ExxonMobil

Solutions for sour gas treating problems

Energy lives here™

ExxonMobil has developed and commercialized the FLEXSORB™ suite of gas treating technologies and absorbents.

The FLEXSORB SE technology is designed for the selective removal of H2S in the presence of $C0_2$ and utilizes proprietary severely sterically hindered amines. This allows FLEXSORB SE solvent to achieve high H_2S cleanup selectively at low solvent circulation rates.

Table 1 provides an overview of the available FLEXSORB solvents and their applications. The technology and absorbents have been widely applied in petroleum refining, natural gas production and petrochemical operations. The FLEXSORB solvents have been applied successfully at offshore and onshore production sites around the world.

Table 1: Solvent type and application

Solvent	Applications
FLEXSORB SE	Selective removal of H_2S
FLEXSORB SE Plus	Selective removal of H2S to less than 10ppm

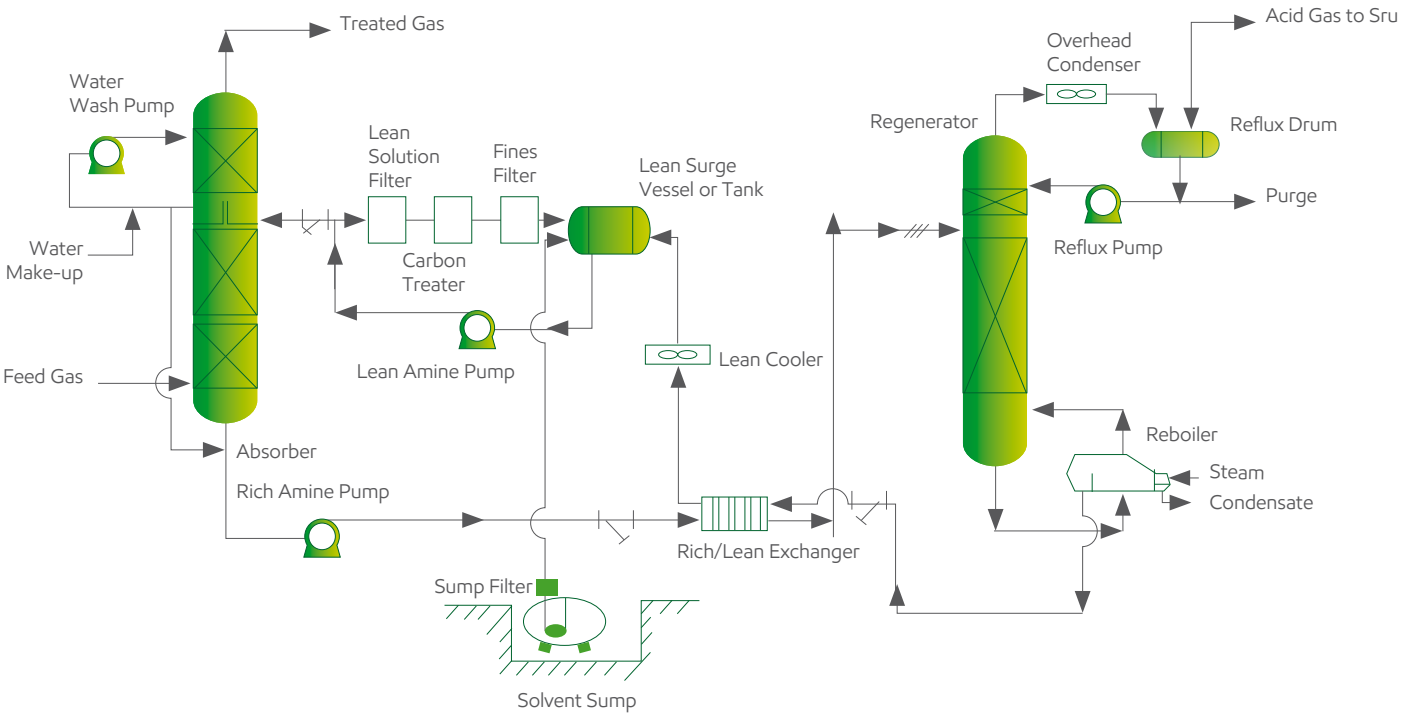
The FLEXSORB SE process has been shown to be the most selective and cost-effective amine solvent process. It's reliable, robust and simple to operate. Operating experience has shown low corrosion and lower foaming than with conventional amines. Corrosion is low even at high rich loadings or high levels of heat-stable salts. Conventional equipment used for other amine solvents, such as countercurrent towers, is used for the FLEXSORB SE process as well.

Tail Gas Treating

In sulfur plant Tail Gas Treating Unit (TGTU) applications, FLEXSORB™ SE solvents can use about half of the circulation rate and regeneration energy typically required by MDEA-based solvents. CO_2 rejection in TGTU applications is very high, typically above 90 percent. FLEXSORB SE provides a reduced vapor and liquid load to the regenerator tower, resulting in a smaller tower diameter compared with competing technologies.

A simplified process flow diagram is shown in Figure 1. The feed gas is contacted countercurrently with lean FLEXSORB SE solution in the absorber tower. With low-pressure applications, it is recommended that the top of this tower include a water wash zone to minimize the loss of FLEXSORB SE amine with the treated gas. The water wash purge is combined with the rich amine to recover the FLEXSORB SE amine.

Figure 1: Simplified Flow Diagram — FLEXSORB® SE Tail Gas Treating Unit (TGTU)



Natural gas treating

Selective H_2S removal from natural gas can be advantageous whenever a portion of the CO_2 can remain in the treated gas. One such application treats a pipeline gas stored in a depleted oil reservoir. The pipeline gas is stored during the summer months and withdrawn during the heating season to supplement pipeline gas flow during peak demands. The unit was originally designed to treat the gas with a conventional hybrid solvent. The need to process at least 25 percent more gas, drove the licensee to change solvents. A comparison of operating data for the two solvents is given in Table 2. FLEXSORB™ SE solvent allowed an increase in gas rate from 400 to 510 MSCFD without changing the existing hardware. This was done at a lower solvent circulation, 300 gpm versus 460 gpm, and a higher CO_2 slip. FLEXSORB SE also improved the operability of the unit by reducing the co-absorption of heavy hydrocarbons, which previously caused numerous plant upsets.

Table 1: Onshore Treating Facility

	Conventional Hybrid	Flexsorb SE
Sour Gas Rate, MSCFD	400	510
Pressure, psig	935	935
Temperature °F	90	90
Feed Composition, vol %		
H_2S	0.06	0.06
CO_2	1.0	1.0
Solvent Rate, gpm	460	300
Reboiler Duty, MBTU/HR	19	14.8
Treated Gas		
H_2S vppm	4	2
CO_2 mole %	0.7	0.85

Acid gas enrichment

Many natural gas fields contain more CO_2 than H_2S. When these acid gases are removed from the methane sales gas, the resulting acid gas stream is likely to contain low H_2S concentrations (< 20 mol%), making it unsuitable for sulfur recovery using the conventional Claus process. Acid Gas Enrichment (AGE) has become an enabling technology to economically produce these natural gas reserves. As the name implies, an AGE unit enriches the H_2S content of the acid gas stream, making it practical to recover sulfur in a Claus unit. Alternatively, AGE technology can also be used to minimize the volume of acid gas for re-injection or to debottleneck existing facilities if new, sourer fields are developed. A limited number of these AGE units are in operation (some report as few as 25 worldwide). FLEXSORB SE or SE PLUS solvents have been specified for 20 AGE units, including the Qatargas II LNG Project (Trains 4 and 5) gas treating facilities that were successfully started in 2009. As the name implies, Acid Gas Enrichment concentrates the H_2S from the AGR system by further gas treatment in a second amine unit utilizing a selective amine solvent. Except for the use of the selective amine solvent, an AGE unit is similar to other traditional amine treating units.

To achieve the twin goals of low H_2S in the treated gas and low CO_2 in the enriched acid gas, the AGE amine solvent must maximize the selectivity for absorbing H_2S. AGE process simulations by Weiland (2008) have demonstrated that the CO_2 and H_2S partial pressure driving forces in the AGE absorber work against achieving these goals simultaneously. As the gas moves up the absorber tower, the H_2S partial pressure is decreasing, reducing the mass transfer driving force. At the same time, the CO_2 partial pressure is increasing, making CO_2 pickup more difficult to avoid.

The level of H_2S enrichment depends primarily on the H_2S concentration in the feed gas and, of course, the solvent selection. The H_2S specification in the treated gas, process operating temperatures and the design of the AGE absorber tower internals can also be important considerations. Higher processing temperatures or lower specification for H_2S in the treated gas stream may require increased lean amine circulation rate and/or increased mass transfer area to ensure that the H_2S specification in the treated gas is met. Increasing the amine rat or mass transfer area will directionally reduce H_2S selectivity.

To successfully achieve the AGE treating goals of a low H_2S content in the treated gas and maximum CO_2 slip requires a solid base of supporting data and careful engineering.

Figure 2 below illustrates the range of H_2S enrichment that can be achieved using FLEXSORB SE or SE PLUS solvent in a single enrichment step

Figure 2: Acid gas enrichment capabilities

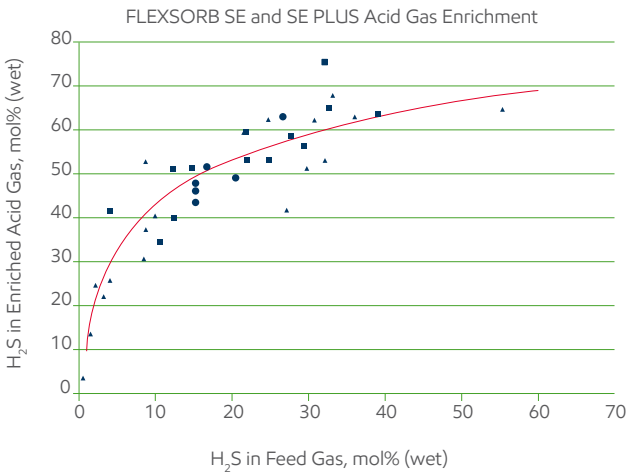


Table 3 provides a concise summary of the range of experience for FLEXSORB™ SE and SE PLUS units.

Table 3: FLEXSORB® AGE Experience Bands

	Minimum	Maximum
Acid Gas Feed Conditions:		
Rate, kNm³/h (MSCFD)	2.0 (1.8)	76.2 (68.3)
Pressure, barg (psig)	0.3 (4.5)	0.8 (11)
Temperature, °C (°F)	27 (80)	49 (120)
Inlet H_2S, mol%	1.4	39

ExxonMobil's FLEXSORB SE or SE PLUS solvents are in use in a wide variety of Acid Gas Enrichment unit designs around the world. These units include both ExxonMobil affiliates and licensees. These plants range in size from three tons to more than 1,000 tons per day of sulfur capacity. CO_2 slip ranges from 73 to 94 percent.

100 Commercial apps

More than 120 commercial applications have repeatedly demonstrated the advantages of FLEXSORB SE and SE PLUS over competing solvents since the first commercial unit was started up in 1983. Commercial applications include ExxonMobil affiliates as well as numerous licensee applications in locations around the world, shown graphically in Figure 4. FLEXSORB SE and SE PLUS solvents are used in a variety of gas treating applications, including Acid Gas Removal (AGR), Acid Gas Enrichment (AGE), and Tail Gas Cleanup Units (TGCU). FLEXSORB technology easily fits into natural gas processing (including onshore and offshore) and refining and petrochemical operations using standard gas treating equipment.

Harmony of solutions for sour gas treating problems

- Absorbs the HvS, rejects the CO_2
- Cost-effective for grassroots and retrofits
- Removes H_2S to less than 10 ppm
- Vast commercial experience (100 + units)
- Enables simple, low-cost retrofits

Figure 4: Graphical representation of commercial applications which include ExxonMobil affiliates as well as numerous licensee applications in locations around the world

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