# Synthetic supports for lipase immobilization and exploitation in biodiesel production and oil esterification

**Benjamin D Summers, Email:benjamin.summers@purolite.com**

**Purolite Ltd., UK**

## Abstract

A major factor preventing the use of biodiesel as a key fuel is the cost of the feedstock [1], which can be reduced by exploiting used cooking oil (UCO) as a feedstock, particularly by enzymatic conversion using immobilized lipases to maintain low costs and high efficiency by recycling the biocatalyst. [2] These immobilised lipases can also be exploited to perform reactions in industries as varied as pharmaceuticals, food and cosmetics. [3,4,5]. A range of lipases and carriers were tested for suitability in the conversion of UCO and alcohols to alkyl esters, focusing on lipases from Candida antarctica, Rhizomucor miehei and Thermomyces lanuginosa. The carriers selected were ECR1061M (styrene/methacrylic), ECR8804M, ECR8806M (octadecyl methacrylic), ECR1090M (styrenic) and ECR1030M (divinylbenzene/methacrylic). Lipase TL immobilized on ECR1090M obtained 80 % conversion of UCO and methanol to methyl esters in <2 hours in both solventcontaining and solvent-free systems. [6, 7]. In another study, the regioselectivity of lipase TL was found to differ between carriers and even between immobilisation methods. In general, the immobilisation of lipase TL on octadecyl-functionalised carriers resulted in non-regioselective activity in the formation of ethyl oleate from triolein and ethanol. When immobilized on Purolite ECR8806F, however, lipase TL showed excellent 1,3-regioselectivity and activity up to ten-fold greater than commercial preparations. On the same support but under different immobilisation conditions, this same preparation could hydrolyse all three triolein ester bonds. [8]. Purolite resins packed in Spinchem® RB and MagRBR systems also show great promise in facilitating the rapid screening of conditions for enzymatic synthesis both for biodiesel and other processes. By exploiting rotating bed technology to drive the rotational forces required, the RB and MagRBR can be used on a 5 mL – 100 L scale and simplifies the handling and cleanup of immobilisation and biotransformations significantly.

Lipases represent the most widely used class of enzymes in biotechnological applications and organic chemistry (Javed et al., 2018; Pinheiro et al., 2018; Souza et al., 2020), due to some unique properties, such as selectivity and mild reaction conditions (Miranda et al., 2014). In fact, lipases are used in different areas, such as biofuel production (Rodrigues and Fernandez-Lafuente, 2010; de Vasconcellos et al., 2018; Sahoo et al., 2018). Among the renewable fuels, biodiesel stands out as one of the most promising (Wenlei and Ning, 2009; Christopher et al., 2014; Okoro et al., 2019).

Biodiesel is a renewable fuel made from biomass, such as plants (vegetable oils) or animals (animal fat) (dos Santos Silva et al., 2011; Chua et al., 2020; Singh et al., 2020). It is a mixture of methyl or ethyl esters of fatty acids (Tiwari et al., 2018; Zhong et al., 2020), produced by the transesterification and esterification reaction in the presence of a catalyst (Teo et al., 2016; Aguieiras et al., 2017), such as lipases (Ycel et al., 2012; Verdasco-Martín et al., 2016; Okoro et al., 2019; Moreira et al., 2020).

Despite the high catalytic efficiency of lipases, factors linked to stability and cost limit the use of these biocatalysts (Fernandez-Lopez et al., 2017). In this sense, the immobilization of lipases is used as a tool for enzyme for favoring recovery and reuse (Brady and Jordaan, 2009; Rodrigues et al., 2015; dos Santos et al., 2017) besides, it promotes an improvement in enzyme activity, selectivity or specificity, stability and purity, aside resistance to such inhibitors (Barbosa et al., 2013, 2015; Rios et al., 2018; Monteiro et al., 2019a; Bezerra et al., 2020).

One strategy for lipase immobilization is the interfacial activation on hydrophobic supports (Adlercreutz, 2013; Lima et al., 2015; Manoel et al., 2015; Reis et al., 2019; Rodrigues et al., 2019). This method allows, among other things, the immobilization, modulation, and stabilization of the enzyme in a single step (Cunha et al., 2014; Manoel et al., 2016). However, at high temperatures or in organic media, lipase molecules may be released from the support (Fernandez-Lorente et al., 2011; Hirata et al., 2016a, b); besides, the desorption of the lipase from the support may also be caused by the surfactant properties of some substrates and reaction products (Virgen-Ortíz et al., 2017).

Magnetic nanoparticles have highlighted among many nanoparticles of distinct materials due to the great possibility of modifying its magnetic properties with the effects of size and large surface area (Xie and Ma, 2009; Karimi, 2016). When used as supports to immobilization, magnetic nanoparticles present as advantages the possible recovery of the enzymatic derivative, by magnetic separation, allowing reuse in several production (dos Santos et al., 2015a; Karimi, 2016; Rodrigues et al., 2019). Through the functionalization of the surface, intended to facilitate the occurrence of the enzyme-support bond, the introduction of chemical groups necessary for the immobilization of enzymes is carried out (Neto et al., 2017; Lee et al., 2019).

### Biography:

After receiving his PhD from the University of York in Chemistry in 2014 studying industrial applications of Baeyer-

*Extended Abstract*

Villiger monooxygenases, Benjamin Summers has focussed his early career on the use of biotransformations in commercial processes. From 2016 he has worked with Purolite Life Sciences to develop the application of immobilised enzymes and chromatographic resins to a wide range of industrial targets.

This work is partly presented at 9th Edition of International Conference on Biofuels and Bioenergy

March 29-30, 2018 Edinburgh, Scotland