PREPARATION OF BIODIESEL USING HETEROGENEOUS CATALYSTS

Kristaps Malins[1], Valdis Kampars[1], Eriks Palcevskis[2], Aivars Blums[1], Janis Brinks[1], Dzidra Jankovica[2], Ints Steins[2], Janis Grabis[2], Julija Prilucka[1]
[1] Institute of Applied Chemistry, Riga Technical University, Riga, Latvia
[2] Institute of Inorganic Chemistry, Riga Technical University, Riga, Latvia

In the biodiesel industry, homogeneous alkaline catalysts such as NaOH, KOH and $NaOCH_3$ are used most widely. These catalysts provide high transesterification reaction yield and ester content with a minimal reaction time. However, homogeneous basic catalysts can not be regenerated for repeated use. Usually after the synthesis process homogeneous alkaline catalysts that are in a high concentration in the crude biodiesel and glycerol, are neutralized by using mineral acids and isolated in the form of salts. These operations and following washing and drying of crude biodiesel significantly increase the cost of biodiesel production. Therefore the use of effective heterogeneous catalysts for the transesterification reaction in biodiesel production would enable the development of a non-waste technology and would give an economic benefit. This abstract summarizes the results of investigation the influence of various synthesised heterogeneous catalysts (see Table 1) on the rapeseed oil methanolysis process.

Table 1

Catalyst	Catalyst preparation	Characteristics	Methyl ester yield, %
Methanolysis reaction conditions in autoclave: 150 ^{o}C, 3 h, methanol/oil=9.5, catalyst - 2 wt %			
H3PW12O40 (Phosphotungstic acid)	Purchased from Sigma – Aldrich Ltd., CAS: 12067-99-1, purity – >98%		6.3
H3PW12O40 (Phosphotungstic acid) / SiO_2	Prepared by the sol-gel combustion technique, calcined at 375 °C for 3 h		2.6
$ZnWO_4$	Prepared by the sol-gel combustion technique, calcined at 700 °C for 2 h	specific surface area = 20 m^2/g	0.0
Methanolysis reaction conditions in atmospheric pressure: 65 ^{o}C, 8 h, methanol/oil=8.25, catalyst - 5 wt %			
ZrO_2-CeO_2	Plasma processed stabilized zirconium	Content of CeO_2 - 25,8 wt.%, specific surface area =30 m^2/g	0.1
Y_2O_3	Plasma processed nanopowder	specific surface area =20 m^2/g	0.4
Silica sulfuric acid	Prepared from the silica gel in reaction with chlorosulfonic acid		5.3
H_2SnO_3	Prepared from zirconium oxychloride by the sol-gel combustion technique, calcined at 530-540 °C for 1 h		2.6
H_2ZrO_3	Prepared from tin tetrachloride by the sol-gel combustion technique, calcined at 630-640 °C for 1 h		0.6
Silica triflate	Prepared from the silica gel in reaction with trifluoromethanesulfonyl chloride		0.9
Propylsulfonic acid-functionalized mesoporous silica	Prepared by one-step synthesis based on the simultaneous hydrolysis and condensation of tetraethoxysilane with (3-mercaptopropyl)trimethoxysilane in the presence of template surfactant using in situ oxidation of the thiol groups with H_2O_2		4.1

The project “Nanostructured Catalysts and Technologies for Production of Biodiesel” is supported by the European Regional Development Fund (contract No. 2010/0304/2DP/2.1.1.1.0/10/APIA/VIAA/087).

Contact person: Kristaps Malins, Azenes 14/22, +37126718554, mkrist@inbox.lv