

# Monitoring Catalyst Presulfiding Step

Applied Analytics Application Note No. AN-015



## Application Summary

Analytes: **H<sub>2</sub>S (hydrogen sulfide), sulfiding agent**

Detector: **OMA-300 H<sub>2</sub>S Analyzer**

Process Stream: **reactor effluent gas**

## Introduction

Catalyst ‘presulfiding’ is a practice which reduces the extent of early catalyst deactivation by preventing coking (carbon deposits). The procedure involves passing a gas stream containing H<sub>2</sub>S over the catalyst or into the reaction feedstock.

In order to generate the H<sub>2</sub>S which will interact with the catalyst, a sulfur carrying agent (e.g. dimethyl sulfide) is injected into the stream. Under high temperature and catalytic reaction, the agent decomposes and releases its sulfur component, forming H<sub>2</sub>S. The H<sub>2</sub>S reacts with the catalyst’s metallic surface to substitute sulfur atoms for oxygen atoms.

The importance of presulfiding is clear, yet the procedure needs to be actively regulated in order to reduce costs and downtime. For example, the presulfiding procedure normally takes 10-36 hours, but can be reduced if presulfiding is terminated as soon as the catalyst is properly sulfided; this can be easily verified by measuring H<sub>2</sub>S concentration in the stream after the reactor (if H<sub>2</sub>S concentration does not drop when injection is ceased, presulfiding is complete).

The OMA-300 Process Analyzer monitors H<sub>2</sub>S and additional analytes at specific sampling points which are critical to the optimization of presulfiding. Measuring real-time H<sub>2</sub>S levels downstream from the reactor validates the completion of presulfiding; additional measurements include low level H<sub>2</sub>S after the dryer system and continuous measurement of sulfiding agent concentration in order to detect fluctuations due to outages.

## OMA Benefits

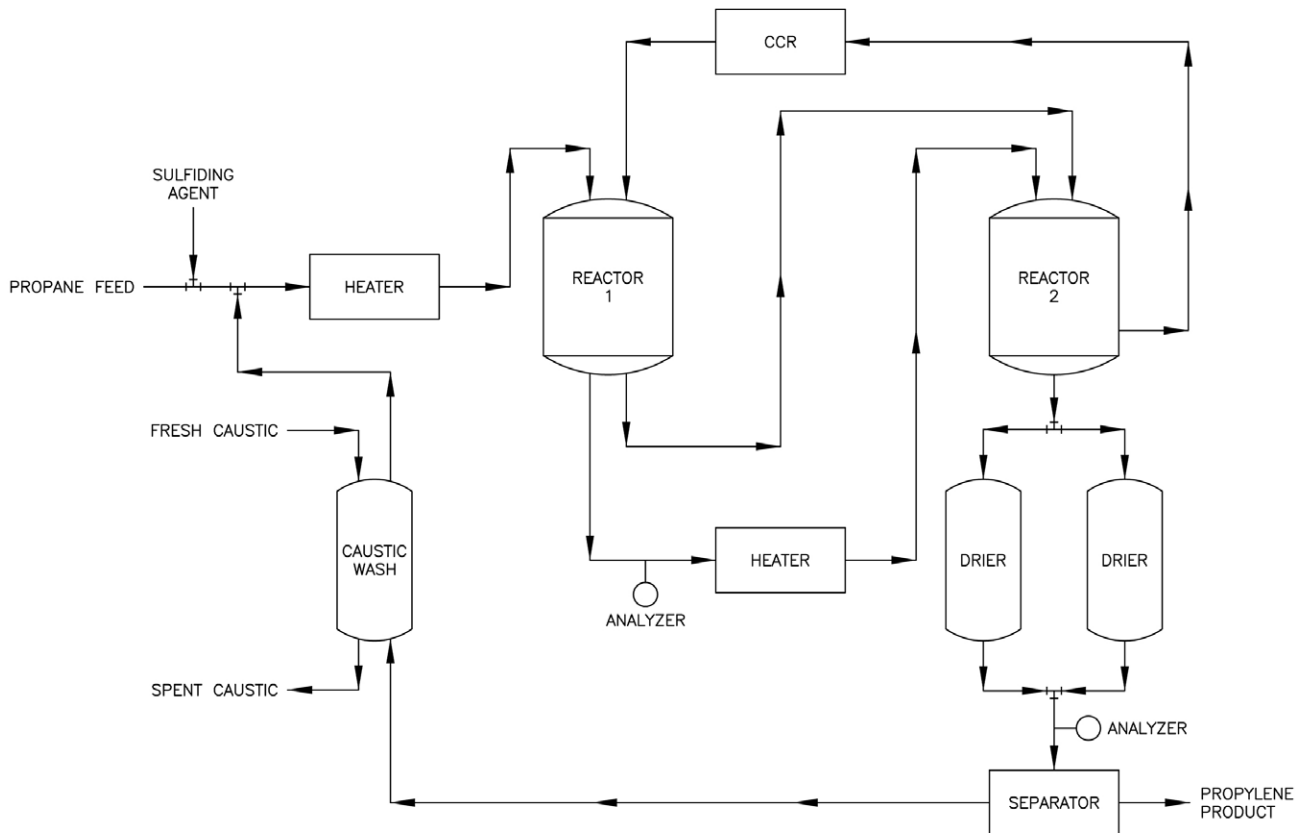
- » Continuously measures H<sub>2</sub>S concentration using dispersive UV-Vis absorbance spectrophotometer
- » Totally solid state build with no moving parts — modern design for low maintenance
- » Easily multiplexed to analyze sample streams from multiple sampling points
- » Decades of field-proven performance in various catalytic processes, e.g. propane dehydrogenation

# Monitoring Catalyst Presulfiding Step

Applied Analytics Application Note No. AN-015

## Presulfiding Analysis Applications

The schematic below illustrates the example of a propane dehydrogenation process, identifying key analysis applications for optimization of the presulfiding step:



The analyzer sampling from the stream after REACTOR 1 serves to validate the presulfiding procedure in real time. Continuous analysis at this point allows the OMA to quickly recognize the completion state and alert the control system so that no superfluous time or resources are dedicated to presulfiding.

The analyzer sampling from the stream after the dual dryer system serves to verify scrubbing efficiency and ensure that no  $H_2S$  is contaminating the propylene product or the recycle stream.

Additional analysis points can be implemented in the sulfiding agent stream to continuously watch for outages or problematic fluctuations that will prevent healthy catalyst operation.

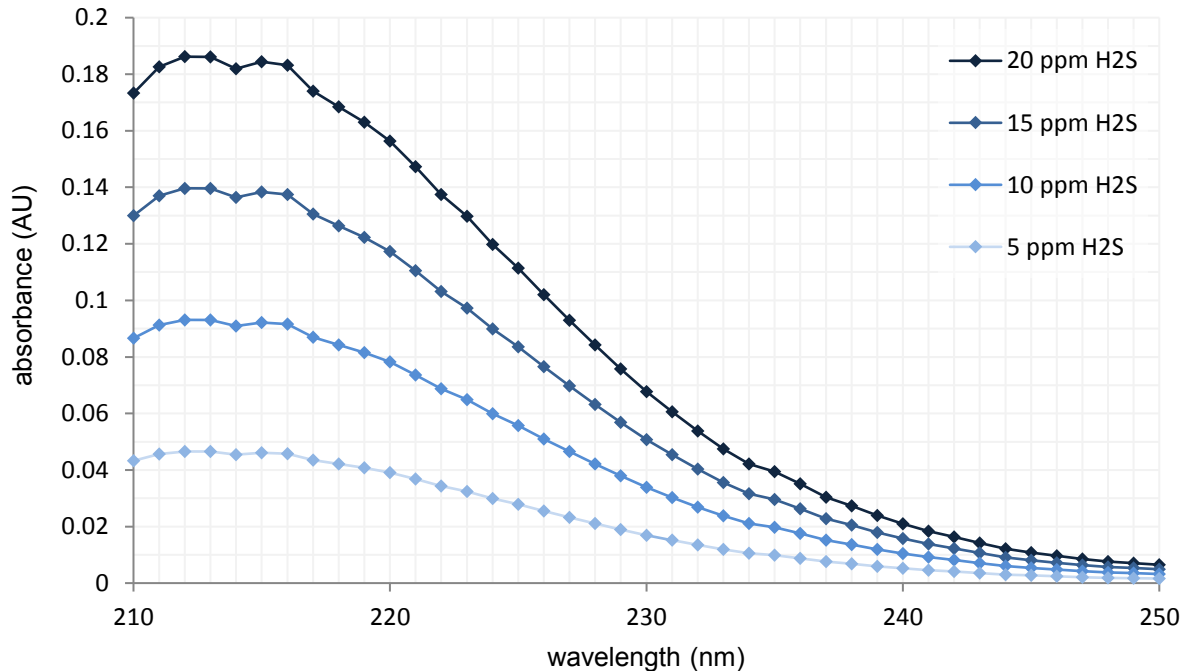
# Monitoring Catalyst Presulfiding Step

Applied Analytics Application Note No. AN-015

## H<sub>2</sub>S Absorbance Curve

Any single photodiode measurement is vulnerable to noise, signal saturation, or unexpected interference. This susceptibility to error makes a lone photodiode data point an unreliable indicator of one chemical's absorbance.

As accepted in the lab community for decades, the best way to neutralize this type of error is to use collateral data in the form of 'confirmation wavelengths,' i.e. many data points at many wavelengths instead of a single wavelength:



In the figures above, each diamond represents a single photodiode and data point. The Nova II registers absorbance at each integer wavelength within the 200-240 nm measurement range and produces an H<sub>2</sub>S absorbance curve. After being calibrated on a full spectrum of an H<sub>2</sub>S calibration standard, the OMA knows the absorbance-concentration correlation for each measurement wavelength; the system can average the modeled concentration value from each wavelength to completely eradicate the effect of noise at any single photodiode.

The OMA visualizes the H<sub>2</sub>S absorbance curve in this manner and knows the expected relation of each data point to the others in terms of the curve's structure. This curve analysis enables the OMA to automatically detect erroneous results at specific wavelengths, such as when a single photodiode is saturated with light. The normal photometer, with a single data point, is completely incapable of internally verifying its measurement.

# Monitoring Catalyst Presulfiding Step

Applied Analytics Application Note No. AN-015

The specifications below represent performance of the OMA-300 Process Analyzer in a typical presulfiding application.

For technical details about the OMA-300 Process Analyzer, see the data sheet:

[https://aai.solutions/documents/AA\\_DS001A\\_OMA300.pdf](https://aai.solutions/documents/AA_DS001A_OMA300.pdf)

All performance specifications are subject to the assumption that the sample conditioning system and unit installation are approved by Applied Analytics. For any other arrangement, please inquire directly with Sales.

Subject to modifications. Specified product characteristics and technical data do not serve as guarantee declarations.

Application Data	
Performance Specifications	
Accuracy	<i>Example ranges below. Custom ranges available. Accuracy may be higher at higher pressure.</i>
	Example ranges below. Custom ranges available. Accuracy may be higher at higher pressure. 0-10 ppm (@1 bar): ±1 ppm (Increased pressure will yield increased accuracy); ±0.2 ppm (@5 bar) 0-100 ppm: ±1% full scale or 1 ppm* 0-10,000 ppm: ±1% full scale 0-100%: ±1% full scale COS 0-200 ppm: ±2% full scale or 4 ppm* CS <sub>2</sub> 0-200 ppm: ±2% full scale or 4 ppm*
	*Whichever is larger.

# Monitoring Catalyst Presulfiding Step

Applied Analytics Application Note No. AN-015

Revised 04 February 2020

## Further Reading

Subject	Location
OMA-300 H <sub>2</sub> S Analyzer Brochure	<a href="https://aai.solutions/documents/OMAH2S.pdf">https://aai.solutions/documents/OMAH2S.pdf</a>
OMA-300 Process Analyzer Data sheet	<a href="https://aai.solutions/documents/AA_DS001A_OMA300.pdf">https://aai.solutions/documents/AA_DS001A_OMA300.pdf</a>
Advantage of Collateral Data Technical Note	<a href="https://aai.solutions/documents/AA_TN-202_CollateralData.pdf">https://aai.solutions/documents/AA_TN-202_CollateralData.pdf</a>
Multi-Component Analysis Technical Note	<a href="https://aai.solutions/documents/AA_TN-203_MultiComponentAnalysis.pdf">https://aai.solutions/documents/AA_TN-203_MultiComponentAnalysis.pdf</a>



is a registered trademark of Applied Analytics, Inc. | [www.aai.solutions](http://www.aai.solutions)

### Headquarters

Applied Analytics, Inc.  
Burlington, MA, USA  
[sales@aai.solutions](mailto:sales@aai.solutions)

### North America Sales

Applied Analytics North America, Ltd.  
Houston, TX, USA  
[sales@appliedanalytics.us](mailto:sales@appliedanalytics.us)

### Brazil Sales

Applied Analytics do Brasil  
Rio de Janeiro, Brazil  
[vendas@aadbl.com.br](mailto:vendas@aadbl.com.br)

### Europe Sales

Applied Analytics Europe, AG  
Genève, Switzerland  
[sales@appliedanalytics.eu](mailto:sales@appliedanalytics.eu)

### Middle East Sales

Applied Analytics Oil & Gas Operations, L.L.C.  
[sales@appliedanalytics.ae](mailto:sales@appliedanalytics.ae)

### India Sales

Applied Analytics (India) Pte. Ltd.  
[sales@appliedanalytics.in](mailto:sales@appliedanalytics.in)

### Asia Pacific Sales

Applied Analytics Asia Pte. Ltd.  
Singapore  
[sales@appliedanalytics.com.sg](mailto:sales@appliedanalytics.com.sg)

### China Sales

Applied Analytics China Limited  
China  
[sales@appliedanalytics.cn](mailto:sales@appliedanalytics.cn)

© 2020 Applied Analytics, Inc. Products or references stated may be trademarks or registered trademarks of their respective owners. All rights reserved. We reserve the right to make technical changes or modify this document without prior notice. Regarding purchase orders, agreed-upon details shall prevail.