HyNet Hydrogen Production Plant 1 – Technical Note

EPR Response - 8a - BAT for prevention/reduction of emissions of Volatile Organic Compounds (VOCs)

Summary

Background

Para 3.7.9 states, “Off-gases from the TEG still column. This stream comprises steam, with CO_2 (23.4 mol %) and methanol (9.5 mol%); there is no residual TEG carry-over as the TEG has been removed in the TEG regeneration system. Proposals to provide a condenser to remove the methanol emission are being pursued by the project.”

Response

The overall TEG process schematic is shown below:

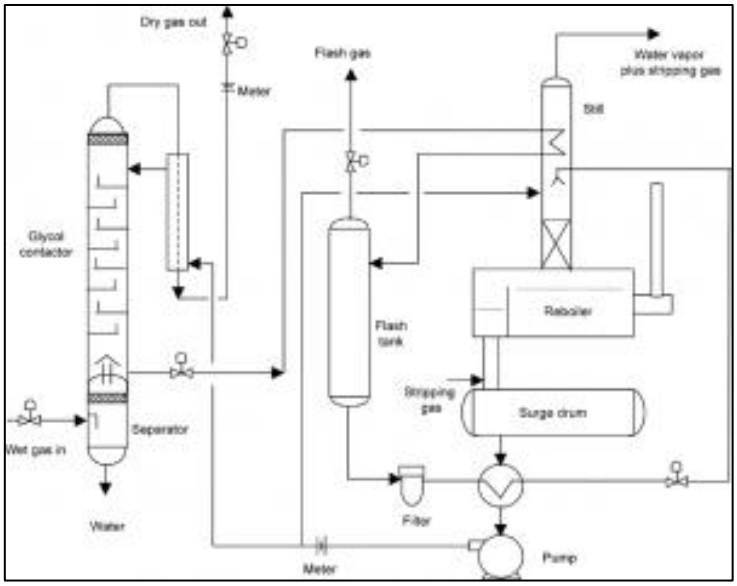

Figure 1: TEG Schematic

TEG losses in the overhead gas (still column off-gas) are minimised by the integrated Overhead Condenser that provides the necessary water reflux. The overhead off-gas containing mostly water, CO_2, methanol, a fraction of hydrogen, and other volatile compounds is available at near to atmospheric pressure and is vented to a safe location.

This still column off-gas was simulated in HYSYS to condense methanol. An air cooler has been used to reduce off-gas temperature thus condensing the methanol.

Following composition of the still column off-gas was used:

Table 1: Still Column Off Gas Composition and Flow Rates:

Sl. No.	Component Name	Component Mole%	Aqueous Phase Flow (kg/hr)	Vapor Phase Flow (kg/hr)
1	Methanol	9.48	2.8	24.5
2	Water	66.75	20	88.2
3	CO_2	23.77	0.0042	94.1
4	Hydrogen	0.01	0	0.0016

The condenser (air cooler) duty was determined with following configuration:

Table 2: Methanol Condenser Configuration

Sl. No.	Parameter	Value
1	Still column off-gas inlet temperature	90.4°C
2	Condenser outlet off-gas temperature	35°C
3	Air temperature	22.2°C
4	Still off-gas inlet pressure	1.05 bara
5	Air cooler pressure drop	0.3 bar
6	No. of rows & tube passes	3 rows, single pass
7	No. of fans	2

The resultant cooled off-gas exiting condenser has following flow rates:

Table 3 Condenser Outlet Off Gas Flow Rates:

Sl. No.	Component Name	Aqueous Phase Flow (kg/hr)	Vapor Phase Flow (kg/hr)
1	Methanol	25.9	1.4
2	Water	105.5	2.7
3	CO_2	0.14	94.0
4	Hydrogen	0	0.0016

HYSYS results suggest a 73kW cooling duty for the condenser, thus reducing the methanol emissions in vapour phase of the off-gas.

A knock-out vessel installed downstream of condenser will be used to collect the liquid methanol and water.

This study confirms that methanol emission in off gases can be reduced by using a condenser. Further studies will confirm the details of this approach. These include optimizing the cooling duty, checking if a chiller can be used, using a blower to increase the off-gas pressure thus reducing required cooling duty & heat exchanger area and so on.

References:

- PFD 5194812-200-49DG02-4-0001-02 Rev 04
- Support Document for Environmental Permit Application 5194812-000-4PER-4-0012, Vendor Bid