Analysis of Bio-Ethanol by Gas Chromatography

Application Note

Energy and Fuels

Authors

Shannon Coleman
Agilent Technologies, Inc.
USA

David Ramby
Agilent Technologies, Inc.
USA

Abstract

A gas chromatography method has been developed for the analysis of impurities in ethanol bio-fuel. This application note describes a method for the analysis of nitrogen, oxygen, carbon dioxide, and ethanol from the headspace of a bio-fuel reactor.

Agilent Technologies

Introduction

The demand for fossil fuels and increase in oil prices have driven research in developing fuels from renewable sources. Bio-fuel is a type of fuel energy that is derived from biological carbon fixation. Bio-fuels are derived from biomass conversion, as well as solid biomass, liquid fuels, and various biogases. Bio-ethanol is an alcohol made by fermentation, which can then be used as fuel for vehicles in its pure form, but is more commonly used as a gasoline additive to increase octane and improve vehicle emissions.

The fermentation process for ethanol production can be monitored by analyzing the headspace of the fermentation vessel. For this analysis, an Agilent 7890 Series GC was fitted with a six-port gas sample valve, a split/splitless inlet, a four-port switching valve, a PoraPLOT Q column and a MolSieve column.

Results and Discussion

This combination of hardware and method development allows the user a simple way to obtain separation of oxygen, nitrogen, carbon dioxide, and ethanol on a single injection at above ambient temperatures. There are three different ways to introduce sample with this configuration; 1) directly from the process through connection of the gas sample valve to the sample source, 2) syringe injection through the gas sample valve, or 3) syringe injection directly into the GC inlet. This configuration allows for simultaneous separation of all components, while eliminating the possibility of contamination of the MolSieve column. The current configuration could be modified to extend the analysis out through heavier hydrocarbons by extending the run time. Additionally, the GC could potentially be expanded with a second inlet and a third detector such as an FID for a more extended hydrocarbon analysis.

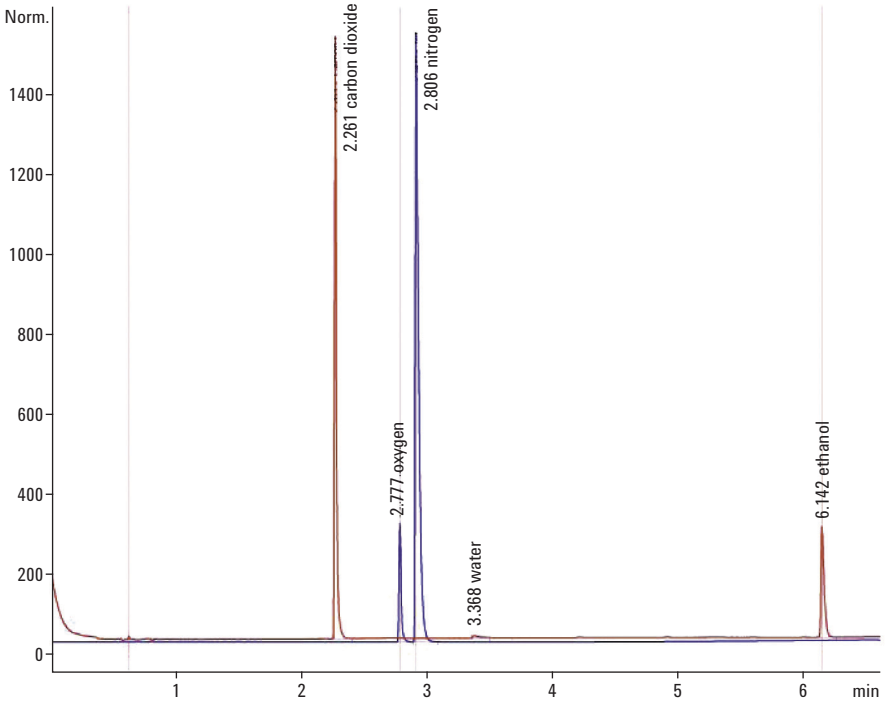

Figure 1. TCD signal overlay from the PoraPLOT Q and MolSieve channels.

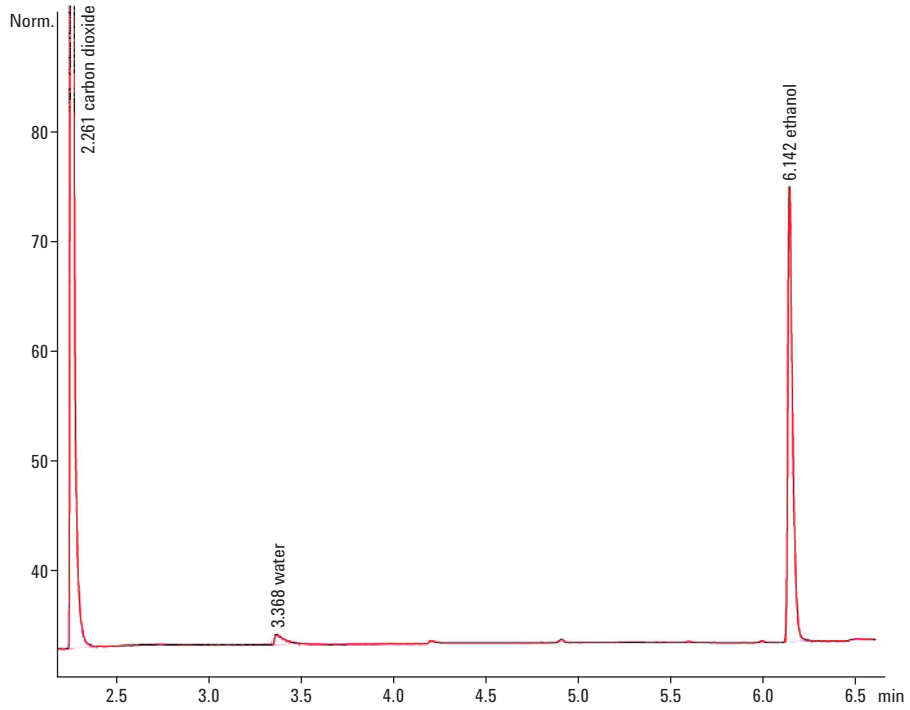

Figure 2. Analysis of carbon dioxide, water, and ethanol on a PoraPLOT Q column by a TCD.

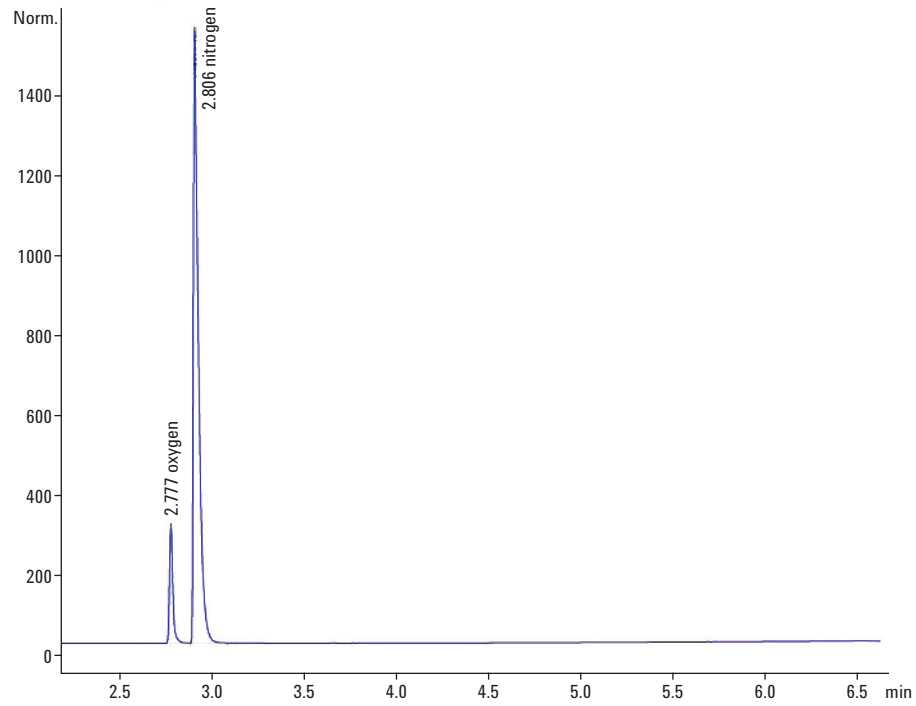

Figure 3. Analysis of oxygen and nitrogen on a MolSieve column by a TCD.

Table 1. Standards

Standards	Oxygen	10.03 %
	Nitrogen	unknown
	Carbon dioxide	5.0 %
	Helium	balance

Table 2. Gas Chromatograph Conditions and Set Points

GC run conditions	
Analytical column	CP7551, CP-PoraPLOT Q, 25 m × 0.32 mm, 10 µm 19091P-MS4, HP-PLOT MolSeive, 30 m × 0.32 mm, 1.2 µm 160-2255-30, Deact. Fused Silica Tubing, 30 m × 0.25 mm (cut)
Inlet temperature	250 °C
Inlet pressure	34.21 psi
Carrier gas	Helium, flow program 4.2557 mL/min for 2.3 min, then 25 mL/min to 8 mL/min for 0 min.
Split ratio	25:1
Oven program	70 °C for 3.5 min, then 70 °C/min to 200 °C for 10 min
Column velocity	50 cm/sec
Injection	Gas sample valve, 0.25 mL
Valve	
Valve Box Temp	150 °C

For More Information

These data represent typical results. For more information on our products and services, visit our Web site at www.agilent.com/chem.

www.agilent.com/chem

Printed in the USA
February 27, 2012
5990-9927EN

Agilent Technologies