Ammonia Plant Economy

- Raw material v/s Product $ (Profit - Product - Raw Material)
- Utilities - gas, oil, steam, water, electricity
- Economic Reports
- SS - Change in $

Problem Statement :

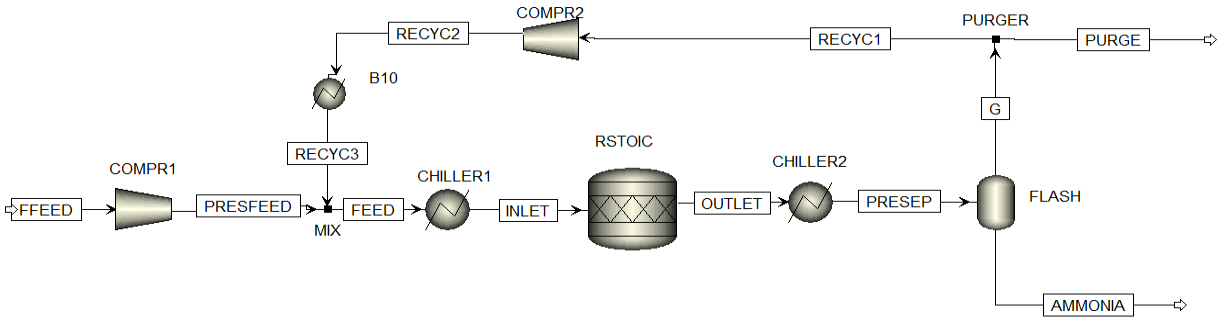
- Ammonia is to be produced via the reaction of N2 and H2 using the Haber process. There is no oxygen in the feed, only trace material such as methane, argon and carbon monoxide. The reactor is isothermal, and has a 40% conversion based on the inlet of nitrogen gas. The cryogenic mix is then cooled down to separate it. The gases, mostly Nitrogen and Hydrogen gas are recycled, all other material purged and the liquid product goes to the “Ammonia” product line.
- Pressure is approx. 270 atm through all the system
- Main focus is to produce 95%+ Ammonia product
- Utilities are to be added, as well as some raw materials / products economics
- Analysis is carried out in Europe and USA

- Prices in USA
  - Materials
    - Syngas = $0.26/kg
    - Product = $0.50/kg
  - Utilities
    - Electricity = $0.06/kWh
    - Cooling Water = 0.0251/tonne → -33.44 kJ/kk
    - Natural Gas = $5.8 / MMBTU → $20.63 MBTU/lb
- Prices in EU
  - Materials
    - Syngas = $0.32/kg
    - Product = $0.550/kg
  - Utilities
    - Electricity = $0.075/kWh
    - Cooling Water = 0.0301/tonne → 35.44 kJ/kk
    - Natural Gas = $5.2 / MMBTU → $18.49 MBTU/lb

Design Methodology :

- (A) Create the plant
- (B) Add Materials Costs & Utilities
- (C) Compare USA vs. Europe Costings
- (D) Sensitivity Analysis of Prices
- (E) Verify the “Economic Analysis” and Economic Reports

Model Design :



USA UTILITIES COST

Utility type		ELECTRICITY	GAS	WATER
Costing rate	$/sec	2.29281	0.159006	0.0571671
Mass flow	kg/hr		2.00066e+06	8.19927e+06
Duty	MBtu/hr	469404	163549	466285
Heating/Cooling value	Btu/lb		37.08	-25.7954
CO2 emission factor data source		US-EPA-RULE-E9-57		
Ultimate fuel source		NATURAL_GAS		
CO2 emission factor	kg/cal	2.34e-07		
CO2 energy source efficiency factor		0.58	1	1
CO2 emission rate	kg/sec	13.2564		
Purchase price	$/kg			2.51e-05
Electricity price	$/kWhr	0.06		
Energy price	$/MBtu		0.0035	0.000441365
Inlet temperature	C			20

USA OPERATING COST

Utility		
Total heating duty	MBtu/hr	163549
Total cooling duty	MBtu/hr	466285
Net duty (Total heating duty - Total cooling duty)	MBtu/hr	-302736
Total heating cost flow	$/hr	572.421
Total cooling cost flow	$/hr	205.802
Net cost (Total heating cost + Total cooling cost)	$/hr	778.222
Electric power	kW	137569
Electric power cost	$/hr	8254.12
Total utility cost	$/hr	9032.34
Stream cost		
Net cost flow of feeds	$/hr	15941
Net cost flow of products	$/hr	28766.5