Chlorine Compound Analysis Applications [OMA-300-CL2]

Applied Analytics Application Note No. DS-001C — Revised 24 June 2013

Application Summary

Available Analytes: Cl_2, ClO_2, $FeCl_3$, NCl_3, $TiCl_4$, $VOCl_3$, more

Detector: OMA-300 Process Analyzer (using UV-Vis dispersive absorbance spectrophotometer)

Introduction

Various industrial processes require continuous monitoring of chlorine compounds' concentrations for healthy operation. The connecting concern between all of these applications is that the monitoring instrument is proofed against the highly corrosive chlorine compounds which will be present in the sample. Additionally, as some of these compounds are notorious for toxicity and/or explosiveness, chlorine compound analysis systems must be designed to prioritize operator safety.

OMA Benefits

- Continuously measures up to 5 chemicals' concentrations using dispersive UV-Vis absorbance spectroscopy
- Totally solid state build with no moving parts — modern design for low maintenance
- Ultra-safe fiber optic design with dedicated sample flow cell — no toxic/corrosive sample fluid in analyzer enclosure
- Long-lifespan xenon light source (avg. 5 years)
- Custom (per-application) sample conditioning design with Teflon wetted parts to withstand long-term corrosion
- Decade of field-proven perfromance in the world's harshest industrial environments

Monitoring Ferric Chloride ($FeCl_3$) and Chlorine (Cl_2) in PVC Precursors

Ethylene dichloride (EDC) is the first intermediate in the manufacturing of the versatile plastic PVC from raw materials. Heated to 500 °C in a cracking furnace, EDC splits into VCM (the precursor to PVC) and recyclable HCl.

The EDC entering the furnace sometimes contains ferric chloride (the catalyst used to chlorinate ethylene in creating EDC; this contamination is far from trivial as trace $FeCl_3$ is known to foul the furnace. Furthermore, PVC made from EDC with impurities (i.e. low levels of chlorine) does not meet the specifications of high-quality PVC and will get rejected by the purchaser.

Solution: the **OMA** is ideal for measuring low concentrations of contaminants in the EDC feed stream and protecting end product quality.

Monitoring Nitrogen Trichloride (NCl_3) in Chemical Production

Most chlorine and caustic soda is produced through electrolysis of sodium chloride brine. Chloride ions in the solution become elemental chlorine at the cathode and caustic soda and hydrogen are produced at the anode. Subsequent liquefaction of chlorine involves scrubbing and cooling to purify the chlorine from various contaminants; among these contaminants is NCl_3 (nitrogen trichloride), formed from reactions between chlorine and nitrogen compounds in salts and additives.

As an explosive sensitive to light, heat, and organic compounds, NCl_3 accumulation presents an enormous safety concern. Plants typically control NCl_3 concentrations to well below 1%, which is the lower explosive limit (LEL) of NCl_3 in air. In the scrubbing and cooling process, chlorine gas is added in order to evaporate the liquid chlorine and leave NCl_3 remaining in the solution. This NCl_3-rich stream is sent to the thermal decomposer, where NCl_3 is dissolved in CCl_4 and broken down.

The traditional NCl_3 concentration monitoring method is Kjeldahl analysis, a lab method with origins in the 19th century. Features of this method include slow and infrequent measurements, high costs, and labor-intensive operation.

Solution: the **OMA** is an always-online analyzer of real-time NCl_3 concentration in the process stream. This capability allows for tight control of the scrubbing/cooling process, proactive reduction of resource waste (e.g. CCl_4 solvent), and early indication of potential safety problems.

Monitoring Titanium Tetrachloride ($TiCl_4$) and Vanadium in Titanium Oxide Pigment Production Process

Known in the paint industry as the “whitest white,” titanium oxide is a pigment used worldwide. In the chloride production method, titanium ore is converted to $TiCl_4$, from which metallic chloride impurities are discarded. Oxidation of purified $TiCl_4$ yeilds bright, finish-ready TiO_2.

There are two critical analysis applications in this process that immediately improve yeild:

(1) Ensuring that the $TiCl_4$ is vanadium-free to protect pigment quality

(2) Monitoring effluent from the oxidation vessel for unreacted $TiCl_4$ (verify reaction efficiency)

Solution: the **OMA** is perfectly suited for this application due to strength in multi-component analysis and stream multiplexing capabilities. A single system can monitor both $TiCl_4$ and vanadium simultaneously in multiple streams.

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The specifications below represent performance of the OMA-300 Process Analyzer in chlorine compound analysis applications.

For technical details about the OMA-300 Process Analyzer, see the data sheet:
http://www.a-a-inc.com/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.

Application Data	
Performance Specifcations	
Accuracy	*All measurement ranges can be customized. Example ranges shown below.* **Cl_2** 0-100 ppm: ±5 ppm 0-10,000 ppm: ±2% full scale or 5 ppm** 0-100%: ±2% full scale **$TiCl_4$** 0-2,000 ppm: ±15 ppm 0-10,000 ppm: ±1% full scale **$FeCl_3$** 0-300 ppm: ±1% full scale 0-10,000 ppm: ±1% full scale **NCl_3** 0-100 ppm: ±5 ppm 0-10,000 ppm: ±1% full scale 0-5%: ±1% full scale **Vanadium** 0-5 ppm: ±0.3 ppm **Whichever is larger

Further Reading

Subject	Location
OMA-300 Process Analyzer Data sheet	http://www.a-a-inc.com/documents/AA_DS001A_OMA300.pdf
Advantage of Collateral Data Technical Note	http://www.a-a-inc.com/documents/AA_TN-202_CollateralData.pdf
Multi-Component Analysis Technical Note	http://www.a-a-inc.com/documents/AA_TN-203_MultiComponentAnalysis.pdf

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