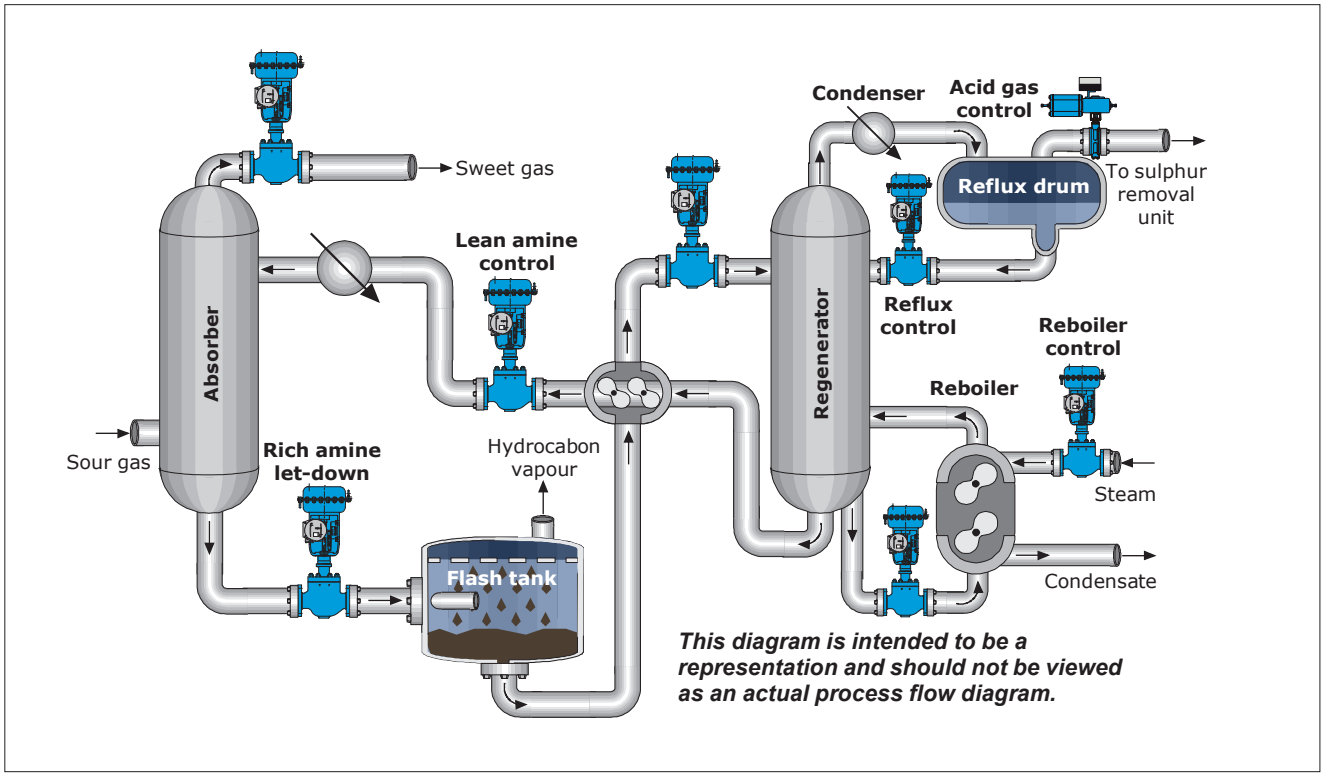
Amine plant



Process overview

Various processes such as hydrotreating, cracking and coking produce gases that contain hydrogen sulphide (H_2S) and occasionally carbon dioxide (CO_2). The amount of sulphur in refinery and gas plant gases is legislated to meet HSE and gas pipeline specifications. Therefore most of the H^2S has to be removed from the gas before it can be burned or processed further.

The sour gas enters the absorber at the bottom and makes its way to the top through multiple trays. A solvent, which enters the absorber at the top, is used to remove H_2S and CO_2 from the gas mix. The most commonly used chemical solvent for hydrogen sulphide removal is diethanolamine. Using methyl-diethanolamine allows better absorption of H_2S at the cost of lower CO_2 absorption.

The rich solution with absorbed H_2S and CO_2 exits the absorber at the bottom and flows into a flash tank. The flash tank is operated at a much lower pressure than the absorber, allowing dissolved light hydrocarbons to be released.

Before entering the regenerator, the solution is preheated by heat exchange with the lean solution coming out of the regenerator.

In the regenerator, steam generated in the reboiler is used to strip the acid gases from the rich solution. The regenerated lean amine is then recycled back to the absorber. The gas exiting the top of the reactor is condensed and the steam is recycled to the regenerator as reflux. The remaining acid gas is then sent to a sulphur removal unit to be converted into elemental sulphur.

Refineries and gas plants may have multiple amine absorbers and a common amine regeneration unit. Some plants have one regeneration unit for cleaner purposes, such as hydrotreaters and another regeneration unit for fluidised catalytic crackers or cokers.

Amine plant applications

Major operating considerations for amine units are maintaining the condition of the amine solution, minimising losses and preventing hydrocarbon carryover to the sulphur recovery unit. This can be obtained by controlling amine concentration, amine circulation rate, lean amine temperature into the absorber and stripping steam generated in the stripper reboiler. Optimisation of an amine plant is a balance between capacity, energy and corrosion.

Lean amine control

One of the most important specifications in an amine process is the acid gas content in the treated gas. The amine circulation rate is one of the two typical process variables to be optimised. The amine flow rate is adjusted according to the acid gas loading to the absorber. Variations in the flow rate have an effect on the process efficiency, lean amine temperature and lean amine loading. Absorber tray efficiency control is important in order to optimise the gas absorption capability. Variations in amine quality, such as solids and foaming affect the system stability and absorption efficiency.

As the ratio of lean amine to sour gas affects the amount of H_2S and CO_2 in the output gas, the valve must be able to accurately and reliably control the flow. Typically the temperature is around 80 °C (180 °F) with a pressure of 25 barG (360 psig).

Neles™ solution for lean amine control

Neles globe valve, with a diaphragm actuator and an ND intelligent valve controller.

- **Minimise leaks,** as the rugged one piece body structure eliminates potential leak paths
- **A variety of trims available,** including the Tendril design, reducing noise and eliminating cavitation
- **Fugitive emission certified** according to ISO 15848
- **Easy maintenance** – Top entry construction for easy access, valve assembly is simple and self-guiding
- **Predictive maintenance** is made possible with the online diagnostics provided by the ND valve controller

Rich amine let-down

The rich amine let-down valve at the bottom controls the liquid level in the absorber. Rich acid gas loading must not be too high due to potential corrosion problems. The rich amine from the bottom is sent to a flash tank which is at lower pressure, causing the leftover methane or ethane gas to be released and used as fuel gas.

Depending on the absorber pressure the pressure drop across the valve can be from 4 barG (60 psig) up to 170 barG (250 psig). Two-phase flow, flashing or outgassing can be expected in this application.

Neles solution for rich amine let-down

Neles angle globe valves are especially suitable for severe applications with high pressure drops and erosive fluids.

- **Avoids direct impact with the medium,** as the angle pattern allows the flow to pass straight down after exiting the trim
- **One piece body,** minimising potential leak paths and making the valve insensitive to pipe stress
- **Top entry construction,** allowing for easy in-line maintenance
- **Handle toxic media** with bellows seal option, ensuring emission free operation
- **Omega™ trim available,** specially designed for severe service applications

Neles angle globe valve

Reboiler and reflux control

The rich solution enters the regenerator at the top. Stripping efficiency depends on the contact between the rising steam and liquid falling down the column. A higher reflux rate allows better amine separation, but requires more heat to be generated in the reboiler. Using a lower reflux rate means more amine is lost with acid gases, but less energy is required for heat generation in the reboiler. Steam is typically used as the heating medium in the reboiler, though sometimes other refinery process streams are used.

Reliable and accurate control performance is required of the valves to ensure efficient regenerator performance. If refinery pr™ocess streams are being used, the medium may be dirty and/or pose an environmental concern. The regenerator is typically operated at about 128 °C (262 °F).

Neles solution for reboiler and reflux

Neles globe valves with a spring diaphragm actuators and intelligent ND valve controllers are the optimal solution for optimising regenerator operation.

- **Reliable and accurate control,** ensuring that the reboiler-reflux ratio can be kept at the optimal amount
- **Wide rangeability** ensures that the same valves can be used when coping with changes in process parameters
- **Metal seated design,** allowing for lasting tightness even in dirtier process steams
- **Accurate and sensitive actuator** ensuring fast and proper operation of the valve
- **Minimise process variability,** with the ND intelligent valve controller

Neles globe valve

Acid gas control

The amine stripper pressure is typically kept at a minimum in order to reduce energy consumption in the reboiler. Higher pressures increase the amine separation from acid gases, but require more energy from the reboiler.

Stability is typically required in order to keep the stripper in stable conditions. Fugitive emission control is important for acid gas service and in many cases NACE can be applied.

Neles solution for acid gas control

For small to medium sizes, **Neles globe valves** offer the best solution for the application.

- **Maximise amine separation** as the globe valve allows the valve to be controlled extremely accurately
- **Bellows seal option** ensuring emissions are kept as low as possible
- **Detect problems in advance** with the ND intelligent valve controller

In case of larger pipe sizes, **Neldic™ butterfly valves** are a reliable and economical solution.

- **Triple eccentric design,** reducing wear and producing tight shut-off
- **No resilient parts exposed to the medium,** extending the life time of the valve
- **HSE-risks reduced,** including noise level, with the flow balancing S-DISC™ design

Benefits

- Reach plant uptime targets with on-line diagnostic capabilities
- Reliable process control improves overall process efficiency
- Optimise reboiler energy consumption
- Meet strict reliability, safety and environmental requirements
- Minimise maintenance costs

Valmet Flow Control Oy
Vanha Porvoontie 229, 01380 Vantaa, Finland.
Tel. +358 10 417 5000.
www.valmet.com/flowcontrol