Maximize Efficiency and Reliability in CO2 Injection with a Dehydration Study

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SUMMARY

Managing water in CO2 streams is critical to avoid corrosion, downtime & delays. A dehydration study provides an analysis to select the proper technology to mitigate risk & meet project goals.

Selecting dehydration technology often involves trade-offs between cost, efficiency, and future expandability. A comprehensive and unbiased study gives you the confidence to choose the *right solution* without surprises.

What factors are essential in a valuable dehy study? Read more inside.

HIGHLIGHTS

- Hidden threats of water in CO2 streams
- Essential components of a CO2 dehydration study framework
- Comparing 4 key CO2 dehydration technologies

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Understanding the variety of CO2 dehydration technologies currently available can help with selecting the right solution for your application. Without this knowledge, projects risk delays, increased costs, and potential damage to equipment and infrastructure. A well executed dehydration technology study will mitigate risks and increase reliability associated with CO2 transportation and injection projects.

The Importance of CO2 Water Content

Determining the correct water content is critical when it comes to CO2 injection projects. The target can range from 10 ppm to 50 LB/MMSCF depending on the CO2 transportation strategy, the materials of selection, and the strategy for the injection of the CO2 downhole. Water in the waste CO2 gas stream may cause issues, including corrosion, hydrate formation, and reduced injection efficiency. These problems disrupt operations and can lead to costly maintenance or equipment replacement. In projects with long pipeline components, water is the dense phase CO2 can form carbonic acid, resulting in integrity issues for the different operation modes of the pipeline. Selecting the best technology to reach the target water content is vital to project success and planning.

Excess Water in CO2 Injection Stream

A common application for CO_2 injection projects is to look at rather pure CO_2 sources. CO_2 from gas treatment in the natural gas midstream space is readily available, typically located near injection sites, and is operated by energy companies that are developing CO_2 capture businesses.

CO_2 removal from natural gas uses water-based solvents, such as methyl diethanolamine (MDEA), in the removal process. During the solvent regeneration process, CO_2 is released along with water vapor and consider water saturated.

Ethanol plants are currently a large focus of CO_2 capture due to the rather high concentration of the CO_2 in the exhaust as well as government incentives for lower carbon fuels. Ethanol plants rely on fermentation to convert the sugars to Ethanol, which produces CO_2. During the fermentation process and the emissions control packages at Ethanol plants, water is mixed with the exhaust stream, leading to water saturated streams for CO_2 capture.

Other CO_2 capture projects are considering combustion sources for CO_2. Water is a natural byproduct of the combustion process, leading to water removal requirements with exhaust streams from combustion as well.

The Essential Components of a CO2 Dehydration Study

A comprehensive dehydration study is the foundation for any successful CO_2 handling project. This study involves several key steps designed to identify the best path forward.

1. Clarifying Project Parameters

The first critical step is to document all project objectives, specifications, assumptions, and concerns.

2. Understanding Composition of the Gas Stream

The study must consider the composition of the waste CO_2 gas stream, including what contaminants are present and in what quantities. Understanding the gas composition is critical to selecting a suitable dehydration technology, as certain contaminants may impact the efficacy or operability of different systems.

3. Evaluation of Dehydration Technologies

Factors to consider include a cost-benefit analysis, evaluating both the initial capital expenditures, and ongoing operational costs associated with each technology. A detailed operability review must also be included in the dehydration study to assess how well existing personnel might manage the new system.

- EVALUATION EXAMPLE -

A particular dehydration technology may have a lower initial investment, however, if complex training or maintenance is required, operational expenditures may quickly exceed any saving realized. This is especially true in settings requiring continuous operations and minimal disruptions.

4. Transparency in Technology Data

Selecting dehydration technology often involve trade-offs between cost, efficiency, and future expandability. Detailed studies identify potential risks, allowing end users to choose the right technology confidently, avoiding unexpected costs and delays later in the project. Transparency is paramount in these studies, providing a clear view of each option’s advantages and disadvantages.

Understand Your Trade-offs.

You will be faced with them: Cost. Efficiency. Future Expandability.

Get the data and insights you need to make confident decisions, right from the start.

What is the RIGHT CO2 Dehydration Technology?

Four common approaches to dehydration are the following:

- Glycol Absorption Dehydration using Tri-Ethylene Glycol (TEG)
- Desiccant Adsorption Systems
- Semi Permeable Membranes
- Chiller/Refrigeration Condensation

Each of these methods have unique strengths and challenges when considering a specific application. See details on next page.

4 Common Technology Approaches to Dehydration

1

Glycol Dehydration is one of the most common methods for removing water from natural gas or other gas streams. Glycol dehydration is a strong candidate for CO2 injection projects. However, it may require additional stages or modifications to achieve low water content. Glycol dehydration systems are legacy technology, effective, and low capital cost. They require heat input (fuel or electric), regular maintenance, and typically require a larger footprint compared to other solutions. Emissions from the processes are typically considered in the evaluation of the reduction in CO2 brought on by the project.

2

Desiccant Systems use solid materials, such as silica gel or molecular sieves, to capture water from the gas stream. These systems are particularly effective at achieving very low water content levels. However, desiccant systems are generally more expensive than glycol systems because of the high desiccant material cost. Desiccant systems can be an excellent choice for CO2 injection projects where water content specification is low or very low.

3

Semi-Permeable Membranes selectively allow certain molecules to pass through while blocking others. Membrane technologies can be highly efficient, achieving very low water content, but require higher upfront investment. Membranes require high inlet pressures (gas compression), require gas pre-treatment to prevent fouling, and are typically more costly.

4

Chiller/Refrigeration solutions uses dew point control to condense water from the vapor phase to a liquid. By reducing the temperature of the gas stream, the saturation capacity of the gas stream is reduced, removing water. Chilling systems depend on temperature differential and solutions can range from air exchangers, cooling water loops, to closed refrigeration loops.

A novel solution in this space is provided by DEXPro, where high pressure gas is expanded (the Joule-Thomson effect) to create cooling and that is used to lower the temperature below the dew point of the cross-exchanged gas stream. These solutions require horsepower and have limitations to the amount of water they can remove. https://dexprodehy.com/dexpro-advantage/

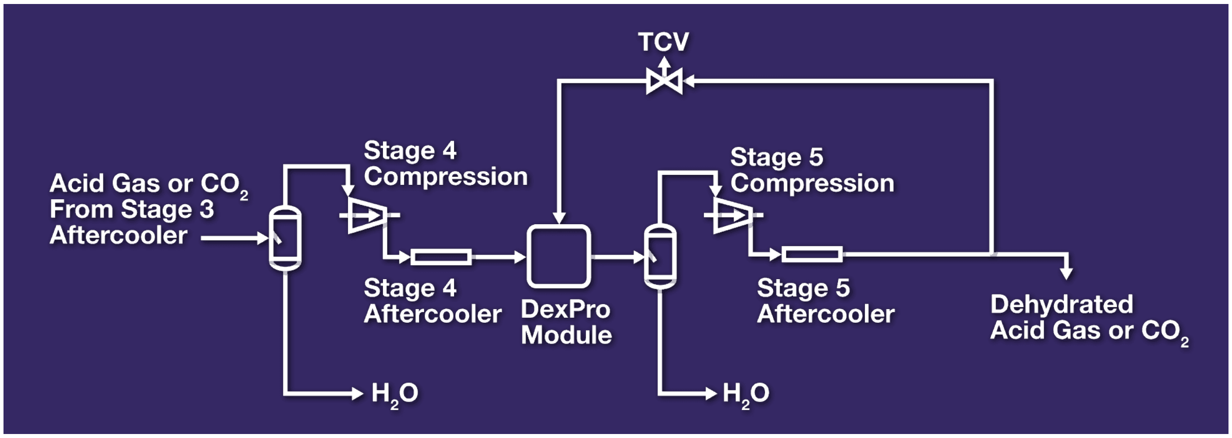

PHOTO CREDIT: DEXProdehy.com

The main DEXPro™ process has no rotating equipment and no contaminating chemicals, which lowers the risk of unplanned maintenance or decontamination. These advantages significantly lower operating costs.

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Recent Evaluation Findings for CO2 Dehydration

For a recent CO2 injection project, CANUSA EPC was asked to evaluate dehydration options for the reducing water to a 25 lb limit in the gas stream prior to injection. The evaluation considered nine key areas within the framework:

1. Reliability
2. Uptime
3. CapEx and OpEx
4. Safety
5. Schedule risk
6. Operability/ease of maintenance
7. Stakeholder support
8. Environmental impact
9. Expansion potential

CANUSA EPC evaluated the dehydration solutions for a traditional TEG, a Chiller Package, and an integrated DEXPro solution to meet the dehydration requirements.

Dehydration Technology	**QUANTITATIVE ANALYSIS**				**QUALITATIVE ANALYSIS**		
	CAPEX	**Install Costs**	**Reliability**	**OPEX/MT**	**Schedule Risk**	**Operating Window**	**Environmental Impact**
Dexpro (JT Valves)	$$$	$	High	$	Long Lead	No rotating equipment, high operability	Reduced Emission through closed loop. No Emissions (CO2). No Chemicals. Marginal parasitic load on compression unit.
TEG	$$	$$	Medium	$$$	Not Critical Path	Rotating equipment and chemical management, medium operability	Emissions from regeneration (CO2), TEG Chemicals, and Combustor for BTEX
Chiller	$	$	Low	$$$	Not Critical Path	Refrigerant, rotating equipment, low operability	MEOH Chemicals

DEXPro was chosen for this application as the integration and environmental impact aligned with the Client goals of the projects.

Why a Dehydration Study is Essential Before Selecting the Project Team

End users must ensure they choose team members with the right expertise for:

- the selected technology,
- reducing the learning curve, and
- improving project efficiency.

Completing a dehydration study before assembling the project team is vital. This study does not merely guide technology selection, it also provides the project team with a clear understanding of the technical challenges, operational requirements, and risk factors. Starting with a solid understanding of the dehydration requirements and technologies allows project managers to set realistic budgets, timelines, and performance targets.

Get the data you need to make technology selections confidently – connect with our team for a consultation.

GAIN CLARITY ON YOUR PROJECT

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