Organic Chemistry: Current Research
ISSN: 2161-0401
OPEN ACCESS Freely available online
Short Communication

Production of Hydrocarbons Using Nickel-based Catalysts

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DESCRIPTION

Hydrocarbons production from vegetable oil and their derivatives for use in aviation, kerosene and diesel are potential alternative approach to reduce the usage of fossil fuels. At a temperature of 300°C and a reaction period of 7 hours, reactions with the catalysts Ni/Al_2O_3 and Ni/Nb_2O_5 demonstrated selectivity of 41.2% and 16.5%, respectively, for soy ester. Under the same conditions, Ni/Beta and Ni/HY zeolites induced superior conversion (between 80% and 99%) compared to oxide catalysts and selectivity (between 30% and 70% for Ni/Beta and Ni/HY, respectively) between 80% and 99%.

Zeolite catalysts also showed high conversion at higher temperatures (340°C) and longer times (9 h), achieving 100% conversion with hydrocarbons selectivity of 76.8% and 61.9% for zeolite Beta and HY, respectively [1-3]. It was possible to observe that zeolite catalysts displayed high selectivity, reaching 100%, when the input material was changed to fatty acids. Given that catalysts work so well in hydro processing reactions, it is possible to view them as a promising alternative path because they can lower production when utilized in place of the industry-standard noble metals.

Sustainability is a crucial component for any alternative fuel to be accepted by the general population. The optimum solution is to advanced biofuels made from cutting-edge technologies and environmentally friendly crops or agricultural byproducts. Over the past ten years, research on diesel and bio kerosene alkanes has increased, including catalytic hydro processing of fatty acids or esters produced from biomass oils (vegetable oils, animal fats, and residual oils). These oils typically contain fatty acids with a C14 to C24 range, with C18 being the predominant one. As a result, they have similar fuel characteristics to petroleum derivatives and can be used to create hydrocarbons.

Nonlauric oil can be derived from this oilseed; it is present in the fibrous pulp that surrounds the fruit seed and is high in carotenoids (Beta-carotene), substantial antioxidants, and lauric oil, which is present in almonds. Palm oil uses less hydrogen during hydro processing than other vegetable oils because its composition comprises less unsaturated fatty acids overall. Through hydro processing, it is possible to transform vegetable oils into liquid alkanes. The double bonds in the vegetable oil are hydrogenated during the reaction, resulting in the formation of monoglycerides, diglycerides, and carboxylic acids [4]. Three separate processes-decarboxylation, decarbonylation, and hydrogenation/dehydration-convert these intermediate products to alkanes. The isomerization and cracking of straight chain alkanes (C15–C18) can result in the production of more luminescent and isomerized alkanes. In contrast, isomerization and cracking reactions can be catalysed by the fatty acids produced during the hydro treating process. Wax esters can also change into hydrocarbons.

Transition metal catalysts, such as those made of nickel, copper, molybdenum, cobalt, tungsten, and iron, or their bimetallic composites supported, in most cases, by alumina (Al_2O_3) or niobium (Nb_2O_5), typically exhibit high conversion in hydroprocessing. However, some raw materials' sulphur leaching can contaminate the finished goods. There has been an increase in research in recent years to create low-cost catalysts due to the high cost of noble metal catalysts and the potential for contamination of the finished product by Sulphur (S) when utilising sulphide catalysts. In terms of conversion, selectivity, stability, and useful life, choosing the best catalysts increases the process's overall economic feasibility and sustainability [5]. The use of catalysts supported on niobium, alumina, and zeolites in hydrolysis, hydroesterification, and hydroprocessing reactions has received massive attention. Under the conditions analyzed for the production of hydrocarbons, the hydroprocessing reaction of palm oil, soybean methyl ester, and fatty acids catalysed on oxides and zeolites supported on nickel produced good results.

CONCLUSION

The hydroprocessing of soybean methyl ester with the Ni/Al_2O_3 catalyst (41.2%) and the hydroprocessing of fatty acids with the zeolites Beta and HY, both at 100%, were shown to have the highest selectivities. The conversion of hydrocarbons was enhanced by the increase in reaction time and temperature. Given the superior performance of catalysts in the catalytic hydroprocessing reaction compared to conversions carried out

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Received: 04-Aug-2022, Manuscript No. OCCR-22-19147; **Editor assigned:** 08-Aug-2022, PreQC No. OCCR-22-19147 (PQ); **Reviewed:** 22-Aug-2022, QC No. OCCR-22-19147; **Revised:** 29-Aug-2022, Manuscript No. OCCR-22-19147 (R); **Published:** 07-Sep-2022, DOI: 10.35841/2161-0401.22.11.290

Citation: Nakano C (2022) Production of Hydrocarbons Using Nickel-based Catalysts. Organic Chem Curr Res. 11: 290.

with noble metals frequently used in the biofuel industry. They can be viewed as promising alternatives because the use of transition metals as a catalyst lowers the cost of production.

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