Hydrocarbons, \( C_1 - C_5 \)

TCT analysis of \( C_1-C_5 \) hydrocarbons in gasoline engine car exhaust gases

Application Note

Energy & Fuels

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Introduction
There is a growing awareness of the fact that not only nitrous oxides (NOx) but also hydrocarbons play a significant role in the formation of environmentally threatening ozone.

NOx and hydrocarbons are released into the air from exhaust gases from factories and cars. Due to a photochemical reaction dangerous ozone is formed. Using a thermal desorption cold trap (TCT) injector in combination with a capillary column, dozens of components present in car exhaust gases are identified through mass-selective detection.
Conditions

Technique : GC-TCT

Column : Agilent CP-ALiO3/KCl, 50 m x 0.32 mm fused silica
PLOT CP-ALiO3/KCl (df = 5 μm) (Part no. CP7515)

Temperature : 40°C (5 min) → 150 °C, 5 °C/min;
150 °C (10 min) → 180 °C, 5 °C/min;
180 °C (2 min)

Carrier Gas : He, 1.3 kg/cm²

Injector : TCT

Cold Trap : 0.53 mm Deactivated Capillary tube
packed with Tenax and Active Carbon
Cold trap temperature : -130 °C
Desorption flow : 10 mL/min
Desorption temperature : 70 °C constant
Back flush flow : 15 mL/min

Detector : FID, 10 x 16
T = 200 °C

Sample Size : 1 mL

Courtesy : Y. Ishikawa, System Dept.,
GL Sciences, Japan

Peak identification

1. methane
2. ethane
3. ethylene
4. propane
5. propene
6-7. 1-butene
8. n-butane
10. trans-2-butene
11. 1-butene
12. iso-butene
13. cis-2-butene
16. iso-pentane
18. n-pentane
19. 1,3-butadiene
21. 3-methyl-1-butene
22. trans-2-pentene
23. 2-methyl-2-butene
24. 1-pentene
25. 2-methyl-1-butene
26. cis-2-pentene
31-35. C₆ components
Sample preparation

In this experiment, exhaust gas was taken directly from the exhaust pipe of a small truck with a 2000 cc engine, by collection in a Tedlar sampling bag. For continuous sampling a Constant Volume Sampler (CVS) should be used.

Instrumentation

By using a PTI injector in the TCT-mode, it is possible to desorb hydrocarbons on the cold trap for subsequent injection and to back-flush all hydrocarbons higher than C_6 after injection.

In order to cryo focus methane as well, the deactivated fused silica cold trap used is packed partially with Tenax-TA and with activated charcoal.

Results

An extremely good separation of the volatile C_1 - C_5 hydrocarbons in car exhaust gases was achieved. The chromatogram demonstrates that a TCT injector is ideal for this type of analysis.

Identification was achieved by comparing the obtained data with the retention times of a standard sample. It is highly likely that this TCT method is suitable for the analysis of hydrocarbons in exhaust gases from LEV (low emission vehicles) and ULEV (ultra low emission vehicles), which are going to be developed in the coming years.