# OXIDATIVE COUPLING OF METHANE PERFORMANCE IN A NOVEL MEMBRANE REACTOR

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## Introduction

The oxidative coupling of methane (OCM) is a direct route for the production of hydrocarbons ($C_{2+}$) from methane.

$$2CH_4 + O_2 \rightarrow C_2H_4 + 2H_2O \qquad \Delta H < 0$$

The OCM yield is hampered by the parallel oxidation reactions, and at least a 30% $C_{2+}$ yield is needed to make the process economically viable.

## Packed bed reactor

The exothermic behaviour of the OCM results in a heat management issue that needs to be solved. In a packed bed reactor, a controlled temperature regime results in a very poor $C_2$ yield.

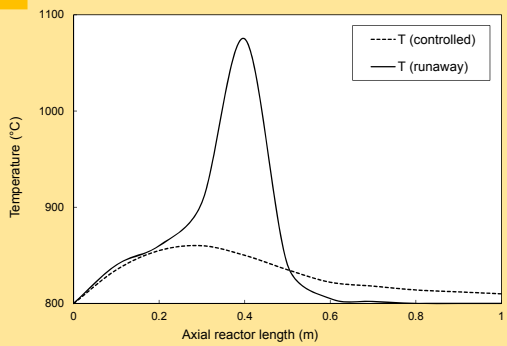


Figure 1. OCM Temperature profiles along the axial reactor length of a packed bed reactor.

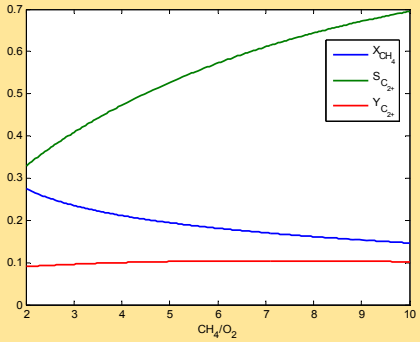


Figure 2. OCM performance for different $CH_4/O_2$ ratios with a conventional configuration.

Very poor performances are achieved with conventional configurations (when $CH_4$ and $O_2$ are co-fed).

## To improve the OCM performance...

Optimization of the catalyst used for the process

Improve reactor design

**Packed bed Membrane Reactor**

$Mn\text{-}Na_2WO_4/SiO_2$, one of the most promising OCM catalysts, has been selected to perform the experiments. The main findings are the following:

- $S_{C2}$ above 50% in membrane reactor conditions.
- Stable under OCM conditions (800 °C and 2 bar) for 100 operating hours.
- $C_2H_6 \rightarrow C_2H_4 + H_2$ main route for the $C_2H_4$ production.
- $C_2H_4 + 3\,O_2 \rightarrow 2\,CO_2 + 2\,H_2O$
  $C_2H_4 + O_2 \rightarrow 2\,CO + 2\,H_2$
  Most important undesired 2ary reactions. Minimization of these fast reactions is crucial to obtain a good OCM performance.
- Use of catalyst increase the velocity of the 2ary reactions, thus faster consuming the $C_2$ formed in previous steps.

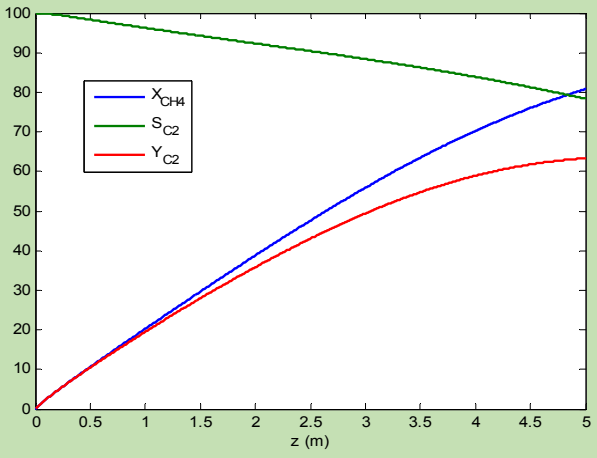


Figure 3. OCM performance along the axial length of a packed bed membrane reactor.

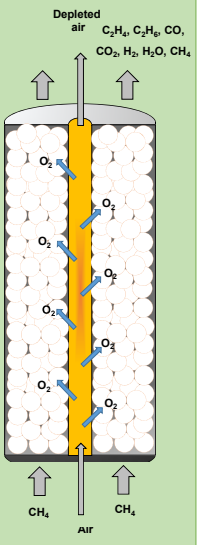


Figure 4. Scheme of an OCM packed bed membrane reactor.

## Conclusions

- The yield obtained with the conventional configuration (packed bed) is not enough to make the process economically viable.
- The utilization of the $Mn\text{-}Na_2WO_4/SiO_2$ catalyst together with the OCM membrane reactor configuration can contribute to reach the 30% $C_2$ yield required to make the process competitive with other ethylene production technologies.

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