Hybrid Flare Gas Recovery System

TEAM M003

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Objectives

Design and validate a hybrid flare gas recovery system to reduce routine flaring by conditioning separator gas for downstream use, supported by full-scale simulation and a simplified compressor–cooler prototype.

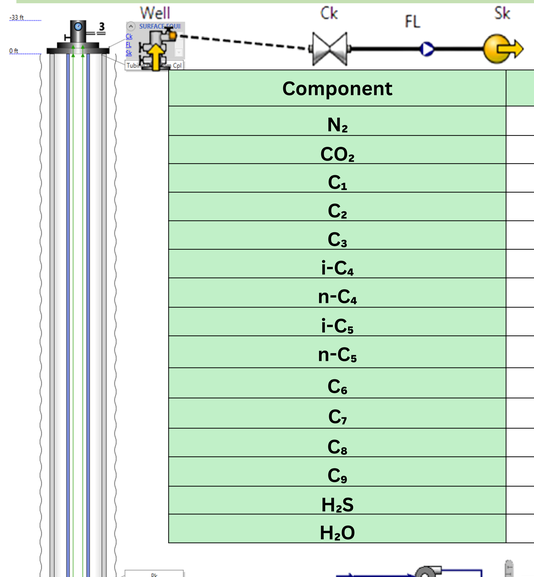
Constraints

- Limited gas availability
- $T_{max} \leq 200°C$
- Variable H_2S/CO_2 & flow

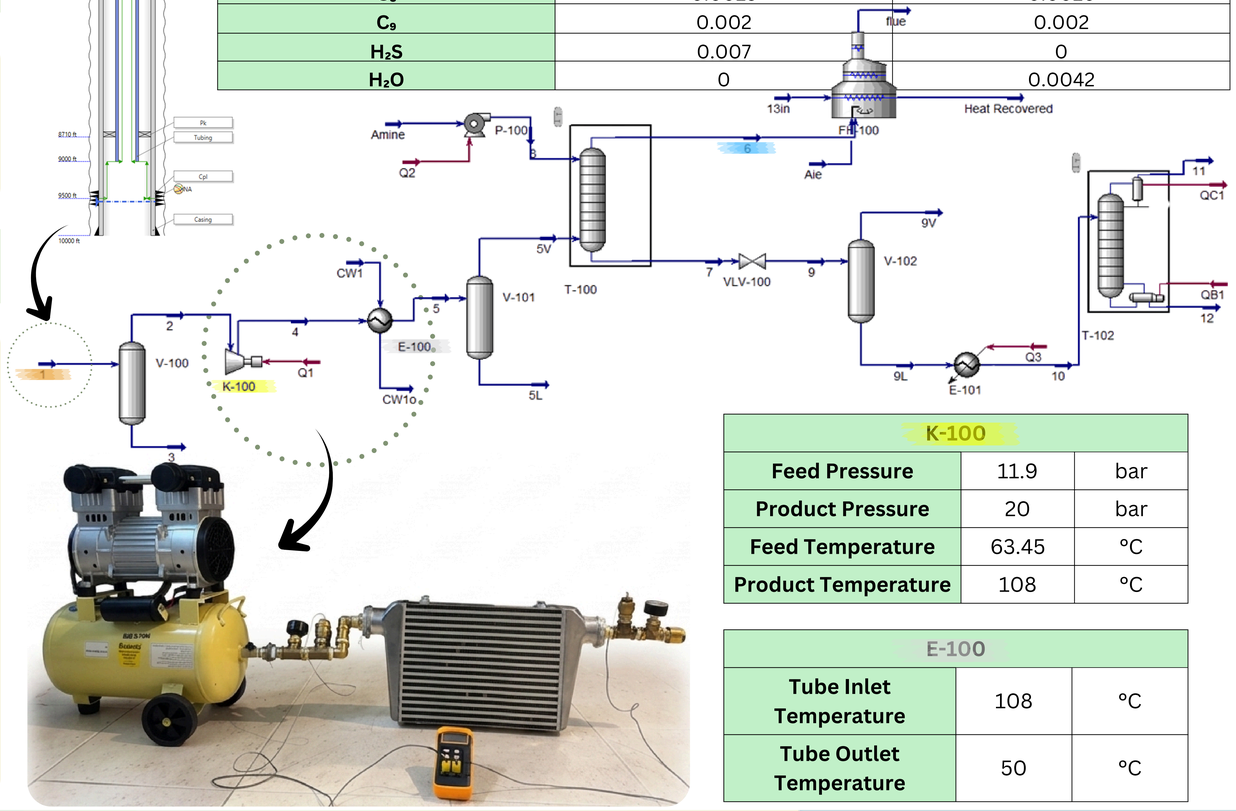
Specifications

- H_2S ≤100 ppm; CO_2 ≤1%
- Net efficiency 50–70% (LHV)
- Prototype ≤16 bar; full-scale ≤40 bar
- Cooler outlet ≤50°C
- GOR 200–800 scf/STB
- Oil ≥90%; CH_4 60–90%
- Total HC recovery ≥95%
- ≥50% energy to useful output
- Maintain P,T within ±15% design

Prototype Development



Component	Inlet (Stream 1)	Outlet (Stream 6)
N_2	0.0136	0.0147
CO_2	0.06	0.0007
C_1	0.7677	0.8212
C_2	0.0639	0.068
C_3	0.0429	0.0455
i-C_4	0.0047	0.0048
n-C_4	0.0157	0.0165
i-C_5	0.0043	0.0045
n-C_5	0.0063	0.0066
C_6	0.0058	0.0061
C_7	0.0045	0.0037
C_8	0.0015	0.0016
C_9	0.002	0.002
H_2S	0.007	0
H_2O	0	0.0042

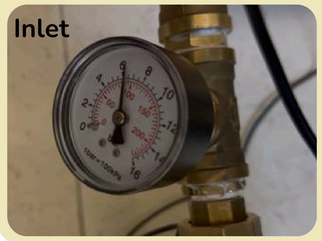


K-100		
Feed Pressure	11.9	bar
Product Pressure	20	bar
Feed Temperature	63.45	°C
Product Temperature	108	°C

E-100		
Tube Inlet Temperature	108	°C
Tube Outlet Temperature	50	°C

Testing/Validation

Prototype Results



Optimized Well Operation Results

Case	Location	Pressure (bar)	Liquid Rate (m³/day)	Gas Rate (m³/day)	Temperature (°C)
Initial	Wellhead	70	648.24	57,240	–
Base Case	Separator	50	758	66,931	63.5
Trial 1	Separator	25	838	73,975	63.5
Trial 2	Separator	10	872.4	77,015	63.5

Energy Performance

Removal Efficiency	
H_2S	100%
CO_2	98.83%

Energy Fed	Energy Burned	% Recovery
1.744×10^{10}	1.717×10^{10}	**98.45**

Conclusion

Recovered separator gas is recovered, conditioned, and treated; it can later be used as fuel to drive an absorption chiller and produce chilled water for site cooling.