Dry Methane Reforming Process using Open Modelica

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A. Background

One of the most important compounds used as a precursor in the petrochemical industries is Methane. Hydrogen is usually produced from Methane by steam reforming where steam reacts with Methane. An alternative route is the dry reforming process in which Methane reacts with Carbon dioxide to produce Hydrogen and Carbon monoxide (Syngas). Low temperatures and high pressures usually favour this process. This process is also advantageous from an environmental standpoint as it utilises two major greenhouse gases in order to produce fuel.

B. Flowsheet description

Pure feed streams containing Carbon dioxide and Methane is sent to a stream mixer. Both the feed streams are at a temperature of 50°C and a pressure of 1 atm. The molar flow rate of each stream is 1000 kmol/h. The mixed stream is then heated to 1100 K. The heated stream is then sent to a conversion reactor where the conversion is fixed at 94.8%. The product stream is then cooled to 81°C. The energy released by the cooler is recycled into the heater for heating the reactants. This flowsheet is based on Luyben (2014)

C. Results and Discussions

The results obtained using OpenModelica v1.11 are tabulated below.

Object	**Methane**	**Carbondioxide**	**Product**	**Unit**
Temperature	323.15	323.15	1100	K
Pressure	101325	101325	101325	Pa
Mass Flow	4.456	12.224	16.681	kg/s
Molar fraction of Methane	1	0	0.01307	
Molar fraction of Hydrogen	0	0	0.48692	
Molar fraction of Carbon monoxide	0	0	0.48692	
Molar fraction of Carbon dioxide	0	1	0.01307	

The results obtained from DWSIM were as follows:

Master Property Table				
Object	**Product**	**Methane**	**Carbon-di-oxide**	
Temperature	1100	323.15	323.15	**K**
Pressure	101325	101325	101325	**Pa**
Mass Flow	16.681055	4.4563889	12.224861	**kg/s**
Molar Fraction (Mixture) / Methane	0.013072569	1	0	
Molar Fraction (Mixture) / Hydrogen	0.48692743	0	0	
Molar Fraction (Mixture) / Carbon monoxide	0.48692743	0	0	
Molar Fraction (Mixture) / Carbon dioxide	0.013072567	0	1	
Molar Fraction (Mixture) / Water	0	0	0	