

Measuring TiCl₄ and Vanadium in TiO₂ Pigment Production

Applied Analytics Application Note No. AN-006



Application Summary

Analytes: TiCl₄ (titanium tetrachloride), vanadium

Detector: OMA-300 Process Analyzer

Process Stream: TiCl₄ feed gas; recycle gas

Typical Measurement Range: 0-10,000 ppm

Introduction

Known in the paint industry as the “whitest white,” titanium dioxide is a pigment used worldwide. In the chloride production method, titanium ore is converted to TiCl₄, from which metallic chloride impurities are discarded. Oxidation of purified TiCl₄ yields bright, finish-ready TiO₂.

There are 2 critical points of analysis in this production process:

- (1) The incoming stream of TiCl₄ needs to be pure to yield high quality TiO₂. This requires verification that the TiCl₄ feed is free of incident vanadium.
- (2) The waste/recycle gas stream should be free of TiCl₄ if the process is running efficiently. The presence of TiCl₄ at this stage indicates incomplete hydrolysis and waste of valuable raw materials.

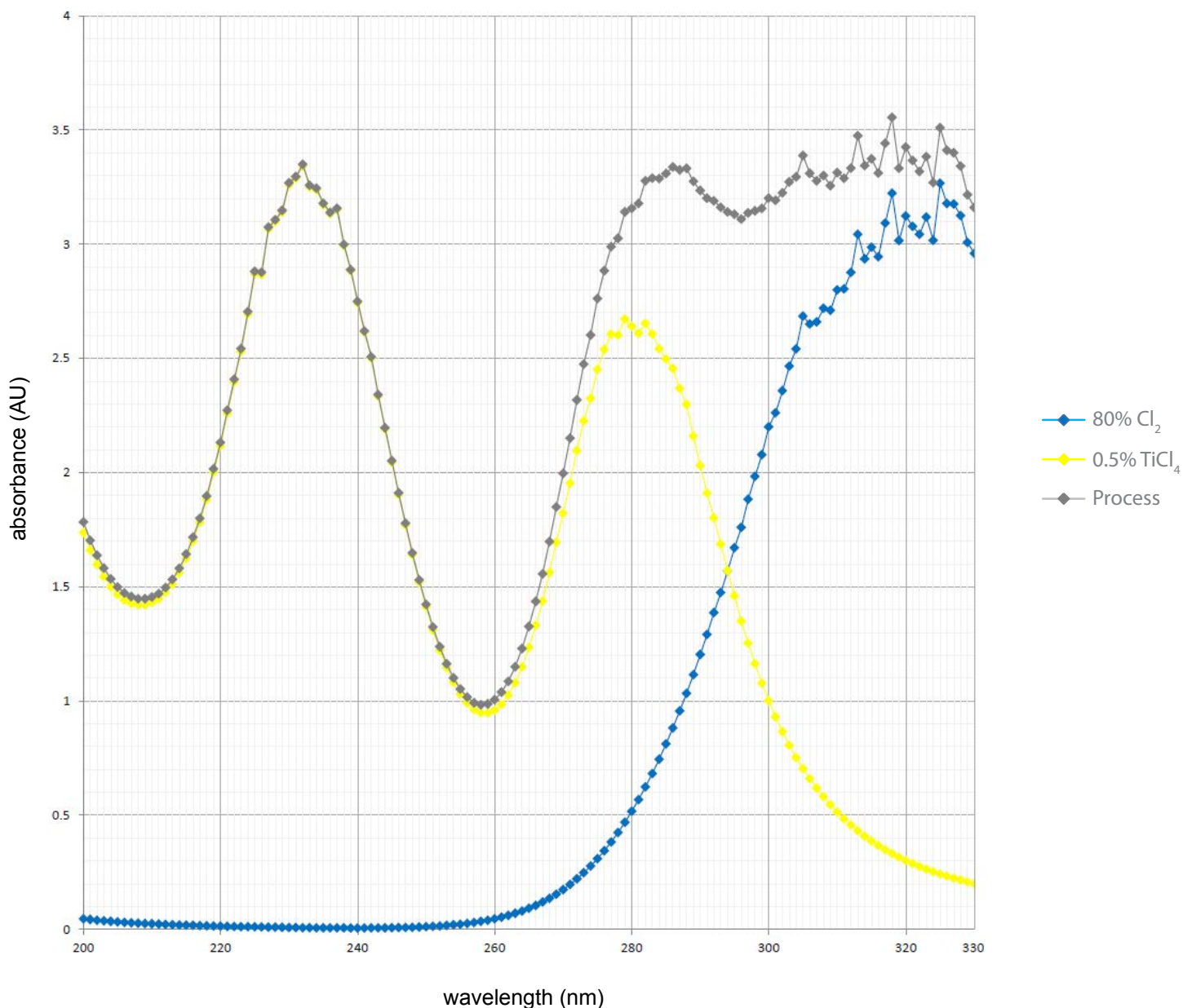
The OMA system is the ideal instrument for both analysis points, as TiCl₄ and vanadium each have distinct, strong absorbance curves in the UV wavelength range. Dispersive analysis is absolutely necessary; collateral data is needed to differentiate the absorbance of TiCl₄ from the absorbance of chlorine in the gas stream.

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Absorbance Spectrum of TiCl_4 in Process Gas

The spectra below demonstrate the overlapping absorbance of the analyte (TiCl_4) and background composition (Cl_2), and the importance of a full-spectrum method. The ECLIPSE software in the OMA uses all of the measurement wavelengths (each diamond in the spectra below represents a single measurement wavelength) as data points to de-convolute the different chemicals' absorbance curves.

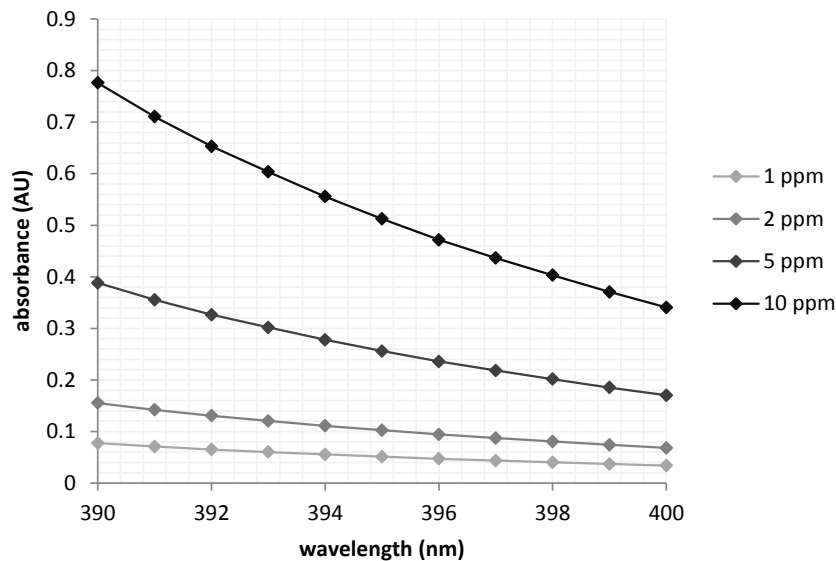


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Absorbance Curve of Vanadium in a TiCl_4 Background

The measurement wavelength range used for measuring vanadium concentration in this application is demonstrated below:



Sample Conditioner for Vanadium Measurement

The system below was built to measure 0-10 ppm vanadium impurity in a liquid TiCl_4 stream:



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The specifications below represent performance of the OMA-300 Process Analyzer in a typical TiCl₄ / vanadium application.

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

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>Custom measurement ranges available; example ranges below.</i>
	TiCl₄ 0-2,000 ppm: ±15 ppm 0-10,000 ppm: ±1% full scale
	vanadium 0-5 ppm: ±0.3 ppm
	Cl₂ 0-100 ppm: ±5 ppm 0-10,000 ppm: ±2% full scale or 5 ppm* 0-100%: ±2% full scale
	*Whichever is larger.

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Further Reading

Subject	Location
OMA-300 Process Analyzer Data sheet	https://aai.solutions/documents/AA_DS001A_OMA300.pdf
Advantage of Collateral Data Technical Note	https://aai.solutions/documents/AA_TN-202_CollateralData.pdf
Multi-Component Analysis Technical Note	https://aai.solutions/documents/AA_TN-203_MultiComponentAnalysis.pdf



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