



# SS2100 HYDROGEN SULFIDE IN CAUSTIC WASH TOWER INLETS

Product Code 56902

## KEY FEATURES

- No cylinder gases or Lead Acetate tape consumed – Low Cost of Ownership
- High resolution laser-based measurement eliminates errors due to interferences
- Reliable Tunable Diode Laser lasts years
- Extremely fast analysis time – 1 second updates possible

In Ethylene production one of the most important steps is removal of Hydrogen Sulfide and Carbon Dioxide from the process stream. Both H<sub>2</sub>S and CO<sub>2</sub> are poisons to polymerization catalysts, and the allowable levels of both components are less than 5 ppmw in polymer grade Ethylene.

**CAUSTIC WASH TOWER** Hydrogen Sulfide is required in Ethylene cracking furnaces to passivate the coil metallurgy, and also to limit the formation of CO<sub>2</sub> and CO, so H<sub>2</sub>S or other sulfur compounds are added to the feedstock. CO<sub>2</sub> and H<sub>2</sub>S are removed in the Caustic Wash Tower (Fig. 1) which is typically located after the third stage of compression on the cracked gas. The acid gases are absorbed in a dilute caustic solution.

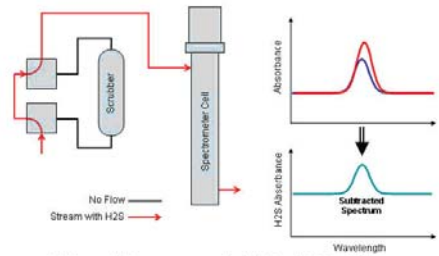
**CRITICAL CONTROL OF HYDROGEN SULFIDE** For optimal efficiency, the caustic strength and low rate through the tower must be matched to the inlet CO<sub>2</sub> and H<sub>2</sub>S concentrations, so measurement of the H<sub>2</sub>S is critical.

**TRADITIONAL MEASUREMENT SOLUTIONS** Lead Acetate Tape devices have been used for on-line H<sub>2</sub>S analysis, but the on-going cost and maintenance effort of replacing the tapes is high. Moreover, many regard the Lead Acetate tape to be a hazardous material with associated handling and disposal problems. On-line gas chromatographs are another method widely used for monitoring the levels of H<sub>2</sub>S in cracked gas streams. Unfortunately, even with the latest in chromatography techniques, the analysis can take 3-6 minutes between measurement updates. Due to rapid changes in the acid gas concentration, this delay may not be acceptable. Gas chromatographs consume carrier and flame fuel cylinder gases, as well as requiring sulfur-free air for flame photometric detectors,

so the consumable costs of GC's are high. Spectroscopic methods using broadband light sources and narrow band pass filters are prone to interferences from changing background concentrations.

**SPECTRASENSORS' SOLUTION** The SpectraSensors SS2100 offers a new solution to this control measurement. The use of Tunable Diode Laser technology means that analysis results can be updated every second if desired. Furthermore, the high resolution that is inherent to TDL technology eliminates errors due to interferences that have hampered other spectrometric approaches.

Only SpectraSensors employs **Differential Spectroscopy** to cope with the changes in background spectrum of the sample caused by changing operating conditions and feedstocks. The sample gas is passed through a copper nanoparticle scrubber to remove H<sub>2</sub>S, and the spectrum of the H<sub>2</sub>S-free sample is measured. The scrubber is then bypassed to measure the raw sample with H<sub>2</sub>S, and the H<sub>2</sub>S is measured by spectral subtraction. As the H<sub>2</sub>S-free background spectrum can be applied repeatedly to the sample, the scrubber is only used as needed, controlled by logic in the electronic controller. The scrubber lifetime in normal service is a minimum of 18 months, so consumable costs and maintenance are low.



Differential Spectroscopy Applied to H<sub>2</sub>S Analysis

# SS2100 Hydrogen Sulfide Analyzer



## SPECIFICATIONS

### Application Data

Target Components	H <sub>2</sub> S in Caustic Wash Tower Feed
Typical Measurement Ranges	0-500ppm*
Typical Precision	±2% of Full Scale
Measurement Response Time	1 to ~60 seconds*
Principle of Measurement	Differential Tunable Diode Laser Absorption Spectroscopy (H <sub>2</sub> S scrubber included)
Environmental Temperature Range	-20° to 50° C (-4° to 122° F) -10° to 60° C (14° to 140° F) <i>optional</i>
Sample Inlet Pressure	70kPag (10 PSIG) typical 210kPag (30 PSIG) maximum
Sample Cell Temperature Range	Maintain at 50° C ±2° C
Maximum Cell Pressure	70kPag (10 PSIG)
Sample Flow Rate	3-4 L/min (6.4 to 8.5 scfh)*
Recommended Validation	Certified blend of H <sub>2</sub> S in Nitrogen balance

### Electrical Data

Power	100-240 VAC, 50-60 Hz standard
Max Current	Controller: 1 A @ 120 VAC
Controller to Cell Cable Length	1m standard (3m, 5m & 10m available optionally)
Communication	Current Loop Output 4-20 mA Isolated, 1200 ohms @ 24 VDC max load. Serial: ASCII Text RS232C standard, Modbus RS232C
Digital Outputs	Four (4) 12 VDC for valve operations: Scrubber (if required), Process/Val, Val 1, Val 2 5 SPDT (Form C) Dry Contacts: Common Fault, Val 1 Active, Val 2 Active, Val Fail, One user assignable DO to standard alarms
LCD Display	Concentration, Cell Pressure and Temperature, Diagnostic Data

### Physical

Controller Enclosure	NEMA 4X – 304 stainless steel <i>standard</i>
Controller Dimensions	343 mm H x 305 mm W x 165 mm D (13.5" H x 12" W x 6 7/16" D)*
Weight Approximately	13.1 Kg (28.6 lbs)*
Sample Cell Dimensions	28m Herriott cell, 559 mm H x 127 mm W (22" H x 5" W)
Sample Cell Construction	316L Series Polished Stainless Steel Standard SilcoNert® coated
Number of Sample Cells	1 (Single Channel SS2100) or 2 (Dual Channel SS2100)
Dimensions with Sample System	1678 mm H x 613 mm W x 427 mm D (66" H x 24-1/8" W x 16-13/16" D)
Weight with Sample System	68 Kg (150lbs)

### Area Classification

Certification	CSA Certified for Class I, Div. 2, Groups ABCD T3C Ex II 2G Ex d IIB+H2 T5; Tamb : -20 ÷ +60 °C
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\* Application specific; consult factory.

**TYPICAL ETHYLENE PROCESS FLOW SHOWING CAUSTIC WASH TOWER**

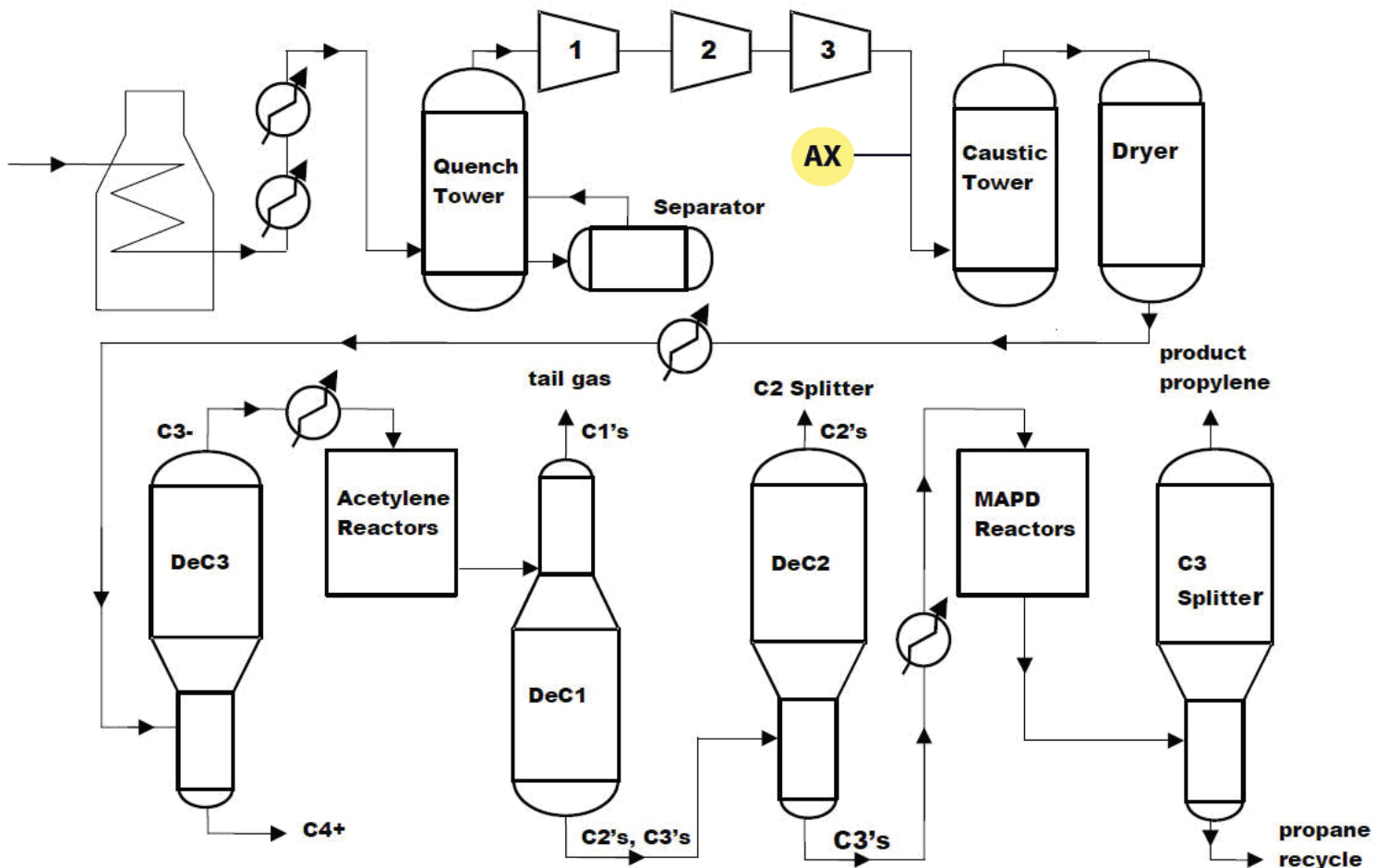


Figure 1

**ANALYZER**

The Analyzer Scope consists of the Electronic controller, cell, and 1m long interconnecting cable. The customer or analytical systems integrator is responsible for providing a sample conditioning system and/or cell enclosure that maintains the sample and cell at a constant temperature (generally 50°C +/- 0.2°C) that is above the hydrocarbon and moisture dew points of the process stream. The sample flow, sample pressure, and temperature specifications listed above must be maintained at all times. Any departure from these specifications must be approved by SpectraSensors.

**VALIDATION**

Validation is done with a certified blend of Acetylene in a background of Nitrogen, typically at a concentration in the middle of the measured range.

**TYPICAL BACKGROUND STREAM COMPOSITION**

Component	Unit	Typical Concentration	Min. for Application	Max. for Application
Hydrogen Sulfide (H <sub>2</sub> S)	ppmv	500	0	1000
Carbon Dioxide (CO <sub>2</sub> )	ppmv	200	10	500
Hydrogen (H <sub>2</sub> )	Mole %	25	15	30
Methane (CH <sub>4</sub> )	Mole %	20	10	30
Ethane (C <sub>2</sub> H <sub>6</sub> )	Mole %	15	10	30
Ethylene (C <sub>2</sub> H <sub>4</sub> )	Mole %	25	20	40
Acetylene (C <sub>2</sub> H <sub>2</sub> )	Mole %	0.3	0	0.5
Propylene (C <sub>2</sub> H <sub>6</sub> )	Mole %	7.5	0	15
Propane (C <sub>3</sub> H <sub>8</sub> )	Mole %	7.5	0	15
Methyl Acetylene (Propyne C <sub>3</sub> H <sub>4</sub> )	Mole %	0.03	0	0.1
Propadiene (C <sub>3</sub> H <sub>4</sub> )	Mole %	0.02	0	0.1
Carbon Monoxide (CO)	Mole %	0.05	0	0.1
Butanes	Mole %	0.05	0	0.1
Butenes	Mole %	0.3	0	0.5
1,3-Butadiene	Mole %	0.5	0	1
C5+	Mole %	0.1	0	0.5
Total	Mole %	100		

The background stream composition must be specified for proper calibration and measurement performance. Specify the Normal composition, along with the minimum and maximum expected values for each component, especially H<sub>2</sub>S, the measured component. Other stream compositions may be allowable with approval from SpectraSensors.

**RELAY CONTROL AND COMMUNICATIONS**

All SS2100 Process Analyzers are supplied with 9 relays:

- o Four (4) are 12 VDC powered and provided for driving switching valves associated with Process, Validation 1 and Validation 2 and a scrubber (for differential systems only).
- o Five (5) SPDT (Form C) dry contact digital outputs are provided for common fault, Val 1 active, Val 2 Active, Validation Fail, and one (1) user-assignable DO to any standard alarm, such as high concentration, high cell pressure, low cell temperature, high cell temperature, low sample flow, etc. depending on the application.

Data Output is via 4-20 mA Isolated Analog Output.

Serial Communication via Modbus protocol is provided. See Modbus specifications for details.

**MEASUREMENT SOLUTION**

Proper sample conditioning is essential to an accurate and reliable measurement. SpectraSensors provides standard and custom engineered Measurement Solutions for all applications. Standard features include:

Inlet Pressure Relief Valve	Automatic Valve for Validation Gases
Inlet and Outlet Shut-off Valves	Cell Flow Rotameter and Control Valve
Sample Filter	Outlet Pressure Gauge
Sample Bypass Pressure Gauge	Cell Outlet Non-return Valve
Bypass Flow Rotameter and Control Valve	