Applying Novel GC Oven Technology to Increase Throughput in Analysis of Diesel Range Organics – Method 8015

Introduction

Analysis of diesel range organics (DRO) by U.S. Environmental Protection Agency (EPA) method 8015, or modified local methods, is commonplace in most environmental analytical laboratories. The key to this analysis is a method that is both fast and robust, allowing the laboratory to achieve the highest throughput with lowest cost. The goal of this brief is to apply the novel oven technology of the PerkinElmer® Clarus® 600 Gas Chromatograph (GC) to a modified 8015 DRO method, achieving improvements in both sample throughput and chromatographic resolution.

The new technology of the Clarus 600 GC oven will allow laboratories to utilize GC oven programs, which begin at near ambient temperatures, and incorporate fast temperature programmed ramps. This combination will improve the peak shape and resolution of the more volatile alkanes, while also achieving the quick elution of the heavier alkanes. Additionally, high oven temperatures will help to move hydrocarbons beyond the diesel range out of the column, reducing the need for maintenance. The cycle time of this high-temperature oven program is reduced with the best-in-class oven cooling and autosampler pre-rinse.

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Experimental conditions

The Clarus 600 Gas Chromatograph (GC) demonstrated here is a single-channel GC configured with a programmable split/splitless (PSS) injector and a flame ionization detector (FID). The injector liner used is a standard 2-mm glass liner packed with glass wool; the glass wool will improve vaporization of heavier alkanes. The column used in this example is a PerkinElmer Elite-1 (10 m x 0.10 mm x 0.10 µm); this micro-bore column allows fast oven programming, while maintaining resolution and peak shape.

The instrumental conditions are as follows. The PSS injector is maintained at 320 °C. The helium carrier gas is set at 30 cm/sec, with a 100:1 split. The GC oven program begins at 32 °C and is held for 0.75 min, the temperature is ramped without hold from 32 °C to 62 °C at 30 °C/min, then to 70 °C at 140 °C/min, then to 115 °C at 105 °C/min, then to 175 °C at 85 °C/min, and finally to 330 °C at 55 °C/min. The final temperature is held for 2.24 minutes bringing the total oven program time to 8 minutes.

Results and discussion

The calibration of method 8015 is typically performed with a fuel type similar to that found in the environmental sample. The total area within a retention-time window (for example C_{10} through C_{28}) is integrated and calculated to determine a total hydrocarbon concentration. In this analysis, a mix of C_{10} through C_{40} was analyzed in less than 8 minutes, with baseline resolution between the solvent hexane (C_6) and C_{10}. The total period between injections is approximately 15 minutes, allowing 4 runs per hour. Pictured in the chromatogram (Figure 1) is a sample run of diesel fuel in hexane with C_{10} eluting at 2.23 minutes and C_{28} at 5.24 minutes.

Conclusion

The technique presented here will allow laboratories to achieve high throughput, while keeping operational cost low with increased chromatographic performance. The cycle time of this analysis is reduced by the exceptionally high cooling rates of the Clarus 600 GC oven. The novel design of this oven optimizes the flow of ambient air into the GC oven, while minimizing mixing between ambient air and heated exhaust.

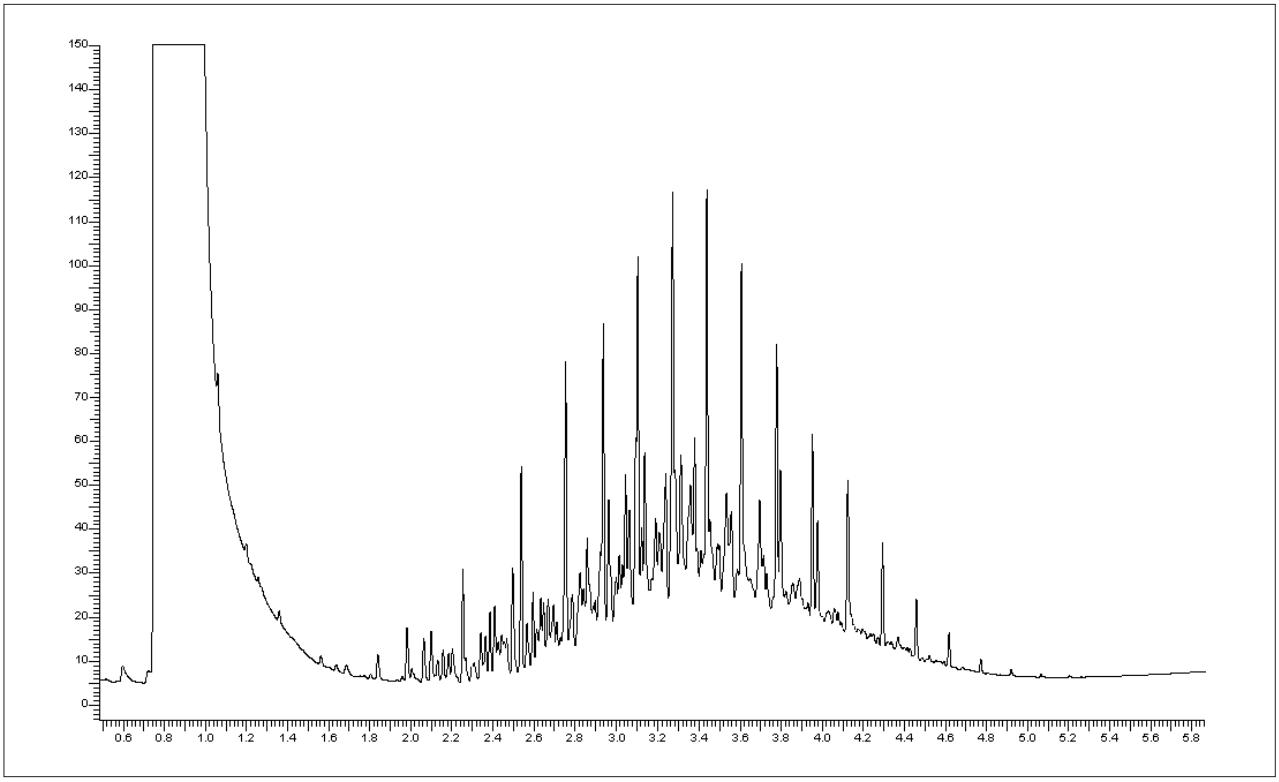

Figure 1. Chromatogram of diesel fuel in hexane (C_{10} elution time is 2.23 minutes and C_{28} is 5.24 minutes). The diesel range organics measurement is based upon the sum of the area under all peaks between C_{10} and C_{28}.

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