Acid Gas Recovery

Refinery - Amine Unit
Filtration Solutions with PECO Products

Parker

ENGINEERING YOUR SUCCESS.
When refining presents complex challenges, Parker, with its breadth of PECO Oil & Gas filtration products, presents solutions which respond to today’s demanding worldwide market. We offer innovative and application-specific filtration to help ensure integrity and purity throughout the downstream process.

**Filtration for process efficiency**
*From crude to final production*

**DOWNSTREAM DEMANDS**
After upstream drilling and transport, crude oil must be processed in a refinery. Efficient processing of several hundred thousand barrels of crude oil a day – essentially a nonstop operation – demands filtration solutions that perform reliably, even under extreme conditions. Parker meets these needs with filtration that gets the job done with minimal maintenance and downtime.

**COMMITTED TO PROCESS OPTIMIZATION**
Parker recognizes that due to the hazards associated with maintenance in petroleum production facilities along with high disposal costs, minimizing both change-out frequency and process downtime are of utmost importance. That’s why we optimize our filtration products to ensure that the total cost of ownership for contaminant control is balanced, without compromising process efficiency.

For over 80 years the PECO brand of products has led the way in oil & gas filtration solutions. Customers trust the PECO brand for quality and performance to handle complex contaminant management issues.

**FILTRATION IN A REFINERY AMINE UNIT**
Parker Industrial Process Filtration provides optimized engineered solutions to:
- Minimize foaming
- Decrease chemical usage
- Protect carbon beds
- Eliminate carbon carryover
- Protect processing equipment
- Improve production and operation efficiency
- Reduce process upsets and downtime
- Lower maintenance costs

**AMINE PROCESS**
The objective of the Amine Treating Unit is to remove $\text{H}_2\text{S}, \text{CO}_2$ and mercaptan compounds from various gas streams, such as recycled gas in hydrotreating and hydrocracking processes, hydrogen plant feed, and fuel gas systems. The $\text{H}_2\text{S}$ recovered is used as feed for the Sulfur Recovery Unit (SRU).

Gas containing hydrogen sulfide ($\text{H}_2\text{S}$) is generated as a result of the hydrotreating process. Amine is used for selective removal of $\text{H}_2\text{S}$ often referred to as “Acid Gas”. Acid gas is introduced to the bottom of the absorber (contact tower) while an amine/water combination is introduced at the upper section of the contactor. As the streams circulate and come into contact with one another, the amine removes the acid gas by absorption. The rich amine is then fractionated to separate and remove the hydrogen sulfide. The lean amine, which is stripped of the hydrogen sulfide, is recycled back to the contact tower.
Running a sulfur recovery operation with dirty amine is analogous to deficit spending. The insidious aspect of circulating dirty amine is its erosive nature. Carbon steel is corroded by clean amine. However, the sulfide products of corrosion stick to the metal surfaces and inhibit further attack. Particulates in the circulating amine erode this protective layer. New metal is exposed to corrosion and then more particulates are generated as the corrosion-erosion cycle perpetuates itself. This environment is manifested by several signs:

- **Foaming**: Dirt reduces the surface tension of liquids. Particulates will cause amine to foam. Foaming in the regeneration system stripper results in high amine concentrations in the regenerator reflux water. Foaming in the absorber causes amine to be carried overhead with the inlet sour gas being scrubbed.

- **Plugged Instrument Taps**: Flow rates in dirty amine systems tend to be erratic. Orifice taps on flow meters and level taps on float chambers often plug. Level control in the bottom of the absorber and stripper becomes unreliable and massive carryover of amine is frequent.

- **Condenser Fouling**: Rich amine regenerator feed splashes overhead. Particulates accumulate in the regenerator condensers, heat transfer is impaired to a certain extent, and the reflux temperature rises. This results in amine carryover.

- **Reboiler Tube Failures**: Enhanced corrosion rates are most evident in the regenerator reboilers. Dirty amine has caused tube failures after six months of service.

- **Filter Plugging**: The dirtier the amine, the shorter the filter life. The shorter the filter life, the dirtier the amine. For really bad amine, filter pressure drop can increase by 1 psi per hour.

- **Regenerator Flooding**: Eventually, dirty amine plugs the regenerator trays in the stripper and the massive carryover of liquid which follows shuts down the SRU.

### AMINE CONTAMINANTS

Amine contaminants can be grouped into five distinct categories:

1. Heat Stable Salts
2. Degradation Products
3. Injection Chemicals
4. Hydrocarbons
5. Particulates

### COLOR OF AMINE – KEY INDICATORS

- **Bright and clear**: Amine is in excellent shape. A yellow tinge indicates the presence of iron, but this is of no great consequence.

- **Grayish cast**: Solution is a pale, dull gray. Objects can be seen through the bottle without difficulty. This is okay; however, do not let the amine solution get dirtier.

- **Translucent black**: Objects can barely be seen through the bottle. Upon standing 10 minutes, a small amount of sediment is visible. You are now in trouble. Erosion-corrosion is generating particulates faster than they can be removed.

- **Opaque black**: Give the bottle a good shake. If you notice a lot of particulates settling in the bottle then this could cause fouling in critical equipment such as the absorber, stripper, heat exchanger and reboiler.

- **Brownish**: Air is getting into the system. Oxidized amine is corrosive.

### AMINE UNIT - KEY ISSUES
REFINERY - AMINE UNIT
FILTRATION & SEPARATION EQUIPMENT

Amine Regeneration Loop - Lean Side
No \( \text{H}_2\text{S} \) - High Temperature

Amine Regeneration Loop - Rich Side
High \( \text{H}_2\text{S} \) - Low Temperature

GAS COALESER
77V

PARTICULATE FILTER
55

CARBON ADSORBER
10

PARTICULATE FILTER
55

Sour Gas from Various Processing Units in the Refinery

Sweet Gas

Flash Gas/Fuel Gas or Sent to Flare Header

Full Stream

Refinery Fuel Gas

Sour Gas from Various Processing Units in the Refinery

GAS COALESER
GEM2
PEACH Gemini PuraSep® 2

PUMP

RICH AMINE

Rich Amine

Lean Amine

Cooler

Pump

Cooler

CONDENSER

Separator

Charge Heater

Feed Furnace
FEED, SOUR GAS FILTRATION

1. Gas Filter-Coalescer
   PECO, PEACH Gemini PuraSep® 2, Series GEM2 horizontal coalescer with PGC cartridges
   • High efficiency 0.3 micron coalescer
   • Prevents hydrocarbon liquid & solids from entering the amine loop
   • Lowers antifoam consumption
   • Reduces amine makeup
   • Provides higher acid gas removal efficiency
   • Protects Absorber Contact Tower
   • Reduces energy consumption in Reboiler

LEAN AMINE FILTRATION (20-30% slip stream)

5. Liquid Filter
   PECO, Series 55 filter with 2.5/3” diameter
   Hot/Chem PEACH® HCP cartridges
   • Minimizes solid contaminants in amine
   • Handles high temperature amine
   • 20 micron filtration or smaller recommended

6. Adsorber Filter
   PECO, Series 10 carbon adsorber with activated carbon canisters
   • Carbon prevents degradation products & liquid hydrocarbons in amine
   • Carbon needs to be changed on a regular basis

7. Liquid Filter
   PECO, Series 55 filter with 2.5/3” diameter
   Hot/Chem PEACH® HCP cartridges
   • Minimizes solid contaminants in amine
   • Handles high temperature amine
   • Post carbon filter that removes carbon fines from amine

RICH AMINE FILTRATION (usually full flow)

2. Liquid Filter
   PECO, XtreamPure®, Series 55X filter with 6” diameter
   XoP cartridges or  PECO, Series 55 filter with 2.5/3” diameter
   PEACH® P90/PPL cartridges
   • Minimizes solid contaminants in amine
   • 20 micron filtration or smaller recommended
   • Reduces fouling in Heat Exchanger, Reboiler, Stripper

3. Carbon Adsorber
   PECO, Series 10 carbon adsorber with bulk activated carbon or PECO, Series 10FB carbon adsorber with activated carbon canisters
   • Carbon prevents degradation products & liquid hydrocarbons in amine
   • Carbon needs to be changed on a regular basis

4. Liquid Filter
   PECO, XtreamPure®, Series 55X filter with 6” diameter
   XoP cartridges or  PECO, Series 55 filter with 2.5/3” diameter
   PEACH® PPL/P90 cartridges
   • High efficiency filter that minimizes solids in amine
   • 20 micron filtration or smaller recommended
   • Post carbon filter that removes carbon fines from amine

REFINERY FUEL GAS (Sweet Gas)

8. Gas Coalescer
   PECO, Spartan PuraSep®, Series 77V vertical coalescer with NGGC cartridges
   • High efficiency 0.3 micron coalescer
   • Removes liquid carryover from the sweet gas
   • Liquid carryover can cause issues with the downstream Refinery Fuel Gas system

ACID GAS TO SULFUR RECOVERY UNIT

9. Gas Filter-Coalescer
   PECO, PEACH Gemini PuraSep® 2, Series GEM2 horizontal coalescer with PGC cartridges
   • High efficiency 0.3 micron coalescing & solids removal
   • Removes particulate and liquid carryover from the acid gas
   • Acid gas after the Steam Stripper goes to the Sulfur Recovery Unit (SRU) to be processed
   • Contaminated acid gas affects the yield of sulfur in the SRU as these contaminants impact the functionality of the Claus catalyst
SERIES GEM2, PEACH GEMINI PURASEP 2
HORIZONTAL GAS FILTER-COALESCER
The PEACH Gemini PuraSep 2 is an innovative product in gas coalescing technology which provides the solids loading capabilities of a filter-separator with the liquid removal efficiency of a vertical coalescer. This patented design provides ultra-clean gas with high efficiency removal of solid and liquid contaminants down to 0.3 microns. It can effectively handle higher inlet solid and liquid loads versus conventional vertical coalescing equipment, and is designed to remove a wide range of liquid contaminants such as lubricating oils, low surface tension liquids and aerosol mists.

SERIES 77V, SPARTAN PURASEP
VERTICAL GAS COALESCER
The Spartan PuraSep gas coalescer is a highly efficient mist and aerosol remover down to the 0.3 micron level. Series 77V coalescers work best with minimal solids and low surface tension liquids such as lube oil and NGL with minimal liquid loading.

SERIES 55X, XTREAMPURE
HIGH FLOW RATE, LIQUID FILTER
The XtreamPure vessel and cartridge line removes particulate in liquid applications with flow rates over 200 gpm. It provides high capacity filtration for virtually any liquid application by utilizing large 6" diameter cartridges in 40", 60" and 80" lengths with a variety of material choices for compatibility and performance needs. The inside-to-outside flow through the cartridge ensures contaminant is captured within the cartridge allowing a cleaner cartridge extraction during change-outs.

SERIES 55 WITH HOT/CHEM PEACH
TRADITIONAL LIQUID FILTER
The Series 55 liquid vessels fit a variety of different styles of 2.5" and 3" diameter cartridges depending on the application needs. The vessel can be coupled with Hot/Chem PEACH, Series HCP cartridges for use in high temperature, sensitive compatibility fluids such as lean amine.

SERIES 10 & 10FB
CARBON ADSORBER
The Series 10 & 10FB carbon vessels utilize high quality activated carbon to adsorb dissolved liquid impurities from process streams such as air, gas, water, amine and glycol. Removal of these impurities is critical to prevent problems such as foaming, odor and contaminant buildup. The Series 10 holds carbon canisters and the Series 10FB holds loose, bulk carbon.
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