Production of Hydrogen using Water Gas Shift Reaction (WGSR)

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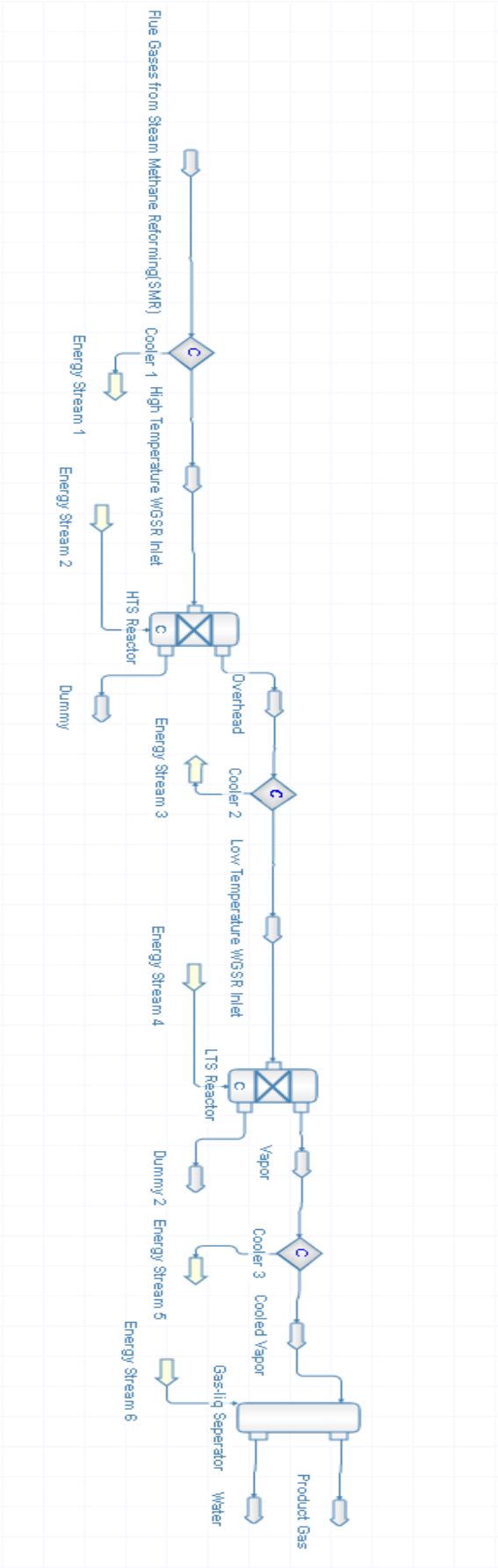
ABSTRACT

Hydrogen happens to be one of the most promising sources of energy. Hydrogen is a propitious source of energy because it can be combusted, similar to gasoline and natural gas, or converted to electricity in a fuel cell without any carbon emissions at the point of use. The production of hydrogen can be achieved via various process technologies, Steam Methane Reforming is the best industrial method to produce Hydrogen till date.

Water Gas Shift Reaction is a major part of Steam Methane Reforming process, the flue gases after methanation has Carbon Monoxide and major part of unconverted steam. WGSR increases the yield of Hydrogen produced by reacting carbon monoxide with the remaining steam. This process is important for two reasons, firstly, it increases yield. Secondly, converts CO to CO_2, hence the emission of poisonous CO gas is avoided.

WGSR is divided into two parts, High Temperature Shift(HTS) and Low Temperature Shift(LTS).Flues gases from SMR enters HTS Reactor which operates at 500-700K, where it converts remaining steam by 35%, then the overhead is passed through a cooler to bring down the temperature to 400K. Later, the cooled stream is taken into LTS Reactor which operates at 300-400k, this is industrially used to increase the H_2 yield by 2-3%. The vapor outlet is cooled and sent to Gas-Liq Separator, where remaining steam is condensed to water and the product gas is taken out, Pressure Swing Adsorption is done and the obtained Hydrogen is liquified.

FLOWSHEET


Flue Gases from Steam Methane Reforming(SMR)
Cooler 1
Energy Stream 1
High Temperature WGSR Inlet
Energy Stream 2
HTS Reactor
Dummy
Overhead
Cooler 2
Energy Stream 3
Low Temperature WGSR Inlet
Energy Stream 4
LTS Reactor
Dummy 2
Vapor
Cooler 3
Energy Stream 5
Cooled Vapor
Energy Stream 6
Gas-liq Seperator
Water
Product Gas

RESULTS

High Temperature Shift Reaction

Compound	Amount
Methane	0.016
Oxygen	0
Nitrogen	0.283
Water	0.1656
Hydrogen	0.3949
Carbon Monoxide	0
Carbon Dioxide	0.132

Low Temperature Shift Reaction

Compound	Amount
Methane	0.016
Oxygen	0
Nitrogen	0.283
Water	0.1656
Hydrogen	0.3949
Carbon Monoxide	0
Carbon Dioxide	0.132

Product Gas

Compound	Amount
Methane	0.019
Oxygen	0
Nitrogen	0.337
Water	0.006
Hydrogen	0.4701
Carbon Monoxide	0
Carbon Dioxide	0.1574

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