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SYNTHESIS AND STUDY EFFECT OF PREPARATION METHOD AND CHARACTERIZATION OF MIXED METAL OXIDE CATALYST FOR FAME PRODUCTION: A COMPARATIVE STUDY

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Abstract:
Studies relating to fatty acid metyl ester(FAME) have gained much interest in recent year due to the demand for eco-friendly energy resouce to replace petroleum. The common process to produce FAME is transesterification of vegetables oil/fats in the presence of the catalyst either homogenous or heterogenous catalyst. Homogenous catalyst is widely acceptable for their fast reaction, however the impact from the aqueous quenching lead to high cost and application of heterogenous catalyst has given attention by most of the researchers. The heterogenous catalyt, mixed metal oxide has known as excellent catalytic activity because of the increasing basic or acid sites and directly give high yield. In this review, the preparation method such as co-precipitation, impregnation and sol-gel been compared on their effect to the FAME yield. It is discussed in detailed how the preparation method effect the catalytic activity of the catalyst. In the comparison, co-precipitation method is the most frequently used and give better performance of the catalyst. Furthermore, characteristic of mixed metal oxide such as crystalline structure, morphology, surface area and functional group were also reviewed using various characterization method like X-ray diffraction (XRD), scanning electron microscope (SEM), brunauer–emmett–teller (BET) and fourier transform infrared spectroscopy (FTIR) respectively. This characterization necessity also relating to the catalytic activity. Catalytic activity is a function of its specific surface area, surface area, base strength and base site concentration. For active transesterification process, the characteristic of catalyst is high specific surface area, strong base strength, and high concentration of base sites. In this review, the comparison between metal mixed oxide has being made to review the effect of method and characterization.

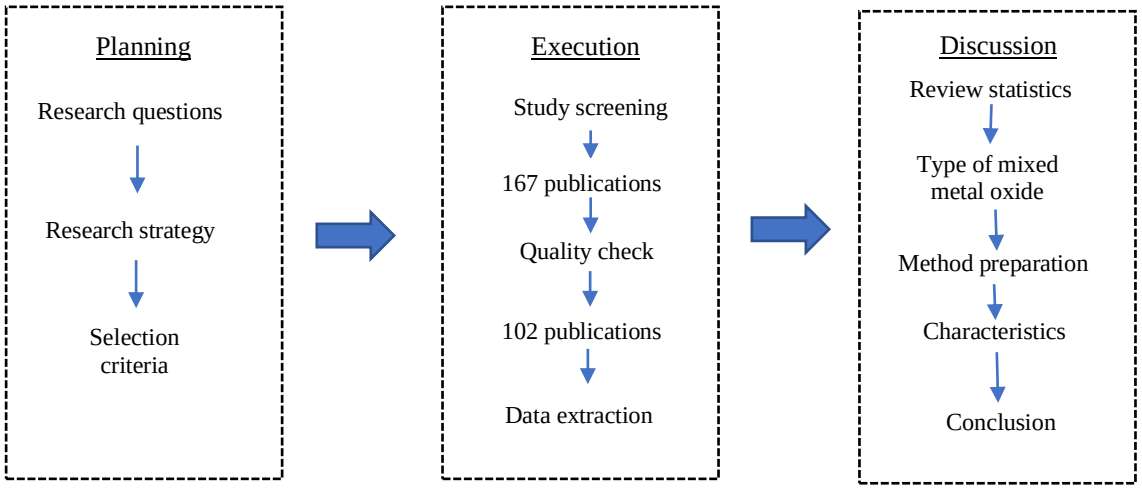
***Keywords*:**
Fatty acid methyl ester, transesterification, heterogenous, mixed metal oxide, characterization.

Objectives:

- To perform comparative study in method used for mixed metal oxide catalyst.

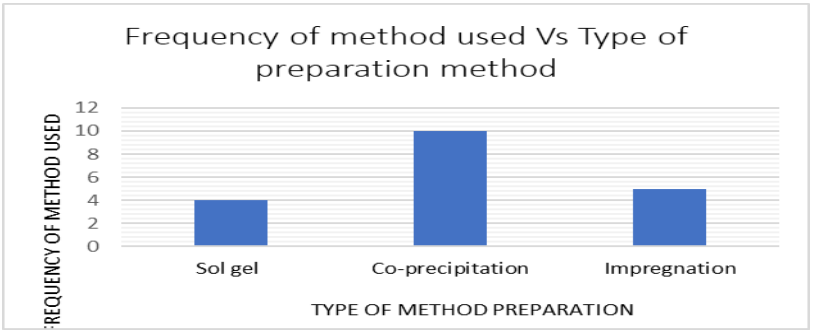
- To investigate the characteristics of mixed metal oxide catalyst, which is crystalline structure, morphology, surface area, and functional group of catalyst

Methodology:



Results:

Effect of preparation method



Catalyst characterization

Morphology

Catalyst	Size of diameter	Category
Al_2O_3	5 µm	Micropores
5Zn/CaO-700	2-5 µm	Micropores
$CrWO_2$	40-50 nm	Mesopores
CeO2-ZrO2	2 µm	Micropores
Zn/CaO	2 µm	Micropores
3Mn-7Zr/CaO	2 µm	Microspores
$CaO-SiO_2$	50 nm	Mesopores

Textural properties

Catalyst	Surface area, S_{BET} (m^2/g)	Average pore size (nm)	Average pore volume (cm3/g)	Yield of FAME (%)
Ti/SO2-700	180.3	6.10	15.39	98
7Mn-3Zr/CaO	13.1	3.8	57.24	84
Cr/Ca/γ-Al_2O_3	95.88	12.99	0.31	93.1
CaO-ZrO_3	22.7	14.8	43.9	85
Pd/Al_2O_3	97.13	10.399	0.2525	90
SrO/Al_2O_3	148	7.9	0.2978	97.6
ZnO/Al_2O_3	147	7.6	0.2792	97.45

Crystalline structure

Type of catalyst	At 2θ value	Crystalline size (nm)	Classification
Ti/SiO_2	25.7˚ (broad peak)	~50	Amorphous
CaO-CAWS	32.49˚,37.64˚, 54.13˚, 64.41˚, 67.63˚	47	Crystalline
MgO-ZrO_2	30.7°	32	Amorphous
Co_3O_4-AA	38.5˚, 66.8˚	71	Crystalline
TiO_2-AA	25.5˚	9	Crystalline
CaMgO	CaO (42.3˚, 62.5˚)	43.8	Crystalline
	MgO (37.5˚, 32.5˚)	35.6	
$MgAl_2O_4$	19.028˚,31.270◦,38.522◦, 59.367◦, 65.238◦	46	Crystalline
Fe/Mg/Al_2O_3	Fe_2O_3 (38.9˚, 60.28˚, 31.94˚)	34.6	
	MgAlO (45.72˚, 31.94˚, 60.28˚, 66.94˚)	39.5	
	Al_2O_3 (45.72˚, 66.94˚)	24.3	Crystalline

Conclusion:

As a conclusion, the effect of method preparation and characteristic of the catalyst has been compared. From the comparison, co-precipitation method has become the highest frequencies use by the researchers. This study is important as the catalytic preparation can control the specific specification of the catalyst to achieve a certain catalytic reaction leading to higher industrial and high productivity via high selectivity and activity of the catalyst. In addition, in catalyst preparation also contain important parameters that need to be considered such as composition, mixing consequences and precursors because it can give impact to the economic value of the catalyst. Characteristic of mixed metal oxide catalyst such as crystalline structure, morphology, surface area and functional group has been identified using XRD, SEM, BET and FTIR respectively. This characterization is crucial as their properties will affecting the performance of the catalyst and the yield obtained of FAME