

Monitoring the Purity of Liquid Carbon Dioxide with an Antaris IGS Gas Analyzer

Key words

Antaris IGS, FTIR, gas analysis, liquid carbon dioxide, CO₂

Introduction

Liquid carbon dioxide (CO₂) is used in a variety of different industries. In the food industry, it is used to quickly freeze products for shipment and storage before sale as well as other cooling and chilling applications. In the beverage industry, it provides the carbonation for beer, soda and other carbonated beverages. In the medical industry, it is used for certain types of cryotherapy and specialized surgical procedures. CO₂ provides an anaerobic environment for bacteriological studies. In the water treatment industry, it is used to balance pH. It is even used in oil field recovery efforts to build pressure and eject trapped oil reserves.

Depending on the application, the purity requirements of liquid carbon dioxide varies greatly. Liquid CO₂ can be specified as industrial quality, beverage quality, and medical quality. The designation implies different levels of purity. For instance, beverage quality CO₂ is 99.95% pure. The better the certified quality provided by the CO₂ supplier, the higher the price the product will bring. The number of impurities present in a given supply source varies by industry, so it is important for suppliers to acquire the product from the cleanest sources available.

With the ever increasing concerns over airborne pollutants and green house gases produced through engine emissions, ethanol requirements in automobile gas has spurred an explosion of ethanol plants. Ethanol is produced in a number of different ways. Grains and corn are very common feedstocks used in the ethanol production process. The starting product is ground into a

fine powder or “meal”. The meal is then mixed with water and enzymes to extract the starch. The starch is put through a saccharification process to convert it to sugar. Fermentation is accomplished by adding yeast to the sugar yielding ethanol and CO₂.

The CO₂ generated from this process is very clean and therefore an excellent candidate for high grade CO₂ production and distribution. CO₂ producers are building plants adjacent to the ethanol plants to capture, clean, and store the product. Ethanol producers benefit greatly from these partnerships. Not only do they avoid fines from environmental agencies for releasing CO₂ into the air, they profit from the sale of the CO₂.



Thermo Scientific Antaris IGS Gas Analyzer



Ethanol plant



CO₂ plant

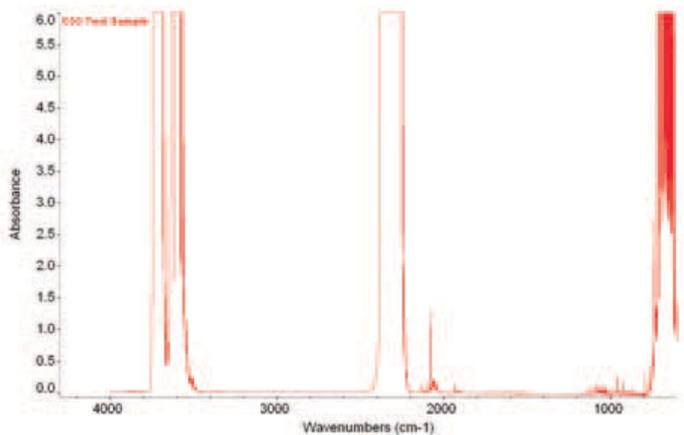


Figure 1: This spectrum is dominated by the contributions of CO₂. Even with multiple spectral regions being rendered useless, large spectral regions are still viable for quantitative measurements.

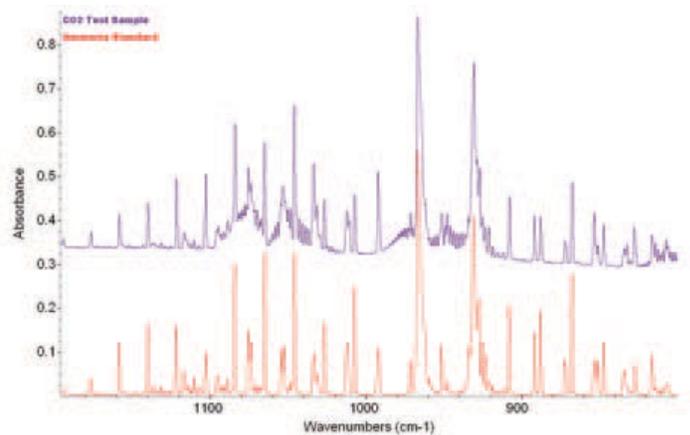


Figure 2: Expanding the region specific to measuring ammonia, there is a clear overlap with the ammonia reference spectrum. Along with the ammonia peaks, additional features from another gas component in the system will need to be monitored as a possible interference to calculating ammonia concentrations.

Experiment

To certify the quality of the CO₂, the manufacturer uses a number of different tests monitoring levels of SO₂, CO, NO₂, CH₄, H₂O, NH₃, NO, NO₂, C₆H₆, and PH₃. These tests are not only costly but time consuming as well. Using the Thermo Scientific Antaris IGS gas analyzer, the manufacturer can test all of these components simultaneously, quickly, and at a greatly reduced cost relative to conventional tests such as Draeger tubes.

Reviewing the data, there is an obvious influence of high levels of CO₂. If we selectively choose the infrared frequencies that absorb light associated with our species of interest while minimizing the effects of the CO₂ absorbances, these interactions can be isolated and measured quantitatively. This is demonstrated in the example of ammonia. The spectrum is dominated by the signature absorbances of CO₂, which makes up > 99% of the sample. A closer view of the area of the spectrum around 1000 – 900 cm⁻¹ is compared to the NH₃ reference spectrum. The classic least squares (CLS) algorithm used to quantify the NH₃ quantity can compensate for the spectral interferences from the overlapping CO₂ bands to deliver an accurate measurement.

The Antaris™ IGS gas analyzer is a rugged, mid-infrared spectrometer platform designed specifically for analyzing process gases in an industrial environment. Coupled with Thermo Scientific RESULT software, this analysis becomes a push button operation. Whether the plant personnel or the driver is running the tests, there is little to no training involved. The truck or railcar is connected to the input stream and the spectrometer does the rest.

Configuring the Antaris IGS with a 10M gas cell and a DTGS detector provides for low detection limit capabilities along with 24/7 operation. Along with the Thermo Scientific RESULT™ OPC and ModBus interface capabilities, the unit has the capacity to control the data flow and alert plant personnel of potential issues. Compatible with most Microsoft® applications, data fields can be populated automatically and reports can be generated for drivers without the need for onsite personnel. Quality control becomes easier, more efficient, and less expensive.

Conclusion

The Thermo Scientific Antaris IGS gas analyzer offers an alternative to time-consuming and expensive tube tests for the monitoring of CO₂ contaminants in real-time at ethanol/carbon dioxide production sites.

Find out more at thermofisher.com/igs