Elessent™
MECS® TECHNOLOGIES

CASE STUDY NO. 55
DYNAWAVE®

HYDROGEN SULFIDE SCRUBBING FOR REFINERY FLARE GAS SYSTEM

APPLICATION

A DynaWave® scrubbing system started up at a refinery in Taiwan in 2010 to control H_2S emissions. The refinery's flare gas system suffered from periodic upsets that would send large amounts of high-concentration H_2S gases to the flare. This upset led to problems with the ambient air quality around the refinery site.

The DynaWave® system collects the hydrogen sulfide from the flare gas system using caustic as the reagent.

PROCESS PARAMETERS: QUICK FACTS	
Inlet gas flow	~3,400 Am³/h (2,000 acfm)
Inlet temperature	100°C
Reagent	Caustic
Inlet H_2S concentration	40% v/v (400,00 ppm)
Removal efficiency	>85%

DYNAWAVE® TECHNOLOGY

Wet gas scrubbing applications to remove hydrogen sulfide from gas streams can use caustic as the reagent. Caustic must be used in preference to other alkaline reagents because the system must operate at a very high pH to absorb the hydrogen sulfide. In this application, MECS® has successfully implemented the DynaWave® technology to efficiently remove hydrogen sulfide from a flue gas stream using caustic as the scrubbing reagent.

Normally selective amines are utilized to scrub hydrogen sulfide from gas streams. In this instance, however, the scrubber is required for only short periods where excess process gas must be treated prior to flaring. A caustic scrubber is able to wait ready in standby state for long periods. It is also able to start up quickly and immediately begins treating the gas stream.

The challenge in this application was to remove most of the hydrogen sulfide from a high-concentration gas stream and to do it in a single scrubbing unit. MECS® solved this problem utilizing the unique advantages of the DynaWave® wet gas scrubber. The DynaWave® utilizes the reverse jet to create a froth zone. The froth zone is a very intense mass and energy transfer region. It is here that the flue gas is quenched and the hydrogen sulfide is transferred from the process gas to the liquid. The reverse jet is capable of a very high rate of liquid renewal within the reaction zone of the scrubber. As a result, the high concentrations in the gas stream can be effectively treated.

The froth zone also allows the DynaWave® to operate in varying gas flow conditions. The system was expected to effectively operate under extreme turndown conditions at less than 10% of the design gas flow. Under these conditions, the froth zone self-compensates and moves up or down the inlet barrel as the gas flow changes and automatically adjusts without operator intervention.

After the H_2S is absorbed into the scrubber circulating liquid, it reacts with caustic according to the following reaction:

$$H_2S + 2NaOH \rightarrow Na_2S + 2H_2O$$

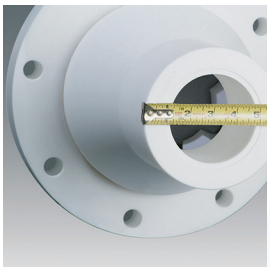
The sodium sulfide created in the vessel is not stable. The reaction is reversible and under certain conditions can evolve the H_2S out of solution. The project also required that the sodium sulfide created to be stabilized so that it would be safe to send to the refinery's waste water treatment system.

The method for stabilizing the solution was to oxidize the sodium sulfide using sodium hypochlorite. The sodium hypochlorite reacts with the sodium sulfide according to the following reaction:

$$Na_2S + 4NaOCl \rightarrow Na_2SO_4 + 4NaCl$$

During startup a performance test was performed on the DynaWave.® A gas stream with greater than 90% hydrogen sulfide was introduced into the system. Based on the outlet gas flow, the DynaWave® achieved greater than 99% removal of the hydrogen sulfide from the gas stream. The DynaWave® scrubber met all customer expectations. They were very pleased with its performance.

This project successfully demonstrated that the DynaWave® wet gas scrubber can be utilized to efficiently treat concentrated hydrogen sulfide gas streams.



REVERSE JET NOZZLE

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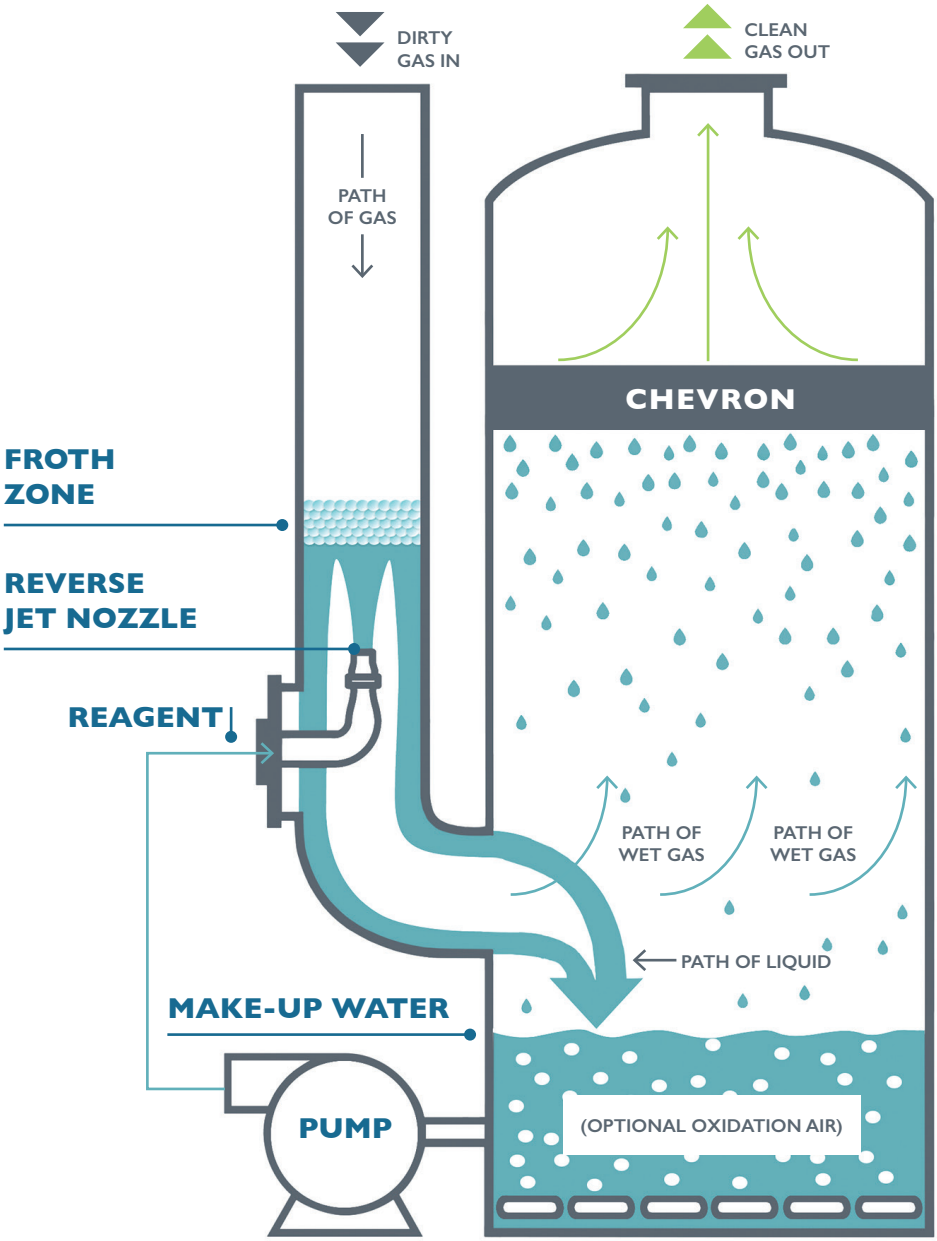

DYNAWAVE® ADVANTAGES

- Project capital costs and the scrubber footprint are minimized as multiple functions are performed in a single vessel
- Smaller diameter, lower height and smaller overall footprint compared to typical spray towers
- High H_2S removal efficiencies obtained while using caustic as the reagent
- The use of large, open nozzles, piping and vessel design which avoid plugging
- Simplicity of operation, robust design and low operator attention required results in low maintenance and high reliability
- Operates effectively in highly variable gas flows

GLOBAL OFFICES

NORTH AMERICA

Global Headquarters
Saint Louis, Missouri, USA

ContactUs-NA@ElessentCT.com

LATIN AMERICA

ContactUs-LA@ElessentCT.com

EUROPE | MIDDLE EAST AFRICA | INDIA

EMEAI Headquarters
Hoeilaart, Belgium

ContactUs-EMEAI@ElessentCT.com

ASIA PACIFIC

AP Headquarters
Shanghai, China

ContactUs-AP@ElessentCT.com

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MECS® Technologies
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