Heat to Fuel

Dry route: CO_2 - gasification of dry biomass in combination with e-fuel synthesis

27-28 April 2022

This project has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement n° 764675

Johnson Matthey
Inspiring science, enhancing life

IREC

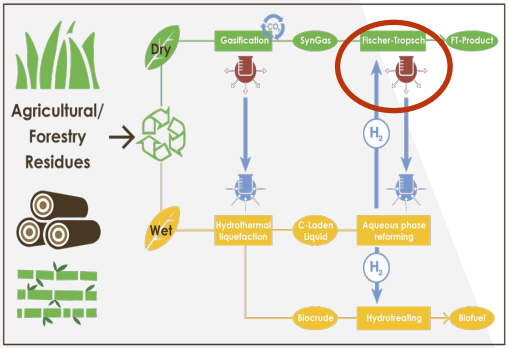
cea

KHIMOD
ALCEN

FT catalytic reaction in Heat to Fuel

Context: FT reaction from Syngas to **Hydrocarbons**

$$(2n+1)\ H_2 + n\ CO \rightarrow C_nH_{2n+2} + n\ H_2O$$

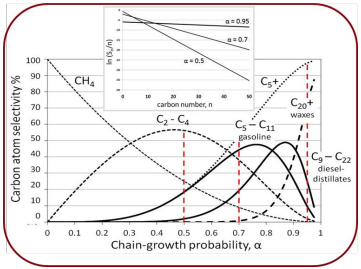


- Non selective reaction

Infinite of possible products depending on:

✔ the reaction conditions

✔ the catalyst



- Highly exothermic reaction :
- 170kJ/mol converted CO

→ Need to control the thermal behavior (catalyst aging and control of the

Heat to Fuel objectives:

Liquid fuel efficiency from 35 to 50%.

Long Chain Hydrocarbons Production for Diesel and Kerosene

Catalyst development

gasification

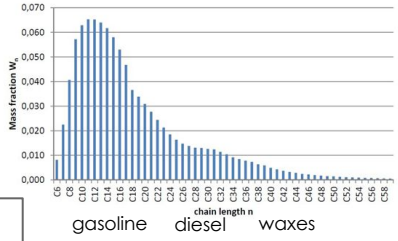
reforming

syngas
$2=H_2/CO/(CO_2)$

T= 230°C
P=20 bar

FT reactor

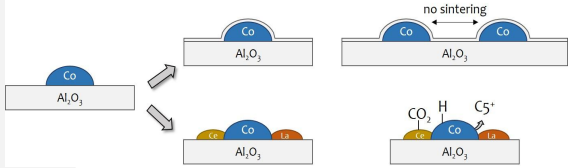
fuel



Parameter	cobalt	iron
α	high	low
activity	high	medium
olefin selectivity	low	high
H_2/CO ratio	>2	0,5-2,5
rWGS	very low	high
methane selectivity	high	low
Temperature	low	low to high
stability	long	short
cost	expensive	cheap
separation from wax	easy	difficult

For long liquid hydrocarbons FT at low T using cobalt

Cobalt micro-catalyst



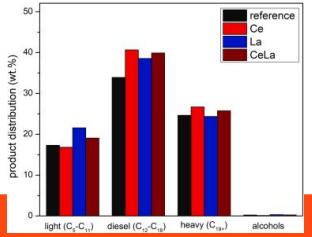
An innovative catalyst

+ stable

+ selective

Promoted by lanthanides

Incorporation of Cerium and Lanthanum by incipient wetness impregnation



Reactor development

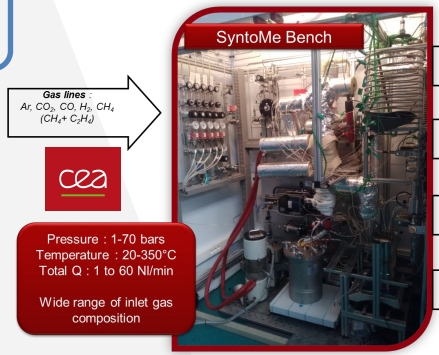
Selected catalyst

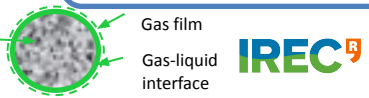
Highly instrumented HX reactor

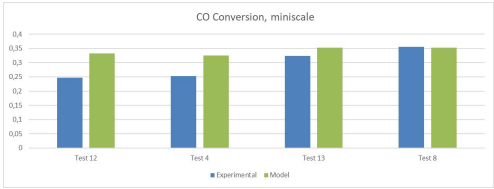
Based on experimental and numerical results

Catalyst and reactor characterisation

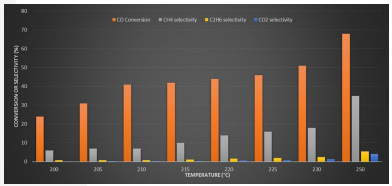
Design tools and detailed analysis







Comparison experiment-model

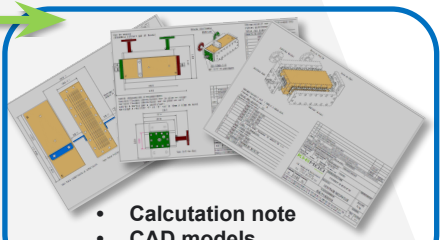


Temperature sensitivity of the coolant and the inlet gases (H2 /CO)
Evolution of CO conversion and selectivities to methane and ethane

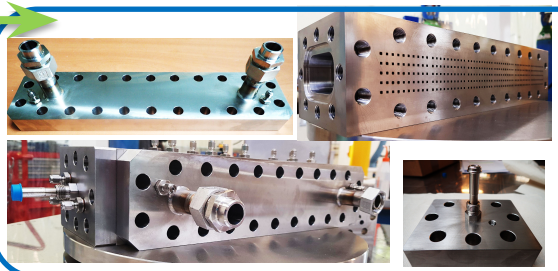
An optimised FT reactor at upper scale

FT reactor manufacturing

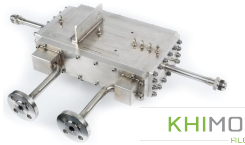
An optimised FT reactor at upper scale



- Calcutation note
- CAD models
- Manufacturing plans



- Manufacturing
- Ensembling
- Hydraulique & Leak tests
- CE certification



KHIMOD PILCEN

Catalyst filling; the catalyst selection and in situ activation method was a previous work made by IREC-JM- CEA.

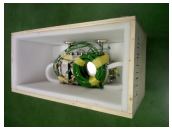
JM

cea

IREC

KHIMOD PILCEN

- Development of a reactor filling technique



- Final instrumentation
- Leak test
- Tightening report
- Final documentation
- Available for operation

BEST Bioenergy and Sustainable Technologies

THANK YOU