Application Note: 51814

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

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Key Words

- Antaris IGS
- Liquid Carbon Dioxide
- CO_2

Introduction

Liquid carbon dioxide (CO_2) 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. It 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. If you have high levels of hydrogen sulfide in your CO_2 and it is being injected into the ground, it is of no consequence. But, if mineral water tastes like rotten eggs, this is a problem. Liquid CO_2 can be specified as industrial quality, beverage quality, and medical quality. The designation implies different levels of purity. For instance, beverage quality is 99.95% pure. The better the certified quality provided by the CO_2 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 CO_2. The CO_2 generated from this process is very clean and therefore an excellent candidate for high grade CO_2 production and distribution. CO_2 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 CO_2 into the air, they profit from the sale of the CO_2.

Thermo Scientific Antaris IGS Gas Analyzer

Ethanol Plant

CO_2 Plant

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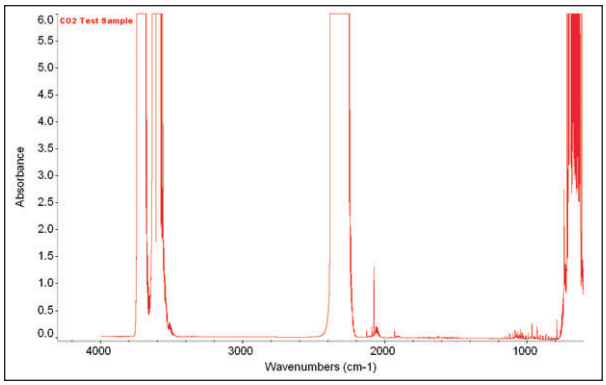

Figure 1: This spectrum is dominated by the contributions of CO_2. Even with multiple spectral regions being rendered useless, large spectral regions are still viable for quantitative measurements.

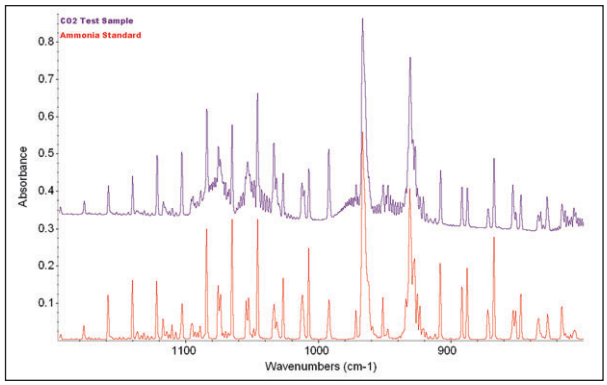

Figure 2: Expanding the region specific to measuring ammonia, there is a clear overlap with the ammonia reference spectrum. Along with the ammonia peaks, additional features from another gas component in the system will need to be monitored as a possible interference to calculating ammonia concentrations.

Experiment

To certify the quality of the CO_2, the manufacturer uses a number of different tests monitoring levels of SO_2, CO, NO_2, CH_4, H_2O, NH_3, NO, NO_2, C_6H_6, and PH_3. 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 detector tubes.

Reviewing the data, there is an obvious influence of high levels of CO_2. If we selectively choose the infrared frequencies that absorb light associated with our species of interest while minimizing the effects of the CO_2 absorbances, these interactions can be isolated and measured quantitatively. This is demonstrated in the example of ammonia. In the spectral data (Figure 1), the full range spectrum is overwhelmed by the CO_2 contributions and an expanded region (Figure 2) showing the contribution of the NH_3 absorbances to the total. Even though there is additional information present in the mixture spectrum, it is easy to identify where the ammonia contributions reside.

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 RESULT™ OPC compatibility, the unit has the capability of controlling the data flow and alerting 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 available. 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 CO_2 contaminants in real-time at ethanol/carbon dioxide production sites.

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