Carbon Dioxide Removal Plant #496

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1. Executive Summary

1.1 Plant Capacity

- 30 MMSCFD

1.2 Products

The plant is designed to remove CO2 from natural gas. Using multiple stage membrane process, the plant reduces CO2 content from 74% to 3%.

Products by design:

Natural gasoline	70.96%	737 BPD
Propane	14.37%	147 BPD
Normal butane	9.69%	100 BPD
Isobutane	4.97%	52 BPD

2. Process Description

CYNARA 4-stage membrane separation process.
First membrane reduces CO2 from 74% to 60%.
Second membrane reduces CO2 from 60% to 20%.
Third membrane reduces CO2 from 20% to 6%.
Fourth membrane reduces CO2 from 6% to 3%.

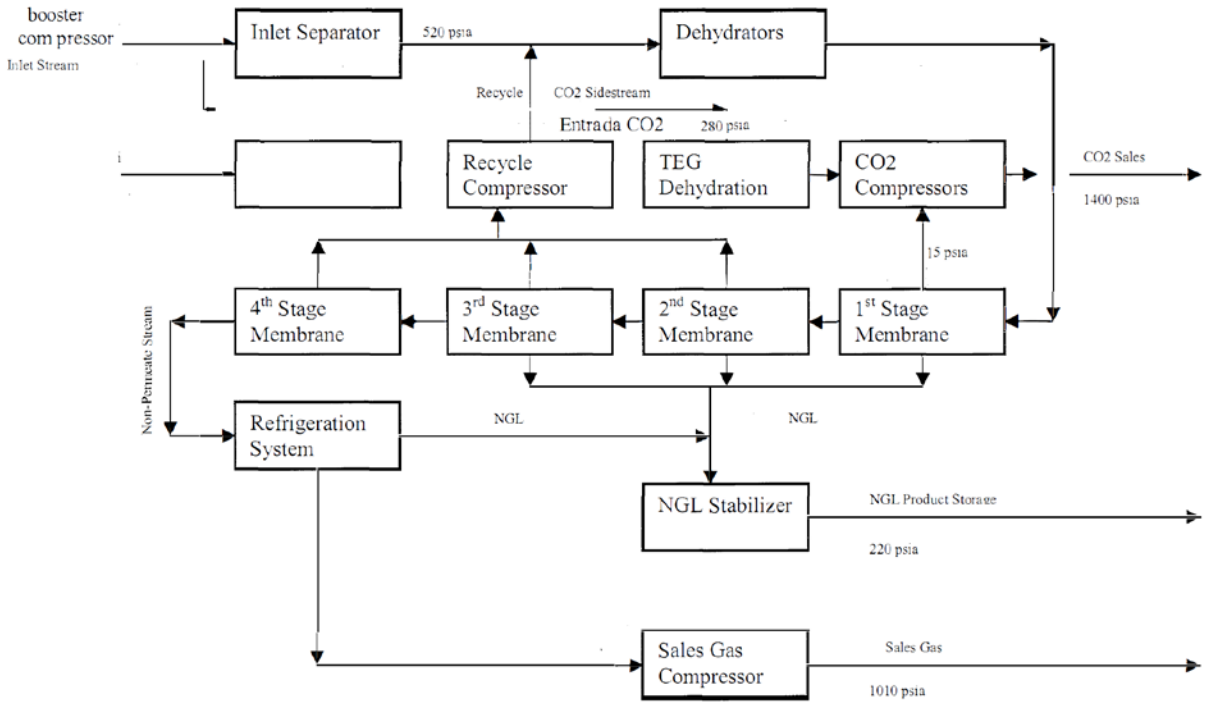
The gas enters the facility and is compressed from 270 psig tonear 520 psia as required for optimum separation of CO2 and hydrocarbon gas. The gas is then routed to a high-pressure separator where any free water and liquid hydrocarbon is removed and routed to waste water storage. The gas is routed from the high-pressure separator to a solid silica gel dehydration where water is removed down to a relatively low dew point as required for satisfactory operation of the membranes and as required to meet sales pipeline quality specifications.

After dehydration, the gas is routed to the first membrane. The first separation removes about 40% of the incoming CO2 and delivers a high CO2 permeate off gas stream at a pressure of near 75 psia. This 96% quality permeate stream can be vented or can be re-compressed and delivered to a CO2 pipeline for commercial sales. The CO2 in the inlet gas stream is reduced from near 74% to near 60% in this first stage. The second stage of the membrane separation reduces the incoming CO2 from 60% to near 20%. The third stage of the membrane reduces the incoming CO2 from near 20% to approximately 6%. The fourth stage of the membrane reduces the incoming CO2 from near 6% to approximately 3%. The second, third and fourth stages of the membrane separation produce permeate streams at a pressure near 30 psia. All three streams are combined together along with a dehydrated side stream coming from well.

This combined stream is compressed to near 180 psia in the Membrane Booster Compressor where it is mixed with the Stabilizer overhead gas. This composite stream is then routed to the Recycle Compressor for re-compression to the 520 psia inlet pressure. The recycle stream is mixed with the inlet stream ahead of the dehydration step. A part of the recycle gas is used as the dehydration regen gas as required.

After each stage of membrane CO2 separation, the treated stream exits the membrane as a two-phase fluid. Each membrane is configured with liquid separation on the treated gas stream. The fourth stage exit stream is refrigerated to condense even more liquid hydrocarbon. The liquid hydrocarbon streams from each stage of membranes are combined and routed to a NGL stabilizer where it is stabilized to meet a MAPCO "Y" grade specification. The resultant product will be stored in NGL storage vessels and trucked out to NGL markets.

3. Process Block Diagram



4. Equipment List

- CO2 extraction membrane packages: 1st, 2nd, 3rd and 4th stage membrane on 2 skids
- Membrane booster compressor
- Recycle compressor
- Sales gas compressor
- CO2 compressor
- NGL stabilizer column
- NGL storage vessels

- Propane refrigeration system
- Instrument air system
- Inlet separator with mist extractor
- Two bed mole sieve dehydration system
- Dehydration valve skid and separator
- Dehydration regeneration gas heater
- TEG dehydration system