SPX Flow Technology

CO2 dryers for CCS applications

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CO_2 Transportation & Storage

Pipeline:

Remains the most common method of transporting the volumes envisaged, with thousands of kilometers of pipeline involved.

Considerations?

Selection of the most cost effective pipeline material. (Specification v Cost)
Reliability of downstream pipeline components (Valves, sensors, booster systems)
Lifespan of the materials and pipeline components.
Maintenance required.
Initial and lifetime costs.

All of which will be influenced by the quality of the CO_2.

Considerations for dehydration in CCS applications

Whatever the capture method at some point the CO_2 will undergo a degree of compression, prior to transportation.

With compression comes contamination, primarily in the form of moisture.

Moisture, if not removed can cause corrosion, inefficiencies with valves, control systems, measurement equipment, sensors and any components incorporated downstream, reducing the lifespan, efficiency and reliability of the infrastructure and components, increasing material selection criteria and operational costs of any project.

Considering dehydration can:

Increase efficiency, longevity and reliability of pipework & infrastructure.
Reduce operational and maintenance costs of the project & infrastructure.
Provide a product of a quality, suitable for potential resale.

CO_2 Usage Consideration

While the majority of Carbon captured may be destined for storage there is always consideration of the potential for revenue recovery through onward usage of the CO_2

Some Existing Uses	Potential Uses
• Enhanced oil recovery	Enhanced Coal Bed Methane Recovery
• Pulp & Paper Processing	Polymer processing
• Water Treatment	Bio-fuel production
• Steel Manufacture	Concrete Curing

Many of these applications may well require a degree of quality from any CO_2 supply and I would suggest a dry clean CO_2 , would be an attractive option to end clients, for onward sale or use.

Dryer System Options

There are two main dryer options:

- Pressure Swing Adsorption dryers (PSA)
- Temperature Swing Adsorption dryers (TSA)

- Both require energy for desiccant regeneration
- Can provide pressure dew-points of up to -70°C.
- High pressures possible.

Information at the consideration stage along with process and system requirements will determine the best system or combination to satisfy the clients requirements.

PSA Regeneration

Pressure Swing Adsorption Dryers (PSA):

- **Use part of the dried gas for regeneration.**
- **Normally this gas is vented to atmosphere.**

Advantages:

Initial lower capital cost (simpler operation).
Low energy consumption.
Low pressure drop.

Considerations:

Short cycle time 10-20 minutes.
2 depressurization per cycle (noise level).
Loss of dried product. Typically 15% @ 7 bar(g) / 8 % at 45 bar(g).

PSA systems are not common for the capacities required for CCS systems, given the increased compressor energy required to compensate the loss of regeneration gas.

TSA regeneration

Temperature Swing Adsorption Dryers (TSA)

- **Use heated non dried process gas /ambient air for regeneration.**
- **After cooling and dehumidifying this gas is dried**

Advantages

No loss/Contamination of the process gas
Long cycle time (typically 6-8 hours)

Considerations:

Cooling water required for cooling the regeneration gas
Energy required to bring the process gas to regeneration temperature
Increased pressure drop, typically 0.35 bar
Higher capital cost (compared to PSA systems)
Possible build up of process gas contamination in the desiccant (Air)

TSA are the most common solution with, final selection being based on working conditions and customers preference/specifications.

Examples

CARBON DIOXIDE DRYERS for 1 million ton/ annum = 114 155 kg/h

DRYER DATA

DEPENDING ON OPERATION CONDITION

OPERATING CONDITIONS

Working pressure	**bar(g)**	10	10	45	45
Inlet temperature	**°C**	40	15	40	15

DRYER DATA

Cycle time	**h**	12	40	12	80
Adsorber diameter	**mm**	3100	3100	2300	2300
Piping size	**DN**	400	400	200	200
Total desiccant quantity	**kg**	36 000	15000	12000	10000
Average power consumption	**kW**	600	210	230	45
Pressure dew-point	**°C pdp**	-32	-50	-50	-60

Product Selection Considerations

Increasing pressure

- Reduces the dryer size and desiccant quantity required
- Reduces the piping diameter
- Reduces the energy consumption
- However increases wall thickness and equipment specifications

Increasing working temperature

- Increases the dryer size and desiccant quantity
- Increases the energy consumption
- Will reduce the dew point capability

PICTURE OF CO2 DRYERS SUPPLIED BY SPX FLOW TECHNOLOGY ETTEN-LEUR

CARBON DIOXIDE DRYER: TYPE	GDCA-NEP 1319

DRYING

MEDIUM	CARBON DIOXIDE
CAPACITY	9.770 Nm³/h
PRESSURE	49 Bar(g)
INLET TEMPERATURE	40 °C
PRESSURE DEW POINT	-40 °C/2.5 PPM(V)

REGENERATION

MEDIUM	AMBIENT AIR
SYSTEM	PSA/TSA combination

PICTURE OF CO2 DRYERS SUPPLIED BY SPX FLOW TECHNOLOGY ETTEN-LEUR

CARBON DIOXIDE DRYER: TYPE	GDCA-NEO 1030/20

DRYING

MEDIUM	CARBON DIOXIDE
CAPACITY	14.575 kg/h
PRESSURE	17,5 Bar(g)
INLET TEMPERATURE	30 °C
PRESSURE DEW POINT	-56 °C/1 ppm(V)

REGENERATION

MEDIUM	CARBON DIOXIDE
SYSTEM	TSA

In Summary

- **Moisture:**

  Causes corrosion & inefficiencies with downstream valves, control systems, measurement equipment, sensors and any components incorporated downstream, reducing the lifespan, efficiency and reliability of the infrastructure and components, increasing material selection criteria and operational costs of any project.

- **Benefits of dehydration:**

  Potential to reduce initial capital infrastructure costs.
  Increase efficiency, longevity and reliability of pipework infrastructure.
  Reduce operational and maintenance costs of the project & infrastructure.
  Potential revenue recovery through onward sale of processed CO_2

Contact Details

Mobile No: 07710 125850
steve.martin@spx.com

Questions