# Hydrogen Production through Methane Catalytic Steam Reforming

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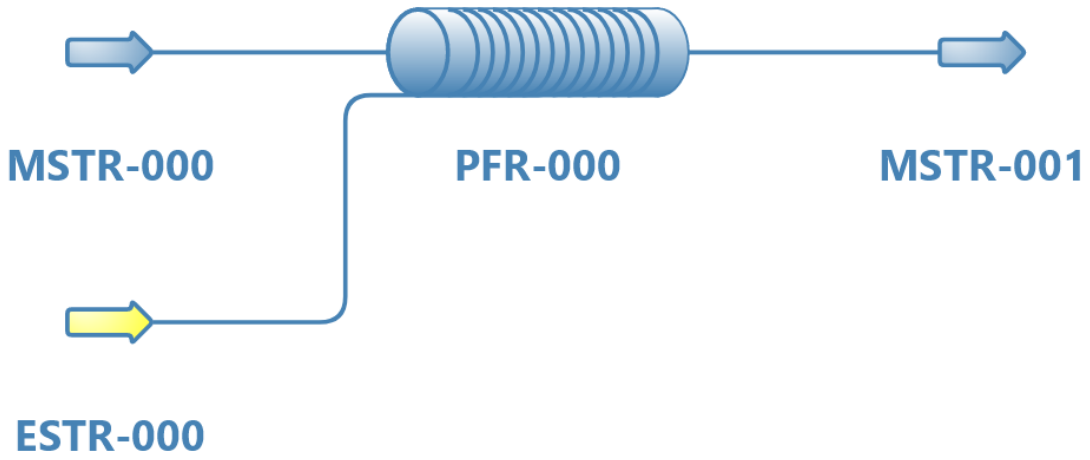
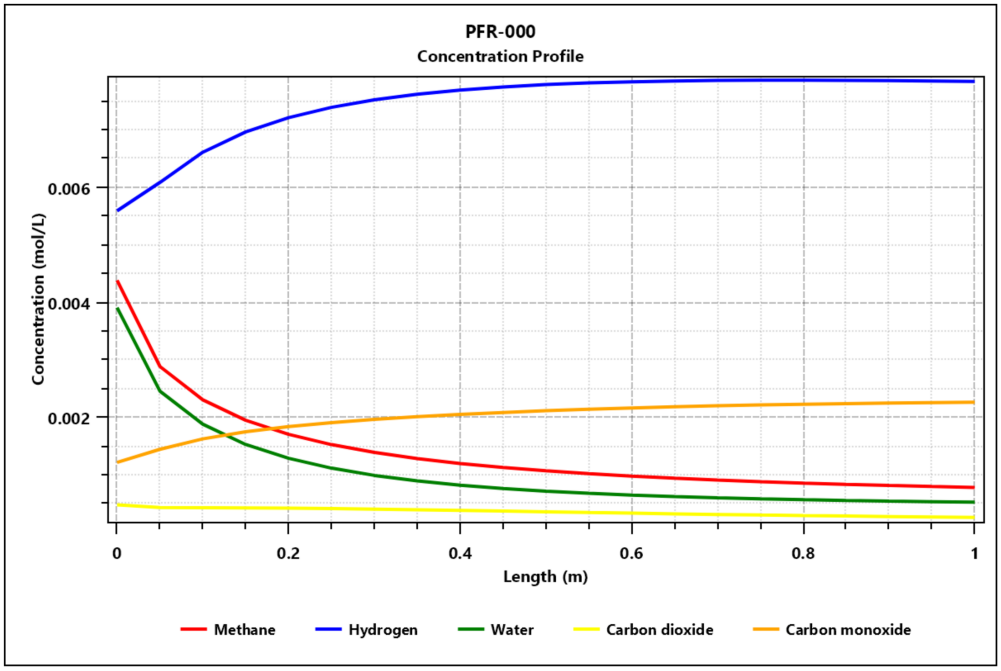
**Background & Description:**
Natural gas has been proposed as a source of hydrogen for fuel cell vehicle applications because of the existing infrastructure. In a process known as steam reforming, natural gas and steam are reacted into mostly carbon monoxide and hydrogen with some carbon dioxide also produced. There can also be excess water in the reformate stream.

A feed consisting of 10000 mol/h $CH_4$, 10000 mol/h $H_2O$, and 100 mol/h $H_2$ enters into a steam reforming reactor that operates at 1000 K and a 1 atm feed pressure. The reactions taking place in the PFR are as follows:
The steam reforming reaction is given as:
$CH_4 + H_2O \rightleftharpoons 3H_2 + CO$
In the steam reformer, the water gas shift reaction also takes place as: $CO + H_2O \rightleftharpoons H_2 + CO_2$
Adding together the steam reforming and water gas shift reactions gives the overall reaction:
$CH_4 + 2H_2O \rightleftharpoons 4H_2 + CO_2$

In the reactor, methane ($CH_4$) and water ($H_2O$) are fed as reactants and carbon dioxide ($CO_2$), carbon monoxide ($CO$), and hydrogen ($H_2$) are produced over a nickel catalyst on an alumina support. The weight of the catalyst is 386 g. The reaction takes place in isothermal mode with reactor volume of 1 $m^3$. 75.62% conversion is obtained for methane.






**Results:**

| **Object** | MSTR-001 | MSTR-000 | |
|---|---|---|---|
| Temperature | 726.85 | 726.85 | C |
| Pressure | 0.96143 | 1.01325 | bar |
| Mass Flow | 340.7791 | 340.7816 | kg/h |
| Molar Flow | 35381.14 | 20100 | mol/h |
| Volumetric Flow | 3060.166 | 1649.323 | $m^3/h$ |

Table 1: Streamwise Results for Hydrogen Production thorugh Methane Catalytic Steam Reforming