ABSTRACT FOR HUMIDIFIER

Description:

Humidifier is a component used to obtain moist air from a relatively dry air. Dry air is fed to the system with a water feed. Input parameters for the system such as relative humidity, pressure, temperature and vapour pressure pertaining to the temperature are set. We get the required moist air.

The equations involve a mass, enthalpy and entropy balance check which are as follows:

1. Mass balance
   - **Total mass balance** => (Mass of dry air) + (mass of water input) = (mass of moist air) + (mass of water outlet)
   - **H2 balance** => (moles of water inlet) = ((mole fraction of water in moist air)*(moles of moist air)) + (moles of water outlet)
2. Enthalpy/entropy balance (enthalpy/entropy is assumed specific)
   - (enthalpy of moist air) = (enthalpy of dry air) + ((humidity ratio)*(enthalpy of water inlet))
   - Humidity ratio = mass flow of water inlet / mass flow of dry air
   - ((enthalpy of dry air)*(mass flow of dry air)) + ((enthalpy of water inlet)*(mass flow of water inlet)) = ((enthalpy of water outlet)*(mass flow of water outlet)) + ((enthalpy of moist air)*(mass flow of moist air))
   - Same applicable for entropy balance

References:

http://web.mit.edu/lienhard/www/Thermodynamic_analysis_of_HD_desalination_cycles_DWT-16-339-2010.pdf

Examples: (Input Parameters: Punit(in Pa) = 101325, RHwetair(in %) = 40, VPh20(in Pa) = 3570, Tunit(in K) = 300)

- **Raoult's Law**

Master Property Table					
Object	WetAir	WaterOut	WaterIn	DryAir	
Temperature	300	373.132	298.15	308.15	K
Pressure	101325	101325	101325	101325	Pa
Mass Flow	10.1027	4.90691	5	10	kg/s
Molar Flow	350.717	272.375	277.542	345.304	mol/s
Mixture Specific Enthalpy	1.86688	25.3247	-2440.95	10.0184	kJ/kg
Mixture Specific Entropy	0.03798	0.111678	-8.18698	0.0330504	kJ/[kg.K]
Molar Fraction (Mixture) / Air	0.985907	0	0	1	
Molar Flow (Mixture) / Water	4.94274	272.375	277.542	0	mol/s

- **UNIFAC**

Master Property Table					
Object	WetAir	WaterOut	WaterIn	DryAir	
Temperature	300	373.132	298.15	308.15	K
Pressure	101325	101325	101325	101325	Pa
Mass Flow	10.1027	4.90691	5	10	kg/s
Molar Flow	350.717	272.375	277.542	345.304	mol/s
Mixture Specific Enthalpy	1.63094	27.3152	-2630.81	9.80846	kJ/kg
Mixture Specific Entropy	0.0373187	0.123636	-7.09726	0.0324587	kJ/[kg.K]
Molar Fraction (Mixture) / Air	0.985907	0	0	1	
Molar Flow (Mixture) / Water	4.94274	272.375	277.542	0	mol/s

- **UNIQUAC**

Master Property Table					
Object	WetAir	WaterOut	WaterIn	DryAir	
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Mixture Specific Entropy	0.0373187	0.123636	-7.09726	0.0324587	kJ/[kg.K]
Molar Fraction (Mixture) / Air	0.985907	0	0	1	
Molar Flow (Mixture) / Water	4.94274	272.375	277.542	0	mol/s

- **Soave-Redlich-Kwong(SRK)**

Master Property Table					
Object	WetAir	WaterOut	WaterIn	DryAir	
Temperature	300	373.132	298.15	308.15	K
Pressure	101325	101325	101325	101325	Pa
Mass Flow	10.1027	4.90691	5	10	kg/s
Molar Flow	350.717	272.375	277.542	345.304	mol/s
Mixture Specific Enthalpy	1.60623	27.0924	-2609.49	9.79453	kJ/kg
Mixture Specific Entropy	0.0372124	0.122184	-7.01756	0.0323772	kJ/[kg.K]
Molar Fraction (Mixture) / Air	0.985907	0	0	1	
Molar Flow (Mixture) / Water	4.94274	272.375	277.542	0	mol/s

- **Peng-Robinson/Lee-Kesler(PR/LK)**

Master Property Table					
Object	WetAir	WaterOut	WaterIn	DryAir	
Temperature	300	373.132	298.15	308.15	K
Pressure	101325	101325	101325	101325	Pa
Mass Flow	10.1027	4.90691	5	10	kg/s
Molar Flow	350.717	272.375	277.542	345.304	mol/s
Mixture Specific Enthalpy	1.63094	27.3152	-2630.81	9.80846	kJ/kg
Mixture Specific Entropy	0.0373187	0.123636	-7.09726	0.0324587	kJ/[kg.K]
Molar Fraction (Mixture) / Air	0.985907	0	0	1	
Molar Flow (Mixture) / Water	4.94274	272.375	277.542	0	mol/s