Biodiesel production through esterification using ionic liquids as catalysts

Arevik Tadevosyan[a], Fernanda Fontana Roman[a], Ana Queiroz[a], António Ribeiro[a], Paulo Brito[a,*]

[a] Department of Chemical and Biological Technology, School of Technology and Management,Polytechnic Institute of Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
*paulo@ipb.pt

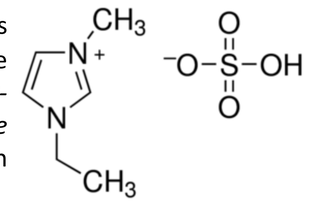
Background

Why biodiesel? There is a growing interest in the development of alternative technologies to the oil economy, based on renewable energy sources. Biodiesel is an alternative fuel that can be produced from a wide range of raw materials such as vegetable oils and animal fats. Yet, the use of sources that do not compete with the food market, such as waste cooking oils - which usually feature high levels of free fatty acids (FFA's) -, can lead to problems in the process of biodiesel production through alkaline transesterification.

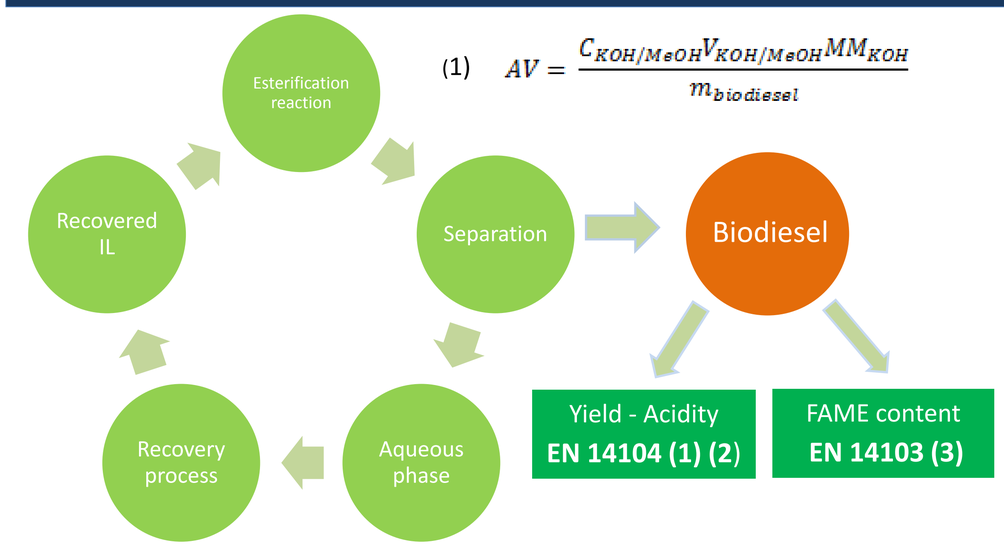
Why ionic liquids? Ionic liquids (ILs) could be employed in the biodiesel production to partially overcome these problems; since they are able to catalyze the esterification reaction of FFA's to biodiesel (FAMEs) as well as the transesterification reaction of triglycerides.

Recovery of ionic liquids Ionic liquids are also viable due to the fact that they can be easily recovered and recycled, decreasing their cost

Goals Experimental results concerning the recyclability of the ionic liquid *1-butyl-3-methylimidazolium hydrogen sulfate [BMIM][*HSO_4] and its influence on the conversion of organic acids to biodiesel and the content of FAMEs will be presented.



Methodologies



(1) $$AV = \frac{C_{KOH/MeOH} V_{KOH/MeOH} MM_{KOH}}{m_{biodiesel}}$$

(2) $$X(\%) = \frac{AV_i - AV_f}{AV_i}$$

(3) $$C = \frac{(\sum A_{FAME} - A_{IS})}{A_{IS}} \times \frac{m_{IS}}{m_{biodiesel}}$$

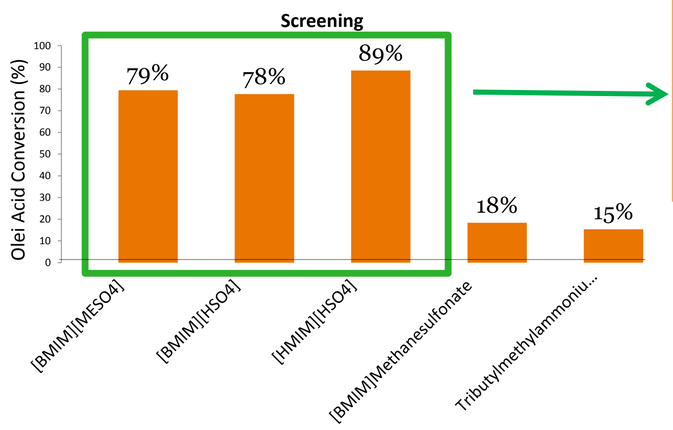
Yield - Acidity **EN 14104 (1) (2)**

FAME content **EN 14103 (3)**

Reaction Conditions: 6h; 90°C, molar ratio MeOH/AO 10:1 and IL dosages of10%, 15% and 20%.

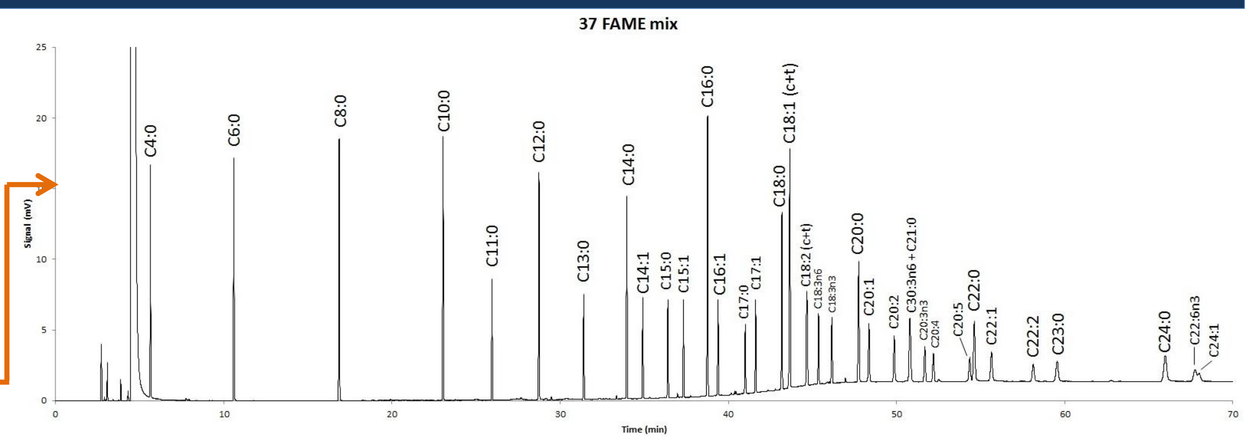
Column SupelcoWax-10 with FID detector
Inlet Temperature: 250°C;
Temperature profile: Hold at 50 °C for 2 min.
Ramp to 220°C at 4°C/min. Hold at 220°C for 40.5 min.
Sample injected: 1µL

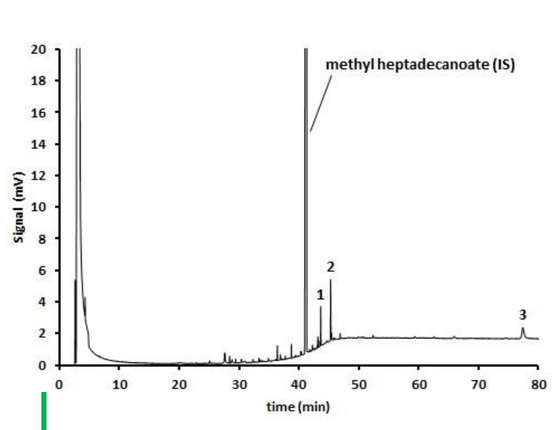
Experimental Results

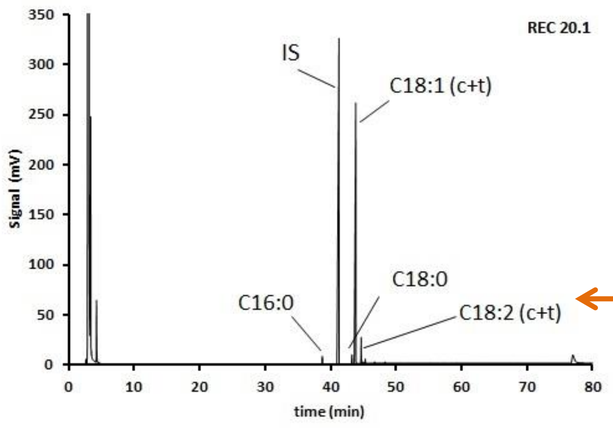


Screening showed that the best catalysts are ***[BMIM][HSO4], [HMIM][HSO4] and [BMIM][MESO4]***. The first was chosen for recovery studies, yet, the other 2 are also being studied

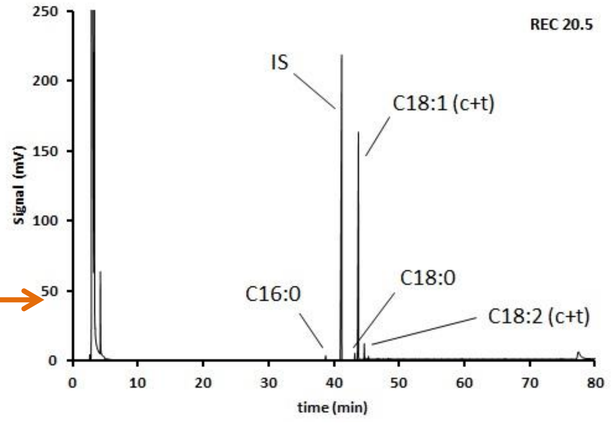
The identification of the FAMEs present in the biodiesel sample is possible through comparison with the 37 FAME mix chromatogram .





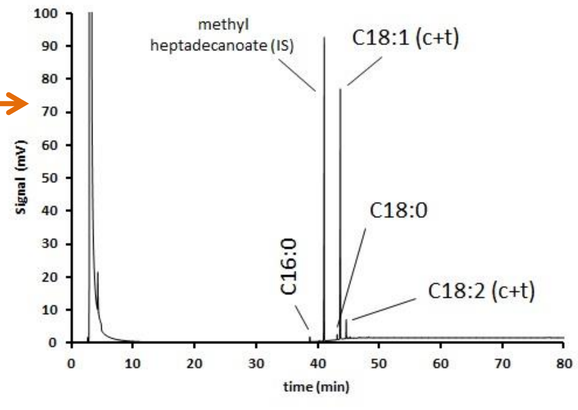


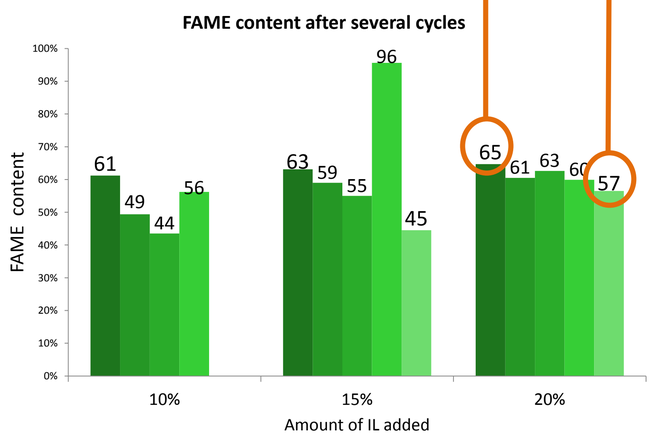
Although there's a slight **decrease** in the **conversion** and in the **FAME content** after 5 cycles, **qualitatively** the sample obtained remains the same, proving that the catalyst [BMIM][HSO4] can be recovered and recycled.

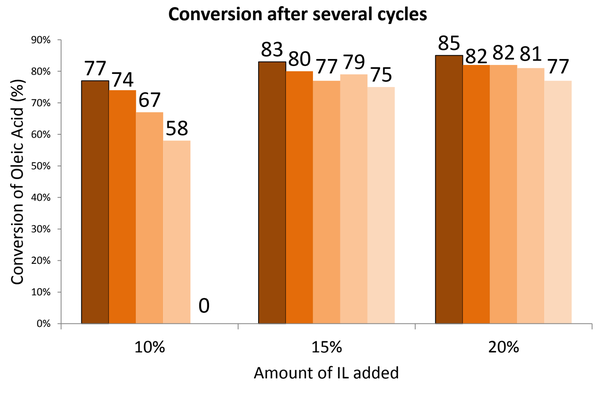


Evaluation of the purity of the Internal Standard (IS) determined as **99,9%**

Complete esterification with H2SO4: FAME content determined as **96,5%,**







Conclusions and Future Work

The **preliminary** study shows that it is possible to recover and recycle the catalyst [BMIM][HSO4].

A deeper study is necessary to confirm the results, mainly for the series of recoveries with lower catalyst dosages (10% and 15%)

The results obtained show that the quality of the biodiesel obtained for every cycle is similar.

Studies concerning the catalysts **[HMIM][HSO4]** and **[BMIM][MeSO4]** are already being performed.