Walter Schablitzky et al. [8] analyzes the Fischer–Tropsch (FT) biowaxes to second-generation biofuels using the Hydroprocessing process and in this article authors compare the first generation of the biofuels with the second generation produced by the Hydrocracking or hydroprocessing. Estevez et al. [9] speaks about the challenges the green oil technology face with it and mentions the higher cost and lesser reliability of the renewable energies used in the hydroprocessing of the biofuel to the second generation biodiesel our newer 3rd generation green petroleums. Zhao et al. [10] state that biofuels are one of the strategies that can be used in the term of carbon emission control. Thus the environmental effects of the energy industry can be controlled using the 2nd and third bio-energy carriers. The literature review done in this section resulted in 4 main questions and shortages found in this field, which are aimed to be answered in this paper.

- Clarification of the 3rd generation of the bio-oil and differing them from biofuel’s 2nd generation.
- The lack of literature and research have done in this field to review the biofuel upgrading hydro process.
- The need to clear describing different Hydrocracking processes.
- Compering different biofuels and different generations with each other.
-

## 3. Hydration-based green oil

### *3.1 Biological oil derived from pyrolysis*

Biomass decomposition oil is made from the process of biomass liquefaction, which in short can be referred to as bio-oil, pyrolysis oil, or bio-oil. In order to produce bio-oil, short reactor time, and rapid cooling or cooling off of pyrolysis temperature are required [32]. Therefore, biomass pyrolysis oil is not a product of thermodynamic-rhyme equilibrium. Remarkably, improving the properties of bio-oils using hydration and carboxyl group compounds in bio-oils can be improved. As with the mild hydration of bio-oils, some carboxylic acid compounds can be converted to alcohols that are esterified with bio acids in bio-oil to produce esters, and the bio-oil properties can be improved under such conditions. Method.

In order to allow FCC processing oil with pyrolysis oil, De Miguel Mercader uses a commercial 5 wt.% Ru / C catalyst at 290 bar, 230 ° C - 340 ° C, and 4 h, hydrogen-oxygen. He did the oil production of Liz. Reaction time in autoclave Despite the relatively high oxygen content (28% by weight by 28% by weight) and the different properties of HDO oils, they dissolved 20% of it in Long Residue and processed by the FCC. Near the oxygen-free hydrocarbons, lipid staining and near-normal FCC were 44-44% by weight of gasoline and 25.3% by weight of cyclic oils with an excessive increase in unwanted coke and dry gas, respectively. It is worth noting that non-boiling HDO oil by catalytic cracking results in much higher coke yields, indicating the importance of using the refinery feed as a diluent source and hydrogen transfer for biofuel processing. Therefore, until the catalytic cracking is completed in the presence of a suitable feed in sufficient quantity, the HDO phase does not require complete oxygen removal. The degree of group reduction through HDO for coke formation should be the degree.

Comparing the combined class of petroleum products for the gungle phase without the catalyst, Rocha [34] investigated the single-step hydrogen dehydrogenation of cellulose with dispersed iron sulfide catalyst and the two-step process with respect to Ni-Mo catalyst. MPa / 520 ° C, Step 2 MPa / 400 ° C). It was detected that the Ni-Mo catalyst in the second step reduces both the oxygen content and the aromatic oils. When purifying the oils from pure cellulose catalyzed by single-phase FeS-catalyzed hydropyrolysis of cellulose, they concluded that: 1) the increase in atmospheric pressure of hydrogen to 10 MPa resulted in a 10% increase in carbon. 2) The oxygen content of pre-Marie oil was reduced by more than 10% to below 20% w / w. 3) The addition of dispersed iron sulfide catalysts increases the oil performance by 10 MPa and reduces the oxygen content by 10%.

Grant thought that two-step processing was necessary for the stability of pyrolysis oils. Low-temperature hydration stabilizes reactions such as reduction of olefins, carbonyls and carboxylic groups, while high-temperature hydrotransactions are aimed more at the hydroxylation of the oxygen of phenols and hydrocarbons of larger molecules. These experiments show that a complete decolorization of pyrolytic oils is needed to eliminate phenolic and erogenic oxygen and to convert heavy molecules to temperatures between 350 and 425 ° C. They thought that H2S could increase specific reactions such as decarboxylation of carboxylic groups and that partial pressure of H2S could be used to control hydrogen consumption. Although 50% by weight of hydrocarbons can be expected for the deep hydrolysis of silylated sisi oils, a moderate hydrocarbon with partial removal of oxygen based on economic considerations would be more economical.

Zhang [36] separated the bio-oil with 70% yield in the oil and water phases and compared the oil phase to the sulfated Co-Mo-P / Al2O3 autoclave in a tetraline-filled autoclave that acts as a hydrogen solvent. , Hydrated. At optimal conditions of 360 ° C and 2 MPa magnesium liquid pressure, the oxygen content decreased from 41.8% crude oil to 3% of the updated one. Together, the crude oil was methanol soluble during a high degree of oil-soluble for hydroxylation.

More than one type of Mo-Ni / γ-Al2O3 catalyst (10 Ni nickel / 90 of aluminum molar ratio), Xu [37] tested the biomass pyrolysis vacuum under a 3 MP low pressure in a bending machine. They first evaluated the catalyst by updating the model compound (glacial acetic acid) at 373 K, which showed that the reduced catalyst had the highest activity with 33.2% acetic acid conversion. Then, after updating the crude biological oil produced using pure pine sawdust, the bio-oil pH increased from 2.16 to 2.84, the water content from 46.2 wt% to 58.99 wt%, and the H element from 6.61. Wt ٪to 6.93 wt ٪. Although the dynamic viscosity decreased slightly, the ester compounds in the updated bio-oil increased by 3-fold. In addition, Xu et al. [38] prepared another catalyst, reducing 0.06 wt% Mo - 10%% nitrate / γ-Al2O3 and reducing it in the hydrogen environment at 873 K. The maximum conversion of acetic acid (33.20%) at 473 kg compared to such a catalyst. Under mild hydrogen pressure (373 K and 3 MPa) for updating crude biological oil, the pH of the bio-oil produced from 2.33 to 2.77, the water content from 35.52 wt% to 41.55 wt% and the hydrogen content from 6.25 wt% to 6.95 wt%.

Over Ru / C catalysts, Wildschut, and so on. [39] Updated rapid pyrolysis oil in a batch reactor at 350 ° C, 200 times, and 4.3 hours to produce liquid transport fuels. The highest RuCl3 activity for the catalyst was 5% wt% loading of ruthenium in the hydrogenation reaction of rapid pyrolysis oil, which caused 55 wt% to 30 wt% oil. However, the H / C ratio of fresh Ru / C decreased from 1.24 for Ru / C twice recovered.

### *3.2 Vegetable oil*

Biofuels can be produced from the hydrogenation of vegetable oils, thereby producing biofuel for hydrocarbons, and are generally carried out in well-defined reaction conditions. Due to the long chain of renewable green oil, the "vegetable diesel sector" can be used as a cetane disinfectant, which has a significant impact on the emissions of vehicles. According to Stomburg [40], the diesel portion of vegetables could be 69% and 63% carbon monoxide and hydrocarbon emissions, respectively, with a relatively modest 4% reduction in NOx emissions, respectively. However, due to its low oxidation resistance and poor cold flow properties, unrefined biodiesel is not suitable for use as diesel fuel. As an emerging process, partial hydrogenation has a good role in improving the protective performance of vegetable oils [41]. Typically, this process acts as a hydroxylation under mild reaction conditions such as 100 ° C - 180 ° C and 0.15 - 0.3 MPa [44], in which nickel or noble metals are supported on silica base.

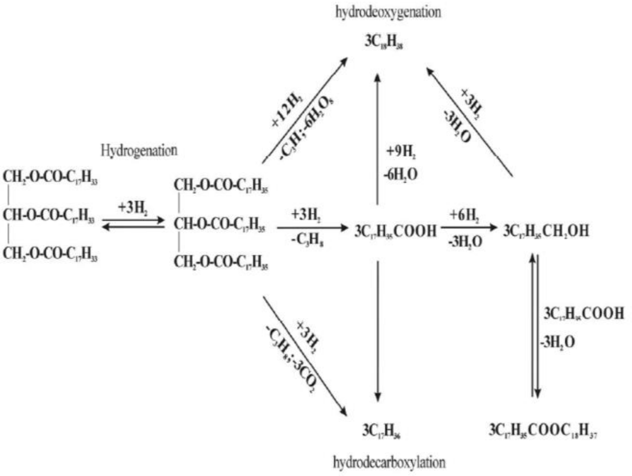
HDO vegetable oil is significantly a process of hydrogen accumulation, and the amount of hydrogen consumed depends on the type of vegetable oil and the mechanism and kinetic reaction pathway of the HDO. High-saturated foods such as palm oil and animal fats appear to have benefits in reducing the need for hydrogen. Although commercial renewable diesel is produced using palm oil and animal fats as raw materials [45], this saturated vegetable feed may be different when low-temperature properties are desired for these products [46]. Whole oil contains relatively high amounts of polyunsaturated fatty acid chains (27% - 40% C18: 3) [47] and can produce air-fuel hydrocarbons that reuse air fuels by providing more gap sites in production. The -ing process of some oils in algae may also contain large amounts of unsaturated chains (48) and has also been reported as a feedstock for use in aviation [49]. Seed oil (about 47 ٪ C18: 3) may, therefore, be appropriate (50).

In order to convert vegetable oils to hydrocarbons for the production of liquid transport fuels, direct conversion of vegetable oils to hydrocarbons by total hydrogen production seems to be a promising path. [51] The process of producing diesel fuel components was developed and commercialized by the Finnish company Neste Oil, based on the total hydrogenation of vegetable oils. However, reactive metallurgy makes it difficult to produce high-acidity vegetable oils in standard hydrogenating reactors because only the unsaturated triglyceride bonds, which are almost exclusively constituents of vegetable oils, are hydrogenated. Typically, the major hydrogenation products of triglycerides are hydrocarbons (n-alkanes) and by-products of propane, water, CO, and CO2 [53]. Unsaturated fats further resulted in the formation of more cycloalkanes and alkylbenzenes with relatively small amounts of shorter chain alkanes. Saturated feeds resulted in fewer alkanes or the same amount of carbon than the primary fatty acid chains.

For complete dehydrogenation of triglycerides for vegetable oil, hydrocarbons are based on two common reaction pathways: oxygenated hydroxylation (HDO) and hydrocarbon-carboxylation (HDC). The number of carbons will vary by different routes: n-Alkanes originating from HDO have the same number of carbons as the original fatty acid chain, meaning even the number of carbons is typically 16 or 18 while the main reaction of the products of this route is water and Propane. HD Expanded hydrocarbons from HDC are one carbon atom per molecule less than the main fatty acid chain, that is, the odd carbon number while the predominant byproducts are CO, CO2, and propane. Research shows that the performance of straight-chain alkanes decreases at> 350 ° C because alkanes were cracking and isomerizing at higher temperatures [54].

### *3.2.1. Rapeseed oil*

Kubička [55] to investigate the mechanism of oxygen desorption of vegetable oils over nickel (12.7%), hair (21.8%), and NiMo sulfide catalysts at 260 ° C - 280 ° C refined rapeseed oil (Food grade) used. , 3.5 MPa, and 0.25 - 4 h / h in a fixed bed reactor. Schema 1 shows the reaction path of vegetable oil. They found that the rate of disappearance of triglycerides was higher than that of binary catalysts, which was approximately two and three times higher than that of Mo and Ni catalysts. As for the rate of oxygen disappearance, the highest rate of 0.3NiMo catalysts is still 3.5 times 19 times slower than the rate of Mo and Ni catalysts. n-heptadecane is selectively formed over Ni / Al2O3, while n-octadecane is formed almost exclusively on Mo / Al2O3. The 0.3NiMo catalyst yields both hydrocarbons with the desired n-octadecane hydrocarbons in the range of 50% - 70%. Apart from the different intermediates of the oxygen product, NiMo / Al2O3 yielded a combination of hydrocarbon decarboxylation and hydrocarbon hydroxylation products, while Ni / Al2O3 yielded only hydrocarbon decarboxylation products and approximately Mo / Al2O3 hydrocarbon hydrocarbons. He had a record. The effect of Ni/(Ni+Mo) atomic ratio in a range of 0.2 - 0.4 on activity and selection was not significant. 56imáček [56] performed rapeseed oil hydrotherapy as a hydrocarbon-based biodiesel source on a Ni-Mo / almina catalyst in a laboratory flow reactor. It demonstrated the plating of rapeseed oil at 360 ° C and yielded 15.7 MPa of oxygen-free hydrocarbon mixtures. At low temperatures of 310 ° C, only small amounts of tents and intermediates were observed in the products, and the products contained more n-heptadecane and n-octa-decane. Organic liquid products (OLPs) containing illegally saturated hydrocarbons contain 14 to 20 carbon atoms, of which C17 and C18 n-alkanes account for more than 75% by weight. However, the hydrosphere rapeseed oil product is of limited application in pure form as the yield point of the hydrated product rises above 20 ° C. They also investigated the effect of different Ni-Mo / alumina hydroferrin catalysts with different metal loading [57]. It was established that at 260 degrees Celsius - 340 degrees Celsius at 7 MPa, no matter what catalyst is used, the reaction products include water, hydrogen-rich gas, and organic liquid product (OLP), which are its main constituents. Like C17, C18 was identified as n-alkanes and i-alkanes. At low reaction temperatures, OLP also contained free fatty acids and triglycerides, while at reaction temperatures above 310 ° C, OLP contained only the hydrocarbons of the diesel fuel fraction.



**Scheme 1.** The deoxygenation reaction of vegetable oil.

### *3.2.2. Hydrocrack*

In the hydrocracking process, Šimaček [58] also inspected the vacuum processing of rapeseed distillate oil. They used direct vacuum distillation (denaturation 0.934, S 1.10 w ٪, 0.17 N w, 350 ° C - 650 ° C) and the same fraction containing 5% of rapeseed (90% C18 unsaturated fatty acids). Chain, 5 ٪ w of palmitic acid chains and 5 ٪ w other acid chains, tent water (460 mg/kg). Commercial Ni-Mo catalysts were used for use at 400/420 ° C, 18 MPa hydrogen gene pressure, 1.0 h-1 LHSV, and H2 / 1000 oil in a bench-scale flow reactor. It was shown that the processing product obtained at 400 ° C (18 MPa) contained significantly greater amounts of C17 and C18 n-alkanes than the product obtained from rapeseed oil-free raw materials. When processed at 420 ° C, the low-temperature properties (cloud temperature 23 ° C, 24 ° C CFPP) were almost similar to gasoline oils obtained from the processing of pure PE raw materials.

### *3.2.3. canola oil*

Cowen used conventional NiMo / g-Al2O3 to purify canola oil at 18.25 - 85.13 times cold hydrogen initial pressure and 300 ° C - 400 ° C in a batch reactor. They found that rapeseed oil mainly converts to hepatic tetanus, and octadecane is formed with hexadecanoic acid as a major intermediate product. As hydrogen pressure increases, reaction times increase, and H2 increases, H2 consumption increases and forms more hexadecane and octadecane. Particularly noted, they also found that the formation of hepatic tetanus and octadecane and hydrogen uptake by wrist-shake were greater than a horizontal orbital shake, suggesting that the three-phase hydrodynamics involved the significant conversion of rapeseed oil. Distribution of reaction products. In addition, Cowan used methyl laurate to evaluate the rate of digestion of liquid biomass. They found that methyl laurate is largely non-disruptive and is formed using lauric acid as a major intermediate product. As the reaction pressure increases, the temperature increases to 300 ° C - 350 ° C and the reaction temperature increases to 350 ° C. - 375 ° C. It was also found that wrist shake was better than a horizontal orbital shake.

Monira [60] used rapeseed oil to investigate the severity of oleic acid oxidation in terms of prescription fatty acids version with molybdenum, tungsten, and vanadium nitride supported on Al2O3 prepared by the planned temperature reaction with NH3. The catalyst was tested at 380 ° C - 410 ° C and 7.15 MPa H2. Based on the proposed reactions as shown below, oxygen can be removed via oleic acid (C17H33COOH) as water by the reactive hydrogenation reaction (1), because CO and H2O are reactive by hydrocarbonylation (2) Or as CO2 by hydrocarbonylation of the reaction (3). Compared with decarbonylation and decarboxylation, molybdenum nitride favored the support of hydrogen oleic acid oxygen to n-C18H38. At 400 ° C and 8.35 MPa H2 over Mo2N / Al2O3, prolonged hydro training testing of 450 kg of rapeseed oil showed that oxygen removal exceeded 90%, and diesel fuel efficiency varied between 38 and 48 wt% based on liquid feed.

$$4H_2 + C_{17}H_{33}COOH \rightarrow n\text{-}C_{18}H_{38} + 2H_2O \qquad (1)$$

$$2H_2 + C_{17}H_{33}COOH \rightarrow n\text{-}C_{17}H_{36} + CO + H_2O \qquad (2)$$

$$1H_2 + C_{17}H_{33}COOH \rightarrow n\text{-}C_{17}H_{36} + CO_2 \qquad (3)$$

### *3.2.4 Sunflower oil Hydrocrack*

Using a Pd / SAPO-31 binary catalyst, Oleg et al. [61] treated sunflower oil at 310 ° C - 360 ° C, WHSV 0.9 - 6 h / h, and a pressure of 2.0 MPa. The experiment showed that at 320 ° C - 350 ° C, the reaction product had the only hydrocarbon. Increasing the reaction temperature or decreasing the oil feed rate caused a decarboxylation/decarbonylation reaction resulting in an increase in the C17 / C18 ratio. At the same time, hydroprocessing of sunflower oil with Pd / SAPO-31 catalysts provides the isomerization of N-alkanes, suggesting that Pd / SAPO-31 could be a perspective catalytic system for a one-step hydroconversion step. O of the vegetables. Oil for the production of hydrocarbon-based biodiesel with appropriate low-temperature relationships. However, PD / SAPO-31 catalysts showed high initial activity but rapid deactivation after several hours of operation. Hancsók [62] used Pt / HZSM-22 / Al2O3 (0.25% - 1.1% Platinum) catalysts to investigate the isotropy of pre-hydrogenated sunflower oils (PHSO) under conditions of 280 ° C - 370 ° C, 35-80 bar pressure, LHSV 1.0 - 4.0 h-1 and H2 / oil 250 - 400. The investigated catalyst Pt / HZSM-22 / Al2O3 is suitable for the isolation of pre-hydrogenated sunflower oils with liquid product performance> 90% of the obtained products having a large number of Astan (84-81) and good cold flow properties (10 ° C - 14 ° C) are. But choosing the hydrogenation intensity before hydrogenation is very important to obtain pre-hydrogenated vegetable oil in the first stage of the catalyst containing low oxygen content. The optimum process conditions for isomerization of pre-hydrogenated sunflower oils (organic graft oxygen content> 100 ppm) at 0.55 ٪ Pt / HZSM-22 were as follows: T = 320 - 330 ° C; p = 50 - 60 bar; LHSV = 2.0 - 3.0 h-1, H2 / HC 300 Nm3 / m3.

### *3.2.5. Palm oil*

With the crude palm oil hydroprocessing on NiMo / gAl2O3 catalyst, Guzman [63] obtained the new Citan renewable diesel at 40 bar hydrogen load pressure conditions, 350 ° C, LHSV of 2h-1 and H2 / 500 oil obtained. This product has an index of 92.54 by province while its density ranges from 0.9152 g / ml to 0.7882, acidity from 7.392 mg KOH / g to 1.50, and kinematic viscosity at 40 ° C from 33.40 mm2 / s to 3.6918. Hydroprocessing of crude palm oil has resulted in highly paraffinic renewable diesel with an excellent Sitan index even when pressurized with low pressure. At low pressures, the hydroxylation cannot be fully achieved, and the appearance of intermediates as C16-C18 alcohols, C16-C18 acids, and esters in the primary reaction product is determined. Current flow tests (TOS) have shown that conventional hydrotreating catalysts suffer from partial inactivation. The 60bar was thought to be economical.

### *3.3 Waste cooking oil*

Kubička [64] deactivates HDS catalysts in oxygen dissipation of rapeseed oils by testing different rapeseed oils with varying degrees of improvement, including refined rapeseed oil (RRO), RRO containing 0.5 wt.% S (DMDS). , RRO checked. Containing 1 wt.% S. on CoMo / -Al2O3 sulfide catalyst (3.0 wt.% CoO / 13.5 wt.% MoO3) at 310 ° C, WHSV2 h / h and 3.5 MPa hydrogen canola oil feed rates. is low. Grease traps, a highly specific waste stream from vegetable oil processing, cause the catalyst to be inactivated severely because all deoxygenation activity has been eliminated during the first 48 hours. They hypothesized that grease traps were likely to deactivate the catalyst using coke because it contained significant amounts of phosphorus with free fatty acids, whereas high concentrations of alkali in waste rapeseed oil were the main cause of inactivation. Continuously added sulfur agent (DMDS) deactivates the catalyst significantly slower, and the presence of H2S reduces the rate of hydroxylation/decarboxylation.

## 4. Green oil research on model compounds

When producing green oil under hydrogen conditions, the oxygenated compounds react more through the hydroxylation (HDO) pathway, which means that the C-O bonds and water production break. In order to guide the selection of process conditions and the impact on joint performance, you need to know what exactly happens during refueling. Of these O-containing compounds that contain biofuels, the high-affinity guaiacol molecule (2-methoxyphenyl) is of interest because the two functions differ from those produced with oxy (phenolic and methoxy groups), which It is considered the first case. As the hardest CO bond to crack [65]. Therefore, this pure model compound has been used as a probe molecule in studies of hydroxylation [66].

Basically, biofuels are produced by two reaction pathways to hydrocarbons: 1) hydroxylation (HDO) and 2) hydrocarbonylation (HDC). n-Alkanes originating from HDO have the same number of carbon as the main fatty acid chain, while the major products of this route are the reaction of water and propane. HDC origin hydrocarbons have a strange carbon with one carbon atom less than the main fatty acid chain, while the byproducts are CO, CO2, and propane [67]. Predictions of thermodynamic alignment show that C18 hydrocarbons are the main reaction products, and their concentration is influenced by temperature and especially pressure.

Catalysts can have different activities depending on the structure of the feeds. NiMo / Al2O3 has higher decarboxylation activity than CoMo / Al2O3 with hydrogen from carboxylic groups that require a temperature of about 300 ° C. The decarboxylation of inactive carboxylic acids reacts at high temperatures and pressures because, although de-heating, requires high transition state energies. Carboxylic acids and esters react with a similar reaction. Alumina supported catalysts exhibited a higher degree of decarboxylation and consolidation than carbon and silica, in which acidity affected the formation of active sites for the decarboxylation and hydrogenation of carboxyl groups.

Echeandia [68] used phenol to detect the synergistic effect between nickel oxide and tungsten supported species on activated carbon in phenol hydroxylation (HDO). The catalyst was Ni-W-P / C (Ni ~ 2.5, Ni 5.5.5, W or Si 0.4 - 11) and was treated in H2 stream under 673K soft conditions for 4 h. To investigate the effect of tungsten precursors (silicotungstic (HSiW), phosphotungstic (HPW), and tungsten acids (HW) on the activity of somewhat reduced Ni-W / AC catalysts, experiments were conducted on hydrogen conditions. The 1.5 MPa pressure, the temperature is flowing from 423 to 573 K, and the WHSV 0.5 hour per hour in a fixed bed reactor. The results showed that: 1) Regardless of the tungsten precursors, after the nickel incorporation into the base W / AC system, a large increase in the performance of the catalyst was observed. 2) Low coke formation at AC level due to classic alumina support. 3) Regardless of the reaction temperature, the reaction is probably through two orientation pathways based on (a) the hydrogenation (HYD) of the phenol aromatic ring (the main reaction pathway) leading to the formation of siloxanes, cyclohexanes, cyclohexanols, and methyl cyclopentane, and b) Be done. The direct cleavage of the CO bond leads to the formation of benzene. 4) Complete elimination of O-containing compounds in the HDO reaction at 573K was archived on Ni-W (P) / AC and Ni-W (Si) / AC oxide catalysts.

Boda [69] investigated the use of triglycerides of biological origin, tricapriline (TC), and caprylic acid (CA) as the hydro control process of triglycerides to cyclic aliphatic hydrocarbons. The catalyst was 3 wt% K / C, 11 wt% Mine - 3 wt% Nitrate / Al2O3, and each of the kata-list experiments in hydrogen solution at 450 ° C was activated for 3 h during the experiment. (TC or CA mixture) / H2 / He to maintain total pressure at 21 bar while partial reactant pressures can be changed. The WHSV compound was 6 h -1, H2 / CA molar ratio 1-20, reaction temperature 300 ° C - 400 ° C for TC or CA. They probably followed successive steps as the hydrogenolysis (HYS) of TC to CA and propane, and then mediated by CA hydrogen-oxygen (HDO). The total reaction speed was governed by the HDO reaction. They also identified two distinct HDO pathways: 1) hydrocarbonylation and 2) oxygen reduction. They found that, over Pd / C catalysts, the dominant reaction pathway for CA hydrocarbon is decarbonylation, which mainly yields C7 alkanes (a carbon atom shorter than the reactive acid) and CO, whereas, over Ni-Mo / Al2O3 did HDO. In the extra steps of continuous H2 water addition, the C8 chain = alkenes, the C8 chain, and water are mainly straight chains. The reaction pathway 1) passes through formic acid, which rapidly decomposes in the presence of H2 to CO and H2O, while the reaction pathway 2) passes through the acid to the intermediate alkanes of the diabetics to achieve alcohol and aldehyde effects.

Kobikoku [70] used a set of herbal oil reset model compounds to redo the search for decarboxylation of vegetable oils, including stearic acid, ethyl stearate, and tristar. Prior to the experiment, he adopted a catalyst supported by activated carbon (5% by weight) activated carbon, which had been reduced in situ at 200 ° C for 2 hours in constant hydrogen flow. The test conditions were 300 ° C - 360 ° C and a pressure of 17 - 40 bar. The results showed that the same end product, n-heptadecane, was obtained for the tested models, including ponds, including stearic acid, ethyl stearate, and Trista-rhine as vegetable oils. And byproducts included hepadaden positional isomers and compatible isomers using dodecylbenzene. Interestingly, the hydrogen pressure was slightly suppressed by the formation of aromatic hydrocarbons. However, a further increase in the partial pressure of hydrogen suppressed the conversion of stearic acid. They were increasing the reaction temperature improved the conversion of ethyl stearate greatly, at the same time leading to the development of unwanted odors.

Smejkala [71] selected the tristar as the pound model to represent vegetable oils in the calculations for a basic thermodynamic analysis of the reaction system that compared its predictions with experimental hydrogenation observations of whole rapeseed oil. His estimates show that the release of hydrogen is important for the reaction because it was limited by the Liq-Uid film on the catalyst particles.

Vito [72] of thyristartate as a thermodynamic model for total tristate hydrogenation at temperatures of 250 ° C - 450 ° C, hydrogenation pressures of 7 - 70 bar and inert H2 gas at approximately 100: 1 (mol/mol) basis. Work done on experimental thermodynamics by preliminary researchers [73], shows the heat capacity of organic compounds belonging to different biofuel groups, which explains the main reaction mechanism of the proposed catalytic transformation summarized in equations ( 1) - (4) As shown below.

$$(CH_2)_2CH\left[(CH_2)_{16}\right]_3(COO)_3(CH_3)_3+3H_2 \\ =3\,C_{17}H_{36}+C_3H_8+3CO_2 \qquad (1)$$

$$(CH_2)_2CH\left[(CH_2)_{16}\right]_3(COO)_3(CH_3)_3+12H_2 \\ =3\,C_{18}H_{38}+C_3H_8+6H_2O \qquad (2)$$

$$CO_2+H_2=CO+H_2O \qquad (3)$$

$$CO_2+4H_2=CH_4+2H_2O \qquad (4)$$

Smejkala [74] demonstrated the importance of pressure in the reaction pathway using rapeseed oil to modeling investigations for dehydrogenation of total triglycerides on Ni-Mo / Al2O3 com-mercury sulfide and reduction of Ni / Al2O3 in a fixed-temperature flat-bed reactor. Be reactionary. 240 ° C - 360 ° C, pressure 0.5 - 8 MPa, WHSV 1 hour per hour, the molar ratio of hydrogen to starting material 100 (mol/mol). They concluded that at 70 bar and higher temperatures, the hydroxylation reaction is preferred, while the hydrocarboxylation reaction is accelerated with the lowest reaction pressure (because the number of moles of products is higher than the reactants). In addition, the effect of changing the reaction pressure on the product distribution is more pronounced than the reaction temperature.

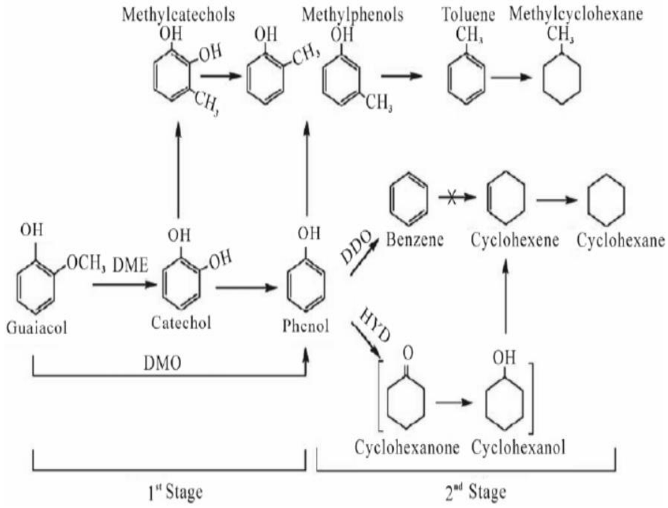
Simultaneous processing of bio-oil in existing units has become an emerging process in refineries. Although the ratio of bio-oil to oil-blend is low, one must understand the influence of the operating parameter on the bio-component of the oil and the effect of bio-oil on the quality of the finished product. Needless to say, sulfur is the most common impurity for exposure, and a limitation in the sulfur reservoir is thought to be one of the most important parameters to meet with refineries. In refineries, on the one hand, targeting the HDS to achieve this goal; on the other hand, processing with oxygenated molecules involves HDO reactions that also consume hydrogen and may compete with the HDS. Meanwhile, ammonia from hydrogen nitrogen degradation is not only depressed

The activity of NiMo and CoMo catalysts for the conversion of sulfur in the conventional hydrogenation process but also for the conversion of carboxylic and methoxy groups, but not ketones [75]. Hydrogen sulfide did not show activity in NiMo but in CoMo in the case of Cu. However, H2S increases the conversion of ester groups and is more effective than CS2 [76]. Therefore, on the one hand, NH3 and H2S can be used to control blood pressure. On the other hand, understanding the HDO would be useful for collaborating on green oil production.

### *4.1. Model combination*

Bui [77] made using 5000 ppm guaiacol as an oxygenated molecule representative of pyrolytic bio-oils on CoMo / Al2O3 catalysts, using direct gasoline oil (SRGO, S 13.500 ppm) and using 5000 ppm guaiacol was reprocessed. Degree Celsius - 360 degrees Celsius, LHSV 1 or 2 hours per hour, total pressure 4 MPa, liquid / H2 500, respectively. They only describe a reaction scheme using the guaiacol probe molecule that describes the different pathways leading to the hydrocarbon compounds. It shows intermediates through the formation of oxygenates, as shown in Schema 2. And HDS can go on without any inhibition. However, they found that, at mild recrystallization temperature (below 320 ° C) and a decrease in spatial location, HDS inhibition was observed.

A hydroxylation reaction scheme was proposed by Senol [78] for the hydrogenation of methyl heptanoate and methyl hexanoate, model compound (3 wt.%) In xylene liquid using commercial base catalysts (NiMo / γ-Al2O3, CoMo / γ-Al2O3). At 250/275/300 ° C, 1.5 MPa, 20 h / h (3 wt%) and H 2 / oil 200. They thought that methyl aliphatic esters produced hydrocarbon concrete through three main pathways: 1) The first pathway led to alcohols, followed by dehydration to hydrocarbons. 2) The de-esterification in the second pathway yields alcohol and a carboxylic acid. 3) Carboxylic acid was converted to hydrocarbons more directly or by alcohol in the form of diabetic alcohol. HDO esters continue through a number of parallel and sequential reactions. Hydrocarbons as end products mainly consist of alcohol and/or carboxylic acid intermediates. Among them, the decarboxylation of the esters led to the hydrocarbons in the third pathway. Therefore, methyl esters can be used for hydrogenation on hydrogen-affected catalysts under moderate conditions. NiMo / γ-Al2O3 sulfide is a more active catalyst than CoMo / γ-Al2O3 sulfide. However, the stability of the catalysts under the conditions studied was not satisfactory (Schema 3 is mentioned in this paragraph).



**Scheme 2.** The reaction for the conversion of guaiacol at 573 K under 4 MPa of H2.

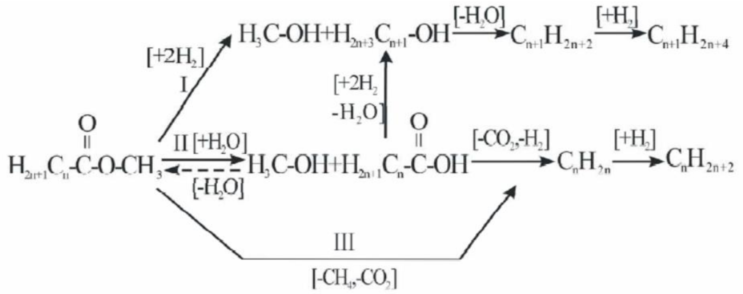
### 4.2 Vegetable oil Cotton Other vegetable oil

In order to investigate the hydration conversion of the esters present in refined cottonseed oil, Sebos [79] used diesel-oil cottonseed oil as a feed to run with CoMo / Al2O3 catalyst at 305 ° C - 345 ° C, 30 times. Kurdish. WHSV 5 - 25 hours per hour, oil / 1000 2 H2 with 500 lbs. Triglyceride conversion was nearly 100% with WHSV less than 5 h/h. Cetane eliminates 3 and 10 percent by weight of diesel in cotton, and other quality-related properties are not affected. In addition, hydroxylation is a first-order reaction with respect to the ester content, and the temperature-dependent hydroxylation is 111 kJ / mol activation energy.

### 4.3 rapeseed oil - vegetable oil

Valandzisky processed LGO with vegetable oil in a commercial hydrolyzing-hydrocracking catalyst (NiMo / Al2O3) simultaneously. They consist of two blends of light oil rape oil, 10% percent (Series 1), and 20% rape oil (Series 2) with diesel oil at 320/350/380 ° C, hydrogen pressure 5.5 MPa, LHSV 2 h-1 and H2 / oil 500. showed that hydrogenolysis of ester bonds and hydrogenation of olefin bonds in vegetable oils were the main reactions in this process. Effect of hydrofoiling for rapeseed oil as an additive (10% or 20%) of light oil in the temperature range 350 ° C - 380 ° C at 5 MPa hydrogen pressure with 95% hydrogenolysis and hydrogenation yields of ester and carboxyl bonds Acid as well as hydrogenation of double bonds. Necessarily, hydrogenated catalysts with cool hydrocracking and isomerization activities play an important role in the deep hydroferring process to make rapeseed oil mixed with diesel fractions. Due to the undesirable increase in CFPP for hydroferrin products, some of the higher melting compounds can crystallize in hydroferrin products.

**Scheme 3.** the main ways for aliphatic methyl esters converted into hydrocarbons.



Hydrodeoxygenation reaction scheme of aliphatic methyl esters(n=6 for methyl heptanoate and n=5 for methyl hexanoate).

### 4.4 Sunflower oil

Huber performed the hydration of a mixture of sunflower oil/vegetable oil and vegetable oil and heavy vacuum oil (HVO). The HVO feed properties are as follows: Density 0.9081 g / cm3, 0.35% S, 1614 ppm N, Conradson carbon 0.15, and D-1160 90 V 824K distillation curve. They used the Haldor-Topsoe TK-525 (NiMo / Al2O3 sulfide, 3.9% NiO, 18.0 wt.% MoO3) with running conditions at 300 ° C - 450 ° C, 50 bar pressure, LHSV 5.2 h-1 and H2 / It was a feed. The ratio of 1600. It appears that all feeds are converted to a maximum reaction temperature of 350 ° C - 400 ° C. The test results are as follows: a) The molar yield of C15 -C18 straight-chain alkanes carbon was 71% carbon-based (95% maximum theoretical yield) for the pure hydration of pure aqueous reaction under optimum reaction conditions. (B) The rate of alkanes production from pure sunflower oil was higher than the HDS value of one HVO with a sulfur content of 1.48 wt% (i.e., 100% conversion of sunflower oil at 350 ° C with 41% of sulfur removal). (C) When sunflower oil was mixed with HVO, the performance of direct chain alkanes increased, indicating that thinning of HVO could improve the reaction chemically. The optimum conditions for simultaneous feeding of vegetable oils with petroleum feedstocks as LHSV were 5.2 h / 50 H2 atmosphere. Increased decarbonylation resistance plus decarboxylation products increased temperature and sunflower oil content. The blend of sunflower oil with HVO did not reduce the detoxification rate, which is probably trapped by other vegetable oils.

### *4.5 Hydrocaching Processing*

Using four vacuum sunflower oil (VGO) oils for simultaneous processing in the hydrocracking process, Lapas et al. [82] have presented the following three process designs for high-quality biofuels: 1) Catalytic analysis of biomass catalysts On intermediate FCC zeolitic catalysts. Temperature 2) Re-lubrication of oil mixed with hydrolyzed biomass pyrolysis liquids for FCC units. 3) Vacuum gas oil synchronized with hydroprocessing (VGO) with sunflower oil. The four blend oils were as follows: Pre-hydrated VGO (HDT-VGO) blend with sunflower oil at 30/70 and 10/90 (V / V) and a blend of direct VGO (not hydration) with sunflower oil with The ratio of 30/70 and 10/90 (volts/volts). The catalyst was gentle metal moisture cracking catalyst, and the test conditions were 350 ° C, 2000 psig, 1.5 h LHSV. The interesting conclusion was that the increase in H / C ratio was much higher for the two feedstocks with higher amounts of bio compounds (70.30), suggesting that hydroperoxide co-operation primarily affects heavy hydrocarbon heavy molecules in the sunflower oil component. Allow. Oxygen removal for two unprocessed sources of VGO-sunflower oil is more effective than two sources of VGO sunflower oil without VGO treatment. The conversion of freshwater from the mixture of VGO-sunflower oil and sunflower oil is not the same as that of conventional VGO (60 - 80) freshwater, indicating that the presence of sunflower oil appears to inhibit hydrocarbon conversion [83].

**Table 1.** presents the advantages and disadvantages of current methods of obtaining biofuels and different generations

| Biofuel | Biodiesel | BiodieselLike Biofuel | Green petroleum | LVLC Blended with Vegetable Oils |
|---|---|---|---|---|
| **Atomic Efficiency** | 85% | 100% | 85% | 100% |
| **By-products/waste generation** | Dirty glycerol (15%) | No wastes | CO, CO2, and H2O (15%) | No wastes |
| **Cleaning process** | Complex, high water consumption | Not needed | Not needed | Not needed |
| **Cetane Index** | Slightly lower than diesel | Slightly lower than diesel | Similar to diesel | Slightly lower than diesel |
| **Lubricity** | High | High | Low | High |
| **Industrial production** | Complex | simple | simple | Very simple |
| **Environmental impact** | High | Low | Low | None |

## 5. Results and discussion

Biofuels have emerged as an attractive alternative to current petroleum-based fuels because they allow fossil diesel engines to be replaced without any engine modifications [84]. In addition, they also exhibit favorable properties in combustion gases and produce fossil fuel carbon monoxide, sulfur dioxide, and burnt hydrocarbons. So biofuels derived from vegetable oils can play a key role in replacing current petroleum-derived fuels because they can be easily replaced in the logistics systems currently in place in the global supply system. To integrate. However, prior to applying vegetable oils to current CI diesel engines, previous oil viscosity reduction is necessary [85]. In the current energy scenario, it is impossible to completely replace petroleum-based fuels with short- or medium-term biofuels because of the inability to produce raw materials, not only because of economic problems and high prices—vegetable oils but also because of the lack of suitable agricultural land. However, energy insecurity and climate change are sufficient driving forces to stimulate the development of biofuels around the world [86]. In any case, this also indicates a great potential for stimulating trade. Therefore, the priority is that by gradually expanding the current land for indirect production, they will be dedicated to producing edible vegetable oil to promote the gradual introduction of biofuels based on renewable raw materials [87]. Three decades ago, at the beginning of energy transfer, the most appropriate way to reduce the viscosity of vegetable oils was to convert them to a mixture of fatty acid methyl esters with a trans-sterile triglyceride reaction [88]. These mixtures are called biodiesel, or FAME, and have rheological properties that make them possible to use as a fuel in mixtures with fossil diesel [89].

Over the next decade and after trying to scale this process down to the industrial level, it turned out to be a series of technical and environmental problems that made it technically and economically impossible [90]. The major disadvantage of the triglyceride translocation is the production of glycerol as a byproduct, which implies a comprehensive process for cleaning biodiesel and also the production of large amounts of glycerol for administration. Therefore, various types of research to obtain biofuels that incorporate glycerol as a biodiesel derivative into biodiesel fuel have begun to use this approach to use vegetable oils as a feedstock for biodiesel use in diesel engines. Make the current CI work. It is also possible that the introduction of vegetable oils as fully biodegradable biofuels by converting them to hydrocarbons, through a catalytic reaction involving hydrolysis and/or decarboxylation/decarbonylation of triglycerides to obtain the so-called diesel. Be. Finally, over the past decade, the study of mixtures of vegetable oils with diuretic solvents of low viscosity [92], as a method to reduce the viscosity of vegetable oils, has become important to the extent necessary for the proper functioning of current CI diesel engines. Table 1 presents the advantages and disadvantages of current methods of obtaining biofuels from various vegetable oils used in current internal combustion diesel engines. Therefore, sufficient technologies are currently available to perform the fossil fuel replacement process, some of which have distinct advantages over the conventional biodiesel production process. In fact, the technology of converting renewable triglycerides into green fuels has been developed in oil refineries over the past five decades. However, in the last decade [93], there has been increasing interest in optimizing this method, focusing mainly on finding the best catalysts and optimal operating conditions for hydrogenated green fuels. In this sense, green diesel can be obtained by hydrolyzing the oils and fats present in oil refinery facilities, using the same catalysts, as well as utilizing the same reactors used in fossil diesel hydro transmission. The resulting paraffin is high-quality compounds that can be delivered immediately using the current logistics system. The maturity of the "green diesel" absorption process in conventional refineries is very high. However, this fact should not preclude further research in the field of biofuels, especially given the options discussed herein for converting triglycerides to renewable diesel without the production of glycerol as a by-product, since it can be It achieved higher atomic performance than the other advantages mentioned above. In this line, it is remarkable in the field of biofuels, such as biodiesel, that has been practically developed over the past decade that 100% atomic efficiency is always achieved without waste [94].

In addition, the biofuels obtained for working on current engines do not need to be refined or refined. This means that if we think on an industrial scale, there is a significant reduction in the cost of economic production. In fact, their product prices are relatively much lower than conventional biodiesel. Another interesting aspect is that all the reagents used in the refining of vegetable oils, for example, ethanol, acetate, or ethyl carbonate, are renewable in nature because, in all cases, it can be obtained from bioethanol, obtained from various agricultural products. It is also an exciting opportunity for CO2 to be produced in many industrial processes. These processes are prioritized to help minimize such greenhouse gas emissions [95].

The most important forms of biodiesel production, such as biodiesel, are catalytic systems used in homogeneous alkaline systems or different lipases. Undoubtedly, an interesting field is open to the search for heterogeneous catalytic systems that are open to the drawbacks of homogeneous systems (neutralization, separation, and cleaning of the product) as well as lowering the economical price of lipases. As a general conclusion, it can be stated that any of the alternative approaches presented in the past decade are capable of competing with conventional biodiesel to achieve a gradual replacement of fossil fuels by others with renewable nature [52], always considering, Needless to say, the fleet of existing cars will still be used, as well as any design changes to the CI diesel engines. It is, therefore, necessary to consider that the biofuel produced or its mixtures with fossil diesel must be as acceptable as prescribed by ASTM D 6751, which is currently required for conventional fossil diesel fuel. Surface demand does not meet the standard of EN 14214 for biofuels, which is ultimately demanded in a mixture of lower quality fossil diesel. Therefore, it is recommended that both policymakers and researchers direct their priorities to the development of these new processes [54], rather than the initial alternative, based on triglyceride transistors. In addition, we must not forget that these biofuels work in current engines, although energy transmission should include vehicles that have electric or hydrogen engines for urban transportation. If this is not the case, generating the biofuel needed to fuel the fleet of diesel-powered cars is not financially feasible without endangering agricultural sources for feed [51,52]. However, even in the long run, a scenario where explosive or combustion engines are not currently working with biofuels is not foreseeable, given that for some situations, electric motors or vehicles can use fuels. Fuel cannot compete with explosion or combustion engines yet, especially in the field of heavy trucks, aviation, or transport [53,55,55].

## 6. Conclusion

Biofuel is a compound containing oxygen. Therefore, understanding the important process for co-processing is crucial. Hydrostring is an effective way to do this with oil processing simultaneously because it can provide the complete hydrocarbon product of the oil phase and eliminate many of the product's properties. Oxygen release in the hydrogenation process involves three major reaction pathways, namely hydrocarbon-bonding, hydrocarboxylation, and hydrodeoxygenation. A different route can lead to the production of oil-phase hydrocarbons. Different path results cause differences in the consumption of hydrogen and the reaction parameter and the type of catalyst on them and prefer the appropriate method. In the current conditions of the refinery, oxygen delivery is achievable in a wide range of functions. Among the hydrotreating parameters, temperature and pressure have prominent effects. Even if higher hydrogen pressure is useful at a degree of hydrogenation, mild conditions should be considered to consider an economic plan based on hydrogen cost and operation. The catalyst plays an important role in the removal of oxygen by the use of hydrogen. Conventional base catalysts were commonly used, and various types of catalysts were tested, including noble metal catalysts and special zeolites or supports incorporated. Based on the present research, noble metal catalysts are likely to prefer hydrocarbonylation, whereas base catalysts prefer hydrogenation. Processed blends of petroleum oil with bio-oil can produce diesel quantities enhanced by the amount of cyanide, which may be a problem in the CFPP. Therefore, although the hydrogenation process can be sufficient to perform pre-mixed processes, especially for mixtures that contain small portions of bio-oil, hydrolysis or even the hydrocarbon process is better. On the one hand, light cycle crude oil (LCO) can be processed with bio-oil and can provide an excellent composition, but must be used in strict medical conditions. On the other hand, heavy gasoline (HGO) appears to have a synergistic effect on vegetable oil processing because the increase in the H / C ratio for feed with higher amounts of bio-component was 30% higher. With more than 10% of bio-components based on hydrocarbon hybrid research. Under slightly higher hydrogen pressure, the formation of aromatic hydrocarbons was suppressed. However, the further increase in the partial pressure of hydrogen has suppressed the conversion of stearic acid. At mild hydrogen pressure, HDS was probably inhibited by HDO.

## Acknowledgements

I’m hereby thank the Energy department of Amirkabir university of technology for the scientific supports.

### References

[1]. B. Kamm, P. R. Gruber and M. Kamm, “Biorefinery Industrial Processes and Products: Status and Future Direction,” Vol. 1-2, Wiley-Verlay Gmbtt and Co. KGaA, Weinheim, (2006).

[2]. C. V. Stevens and R. Verhe, “Renewable Bioresources Scope and Modification for Non-Food Application,” John Wiley and Sons Ltd., England, (2004).

[3]. D. Puppan, “Environmental Evaluation of Biofuels,” Period Polytechnica, Vol. 10, No. 1, (2002), pp. 95-116.

[4]. K. S. Tyson, “Biodiesel Handling and Use Guidelines,” National Renewable Energy Laboratory, Golden, (2001), p. 22.

[5]. J. L. Shumaker, C. Crofcheck, S. A. Tackett, E. Santillan-Jimenez and M. Crocker; Biodiesel Production from Soybean Oil Using Calcined Li-Al Layered Double Hydroxide Catalysts. *Catal. Lett.,* 115 (2007) 56-61.

[6]. J. Holmgren, “Biofuels: Unlocking the Potential,” ERTC 12th Annual Meeting, Barcelona, 19-21 November, (2007).

[7]. N. Eisberg, Harvesting Energy. *Chem. Ind.,* No. 17, (2006), pp. 24-25.

[8]. European Commission (EC), “Promoting Biofuels in Europe,” Directorate-General for Energy and Transport, Bruxelles, (2004), B-1049.

[9]. Meet Clean Diesel, “Renewable Diesel Fuels”. http://www.dieselforum.org

[10]. G. Knothe, Biodiesel and Renewable Diesel: A Comparison. *Prog. Energy. Combust. Sci.,* 36 (2010) 364-373.

[11]. O. i. Şenol, T.-R. Viljava and A. O. I. Krause, Hydrodeoxygenation of Aliphatic Esters on Sulphided Ni-MO/γ-Al2O3 and CoMo/γ-Al2O3 Catalyst: The Effect of Water. *Catal. Today.,* 106 (2005) 186-189.

[12]. O. i. Şenol, E.-M. Ryymin, T.-R. Viljava and A. O. I. Krause, Reactions of Methyl Heptanoate Hydrodeoxygenation on Sulphided Catalysts. *J. Mol. Catal. A. Chem.,* 268 (2007) 1-8.

[13]. O. i. Şenol, E.-M. Ryymin, T.-R. Viljava and A. O. I. Krause, Effect of Hydrogen Sulphide on the Hydrodeoxygenation of Aromatic and Aliphatic Oxygenates on Sulphided Catalysts. *J. Mol. Catal. A. Chem.,* 277 (2007).

[14]. S. Bezergianni, A. Kalogianni and I. A. Vasalos, Hydro-cracking of Vacuum Gas Oil-Vegetable Oil Mixtures for Biofuels Production. *Bioresour. Technol.,* 100 (2009) 3036-3042.

[15]. M. Ferrari, S. Bosmans, R. Maggi, B. Delmon and P. Grange, CoMo/Carbon Hydrodeoxygenation Catalysts: Influence of the Hydrogen Sulfide Partial Pressure and of the Sulfidation Temperature. *Catal. Today.,* 65 (2001) 257-264.

[16]. M. Ferrari, R. Maggi, B. Delmon and P. Grange, Influences of the Hydrogen Sulfide Partial Pressure and of a Nitrogen Compound on the Hydrodeoxygenation Activity of a CoMo/Carbon Catalyst. J. Catal., 198 (2001) 47-55.

[17]. G. de la Puente, A. Gil, J. J. Pis and P. Grange, Effects of Support Surface Chemistry in Hydrodeoxygenation Reactions over CoMo/Activated Carbon Sulfided Cata-lysts. *Langmuir.,* 15 (1999) 5800-5806.

[18]. J. Gusmaäo, D. Brodzki, G. Djéga-Mariadassou and R. Frety, Utilization of Vegetable Oils as an Alternative Source for Dieseltype Fuel: Hydrocracking on Educed Ni/SiO2 and Sulfided Ni-Mo/γ-Al2O3. Catal. Today., 4 (1989) 533-544.

[19]. W. F. Maier, W. Roth, I. Thies and P. V. Ragué Schleyer, Hydrogenolysis, IV. Gas Phase Decarboxylation of Car-boxylic Acids. *Chem. Ber.,* 115 (1982) 808-812.

[20]. P. Mäki-Arvela, I. Kubičkova, M. Snare, K. Eränen and D. Y. Murzin, Catalytic Deoxygenation of Fatty Acids and Their Derivatives. *Energy. Fuel.,* 21 (2007) 30-41.

[21]. M. Snare, I. Kubičkova, P. Mäki-Arvela, D. Chichova, K. Eränen and D. Y. Murzin, Catalytic Deoxygenation of Unsaturated Renewable Feedstocks for Roduction of Diesel Fuel Hydrocarbons. Fuel., 87 (2008) 933-945.

[22]. P. P. Nunes, D. Brodzki, G. Bugli, G. Djega-Mariadassou, Soybean Oil Hydrocracking under Pressure: Process and General Aspect of the Transformation. *Rev.*

*Inst. Franç. Pétrole.*, 41 (1986) 421-431.

[23]. M. E. Halttunena, M. K. Niemeläa, A. O. I. Krausea and A. I. Vuori, Rh/C Catalysts for Methanol Hydrocarbonylation. II. Activity in the Presence of MeI. *Appl. Catal. A. Gen.*, 182 (1999) 115-123.

[24]. M. Snare, I. Kubičková, P. Mäki-Arvela, K. Eränen, J. Wärna, D. Y. Murzin, Heterogeneous Catalytic Deoxygenation of Stearic Acid for Production of Biodiesel. Ind. Eng. Chem. Res., 45 (2006) 5708-5715.

[25]. G. W. Huber and A. Corma, Synergies between Bio- and Oil Refineries for the Production of Fuels from Biomass. *Angew. Chem. Int. Ed.*, 46 (2007) 7184-7201.

[26]. L. Reijnders, Conditions for the Sustainability of Biomass Based Fuel Use. *Energ. Policy.*, 34 (2006) 863-876.

[27]. L. C. Meher, D. V. Sagar and S. N. Naik, Technical Aspects of Biodiesel Production by Transesterification— A Review. *Renew. Sust. Energ. Rev.*, 10 (2006) 248-268.

[28]. C. Difiglio, Using Advanced Technologies to Reduce Motor Vehicle Greenhouse Gas Emissions. *Energ. Policy.*, 25 (1997) 1173-1178.

[29]. J. H. Marsman, J. Wildschut, F. Mahfud and H. J. Heeres, Identification of Components in Fast Pyrolysis Oil and Upgraded Products by Comprehensive Two-Dimensional Gas Chromatography and Flame Ionisation Detection. *J. Chromat. A.*, 1150 (2007) 21-27.

[30]. J. H. Marsman, J. Wildschut, P. Evers, S. de Koning and H. J. Heeres, Identification and Classification of Components in Flash Pyrolysis Oil and Hydrodeoxygenated Oils by Two-Dimensional Gas Chromatography and Time- of-Flight Mass Spectrometry. *J. Chromat. A.*, 1188 (2008) 17-25.

[31]. F. de Miguel Mercader, M. J. Groeneveld, S. R. A. Kersten, N. W. J. Way, C. J. Schaverien and J. A. Hogen-doorn, Production of Advanced Biofuels: Co-Processing of Upgraded Pyrolysis Oil in Standard Refinery Units. *Appl. Catal. B. Environ.*, 96 (2010) 57-66.

[32]. J. D. Rocha, C. A. Luengo and C. E. Snape, Hydrodexygenation of Oils from Ceelulose in Single and Two-Stage Hydripyrolysis. *Renew. Energ.*, 9 (1996) 950-953.

[33]. P. Grange, E. Laurent, R. Maggi, A. Centeno and B. Delmon, Hydrotreatment of Pyrolysis Oils from Biomass: Reactivity of the Various Categories of Oxygenated Compounds and Preliminary Techno-Economical study. *Catal. Today.*, 29 (1996) 297-301.

[34]. S. P. Zhang, Y. Yongjie, T. Li, et al. Upgrading of Liquid Fuel from the Pyrolysis of Biomass. *Bioresour. Technol.*, 96 (2005) 545-550.

[35]. Y. Xu, T. Wang, L. Ma, Q. Zhang and L. Wang, Upgrading of Liquid Fuel from the Vacuum Pyrolysis of Biomass over the Mo-Ni/γ-$Al2O3$ Catalysts. *Biomass. Bioenerg.*, 33 (2009) 1030-1036.

[36]. Y. Xu, T. Wang, L. Ma, Q. Zhang and W. Liang, Upgrading of the Liquid Fuel from Fast Pyrolysis of Bio-mass over MoNi/γ-$Al2O3$ Catalysts. *Appl. Energ.*, 87 (2010) 2886-2891.

[37]. J. Wildschut, I. Melián-Cabrera and H. J. Heeres, Catalyst Studies on the Hydrotreatment of Fast Pyrolysis Oil. *Appl. Catal. B. Environ.*, 99 (2010) 298-306.

[38]. M. Stumborg, A. Wong and E. Hogan, Hydroprocessed Vegetable Oils for Diesel Fuel Improvements. *Bioresour. Technol.*, 56 (1996) 13-18.

[39]. L. Avaullée, P. Duchet-Suchaux, M. Durandeu and J. N. Jaubert, A New Approach in Correlating the Oil Thermodynamic Properties. *J. Petrol. Sci. Eng.*, 30 (2001) 43-65.

[40]. C. Fragale, M. Gargano, N. Ravasio, M. Rossi and I. Santo, Catalytic Hydrogenation of Vegetable Oils: III. A Comparison of Reactivity and Selectivity between Cyclic Polyenes and Polyunsaturated Fatty Acids with Copper Chromite as Catalyst. *Inorg. Chim. Acta.*, 82 (1984) 157-160.

[41]. J. S. Milano-Brusco and R. Schomäcker, Catalytic Hydrogenations in Microemulsion Systems with Rh-TPPTS: Partial Hydrogenation of Sunflower Oil. *Catal. Lett.*, 133, (2009) 273-279.

[42]. Ullmann, "Ullmann's Encyclopedia of Industrial Chemis-try," Vol. 13, Wiley-VCH Verlag GmbH & Co., Wein-heim, (2003).

[43]. R. C. Christiansen, Neste Oil Building Singapore Renewable Diesel Plant. Biodiesel Magazine, March (2009). http://www.biodieselmagazine.com/article.

[44]. Schill, S.R. JAL flight to test camelina-jatropha-algae fuel. Biodiesel Magazine, January (2008). http://www.biodieselmagazine.com/article

[45]. J. L. Harwood and F. D. Gunstone, Occurrence and char-acterisation of oils and fats," In: F. D. Gunstone, J. L. Harwood and J. L. Dijkstra, Eds., The Lipid Handbook, CRC Press, *Boca. Raton.*, (2007) 37-141.

[46]. Q. Hu, M. Sommerfeld, E. Jarvis, M. Ghirardi, M, Pose-witz, M. Seibert, et al., Microalgal Triacylglycerols as Feedstocks for Biofuel Production: Erspectives and Advances. *Plant. J.*, 54, (2008) 621-639.

[47]. J. L. Guil-Guerrero, F. Gómez-Mercado, F. García-Marotoc and P. Campra-Madrida, Occurrence and Characterization of Oils Rich in γ-Linolenic Acid: Part I: Echium Seeds from Macaronesia. *Phytochem.*, 53 (2000) 451-456.

[48]. D. Kubička, J. Chudoba, P. Šimaček, "Europacat VIII," Turku, 26-31 August (2007).

[49]. N. Zeman, "Neste Oil Starts Construction on Europe's Largest Renewable Fuels Plant," Biodiesel Magazine, May (2009). http://www.biodieselmagazine.com/article

[50]. M. Izadifar and M. Z. Jahromi, "Application of Genetic Algorithm for Optimization of Vegetable Oil Hydrogenation Process. *J. Food. Eng.*, 78 (2007) 1-8.

[51]. G. N. da Rocha Filho, D. Brodzki and G. Djéga-Mariadassou Formation of Alkanes, Alkylcycloalkanes and Alkylbenzenes during the Catalytic Hydrocracking of Vegetable Oils, *Fuel.*, 72 (1993) 543-549.

[52]. D. Kubička and L. Kaluža, Deoxygenation of Vegetable Oils over Sulfided Ni, Mo and NiMo Catalysts. *Appl. Catal. A. Gene.*, 372 (2010) 199-208.

[53]. P. Šimáček, D. Kubička, G. Šebor and M. Pospíšil, Fuel Properties of Hydroprocessed Rapeseed Oil. *Fuel.*, 89 (2010) 611-615.

[54]. P. Šimáček, D. Kubička, G. Šebor and M. Pospíšil, Hydroprocessed Rapeseed Oil as a Source of Hydrocar-bon-Based Biodiesel. *Fuel.*, 88 (2009) 456-460.

[55]. P. Šimaček and D. Kubičk, Hydrocracking of Petroleum Vacuum Distillate Containing Rapeseed Oil: Evaluation of Diesel Fuel. *Fuel.*, 89 (2010) 1508-1513.

[56]. K. C. Kwon, H. Mayfield, T. Marolla, B. Nichols and M. Mashburn, Catalytic Deoxygenation of Liquid Biomass

[57]. for Hydrocarbon Fuels. *Renew. Energ.*, 36 (2011) 907-915.

[58]. J. Monniera, H. Sulimmab, A. Dalaib and G. Caravaggio, Hydrodeoxygenation of Oleic Acid and Canola Oil over Alumina-Supported Metal Nitrides. *Appl. Catal. A. Gen.*, 382 (2010) 176-180.

[59]. O. V. Kikhtyanin, A. E. Rubanov, A. B. Ayupov and G. V. Echevsky, Hydroconversion of Sunflower Oil on Pd/SAPO-31 Catalyst. *Fuel.*, 89 (2010) 3085-3092.

[60]. J. Hancsók, M. Krár, S. Magyar, L. Boda, A. Holló and D. Kalló, Investigation of the Production of High Cetane Number Bio Gas Oil from Pre-Hydrogenated Vegetable Oils

over Pt/HZSM-22/Al2O3. *Microporous. Mesoporous. Mater.,* 101 (2007) 148-152.

[61]. D. Kubička and J. Hořácek, Deactivation of HDS Catalysts in Deoxygenation of Vegetable Oils. *Appl. Catal. A. Gene.,* 394 (2010) 9-17.

[62]. E. Furimsky, Chemistry of Catalytic Hydrogenation. *Catal. Rev. Sci. Eng.,* 25 (1983) 421-458.

[63]. E. Dorrestijn and P. Mulder, The Radical-Induced Decomposition of 2-Methoxyphenol. *J. Chem. Soc.,* 2 (1999) 777-780.

[64]. G. N. da Rocha Filho, D. Brodzki and G. Djéga-Mariadassou, Formation of Alkanes, Alkylcycloalkanes and Alkyl-benzenes during the Catalytic Hydrocracking of Vegeta-ble Oils. *Fuel.,* 72 (1993) 543-549.

[65]. S. Echeandia, P. L. Arias, V. L. Barrio, B. Pawelec and J. L. G. Fierro, Synergy Effect in the HDO of Phenol Over Ni-W Catalysts Supported on Active Carbon: Effect of Tungsten Precursors. *Appl. Catal. B. Environ.,* 101 (2010) 1-12.

[66]. L. Boda, G. Onyestyák, H. Solt, F. Lónyi, J. Valyon and A. Thernesz, Catalytic Hydroconversion of Tricaprylin and Caprylic Acid as Model Reaction for Biofuel Produc-tion from Triglycerides. *Appl. Catal. A. Gene.,* 374 (2012) 158-169.

[67]. Kubičková, M. Snare, K. Eränen, P. Mäki-Arvela and D.Y. Murzin, Hydrocarbons for Diesel Fuel via Decarboxylation of Vegetable Oils. Catal. Today., 106 (2005) 197-200.

[68]. Q. Smejkala, L. Smejkalováa and D. Kubičkab, Thermodynamic Balance in Reaction System of Total Vegeta-ble Oil Hydrogenation. *Chem. Eng. J.,* 146 (2009) 155-160.

[69]. S. Vitu, R. Privat, J. N. Jaubert and F. Mutelet, Predicting the Phase Equilibria of CO2 + Hydrocarbon Systems with the PPR78 Model (PR EOS and kij Calculated through a Group Contribution Method). *J. Supercrit. Fluids.,* 45 (2008) 1-26.

[70]. G. Joback, A Unified Approach to Physical Property Estimation Using Multivariate Statistical Techniques. Master's Thesis, MIT, Cambridge, (1984).

[71]. Q. Smejkala, L. Smejkalová and D. Kubička, Thermodynamic Balance in Reaction System of Total Vegetable Oil Hydrogenation. *Chem. Eng. J.,* 146 (2009) 155-160.

[72]. E. Laurent and B. Delmon. Study of the Hydrodeoxygenation of Carbonyl, Carboxylic and Guaiacyl Groups over Sulfided CoMo/γ-Al2O3 and NiMo/γ-Al2O3 Catalysts: II. Influence of Water, Ammonia and Hydrogen Sulfide. *Appl. Catal. A. Gen.,* 109 (1994) 97-115.

[73]. O. I. Şenol, T.-R. Viljava and A. O. I. Krause, Effect of Sulphiding Agents on the Hydrodeoxygenation of Ali-phatic Esters on Sulphided Catalysts. *Appl. Catal. A. Gen.,* 326 (2007) 236-244.

[74]. V. N. Bui, G. Toussaint, D. Laurenti, C. Mirodatos and C. Geantet, Co-Processing of Pyrolisis Bio Oils and Gas Oil for New Generation of Bio-Fuels: Hydrodeoxygena-tion of Guaïacol and SRGO Mixed Feed. *Catal. Today.,* 143 (2009) 172-178.

[75]. O. İ. Şenol, T.-R. Viljava and A. O. I. Krausede, Hydrodeoxygenation of Methyl Esters on Sulphided NiMO/γ-Al2O3 and CoMo/γ-Al2O3 catalysts. *Catal. Today.,* 100 (2005) 331-335.

[76]. Sebos, A. Matsoukas, V. Apostolopoulos and N. Papayannakos, Catalytic Hydroprocessing of Cottonseed Oil in Petroleum Diesel Mixtures for Production of Re-newable Diesel. *Fuel.,* 88 (2009) 145-149.

[77]. Walendziewski, M. Stolarski, R. Łużny and B. Klimek, Hydroprocesssing of Light Gas Oil—Rape Oil Mixtures. *Fuel. Process. Technol.,* 90 (2009) 686-691.

[78]. G. W. Huber, P. ƠConnor and A. Corma, Processing Biomass in Conventional Oil Refineries: Production of High Quality Diesel by Hydrotreating Vegetable Oils in Heavy Vacuum Oil Mixtures. *Appl. Catal. A. Gene.,* 329 (2007) 120-129.

[79]. F. Z. Benhachem; T. A.; Fouzia Bouabdallah. Kinetic study of adsorption methylene blue dye from aqueous solutions using activated carbon. *Chem. Rev. Lett.,* 2 (2019) 33-39.

[80]. S. Sarhandi., Z. Rahmani., R. Moghadami, M. Vali, E. Vessally. New insight in Hiyama cross-coupling reactions: Decarboxylative, denitrogenative and desulfidative couplings. *Chem. Rev. Lett.,* 1 (2018) 9-15.

[81]. F. Valinia; N. Shojaei; P. Ojaghloo. Novel 1-(4-chlorophenyl)-3-(2-ethoxyphenyl)triazene ligand: Synthesis, X-ray crystallographic studies, spectroscopic characterization and DFT calculations. *Chem. Rev. Lett.,* 2 (2019) 90-97.

[82]. S. A. Siadati; K Kula; E. Babanezhad. The possibility of a two-step oxidation of the surface of C20 fullerene by a single molecule of nitric (V) acid. *Chem. Rev. Lett.,* 2 (2019) 2-6.

[83]. F. Krika; A. Krika; A. Azizi. Arundo donax L. as a low-cost and promising biosorbent for the removal of crystal violet from aqueous media: kinetic, isotherm and thermodynamic investigations. *Chem. Rev. Lett.,* 2 (2019) 59-68.

[84]. S. Majedi; H. G. Rauf; M. Boustanbakhsh. DFT study on sensing possibility of the pristine and Al- and Ga-embeded B12N12 nanostructures toward hydrazine and hydrogen peroxide and their analogues. *Chem. Rev. Lett.,* 2 (2019) 176-186.

[85]. R. Kakulvand. The effects of transient heat flux on the tube in contact with the natural convection, on enthalpy and entropy generation, for developed laminar flow of fluid with high Prandtl number. *Chem. Rev. Lett.,* 2 (2019) 165-175.

[86]. D. E. Arthur; A. A. Oyibo; S. N. Adawara; S. Hassan; E. Uwaiya. Miscibility study of poly acrylamide (PAM) and Acacia Senegal (gum arabic) blends. *Chem. Rev. Lett.,* 2 (2019) 157-164.

[87]. E. A. Mahmood; B. Azizi; S. Majedi. Decarboxylative cyanation and azidation of carboxylic acids: An overview. *Chem. Rev. Lett.,* 3 (2020) 2-8.

R. Moladoust. Sensing performance of boron nitride nanosheets to a toxic gas cyanogen chloride: Computational exploring. *Chem. Rev. Lett.,* 2 (2019) 151-156.

[88]. C. Mustapha; D. Benamar. Comparison of the bromate ions removal by nanofiltration membranes made from different polymers at different conditions. *Chem. Rev. Lett.,* 2 (2019) 118-122.

[89]. M. Nikpassand; Leila Zare Fekri. Synthesis of bis coumarinyl methanes using of potassium 2-oxoimidazolidine-1,3-diide as a novel, efficient and reusable catalyst. *Chem. Rev. Lett.,* 2 (2019) 7-12.

[90]. A. O. Gezerman. Effects of ammonium thiosulfate and guanyl thiourea as calcium ammonium nitrate inhibitors on fertilization and plants. *Chem. Rev. Lett.,* 2 (2019) 84-89.

[91]. N. Norouzi, M. Fani, Z. K. Ziarani, The fall of oil Age:A scenario planning approach over the last peak oil of human history by 2040, Journal of Petroleum Science and Engineering, Volume 188, (2020), 106827, ISSN 0920-4105.

[92]. F. B.; Z. Asadi; Y. J. Sadeghi. Synthesis, spectroscopic and computational investigation of bis (3-methoxyphenylthio) ethyl) naphthalene. *Chem. Rev. Lett.,* 1 (2018) 68-76.

[93]. F. Gharibzadeh; S. Gohari; K. Nejati; B. Hashemzadeh;

S. Mohammadiyan. The Be atom doping: An effective way to improve the Li-atom adsorption in boron rich nanoflake of B24. *Chem. Rev. Lett.*, 1 (2018) 16-22.

[94]. E. Babanezhad; A. Beheshti. The Possibility of Selective Sensing of the Straight-Chain Alcohols (Including Methanol to n-Pentanol) Using the C20 Fullerene and C18NB Nano Cage. *Chem. Rev. Lett.*, 1 (2018) 82-88.

[95]. M. H. N. Janjanpour; M. Vakili; S. Daneshmehr; K. Jalalierad; F. Alipour. Study of the Ionization Potential, Electron Affinity and HOMO-LUMO Gaps in the Smal Fullerene Nanostructures. *Chem. Rev. Lett.*, 1 (2018) 45-48.

## How to Cite This Article

Nima Norouzi; Saeed Talebi. "An overview on the green petroleum production". Chemical Review and Letters, 3, 1, 2020, 38-52. doi: 10.22034/crl.2020.222515.1041