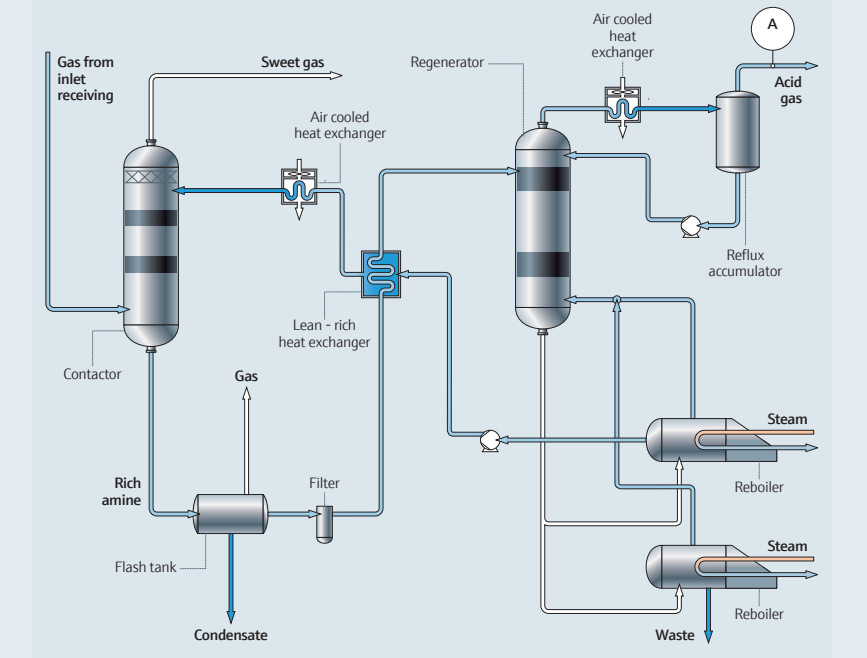
Carbon capture, utilization, and storage (CCUS) - CO_2 purity after amine treatment

Benefits at a glance

- Fast response to CO_2 concentration changes
- Laser-based measurement is highly selective and accurate for CO_2
- Non-contact design avoids fouling and corrosion for reliable long-term operation
- Low maintenance and OPEX costs - no carrier gases or consumable items



Amine treatment unit

Amine treatment for carbon capture applications

There are multiple technologies which can used to remove CO_2 from industrial gases. Amine treatment is well known for CO_2 removal in natural gas applications and is now finding new life in post-combustion gas treatment. Whichever process is used, CO_2 exiting the amine treatment process must be monitored for purity prior to injection into a pipeline or further liquefaction stages.

The process

Gas containing CO_2 enters the amine absorber vessel where it encounters the aqueous lean amine solvent. A chemical reaction binds CO_2 to the amine molecule. The rich amine is fed to a desorber column where elevated temperature is used to break the CO_2 from the rich amine. The resulting off-gas from the desorber contains primarily CO_2, water vapor, and trace contaminants. A reflux condenser further cools the gas to knock out additional moisture. The final gas exiting the amine treatment process is typically >95% pure CO_2. Purified CO_2 may be transported either as a dense phase gas in pipelines or liquified for rail or ship applications.

CO_2 quality measurement

Continuous CO_2 concentration measurement is an important quality parameter. High fluctuations in CO_2 concentration can be a precursor to problems with amine regeneration. Downstream from amine treatment, CO_2 purity is an important tariff value required for custody transfer between emitters and carbon capture users. Tunable diode laser absorption spectroscopy (TDLAS) is a Endress+Hauser proven technology for this critical gas quality measurement. This optical measurement provides extremely fast response to changes in CO_2 concentration, so process upsets are quickly detected. The analyzer requires no field calibration and laser/detector is isolated from the process gas, making it ideal for long term, stable operation in this process.

Endress+Hauser
People for Process Automation

Application data

Target components	CO_2 at the acid gas outlet of the amine treater
Typical measurement range	0 - 90% up to 0 - 100%
Typical repeatability	± 1000 ppmv
Measurement response time	1 to ~ 60 seconds*
Principle of measurement	Non-differential tunable diode laser absorption spectroscopy (TDLAS)
Validation	Certified blend of CO_2 in nitrogen background

*Application specific, consult factory

Typical stream composition*

Component	Minimum (Mol%)	Typical (Mol%)	Maximum (Mol%)
Carbon dioxide (CO_2)	> 90	> 95	> 99
Water (H_2O)	< 100 ppm	< 40 ppm	< 40 ppm
Hydrogen sulfide (H_2S)	< 200 ppm	< 5 ppm	< 5 ppm
Oxygen (O_2)	< 200 ppm	< 40 ppm	< 10 ppm
Nitrogen (N_2)	< 2	< 2	< 0.5
Methane (CH_4)	<5	<1	< 0.1
Amines	< 10 ppm	< 10 ppm	< 10 ppm
Ammonia (NH_3)	< 10 ppm	< 10 ppm	< 10 ppm

*Stream composition may vary depending on the gas being treated. Typical concentrations representative of CO_2 for pipeline applications. Maximum concentrations representative of CO_2 for liquefaction.