

# Heterogeneously Catalytic Hydrogenation of Animal Fatty Acids in Supercritical CO<sub>2</sub>

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The heterogeneous catalytic hydrogenation of fatty acids is a possible system to obtain biodiesel from renewable resources [1], because they are not chemically very different from some petroleum fractions [2]. Non conventional solvents as supercritical fluids can be investigated to develop a process that follows the principles of green chemistry and environmental sustainability. Carbon dioxide is readily available, cheap, recyclable, non-toxic and non-flammable and for these reasons it is used as solvent in many types of catalytic reactions [3].

The LNEG laboratory is optimizing a green process to obtain chains of C16-C18 hydrocarbons by catalytic hydrogenation of animal fats using H<sub>2</sub> pressure and supercritical CO<sub>2</sub>.

## Animal Fatty Acids



## Biodiesel



The catalytic reactions were performed varying the temperature and CO<sub>2</sub> and H<sub>2</sub> pressures. The raw material used was a mixture of animal fatty acids and the catalyst was a Fluid Catalytic Cracking (FCC) one, used in industry for the cracking of high-molecular weight hydrocarbon fractions. The data of the optimization reactions are reported in **Table 1**. The system used for the hydrogenations of fatty acids is shown in **Figure 1**.

**Table 1.** Reactions of hydrogenation of animal fatty acids, catalyzed by FCC in supercritical CO<sub>2</sub>: optimization of the temperature and the H<sub>2</sub> and CO<sub>2</sub> pressures.

Run	T (°C)	H <sub>2</sub> p (bar)	CO <sub>2</sub> p (bar)	Catalyst Recovered (g)	Liquid phase (g)	Solid phase (g)	Total yield (g)	Total percent yield (%)
R14	340	11	140	5.351	4.706	5.821	10.527	94
R15	320	11	140	5.541	-	14.829	14.829	132
R16	300	11	140	5.339	-	10.687	10.687	95
R17	340	5.5	140	5.222	5.274	2.903	8.177	73
R18	340	22	140	5.070	4.819	3.205	8.024	72
R19	340	5.5	160	4.999	2.750	4.582	7.332	65

Experimental conditions: FCC catalyst = 4.8 g, raw material = 11.2 g.



**Figure 1.** The reactor and the system used to hydrogenate the animal fats with CO<sub>2</sub> and H<sub>2</sub> pressures.

The mixture constituted by chains of C16-C18 alkanes should be liquid in the reactor at the end of the reaction and so we can suppose that the optimal conditions of temperature and pressure of H<sub>2</sub> and CO<sub>2</sub> are those reported in **Run R17**, because there was a higher amount of liquid phase than in the others.

These assumptions can be confirmed by GC analysis.

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## References:

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