BIODIESEL FROM *JATROPHA CURCAS* OIL USING Li/PUMICE AS HETEROGENEOUS CATALYST

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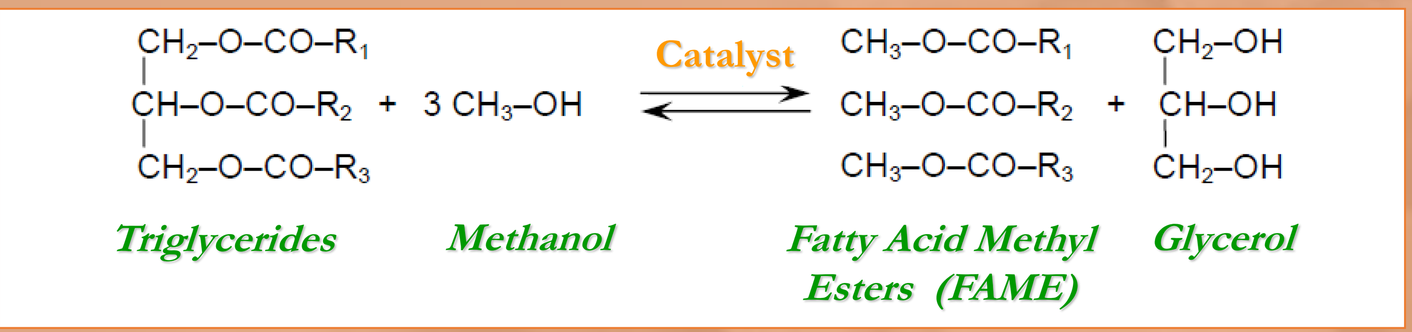
INTRODUCTION

Biodiesel

Potential substitute of fossil fuels (mono-alkyl esters of long chain fatty acids derived from renewable sources, such as vegetable oils and animal fats).

Transesterification reaction



Catalyst

Homogeneous	Heterogeneous
• Can not be recovered from reaction products. • Waste water stream from biodiesel washing.	• Can be easily separated from reaction products. • Continuous process.

➢ **Objective:**

Synthesis of a solid catalyst, by impregnation of pumice stone with a lithium precursor, for the production of biodiesel from *Jatropha Curcas* oil (non-edible oil).

EXPERIMENTAL

Synthesis and characterization of the catalyst

Pumice granules (1.4–3.0 mm)

Impregnation with a lithium precursor (1-5% w/w)

Li/Pumice

Physicochemical and structural properties (SEM, XRD and FT-IR).

Catalytic activity

Raw materials: Methanol/ commercial sunflower oil/ *Jatropha Curcas* oil extracted from the seeds.

Oils	$\rho_{15^\circ C}$ (g/cm³)	$\nu_{40^\circ C}$ (cSt)	Acid number (mg KOH/g)
Jatropha curcas	0.922	29.5	3.7
Sunflower	0.920	22.6	0.2

Reactions for biodiesel production → batch slurry reactor. After the reaction the two phases formed were separated and the FAME content of the main product was determined [1].

- Influence of the percentage of impregnated lithium: sunflower oil, 55ºC, 2 h, 20:1 MeOH/oil molar ratio, catalyst 20% weight catalyst/weight oil.
- Biodiesel production from *Jatropha curcas* oil:

Reaction conditions				
Exp.	**%Cat.**	**T (ºC)**	**t (min)**	**MeOH/oil**
E_1- E_2	1.0	60	90	7:1
$T_{Heterogeneous}$	35.0	60	60	20:1
$T_{Homogeneous}$	0.5	65	60	6:1

CONCLUSIONS

- The textural properties of the pumice were modified when it was impregnated with Li. According to the XRD results pumice is amorphous; however Li/Pumice presents crystallinity.
- The 5% Li/Pumice is the material that presents a higher catalytic activity.
- Prior to the transesterification reaction, it is necessary to esterify the *Jatropha curcas* oil to achieve a high FAME content.
- Use of the heterogeneous catalyst (5% Li/Pumice) is more advantageous than the homogeneous catalyst (NaOH): biodiesel washings are not necessary, catalyst is easily separated from reaction products and a continuous process can be carried out.

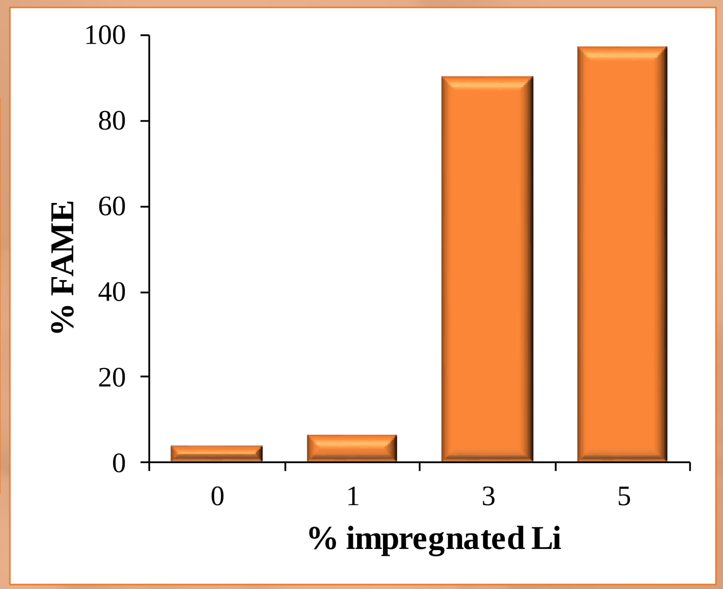
REFERENCES

[1] Borges, M.E., Díaz, L., Gavín, J., y Brito, A. (2011). Estimation of the content of fatty acid methyl esters (FAME) in biodiesel samples from dynamic viscosity measurements. Fuel Processing Technology, 92 (3), 597-599.

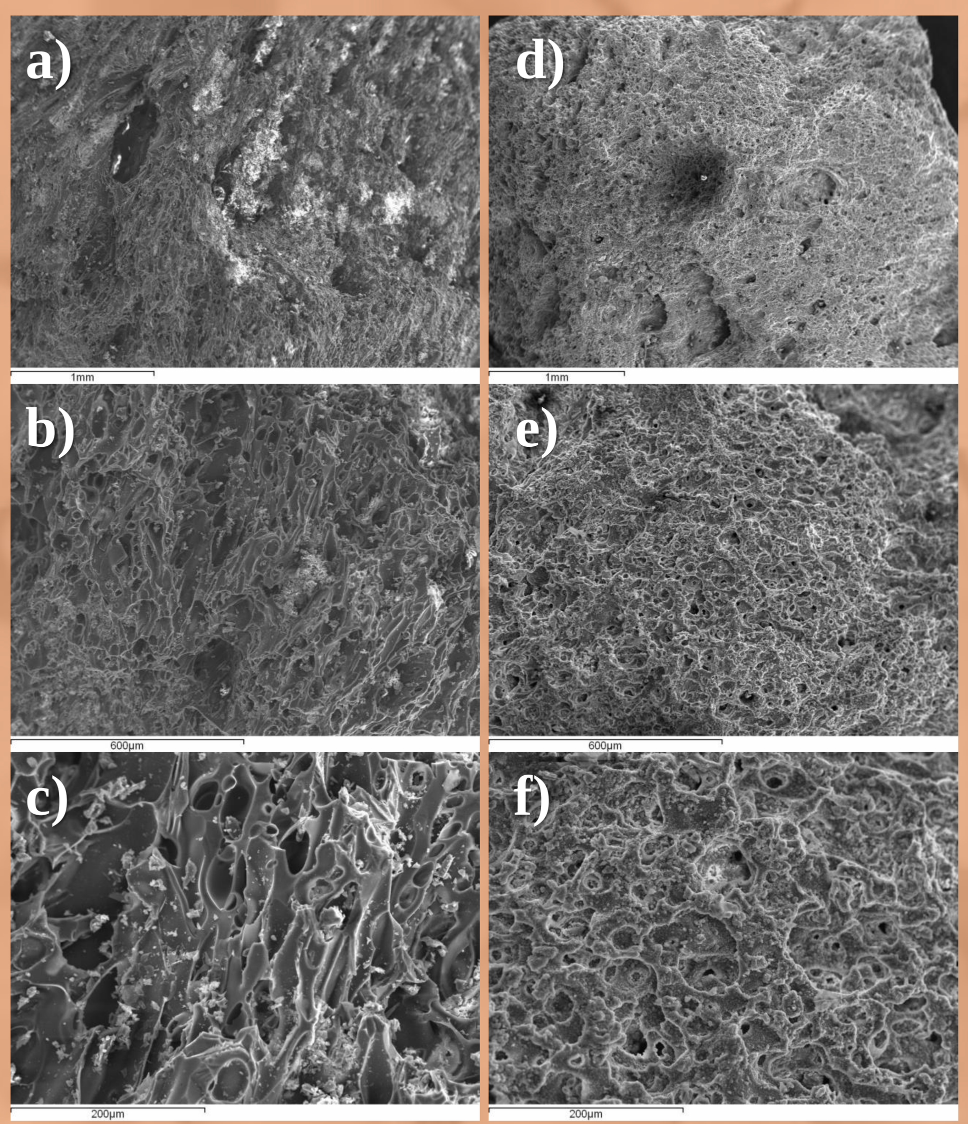
RESULTS AND DISCUSSION

Influence of the percentage of impregnated lithium

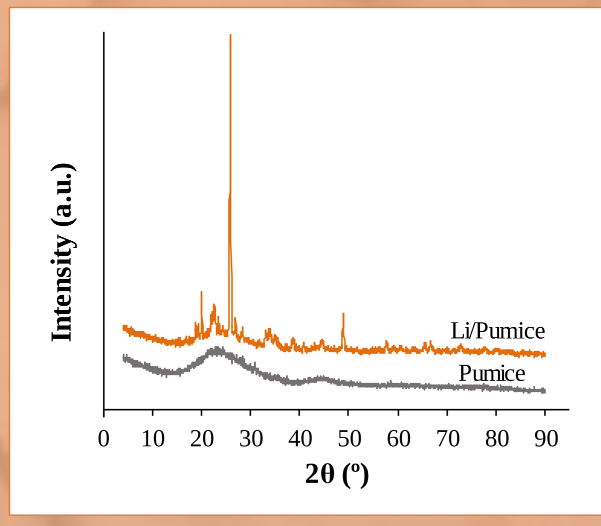
The activity of the catalyst (Li/Pumice), using sunflower oil as raw material, increases when percentage of impregnated lithium on the pumice is increased, reaching the maximum FAME content for 5% lithium.



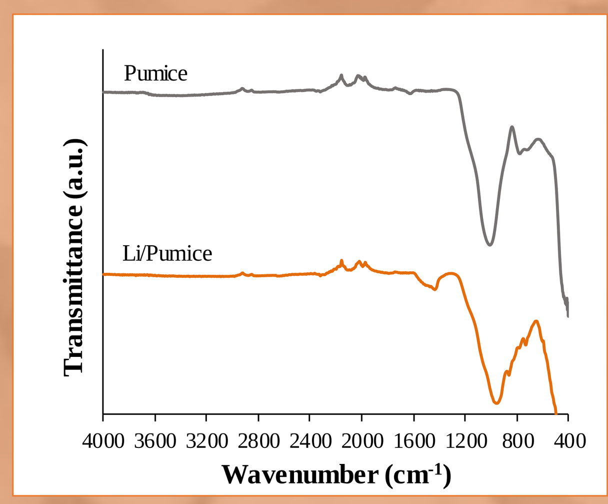
5% Li/Pumice characterization



SEM images (a-c) Pumice y (d-f) 5% Li/Pumice



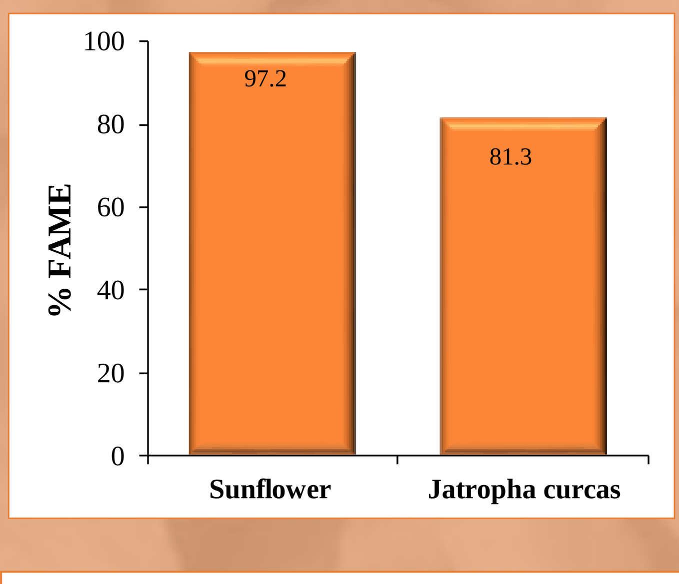
XRD pattern



FTIR spectra

- SEM images show that textural properties of the pumice were modified when it was impregnated with Li.
- Pumice is an amorphous material according to the XRD results, while Li/Pumice presents crystallinity.
- FTIR spectra show the characteristic bands of the aluminosilicates. The wide band located between 600-1200 cm^{-1} is attributed to the internal vibration of the TO_4. The wideness of this band is attributed mainly to the amorphous nature of the materials. The most intense signal observed in the pumice spectrum (1009 cm^{-1}) suffers a shift towards slightly lower frequencies after impregnation.

Jatroha curcas as raw material



Direct transesterification reaction (Catalyst: 5% Li/Pumice)

FAME content of biodiesel produced from *Jatropha curcas* oil is lower than that produced from sunflower oil, this is due to the high acidity of the non-edible oil.

Two-stage reaction: Prior to the transesterification reaction, esterification reaction of the *Jatropha curcas* oil was carried out to reduce free fatty acids content (from 3.7 to 0.2-0.4 mg KOH/ g oil).

Jatropha curcas oil
Acid number= **3.7** mg KOH/g

Esterification reaction
(E_1 and E_2)/(H_2SO_4)

Jatropha curcas oil Acid number= **0.2** mg KOH/g	*Jatropha curcas* oil Acid number= **0.4** mg KOH/g
Transesterification reaction ($T_{Homogeneous}$)/(**NaOH**)	Transesterification reaction ($T_{Heterogeneous}$)/(**5% Li/Pumice**)
100% FAME $\rho_{15^\circ C}$ = 883 kg/m³ $\nu_{40^\circ C}$ =3.5 cSt	**100% FAME** $\rho_{15^\circ C}$ = 884 kg/m³ $\nu_{40^\circ C}$ =3.5 cSt

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