

Kalina Cycle

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Background & Description:

A Kalina cycle consist of: absorber, condenser, gas-liquid separator, heat exchangers, valves, pumps and one or more turbine for producing power. Because of high performance and acceptable efficiency of the Kalina cycles, these cycles are very developed and investigated in recent years.

In this power generation cycle, ammonia-water mixture is used as the working fluid. Stream S-01 at 74.3565 °C, 3.5 bar and 0.3116 M fraction of NH₃ with 3600 kg/h mass flow rate, enters gas-liquid separator in order to divide to rich vapor of the ammonia (S-10) and poor solution of the ammonia (S-02). Stream S-10 enters MIX-01 to mix with the stream S-09 and stream S-02 is sent to HE-01 heat exchanger to preheat the stream S-13. S-14 at 55.113°C, is sent to the HEAT-01 in order to absorb the solar thermal energy. Outlet stream of the HEAT-01 (S-15) at 300 °C and 80 bar, enters EXP-01 turbine to generate electricity. Stream S-16 leaves the turbine at 85.1638 °C and 1.29 bar and enters HE-02 heat exchanger. Temperature of stream S-17 is reduced to 49.821 °C and with stream S-04 is sent to the MIX-02 mixer. The outlet stream of MIX-02 (S-05) at 49.5955 °C enters COOL-02 absorber. In COOL-02, temperature of ammonia-water mixture reaches to 25 °C, by exchanging heat with water stream. S-06 stream at 25 °C and 1.29 bar is sent to PUMP-01 pump and pressure of it reaches to 3.5 bar. S-07 stream at 3.5 bar and with 4500 kg/h mass flow rate, leaves PUMP-01 pump and enters SPLT-01 splitter to divide into two streams: S-9 and S-08. Stream S-09 with 900 kg/h mass flow rate mixes with stream S-10 that comes from the SEP-01 gas-liquid separator. Temperature of the outlet stream of MIX-01 mixer (S-11) reaches to 56.0799 °C. Next it enters COOL-01 condenser and is cooled with water stream. After cooling, temperature of stream (S-12) reaches to 24.2 °C and next is sent to PUMP-02 pump. Pressure of the outlet stream (S-13) increases to 80 bar and then for preheating enters HE-01 heat exchanger. Stream S-03 at 62.1734 °C and 3.5 bar enters VALV-01 valve. After passing through the VALV-01, pressure of the stream reaches to 1.29 bar and mixes with stream S-17. Stream S-8 with 3600 kg/h mass flow rate is sent to HE-02 and after exchanging heat, at 74.3565 °C enters SEP-01 gas-liquid separator.

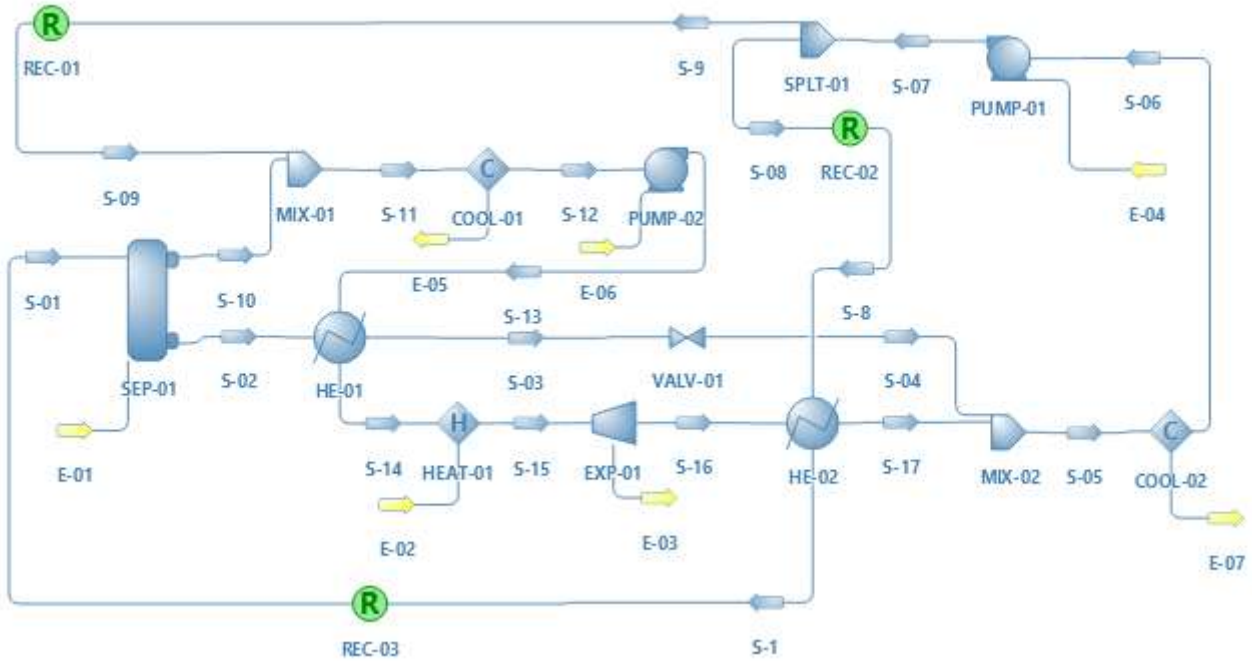
System of Units:

Temperature : °C,
Pressure : bar,
Molar flow : Kmol/h,
Mass flow : kg/h

Property Package:

Cape Open (Predictive-SRK model)

Flowsheet:



Results:

Object	S-09	S-08	S-07	S-06	S-05	S-04	S-03	S-02	S-01	
Temperature	25.0037	25.0037	25.0037	25	49.5955	49.5026	62.1734	75	74.3565	C
Pressure	3.5	3.5	3.5	1.29	1.29	1.29	3.5	3.5	3.5	bar
Mass Flow	900	3600	4500	4500	4500	3192.1	3192.1	3192.1	3600	kg/h
Molar Flow	50.8232	203.293	254.116	254.116	254.116	179.452	179.452	179.452	203.293	kmol/h
Molar Fraction (Mixture) / Ammonia	0.311574	0.311574	0.311574	0.311574	0.311574	0.230824	0.230824	0.230824	0.311574	
Molar Fraction (Mixture) / Water	0.688426	0.688426	0.688426	0.688426	0.688426	0.769176	0.769176	0.769176	0.688426	

Object	S-17	S-16	S-15	S-14	S-13	S-12	S-11	S-10	
Temperature	49.821	85.1638	300	55.113	-24.6606	24.2	56.0799	75	C
Pressure	1.29	1.29	80	80	80	3.5	3.5	3.5	bar
Mass Flow	1307.9	1307.9	1307.9	1307.9	1307.9	1307.9	1307.9	407.904	kg/h
Molar Flow	74.6634	74.6634	74.6634	74.6634	74.6634	74.6634	74.6634	23.8402	kmol/h
Molar Fraction (Mixture) / Ammonia	0.505655	0.505655	0.505655	0.505655	0.505655	0.505655	0.505655	0.919402	
Molar Fraction (Mixture) / Water	0.494345	0.494345	0.494345	0.494345	0.494345	0.494345	0.494345	0.0805981	