OXIDATIVE COUPLING OF METHANE: A COMPARISON OF DIFFERENT REACTOR CONFIGURATIONS

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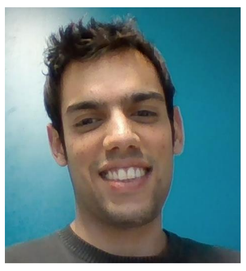


Introduction

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.

Experimental and results

- A phenomenological 1D model has been developed to simulate the most common reactor configurations.
- The La_2O_3/CaO catalyst has been chosen as the OCM catalyst. The inlet temperature was set to 800 °C and the pressure to 2 bar.

Packed bed reactor

The heat management control becomes easier with the use of a fluidized bed reactor

Fluidized bed reactor

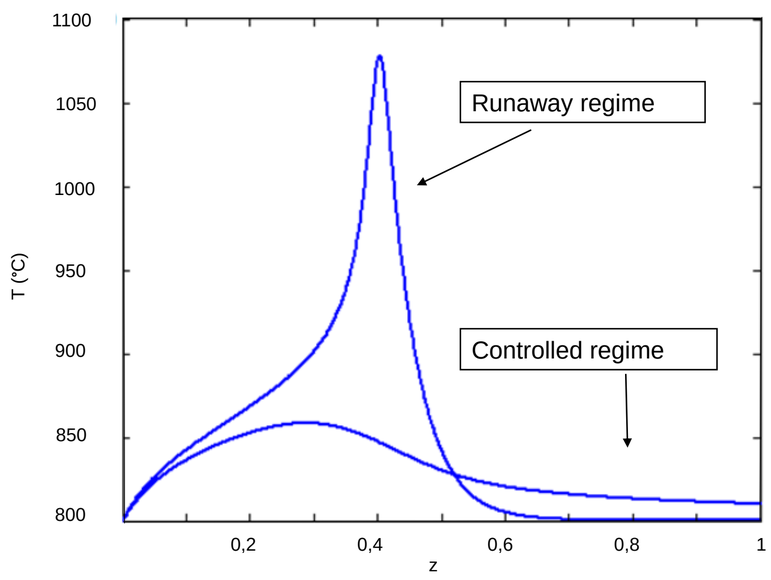


Figure 1. OCM Temperature profiles in the axial reactor length of a packed bed reactor.

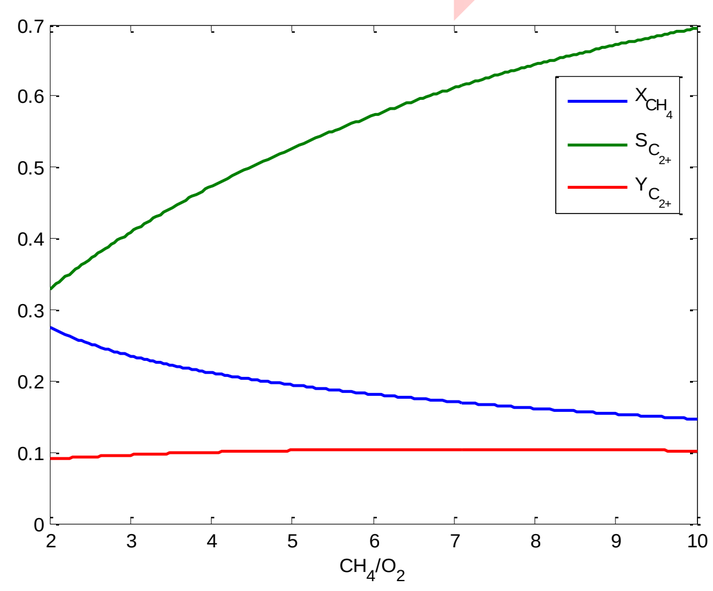


Figure 2. OCM performance for different CH_4/O_2 ratios with a fluidized bed reactor configurations.

The exothermic behaviour of the OCM results in a heat management issue that needs to be solved.

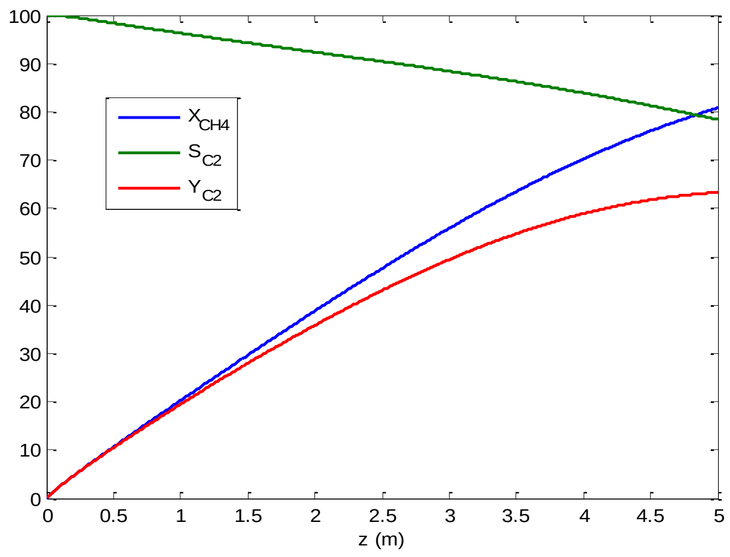


Figure 3. OCM performance along the axial length of a packed bed membrane reactor.

Reactor configuration	Maximum C_{2+} yield (%)
PB reactor	14 (*)
FB reactor	9,9
PB membrane reactor	60
FB membrane reactor	54,9

(*) Without taking into account the hotspot problem

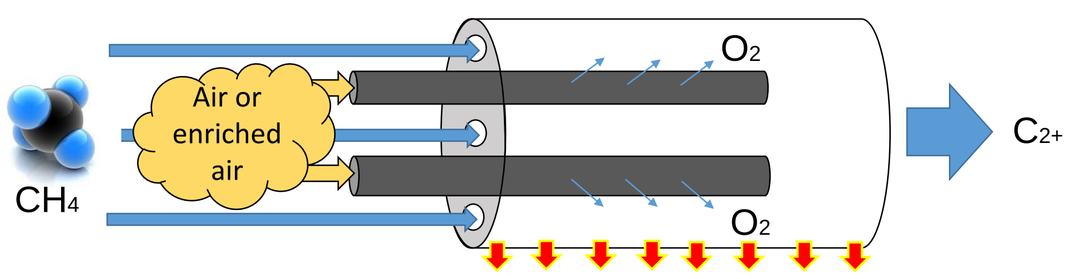
Figure 4. Maximum C_{2+} yield achieved with the different reactor configurations for the OCM process.

The poor OCM performance obtained with the fluidized bed hinders its application.

Membrane reactor

The O_2 membranes:

- **Keeps a low P_{O_2}, favouring the desired reactions and increasing the yield**
- **Distributes the reaction and the heat released along the axial reactor length**



Conclusions

- The yield obtained with conventional configurations (packed and fluidized bed) is not enough to make the process economically viable.
- The introduction of oxygen membranes can solve the problem of the heat management and can widely increase the performance of the process.

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