



ProDry - Joint Industry Project

Robust and compact contactor for moderate water dew point reduction



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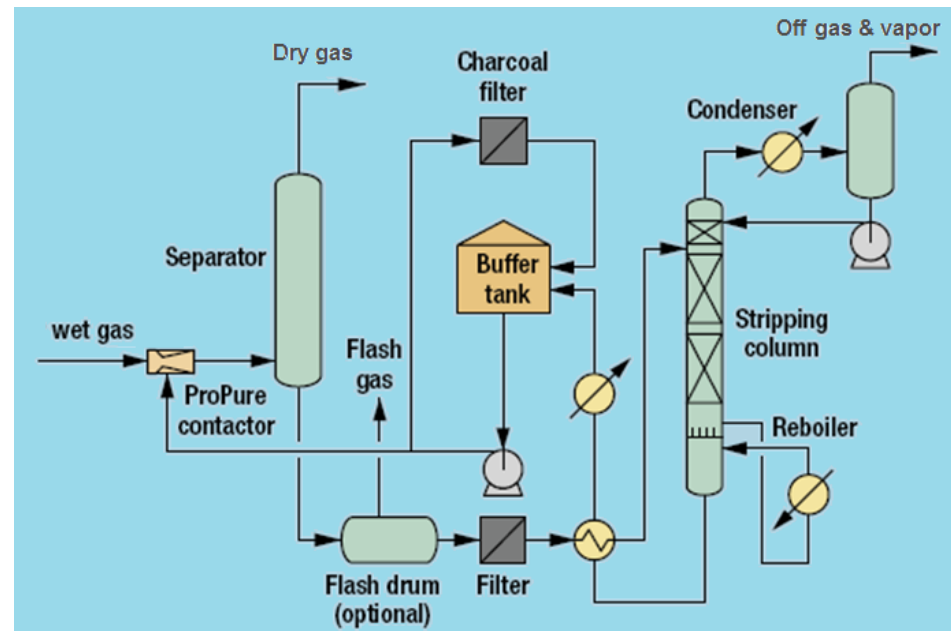
ProDry - description

Application:

Moderate dew point reduction based on the novel co-current ProPure gas-liquid contactor and a regenerative solvent.

Description:

- ProDry is the ProPure co-current contactor in combination with a separator
- ProDry replaces the counter-current contactor in a conventional gas dehydration plant.
- Moderate dew point reduction (up to 30 degC) is achieved



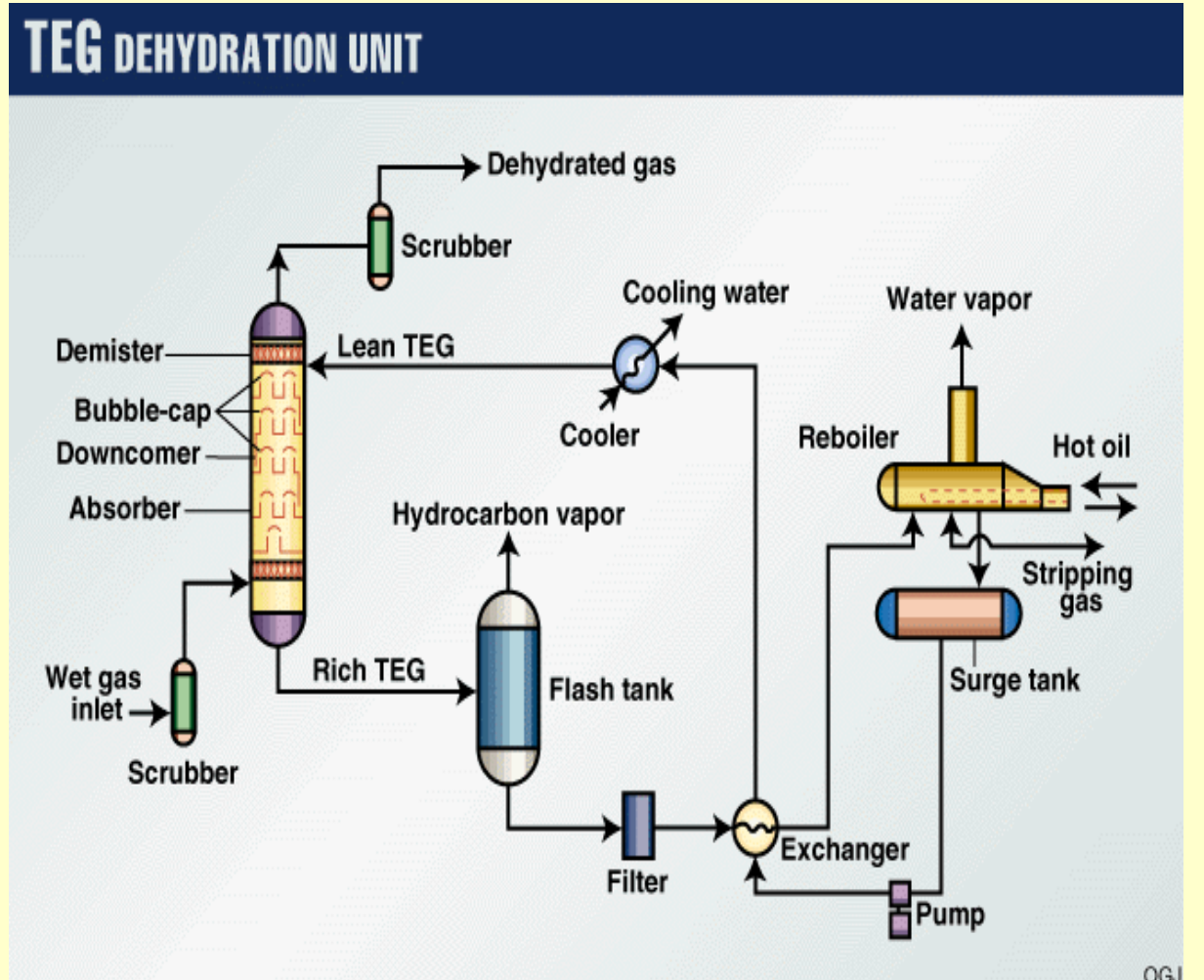
Gas treatment with ProDry

Conventional glycol dehydration process

- ✓ High pressure part where HC gas is present
- ✓ Low pressure regeneration unit.

The high pressure part consist of:

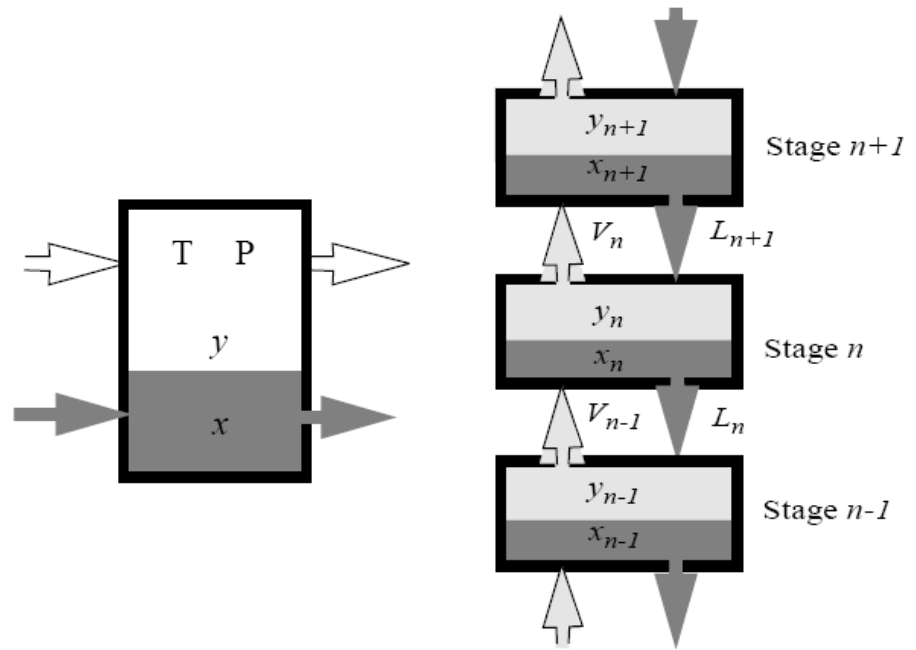
- Inlet scrubber
- Contactor column
- Outlet scrubber



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ProDry – principle of co-current contacting

- ✓ ProDry corresponds to one theoretical stage in a conventional counter/current process.
- ✓ A conventional absorber represent typically 2 – 4 theoretical stages
- ✓ The dried gas leaving ProDry is in equilibrium with the rich glycol.
- ✓ For a multi stage process the dried gas is in equilibrium with the lean glycol.
- ✓ The ProDry has a high interfacial area between the gas and liquid phase



A one stage process (left) compared to multi stage counter-current process (right)

ProDry - features

- ✓ Major **size and weight reduction** at moderate dew point reduction; (below 30° C reduction).
- ✓ Operational **robustness towards hydrocarbon** entrained with feed gas, no flooding or foaming
- ✓ Main application areas identified;
 - ***Fuel gas dehydration***
 - ***Subsea gas dehydration***
 - ***Dehydration for gas reinjection***
 - ***Debottlenecking of existing dehydration units***
 - ***Long distance transportation with moderate and low dew point reduction***



The ProPure C100W injection mixer

ProDry – technology development and qualification

Phase I (May 2007-November 2007) - **Conceptual study.**

Phase II (Dec. 2007-Dec. 2008) – **Performance testing and engineering of contactor design and performance.**

ProPure Test Facilities, Norway; 11 bar, saturated inert gas, 3” pipe.
Issues: Compactness, turn-down, TEG quality and temperature, entrained hydrocarbon liquid

Phases III & IV (Jan 2009-June 2011) – **Pilot testing**

Testing at TIGF Lussagnet, France: 55-65 bar, natural gas.
Issues: Turn-down, operation, long term stability, scale-up (3” and 6” pipe), entrained hydrocarbon liquid

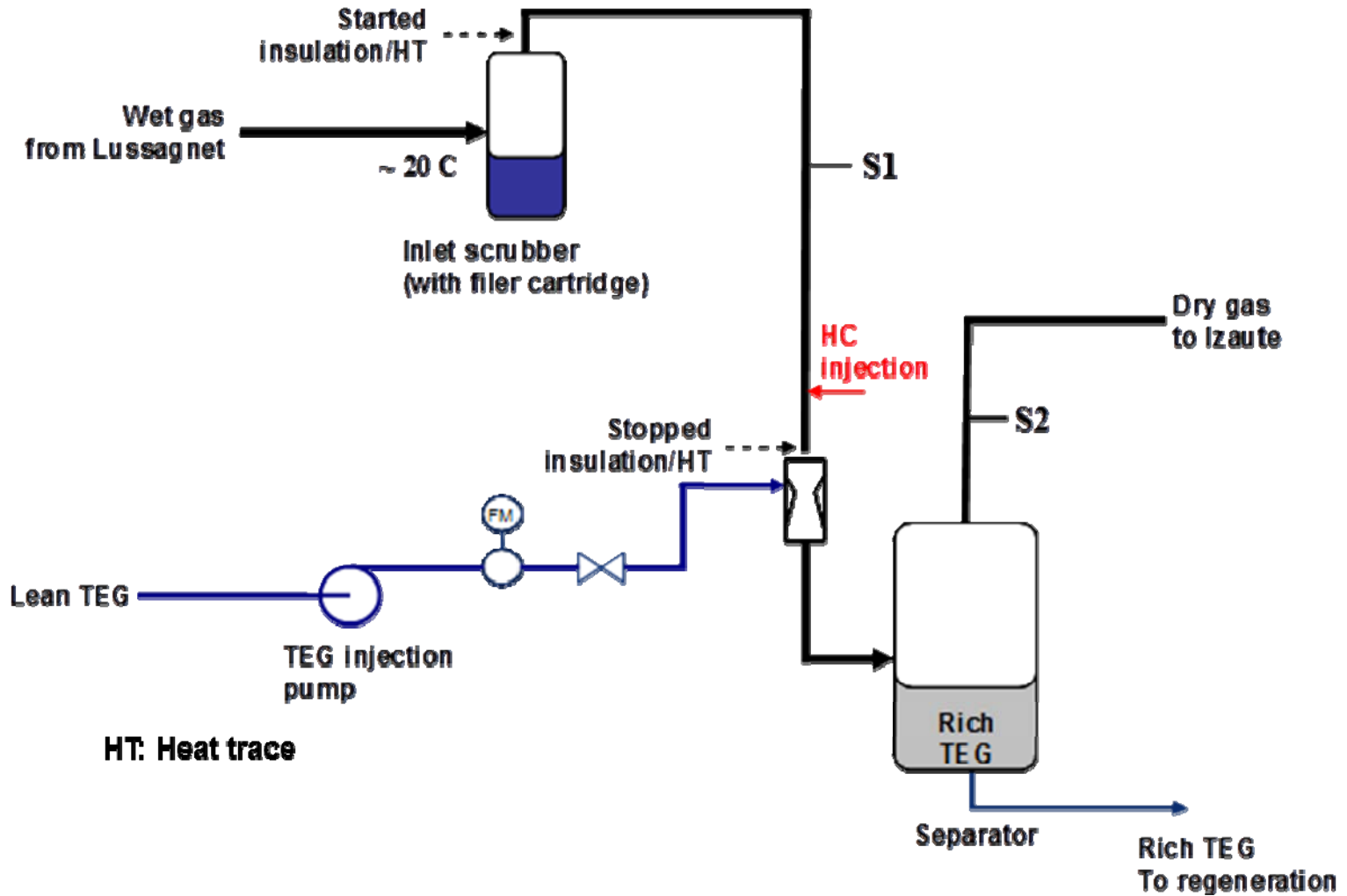
The ProDry design methodology is based on both the ProDry pilot natural gas tests in France and the ProDry inert gas tests in Norway.

ProDry Pilot at TIGF Gas Storage Center Lussagnet (France)

- ✓ *Natural gas (wet gas) at 55 – 65 bar*
- ✓ *Injected glycol was regenerated TEG from the plant (TEG purity higher than 99%wt)*
- ✓ *Contactor dim. 3" and 6"*
- ✓ *Contactor length 1 & 2 m, vertical and horizontal orientations*
- ✓ *Entrained hydrocarbon liquid tests as carried out with condensate*
- ✓ *Turn-down:
gas velocity 3 – 15 m/s,
gas-TEG flowrate ratio 200 - 5000*



Experimental set-up - ProDry test unit



ProDry performance

- *Close to equilibrium dehydration performance verified for a broad range of process conditions and operational modes:*
 - *Natural gas at high pressure*
 - *Gas and TEG flow rate*
 - *Long-term stability*
 - *Contactor compactness and orientation (contactor length)*
 - *Contactor scale-up (3" and 6")*
 - *Entrained hydrocarbon liquid*

