Sulfur-Iodine Hydrogen Production

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Background

This project aims to efficiently produce hydrogen using a sulfur-iodine thermochemical water splitting cycle. The process is carbon emission free and would help aid in the transition to sustainable clean energy. Using hydrogen as an energy source will help lead to cleaner regional air quality in the long run due to reduced CO_2 emissions and increase energy security as a result of the decreasing need of hydrocarbon fuel imports.

Sulphur-Iodine Thermochemical Water Splitting

The three stoichiometry equations in this process are:

$$I_2 + H_2O + SO_2 \rightleftarrows 2\,HI + H_2SO_4$$
(Exothermic between 293 K – 393 K)

$$H_2SO_4 \rightleftarrows SO_2 + H_2O + \tfrac{1}{2}\,O_2$$
(Endothermic between 1073 K – 1173 K)

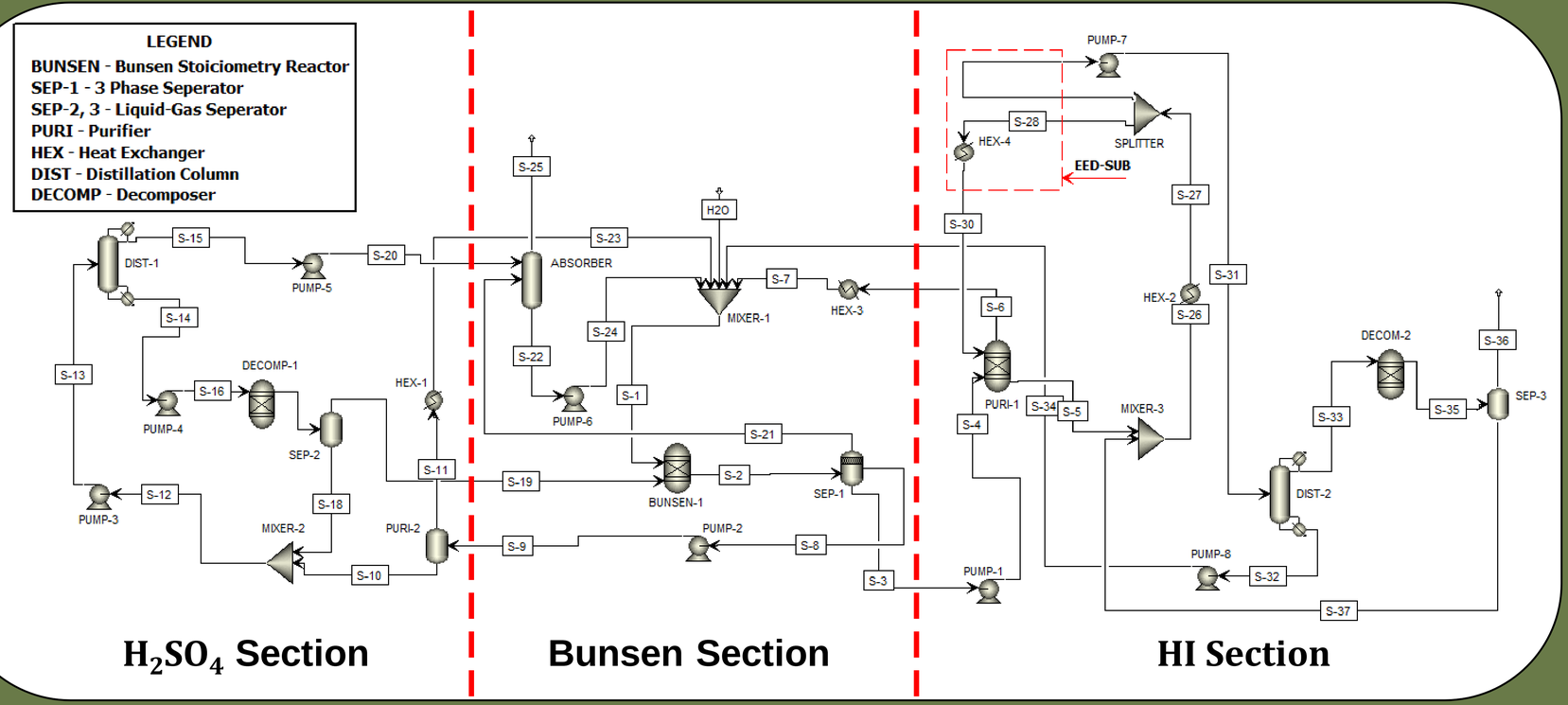
$$2\,HI \rightleftarrows I_2 + H_2$$
(Endothermic between 573 K – 773 K)

Main sections of the process:

- Bunsen Section
  - Water, sulfur dioxide and iodine as input
  - Mixes Chemicals & Recycle Streams
  - Phase Separation into liquid-liquid-Gas after the mixing
- HI Section
  - Refines and Filters Chemicals
  - From the refining and filtering recycles reactants
  - H_2 Production
- H_2SO_4 Section
  - Refines and Filters Chemicals
  - From the refining and filtering recycles reactants
  - O_2 production as a by product

Key Benefits of Sulfur Iodine Water Splitting Cycle:

- Zero Carbon emissions
- No hydrocarbon-fuels required
- Compatible with renewable energy sources
- A closed loop system that consumes only H_2O while producing H_2 and O_2



Project Goals/Objectives

- Pre-Feasibility Assessment
- Produce pure hydrogen at a rate of at least 140 tonnes/day
- Complete Simulation of Sulfur Iodine Thermochemical-water splitting using Aspen Plus
- Techno-economic analysis detailing the economic performance of the process

Equipment Needed

- Bunsen Section
  - Mixer, Stoichiometry Reactor, 3-Phase Separator, Absorber, Heat Exchangers, and Pumps
- HI Section
  - Purifier, EED, Splitter, Mixer, Distillation Column, Decomposer, 2-Phase Separator, Heat Exchangers, and Pumps
- H_2SO_4 Section
  - Purifier, Mixer, Distillation Column, Decomposer, 2-Phase Separator, Heat Exchangers, and Pumps

Outcomes

Pure Hydrogen is produced at a rate of 143 tonnes/day.
Approximate Techno-economic analysis
Components selected:

- Radially Split Pump
- Shell and Tube Heat Exchanger
- 18 Nominal Schedule 160 Stainless Steel Pipe
- Custom Made Tank

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