ENERGY GENERATION BY COMBUSTION OF METHANE

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Abstract

Simulation of a possible electricity generating plant was done from combustion of methane(Natural gas).The heat of reaction was tapped from a conversion reactor (RC-01) operated at isothermal conditions with an overall efficiency of 40%.NRTL thermodynamic package was used for the vapor phase reaction of methane. $CH_4 + 2O_2 \longrightarrow C0_2 + 2H_2O$.The heat of reaction -5564.42 w was used to heat the working fluid, toluene for an in situ organic Rankine cycle. An ORC cycle consists of a pump (P-01), heater (HT-01), turbine (T-001) and a cooler (Cl-01). The heater used was 80% efficient. The amount of heat transferred to the heater was 3000Kw, with efficiency of about 54% compared to the heat given of during the reaction. The working fluid entered the process at 298.15K and at pressures of 1atm .Pump (P-01)with an efficiency of 75% increased the outlet pressure of toluene to 14bars .Turbine (T-001)operated as adiabatic with efficiency of 75% was used to generate 198.75Kw of mechanical energy while 2203.36Kw was rejected from the cooler(the outlet temperature was 298.15K). This Rankine cycle used Peng Robinson thermodynamic model.

RESULTS

Master Property Table									
Object	s-05	s-03	s-02	S-11	S-09	S-08	S-07	S-01	
Temperature	1167.13	298.15	298.15	298.15	298.702	298.15	1098.87	298.15	K
Pressure	1.4E+06	101325	101325	101325	1.4E+06	101325	101325	101325	Pa
Mass Flow	1	0.211369	0.788631	1	1	1	1	1	kg/s
Molar Flow	10.8532	11.6765	27.3612	10.8532	10.8532	10.8532	10.8532	39.0377	mol/s
Volumetric Flow	0.0748449	0.000212475	0.669366	0.00115665	0.00115568	0.00115665	0.977927	0.95502	m3/s
Heat Capacity (Vapor)	3.03041	0	1.16404	0	0	0	2.95334	1.25075	kJ/[kg.K]
Molar Fraction (Vapor) / Toluene	1	0	0	1	1	1	1	0	
Molar Fraction (Liquid 1) / Toluene	1	0	0	1	1	1	1	0	

PROPERTIES TABLE			
T-001	Pressure Drop	1.29868E+06	Pa
T-001	Adiabatic Efficiency	75	%
T-001	Power Generated	198.746	kW
HT-01	Pressure Drop	0	Pa
HT-01	Efficiency	80	
HT-01	Outlet Temperature	1167.13	K
CL-01	Pressure Drop	0	Pa
CL-01	Efficiency	100	
CL-01	Heat Removed	2203.26	kW
P-01	Outlet Pressure	1.4E+06	Pa
P-01	Efficiency	75	

Snip of flowsheet