SIIC017

SYNTHESIS AND CHARACTERIZATION OF METAL OXIDES CATALYST FOR PRODUCTION OF FAME: A COMPARATIVE STUDY

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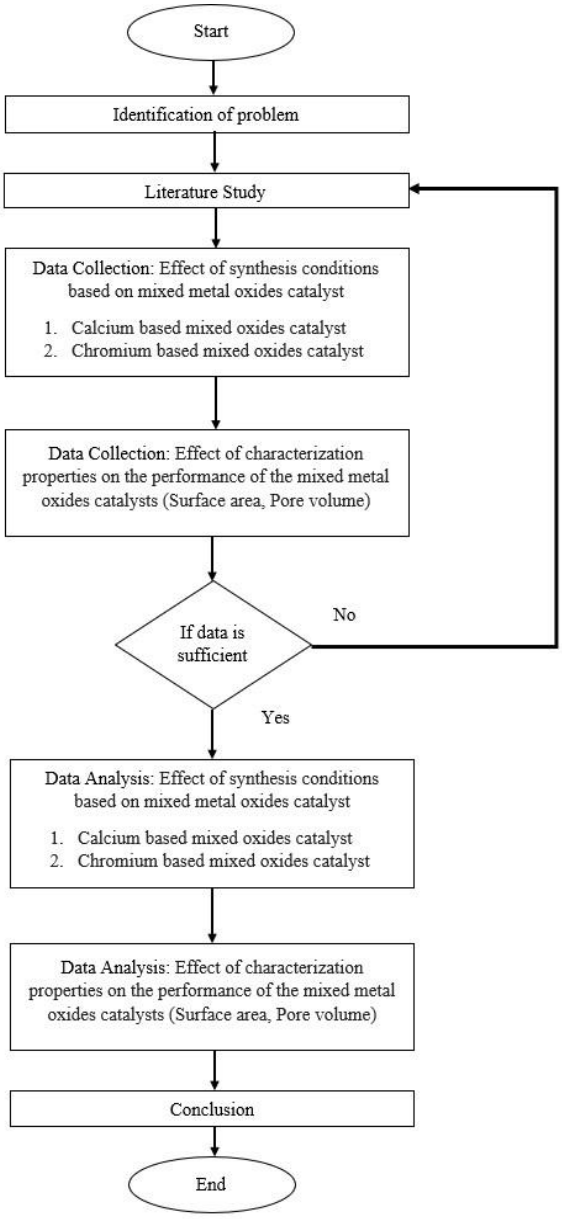
Abstract:
The accelerating growth and demands in energy consumption, together with growing environmental concerns has sparked renewed attention on the search for an alternative fuel to replace conventional diesel. At present, the pressing awareness on global environmental problem contributed by the burning of fossil fuel as non- renewable energy urge researchers around the world to perform study on biodiesel as an alternative for current world energy sources. Numerous research studies have shown the potential of the usage of heterogenous catalyst in the transesterification process for the production of biodiesel varied through various parameters. Despite the success of numerous heterogenous catalyst in the. industry, Calcium and Chromium based mixed metal oxides catalyst continues to show its promising capability and performance in catalysing the transesterification reaction. In this regard, this research paper presents a comparative approach of synthesis and characterization process of these metal oxides catalyst for production of FAME. The performance of these mixed oxides catalysts was reviewed through its catalytic activity under optimal condition as well as its surface area and pore volume characterization study. This review also includes the recent application of mixed metal oxides catalyst in biodiesel conversion as well its future outlook and suitability for industrial application.

***Keywords*:**
Methyl ester, Biodiesel, Metal oxides, Transesterification, Heterogenous catalyst

Objectives:

- To perform comparative study on synthesis and characterization of metal oxides catalysts for production of FAME based on past research study.
- To study the characterization of metal oxide catalysts based on the analysis of surface area, porosity, pore volume, pore size distribution properties and thermal stability.

Methodology:



Results:

Catalyst	Oil	Optimum reaction condition				FAME yield (%)	Surface Area (m^2/g)	Reference
		Temp (°C)	Methanol to oil ratio	Catalyst loading (%)	Reaction time (hours)			
$CaO\text{-}CeO_2$	Jatropha curcas oil	65	15:1	4	-	95	18	[11]
CaLaO	Jatropha curcas oil	240	21:1	1	1	93	10.3	[14]

$CaO\text{-}La_2O_3$	Jatropha curcas oil	65	24:1	4	1	86.51	11.1	[16]
CaZnO	Jatropha curcas oil	65	15:1	4	6	86	15.5	[17]
CaMgO	Jatropha curcas oil	65	15:1	4	6	89	9.8	[17]
Ca_3La_1	Jatropha curcas oil	65	10:7.6	5	1.5	94.3	62.6	[18]
CaZr	Rapeseed oil	120	72:1	8	6	92.6	42.82	[19]
CaAl	Soybean oil	60	12:1	6	1	93	89	[20]
CaFeAl	Soybean oil	60	12:1	6	1	98	117	[20]
CaO/Mo-Zr	Waste cooking oil	80	15:1	3	3	90.1	6.5	[21]
$CaO\text{-}La_2O_3$	Jatropha curcas oil	120	25:1	12	3	90	7.7	[22]
CaO	Rice bran oil	1100	30:1	0.4	2	93	1.34	[13]
Cr/Ca Oxide	Cooking palm oil	60	6:1	1	3 hrs	27.8	3.69	[15]
Cr/Zn Oxide	Cooking palm oil	60	6:1	1	3 hrs	7.4	3.99	[15]
$CrWTiO_2$	PFAD	170	2:1	2	3 hrs	80.28	75.48	[5]
$CrWO_2$	PFAD	170	2:1	1.5	3 hrs	85.78	3.11	[8]
$CrWMnO_2$	PFAD	170	3:1	1.5	3 hrs		85	[23]
Cr/Ca/gAl2O3	Low grade cooking oil	600	-	11.2	24 h	93.10	196.46	[24]
Cr/Mo oxide	Vegetable oils	130	75:1	5	7 hrs	43	253	[25]

Conclusion:

Numerous past studies agrees that differences in surface area of catalyst could greatly affect its catalytic activity, thus, escalating its FAME yield [35]–[38]. The observation on past studies suggest that catalysts with larger surface areas tend to exhibit higher FAME conversion. Larger surface areas provide higher catalytic interaction which results in better performance of catalyst. Similarly, it was reported that the specific pore volume of catalyst will contributes to its performance. The pore size distribution and its volume are important to ensure efficient transport of reactants and products to and from the active surface [39]. Most of the findings discussed agreed that the larger pore volume and size distribution of catalyst reflects on their best catalytic activity under optimal condition. Numerous research articles on mixed metal oxides catalyst evidence on its capability as a promising potential in biodiesel production in the near future. Mechanism of mixed metal oxides catalyst-based transesterification has already had substantial catalytic activity, and as to further enhance its performance, current researches are in effort by number of possible ways and means. This scenario gives even a brighter outlook for the use of mixed oxides catalyst in transesterification reaction to produce FAME. However, many areas need to be explored to further enhance the performance of these mixed oxide catalyst, thus, more intense research has to be made to evidence on their potential as on of the best catalyst to be used in the industrial level.