

# CANSOLV TECHNOLOGIES INC. SO<sub>2</sub> SCRUBBING SYSTEM

The industry's leading, regenerable sulphur dioxide (SO<sub>2</sub>) control technology

Shell Global Solutions



## AT A GLANCE

**Customer driver:** Legislative constraints (permits/licence to operate, fuel specifications); margin improvement (optimised production, efficiency and availability); availability of market to absorb high sulphur residue

**Solution:** Regenerable SO<sub>2</sub> scrubbing system

**Value delivered:** Reduced plant emissions (SO<sub>2</sub> emissions of <20 ppm can be achieved) and increased production capacity

**Proof point:** 15 plants worldwide

The spread between sweet and sour crude prices has led refiners to increase their use of high-sulphur crudes. This can improve refinery margins but generates greater quantities of sulphur and, consequently, increased emissions of SO<sub>2</sub>.

Strict environmental regulations, both at the refinery and in refined product markets, put pressure on a refiner to limit SO<sub>2</sub> emissions and to generate refined products that contain less organic sulphur.

Large amounts of high-sulphur residue can be economically converted to high-value products in new or modified units. Markets for smaller volumes of high-sulphur residue are more limited: they are typically used in bitumen markets or electrical power production. Meanwhile, many refiners are choosing to consume excess high-sulphur residue on-site to generate steam and electricity, which requires facilities to capture SO<sub>2</sub> from the flue gas generated by the high-sulphur fuel.

When flue gas streams contain low concentrations of SO<sub>2</sub>, non-regenerable SO<sub>2</sub> scrubbers are often used. These:

- consume commonly available alkaline materials such as lime, limestone and sodium hydroxide;
- generate waste products that are most often directed either to landfill or to waste-water treating systems; and
- cause less air pollution, but have greater impact on waste-water and landfill resources.

At higher SO<sub>2</sub> concentrations or when more-stringent limitations for waste-water and landfill disposal apply, pressure on refiners to consider regenerable SO<sub>2</sub> scrubbing systems increases. These systems direct the sulphur into existing by-product market streams and away from air, wastewater and landfill facilities.

The Cansolv® SO<sub>2</sub> Scrubbing System controls emissions and captures additional by-product value from the SO<sub>2</sub> emitted in various refinery flue gas streams, such as those generated by fluidised catalytic cracking units, process heaters and boilers, sulphur plants and spent acid regeneration units. The SO<sub>2</sub> can be recycled to the sulphur recovery unit to produce marketable sulphur or it can be converted to sulphuric acid in a sulphuric acid unit and sold into acid markets.

## ABOUT THE TECHNOLOGY

There is wide use of alkali-reagent-type processes that convert SO<sub>2</sub> to calcium or sodium sulphate in the power and energy sectors to control SO<sub>2</sub> emissions from combustion systems. These processes create aqueous and solid waste streams that must be disposed of to landfill or waste-water treating systems, if marketable byproduct markets cannot be found.

Crucially, the Cansolv SO<sub>2</sub> scrubbing system is regenerable: a proprietary amine technology captures and releases a pure stream of SO<sub>2</sub> that is converted to marketable by-products. It generates a small fraction of the waste generated by alternative non-regenerable, alkaline reagent processes, and consumes much less reagent than non-regenerable processes. High-cost consumable absorbents are not required, and effluents are reduced to a minimum.

This technology has enjoyed rapid take-up since its first commercial application in 2002: 15 units are operating,

The technology's developer, gas emissions treating specialist Cansolv Technologies Inc., is wholly owned by Shell Global Solutions International BV.

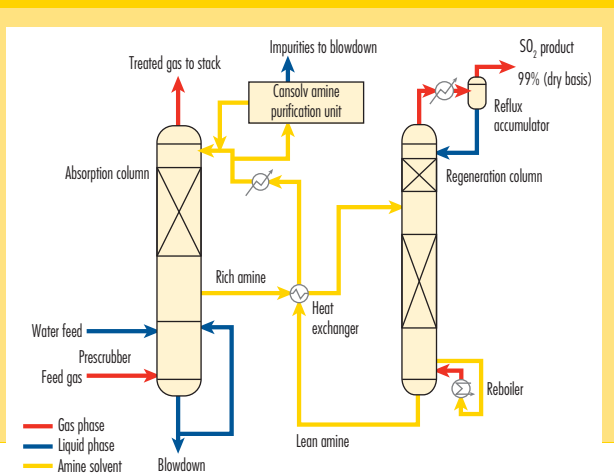


Figure 1: The Cansolv SO<sub>2</sub> scrubbing system.

start-up or in construction phase and more are in the detailed engineering or procurement phase.

### PROCESS DESCRIPTION

This patented technology uses an aqueous amine solution to achieve highly efficient, selective absorption of SO<sub>2</sub> from flue gas. The key process steps are (Figure 1):

1. Feed gas is quenched and saturated in a circulated water pre-scrubber.
2. The gas contacts the lean amine solution in a counter-current absorption column.
3. SO<sub>2</sub> is absorbed and the treated gas exits the absorber to atmosphere.
4. SO<sub>2</sub>-rich amine from the absorption column is pumped through a lean–rich amine heat exchanger for energy recovery and on to the regeneration column.
5. Steam stripping regenerates the lean amine solution, and the SO<sub>2</sub> is recovered as a pure, water-saturated product.
6. Lean amine is pumped from the stripper reboiler to the absorption column through the lean–rich amine heat exchanger and the lean amine cooler.
7. By-product SO<sub>2</sub> is directed to by-product management systems and is converted to various products, including liquid SO<sub>2</sub>, sulphuric acid and elemental sulphur.

### PERFORMANCE DATA

The technology is a highly flexible system and is adaptable to a wide variety of industrial applications, gas flow rates and SO<sub>2</sub> concentrations. Licensed units treating gas flow rates from 4,000 to 486,000 Nm<sup>3</sup>/h and SO<sub>2</sub> concentrations from 800 to 12,000 vppm are operating successfully, and units are under construction to process up to 1,750,000 Nm<sup>3</sup>/hr of flue gas.

SO<sub>2</sub> emissions below 20 ppmv can be achieved with base design configuration, and with minimal effluent production.

## PROOF POINTS

Faced with stricter SO<sub>2</sub> regulations, a refinery in California, USA, needed to find an alternative solution to treat the tail gas of its alkylation spent acid regeneration plant, as the existing ammonium sulphate process was troublesome and did not integrate well with the refinery sulphur product chain.

A Cansolv SO<sub>2</sub> scrubbing system was selected to replace the existing ammonium sulphate system. Since the unit's start-up in 2002, performance has exceeded the targeted design conditions. The refiner has decoupled the operation of the acid plant from its SO<sub>2</sub> emissions by exploiting the technology's ability to treat a range of inlet SO<sub>2</sub> concentrations. The Cansolv SO<sub>2</sub> scrubbing system has consistently met SO<sub>2</sub> emissions of 20 ppmv or less while treating acid plant tail gas with SO<sub>2</sub> content as high as 6,000 ppmv.

Moreover, the system has been designed for reliability: five years' uninterrupted run time has been achieved on 40,000-Nm<sup>3</sup>/h applications.

### BUSINESS VALUE

The technology can help refiners to meet stringent emissions regulations by removing SO<sub>2</sub> from refinery gas streams and flue gases, and recycling SO<sub>2</sub> from sulphuric acid plant tail gases.

In certain applications, it can also help to enhance margins. For instance, in sulphur recovery unit applications, capacity can be increased by over 12%. Moreover, marketable by-products are recovered (high-quality SO<sub>2</sub>, sulphur and sulphuric acid) and there is no solid waste.

As it is a regenerable system, the Cansolv SO<sub>2</sub> scrubbing system can help to ease many of the environmental and market-induced pressures that are associated with using of greater quantities of opportunistic crudes.

### HAVE YOU CONSIDERED HOW YOU CAN

- meet ultra-low SO<sub>2</sub> emissions limits?
- increase the capacity of your sulphur recovery unit?
- maximise the use of high-sulphur residue fuels?

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