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CO_2 to Olefins

Improved yield reaction with ceramic coated reactor

INTRODUCTION

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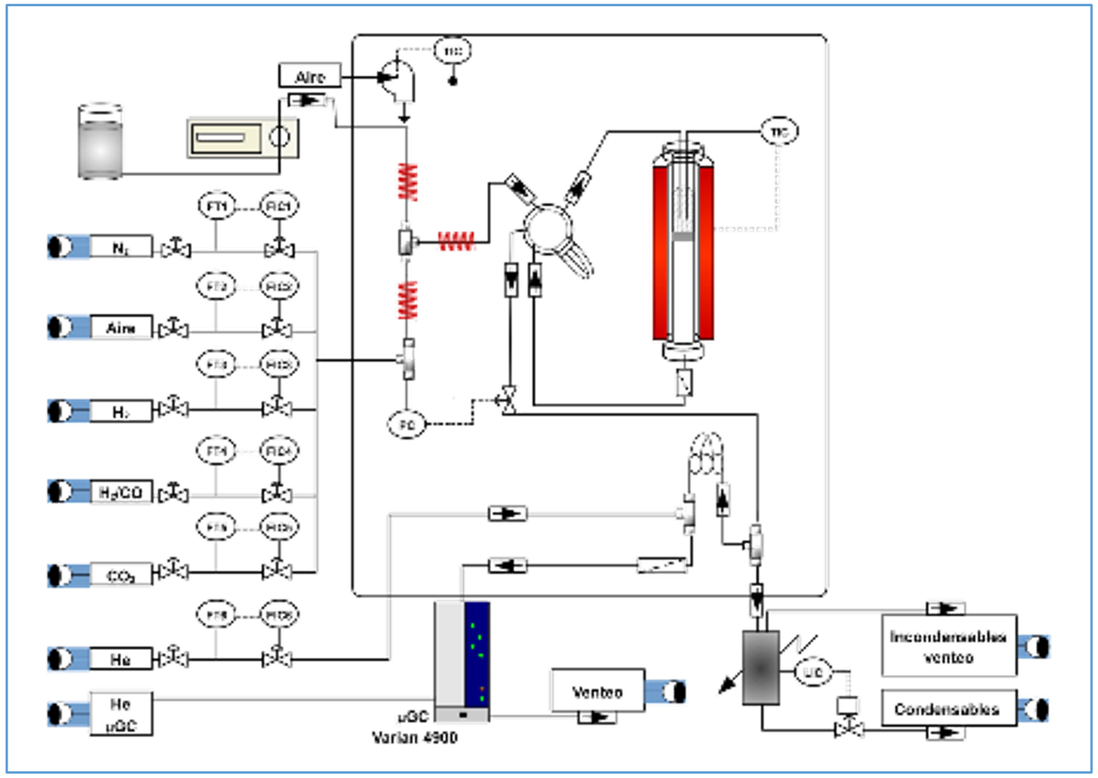
- Tubacoat and *CPWV group have researched the effect of using a ceramic coated reactor in the production of Olefins from CO_2

- The CPWV group is involved in the production of Olefins from CO2, in one single reactor, where at the same time Methanol is formed and transformed into olefins, using a tandem of oxide/zeolites catalysts.

- Experimental Set Up



Fixed bed reactor

- 316 stainless steel
- D = 9 mm
- $L_{effective}$= 10cm
- P= up to 100 atm
- T=up to 700 ºC
- W_{cat}= up to 5 g

Products

DME
MeOH
HC (C_1-C_4)
H_2O

Conditions

P = 30 bar
T = 400 ºC
τ= 5 g_{cat} h mol_c^{-1}
H_2/CO_x = 3
CO_2/CO_x = 0-1

REACTOR CHEMICAL INERTIA STUDY

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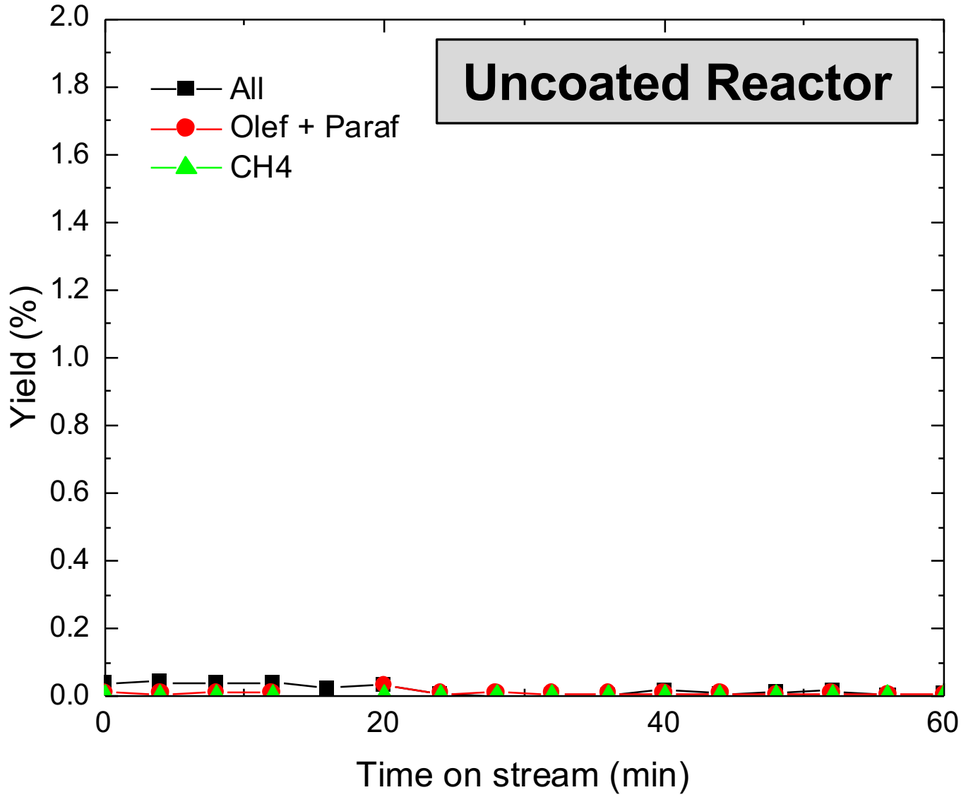
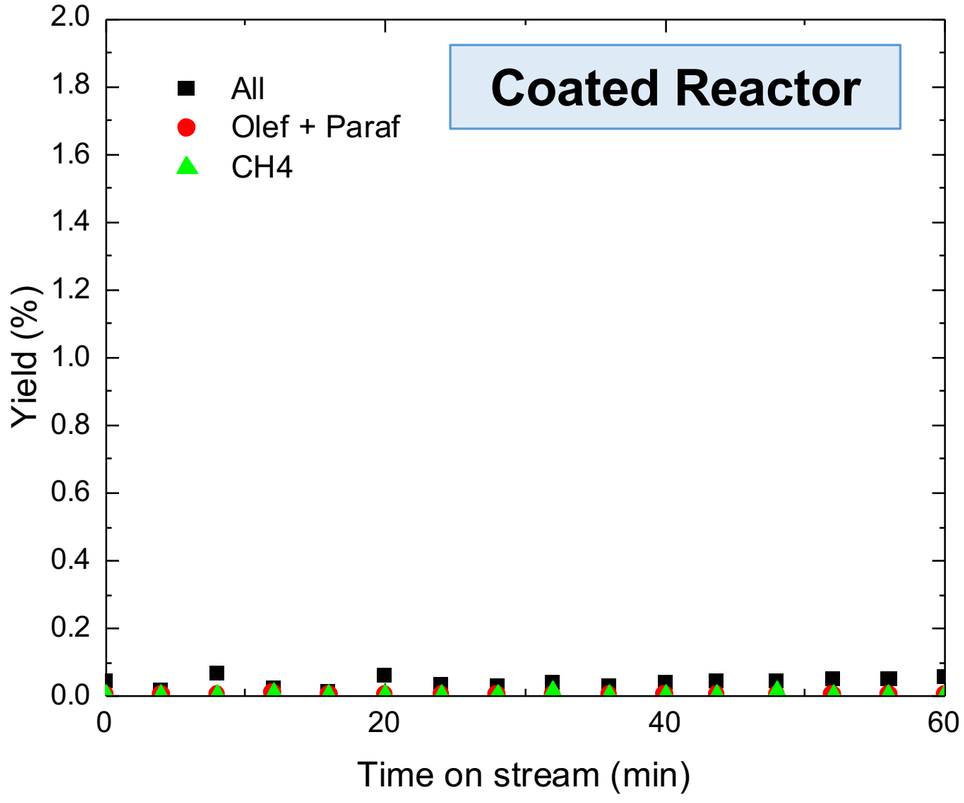
Reaction: H2/CO mixture at 400ºC and 30 bar

- **If catalyst is not used, with both reactors the production of products is negligible, evidencing that the reactors are completely inert before its FIRST use.**

With No Catalyst



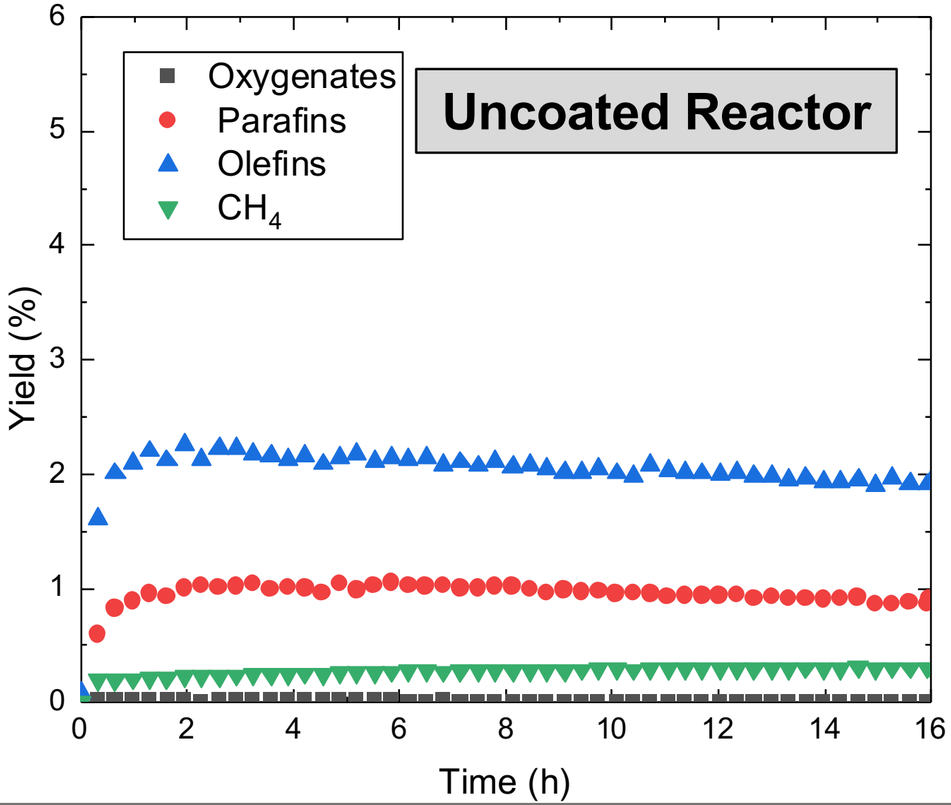


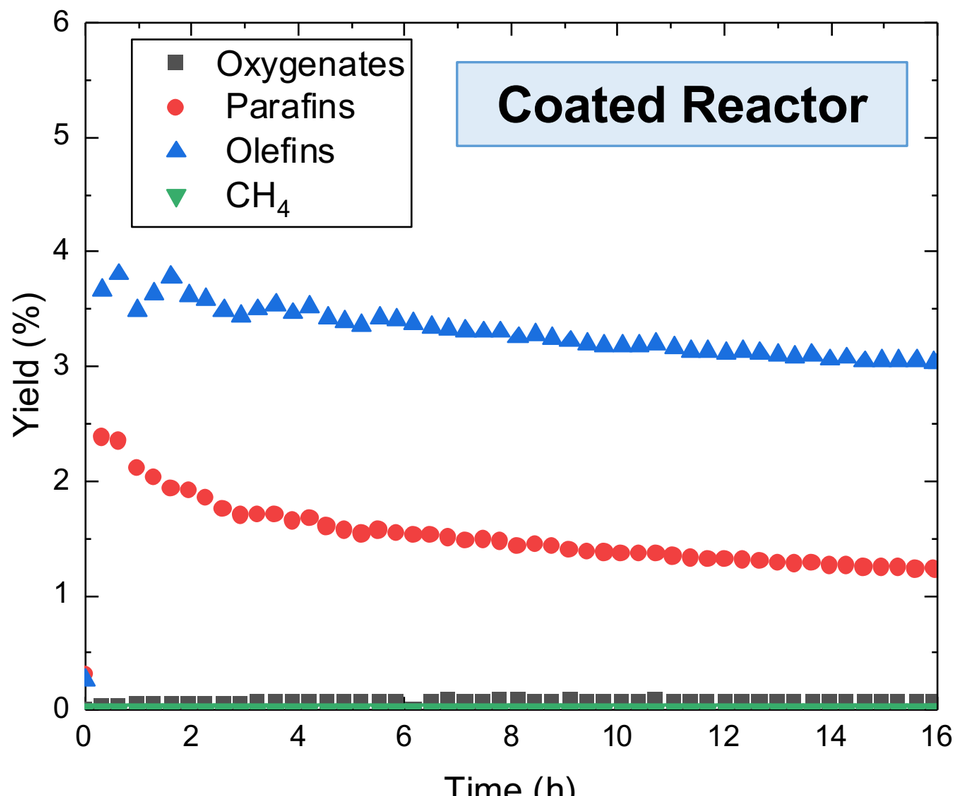
CO_2 to Olefins Reaction Process

Reaction: H2/CO/CO_2 mixture at 400°C and 30 bar

- If catalyst is used, the difference in yield among both reactors is NOTICEABLE
- With the uncoated reactor, CH4 is formed due the catalytic activity of the Fe coming from the steel surface.
- No CH4 formation is observed after 16hours with the CERAMIC COATED REACTOR
- Methane yield is avoided and therefore the synergy among the catalysts is boosted

With presence of CO2 to Olefins Catalysts





Ceramic Coated Reactor Repeatability Performance

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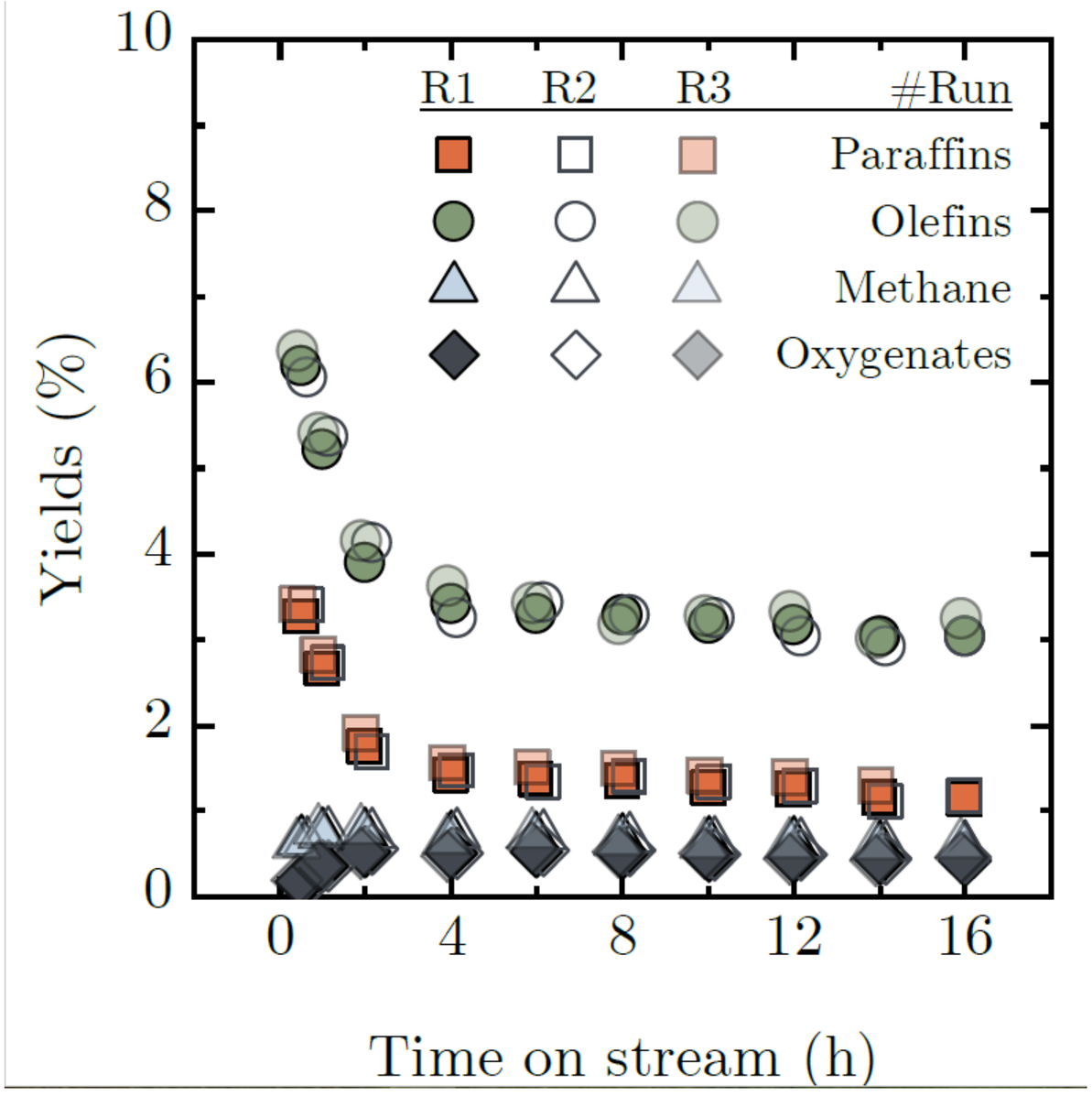
Reaction: H2/CO/CO_2 mixture at 400ºC and 30 bar

- **After 1000 hours of use, in several cycles of 16 hour each, the obtained products are completely reproducible, evidencing that the coating is still inert.**



CH4 formation in the reaction medium

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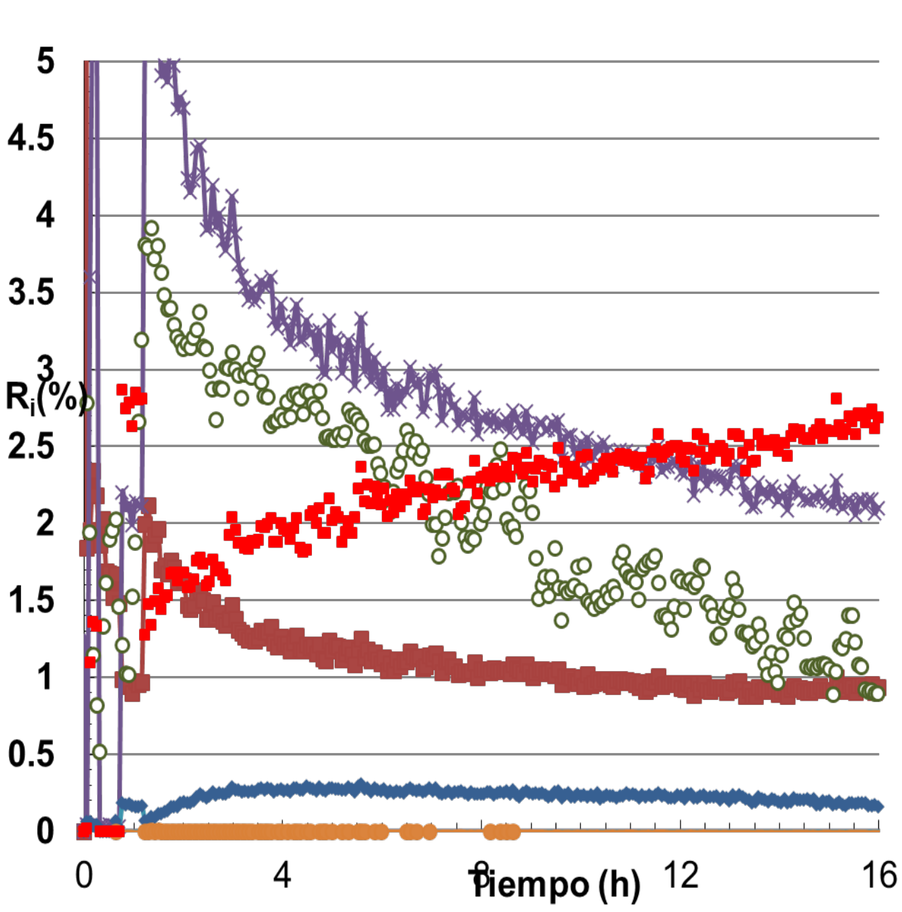
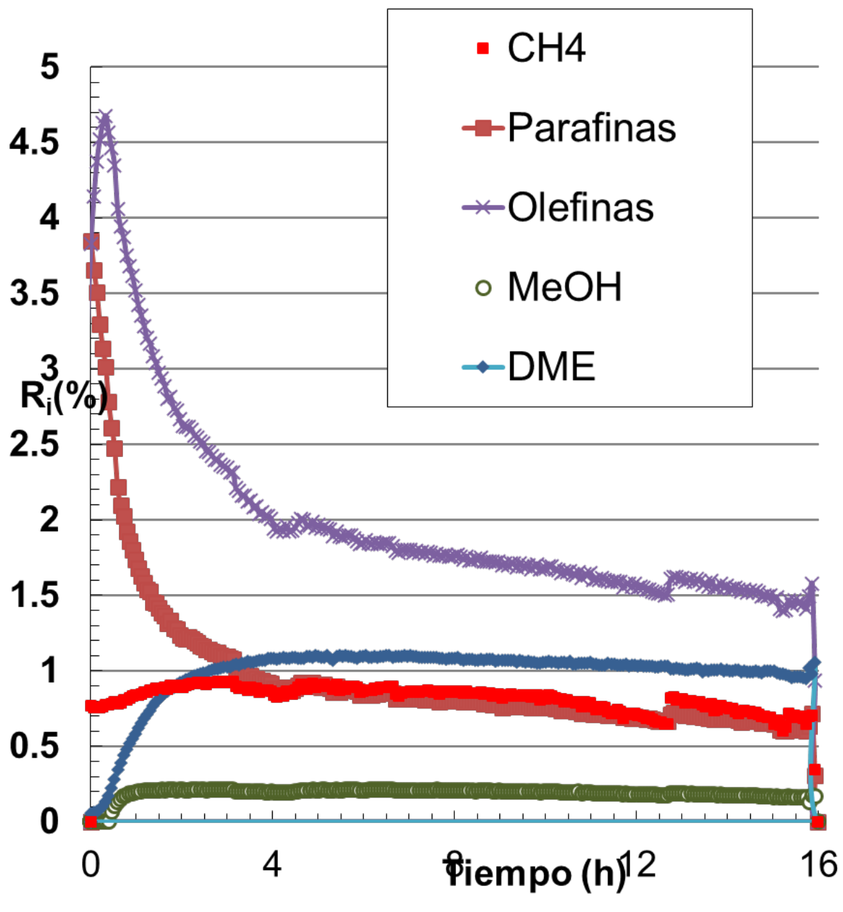
Reaction: H2/CO/CO_2 mixture at 400ºC and 30 bar

- **When CH4 is formed in the reaction medium, due to the cracking of DME, with the uncoated reactor the steel surface promotes the autocatalytic CH_4 formation and the CH_4 starts increasing.**



Uncoated Reactor



Coated Reactor

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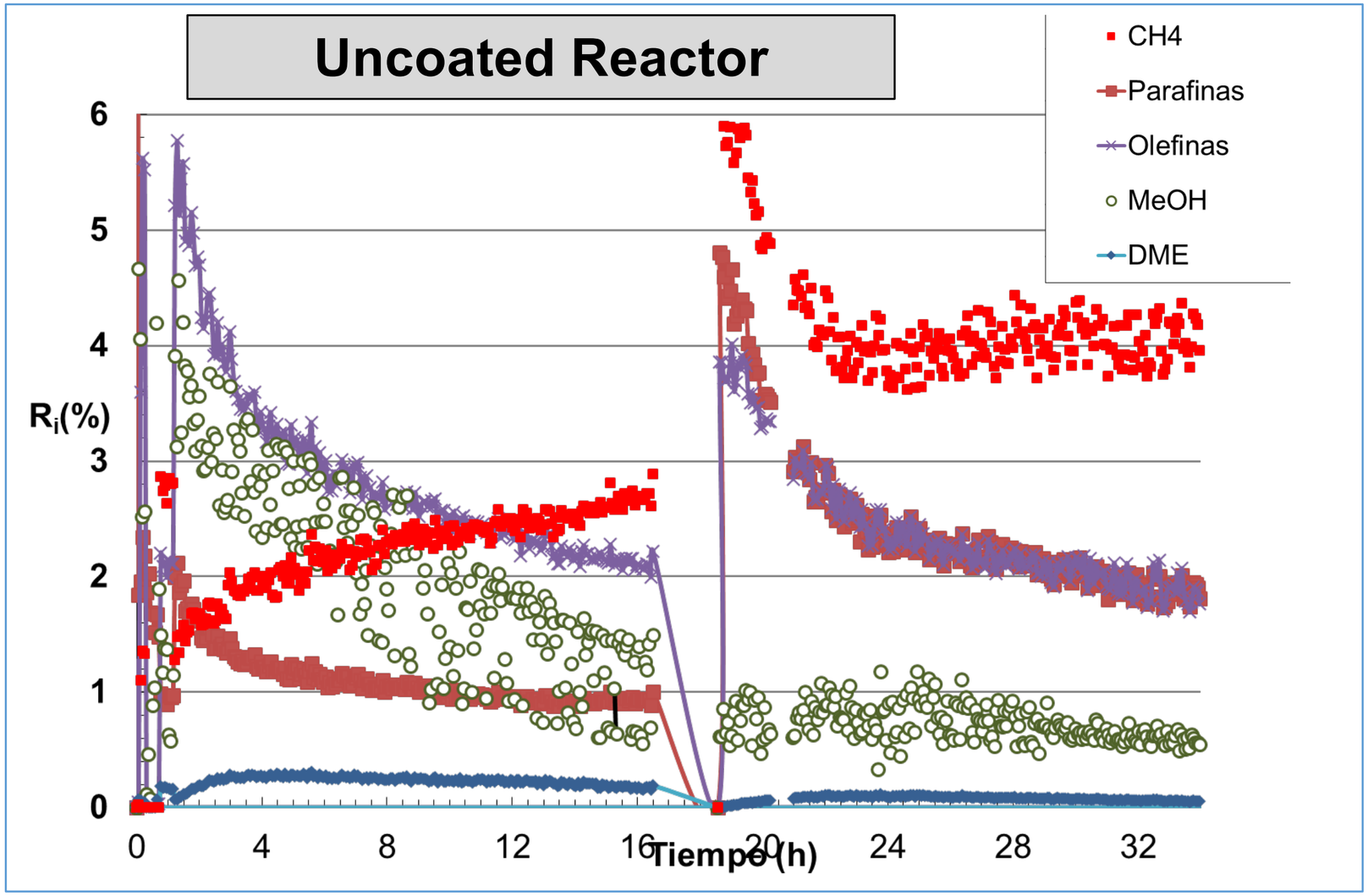
Reaction: H2/CO/CO_2 mixture at 400ºC and 30 bar

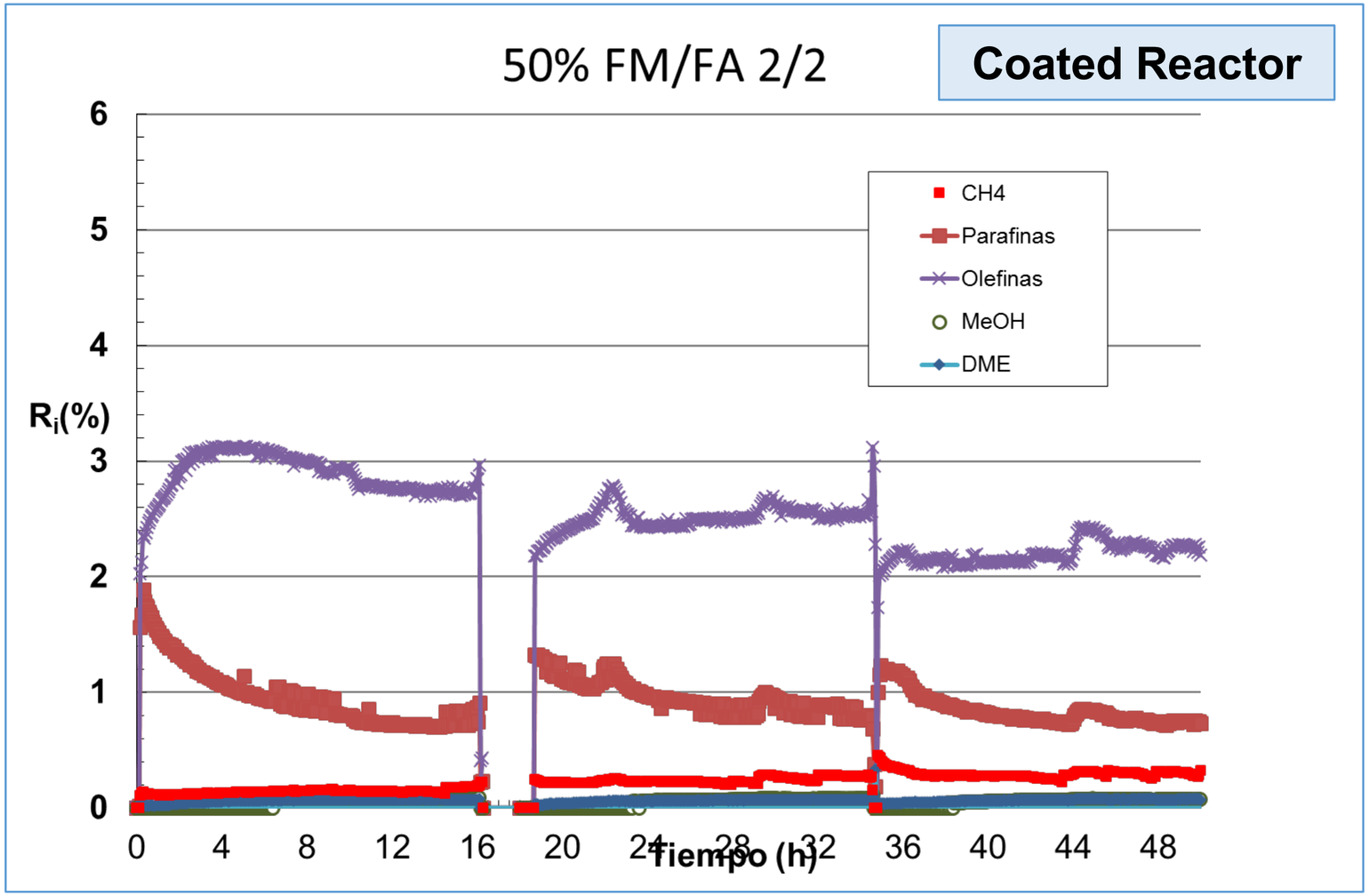
- **When the catalyst is regenerated at 400ºC in air, which is mandatory for the viability of the process, CH4 formation is boosted even more after the contact of the steel surface with the oxygen, completely changing the obtained results.**



Catalyst Regeneration Effect

Reaction: H2/CO/CO_2 mixture at 400ºC and 30 bar

- **When the regeneration of the catalyst is done with the ceramic coated reactor, the CH4 formation after each regeneration cycle is not observed nor boosted.**



THANK YOU!

TUBACOAT PLANT IN CANTABRIA, SPAIN

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