A PROJECT REPORT ON

Biodiesel production using CaO deposited on microporous Activated carbon (CaO/C- K_2CO_3) from waste cooking oil

Dissertation submitted to

GOA UNIVERSITY

In partial fulfillment of the award of the degree of

MASTER OF SCIENCE

SEMESTER IV

By

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Roll No.: 20P0490026

Under the guidance of

Dr. Anjani P. Nagvenkar

To the

DEPARTMENT OF CHEMISTRY

GOA UNIVERSITY

CERTIFICATE

This is to certify that work incorporated in the project entitled "**Biodiesel production using CaO deposited on microporous activated carbon (CaO/C- K_2CO_3) from waste cooking oil"** is bonafied work done by **Miss Amita G.Gaonkar** during the period of study under my guidance in partial fulfillment of requirement for the award of the Degree of Master of science in Chemistry at the Department of Chemistry, Goa University during the academic year **2021- 2022**.

Dr. Anjani P. Nagvenkar

Project guide

School of Chemical Sciences

Goa University

Prof. Vidhyadatta Verenkar

Dean

School of Chemical Sciences

Goa University

DECLARATION

I declare that matter presented in this project entitled "**Biodiesel production using CaO deposited on microporous activated carbon (CaO/C- K_2CO_3) from waste cooking oil**" is the original work done by me at the Department of Chemistry, Goa University, Taleigao Plateau, Goa under the guidance of Dr. Anjani P. Nagvenkar. And to the best of my knowledge similar work has not been submitted elsewhere for the fulfillment of the requirement of course of study.

Date: 29 April 2022 Candidate Signature

Place: Goa University,

Taleigao- Goa AMITA G. GAONKAR

(M.Sc. Part- II)

ACKNOWLEGDEMENTS

I would like to express my special thanks of gratitude to my project guide Dr. Anjani P. Nagvenkar who gave me the golden opportunity to do this wonderful project on the topic "**Biodiesel production using catalyst calcium oxide deposited on microporous activated carbon (CaO/C- K_2CO_3) from waste cooking oil**", which also helped in doing a lot of research and I come to know about many new things.

Secondly I would also like to thank IT Department who provided us good internet connection. And I like express my deep appreciation for the individual support, guidance, co- operation and encouragement rendered by my parents and friends throughout this project and college life.

CONTENT

BIODIESEL PRODUCTION USING CATALYST CaO DEPOSITED ON MICROPOROUS ACTIVATED CARBON (CaO/C- K_2CO_3) FROM WASTE COOKING OIL

1. INTRODUCTION

Fossil fuels now becoming as emerging fuel and using fossil fuel environmental impact also increasing. It is necessary to find solution for this for future generation. Biodiesel production is the best remedies to overcome this problems. Biodiesel is defined as a mixture of fatty acid methyl esters (FAME) obtained through transesterification of triglycerides from renewable sources. Biodiesel is renewable, clean burning liquid fuel, which can be produce by transesterification reaction from biomass sources like waste cooking oil [1,2,3,4,16].

Transesterification is one of the reversible reaction and proceeds via mixing reactants, so need of catalyst to accelerate the conversion. Heterogeneous catalyst are more used over homogeneous catalyst since it provide easy separation of product, non corrosive and ecofriendly. Many metal oxides, such as alkali earth metal oxide, transition oxides, mixed metal oxides and supported metal oxides, has been studied as heterogeneous solid catalyst [1,5,6,7,8]..

The order of activity of alkaline earth metal oxides catalyst is given as follow BaO > SrO > CaO >MgO [1]. Barium is rare metal and BaO dissolves in methanol and Sr is expensive [9]. Availability of CaO is naturally abundant as limestone and other source of CaO production are waste shells, such as crab shells, egg shells, mussel shells. Several work has been

reported using catalytic support which can provide high surface area thus can increase the yield[10,5,11,12,13]. Microporous activated carbon acts as highly effective catalyst support, which provide high surface area, stability, controllable pore size and allow disperse reactant effectively [1,14,5,15,3,16].

CaO shows higher basicity, non- corrosive, can be synthesized with lower price and easy to handle. The main purpose of this study is to enhance the production of biodiesel from waste cooking oil using CaO deposited on microporous activated carbon. It is expected that replacing the commercial CaO with CaO deposited on microporous activated carbon can lead to further improvement in the transesterification rate[7,4,17,18,16,19]

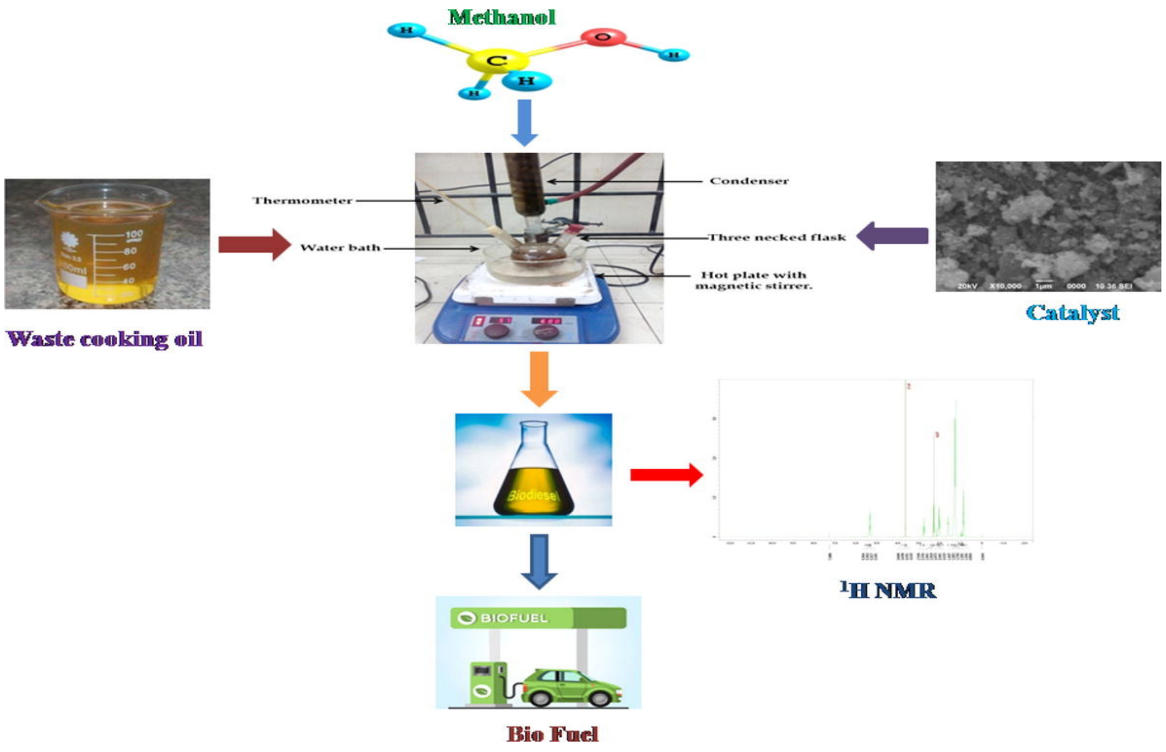

Fig. 1. Transesterification of waste cooking oil for biodiesel production catalyzed by CaO

2. IMPORTANCE OF PROJECT

The utilization of successful heterogeneous catalyst will cope with most of economical and environmental drawbacks of homogeneous process. CaO impregnated on microprous activated carbon will increase the catalyst performance thus increase the yield of biodiesel. CaO is easily available in nature as limestone and one can make use of egg shell, mussel shell, crab shell for production of CaO this will be cost effective [20,17,21,22,7,9]. Among the alkali and alkali metal oxides, CaO is one of the solids that have displayed higher transesterification activity. Many studies reported that CaO is an attractive catalyst for the transesterification reaction of the waste cooking oil that can be re- used for several runs without any deactivation. Finally other alkali earth oxides or hydroxides, like for instance SrO or Ba(OH)2 show higher activity but they dissolves in reaction medium [11,1,23,24,5,14]. So CaO deposited on microporous activated carbon will be most suitable catalyst to be used for enhancement of biodiesel production.

3. METHODOLOGY

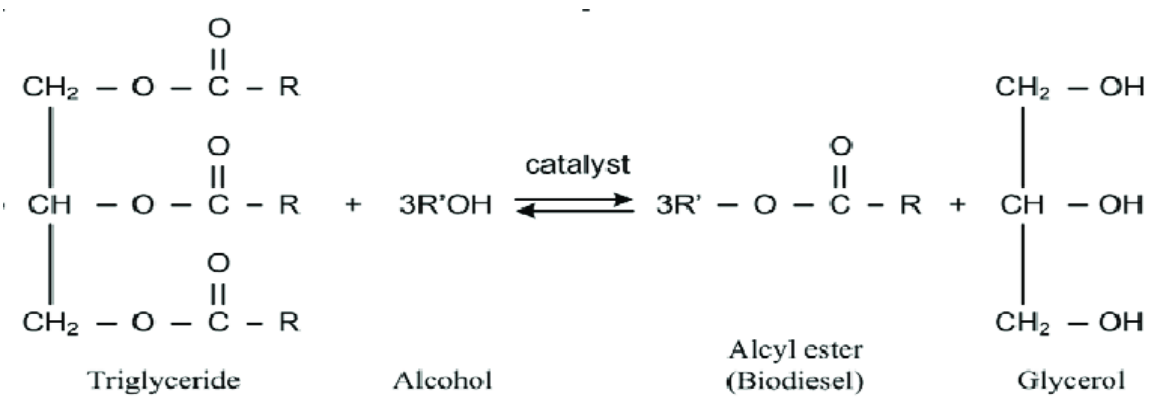

Fig. 2.Transesterification of a triglyceride for biodiesel production

To enhance the catalytic activity of catalyst activation of carbon will be done by using K_2CO_3 which will introduce more micropororsity compared to KOH activated carbon [2,25,]. This will be proceeded by mixing carbon source with K_2CO_3 for 24 hours than mixer will be dried at 110^0c this impregnated sample was pyrolysed at the temperature of around 600^0c under N_2 flow of 30ml min^{-1} at a heating rate 5^0c min^1. Carbonised sample will be washed with hot water till it treated with HCl to remove impurity and washing of hot water will be given to remove chloride ions and finally product id dried at 110^0c.

Collected waste cooking oil will be treated to remove the residual moisture content, precipitate and other residue in oil with phosphoric acid and by maintaining standard temperature. Further it will be filtered using whatmann filter paper. Filtered WCO will directly used for FAME production [13,1,10,27].

In order to enhance the catalytic activity of catalyst, dried and grounded CaO will be mixed with activated carbon followed by calcination at optimum temperature for few hours in N_2

flow. The catalytic performance of CaO supported on activated microporous carbon will evaluate in transesterification of waste cooking oil with methanol.

The transesterification will be performed in a 100- ml three- neck round- bottom flask equipped addition of the oil. The reaction mixture is then vigorously stirred at 500 rpm and refluxed at different temperatures for 6h [5,12,24,28].

Performance of synthesized catalyst will be compared with without supported CaO with carbon in production of biodiesel. Characterisation of synthesized catalyst will be done followed by basicity and specific surface area of catalyst will be characterized using Hammet indicator and Brunaeur- Emmet- Teller(BET) methods respectively. Catalytic activity measurement and reutilization of the catalyst will be done.

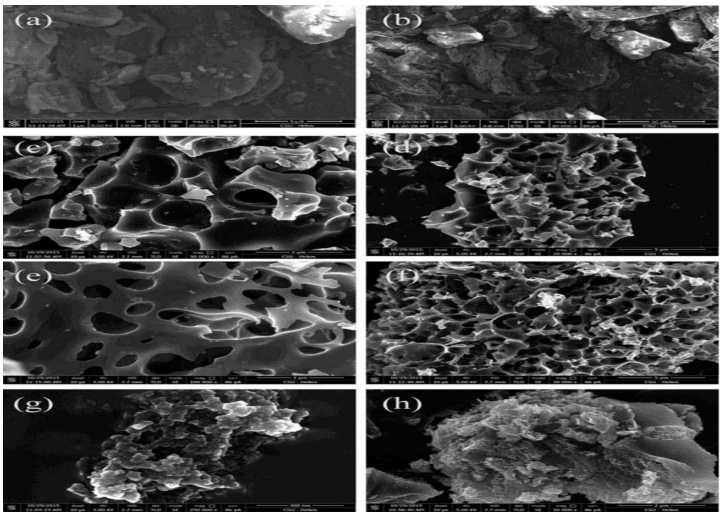

Fig. 3. SEM image of (a, b) raw tobacco stem and AC samples, (c, d) activation with KOH, (e, f) activated with K_2CO_3, and (g, h) activated with $ZnCl_2$.

4. OUTCOME

The use of this novel catalyst CaO deposited on microporous activated carbon this catalysts will become a recent interest to make biodiesel production more sustainable. In addition, the use of these catalysts will promise to reduce the current high cost of biodiesel production, making biodiesel competitive with petrodiesel fuels. Research is therefore aimed to develop environmentally friendly, cost- effective, and efficient biobased catalyst for biodiesel production. Consequently, different natural sources (animals, plants, microorganisms) have been used for synthesizing biobased catalysts including acid catalysts, alkali catalysts, and enzymes. The catalytic activity of these catalysts varies among other catalyst since CaO will deposite on microporous activated carbon, activation of carbon will done using K_2CO_3 which will increase microporosity compared to KOH activated carbon which alternetly result in increasing biodiesel yield.

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