Application Note

Simple and Rapid Measurement of Oxygen, Nitrogen, Carbon Monoxide and Carbon Dioxide in Coffee Bean Storage Bags

Introduction

Roasting coffee beans produces the flavor and aroma components that consumers enjoy. Oxygen (O_2) is responsible for degrading coffee's aroma and taste and is therefore undesired in packaging. When packaging coffee, it is important to first remove oxygen by vacuum, gas flush or a combination of both to retain optimum coffee quality and freshness. The amount of residual O_2 and nitrogen (N_2) in a package plays a key role in preserving the coffee's quality and freshness. In contrast, when coffee is first packaged fresh out of the roaster, large concentrations of carbon dioxide (CO_2) and carbon monoxide (CO) are evolved and are present inside the package.

An INFICON Micro Gas Chromatograph (Micro GC) Fusion® gas analyzer was used to analyze the concentrations of O_2, N_2, CO, and CO_2 evolved from both whole and ground coffee beans contained in commercial foil storage bags. This simple Micro GC Fusion procedure can be used to help understand whole or ground bean health, after packaging and storage, as well as understanding packaging integrity. Concentrations from <100ppm to high % levels can be analyzed in less than 70 seconds.

Experimental

A Micro GC Fusion configured with two modules was used for this experiment. Module A used a 10 m RT-Molsieve 5a capillary column and Module B used a 12 m RT-Q-Bond capillary column. Gas injected into Micro GC Fusion is split to both modules simultaneously. Micro GC Fusion was calibrated using commercially prepared calibration gases containing different concentration levels for the components of interest.

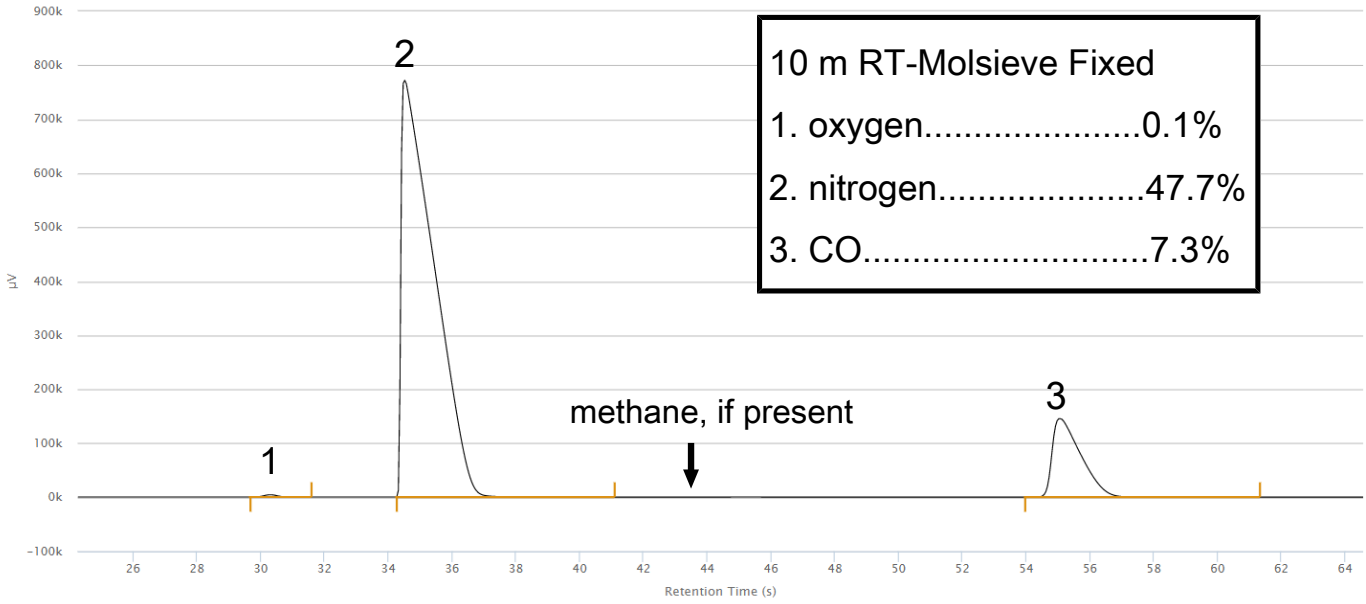
To directly sample from the headspace of the coffee bag, a side-port needle was attached to the front 1/16 in. Swagelok© connection of the sample filter installed on Micro GC Fusion. This filter is necessary to trap coffee particles in the gas and prevent them from entering the modules. The pointed needle was then inserted through a small rubber septum (which is placed on the coffee bag near the top). At the start of the run, the internal Micro GC Fusion sampling pump was used to pull the headspace gas above the coffee beans and grounds directly into the instrument. The pump sampling time can be adjusted and is typically set between 10-15 seconds. Analysis times are generally less than 70 seconds and can be adjusted for faster analysis if necessary.

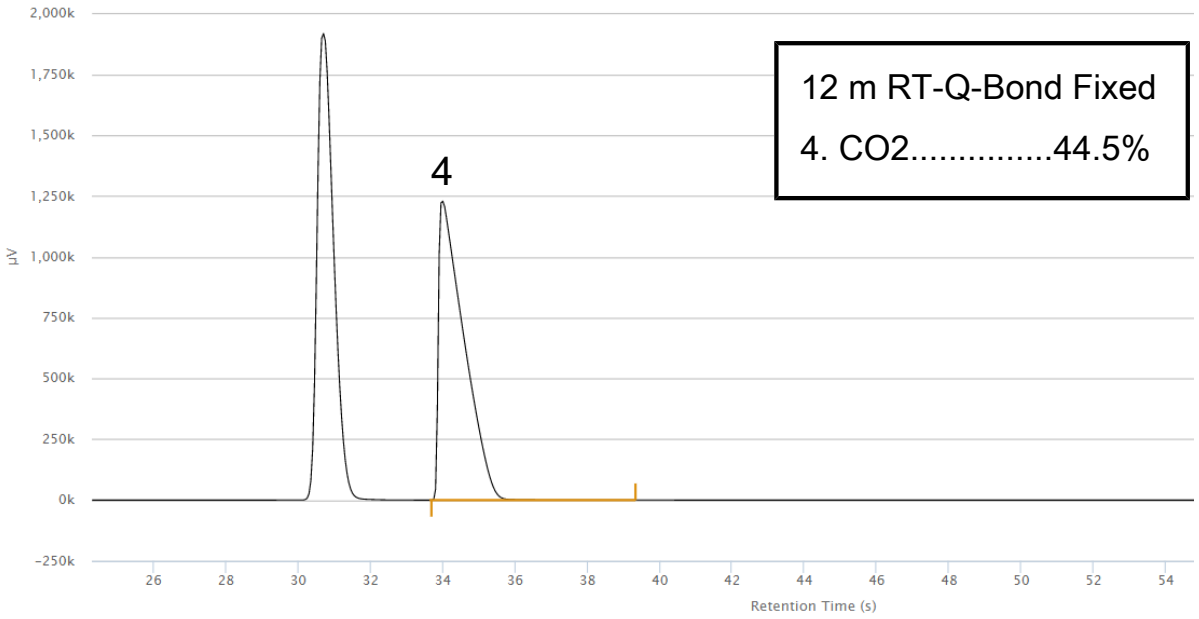
Parameter	10 m Rt-Molsieve Fixed volume injector	12 m RT-Q-Bond Fixed volume injector
Injection time	35 ms	35 ms
Injector temperature	90°C	90°C
TCD heater	70°C	70°C
TCD delta	5°C	5°C
Column pressure	23.5 psi, 99.999+ helium	21.5 psi, 99.999+ helium
Data rate	100 Hz	100 Hz
Column temperature	100°C (75s)	70°C (75s)
Sample pump time	10 s	10 s
Sample inlet temperature	90°C	90°C

Results

Typical results and chromatograms from the headspace of a coffee test bag are shown below. Methane can also be detected if present and measured on the RT-Molsieve module between nitrogen and CO.

Within 70 seconds, all desired compounds were analyzed.





Conclusion

With its speed, simplicity and detection capabilities, Micro GC Fusion is ideal for analyzing various fixed gases found in coffee bags using a 10 m RT-Molsieve module and a 12 m RT-Q-Bond module. All desired compounds were resolved and analyzed in less than 70 seconds.