Analysis of Gasoline and Alcohol using PONA System

Gasoline contains over 300 hydrocarbons with carbon numbers of four to twelve. The characteristics of hydrocarbons depend on factors such as carbon number and structure and they are divided into five main types (paraffin, olefin, naphthene, aromatics, and others). Among the procedures for classifying and quantifying gasoline by types of hydrocarbons are "Total Composition Testing Method by GC (JIS-K2536)" stipulated by Japanese Industrial Standards Committee and "Total Composition Analysis by Capillary Gas Chromatogram (JPI-5S-52-99)" stipulated by the Japan Petroleum Institute. These methods are generally called PONA analyses.
PONA analysis systems measure volume and weight concentrations and mol ratios of components in gasoline and gasoline-based materials to compute octane numbers, hydrogen content, carbon content, average density and vapor pressure.
However, chromatograms obtained in PONA analyses have extremely large numbers of peaks, causing inaccurate analysis due to misidentification by slight shifts in the retention time. Also in some cases, it takes a long time to correct the identification table. Consequently the repeatability of the retention time is a very important factor in PONA analysis. This application news introduces the stability of the retention time for gasoline components when using a PONA analysis system incorporating the GC-2010 with the CRG cryogenic attachment.
In recent years, many types of fuels alternative to gasoline that contain lower alcohols are on the market, thus creating increasing demand for analysis them. This article also introduces the result of separation between gasoline components and lower alcohols using the PONA analysis system under the same analysis conditions.

Fig.1 Construction of PONA System

Analytical Conditions

Equipment	:PONA System (GC-2010AF / AOC+CRG-2010)
Column	:GLC-Petrostar 0.25mm×100m df=0.5µm
Col.Temp.	:5˚C(7min)→ 2˚C/min→ 45˚C(0min) → 5˚C/min→ 200˚C(10min)
Carrier Gas	:He, Split:1:200

Fig. 1 shows the configuration of the PONA analysis system using the GC-2010. GCsolution that performs GC control and data acquisition and analysis, and PONAsolution that performs qualification and PONA computation are available as software for the PONA analysis system. As listed in Table 1, PONAsolution features functions such as PONA manager, manual chromatogram identification, manual chromatogram quantification and master file editing.
Fig. 2 shows the chromatogram obtained by analyzing the identical gasoline five times. Parts of the chromatogram are enlarged in Figs. 3 to 5. The variation coefficients of retention times for several peaks were computed and results are shown in Table 2. The figures show good repeatability.
Fig. 6 shows the chromatogram of alcohol standard sample and gasoline. Separation of alcohols and gasoline is summarized in Table 3. No overlapping components were found for methanol, ethanol, n-propanol and 2-butanol.
The PONA analysis system is expected to be applied to the quantitative and qualitative analyses of fuels alternative to gasoline.

Table 1 PONAsolution Functions

PONA Manager	Automatically identifies peaks after data acquisition and batch reanalysis to compute concentration and physical property values and perform statistic calculation.
Manual chromatogram identification	Selects data and identification results for concentration and PONA calculation.
Manual chromatogram qualification	Corrects retention time in the identification table (visual operation by moving the ID mark with the mouse).
Master file editing	Makes new entries or deletions on the identification table of elution components. Copies new items from the reference table.

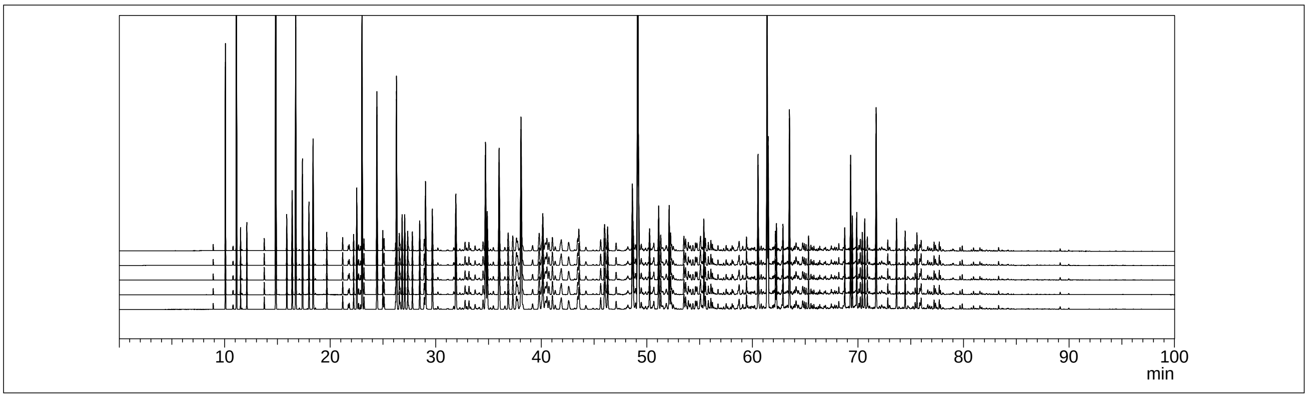

Fig.2 Chromatogram of Gasoline

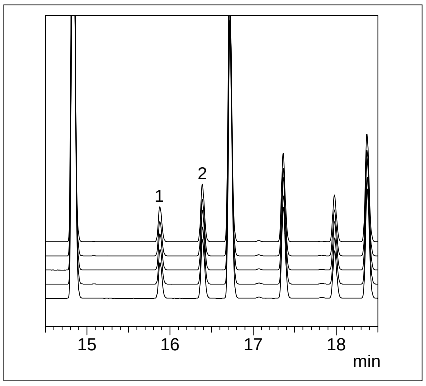

Fig.3 Enlarged figure of Fig.2

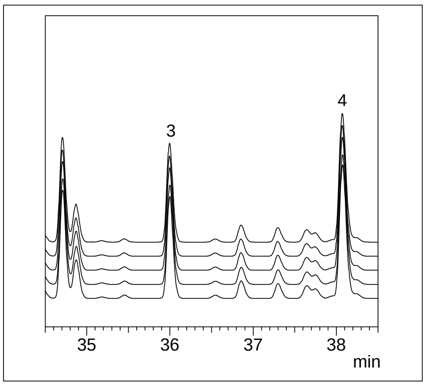

Fig.4 Enlarged figure of Fig.2

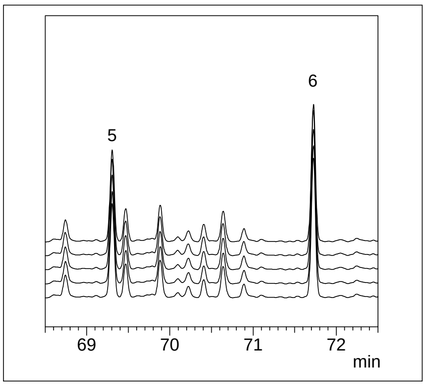

Fig.5 Enlarged figure of Fig.2

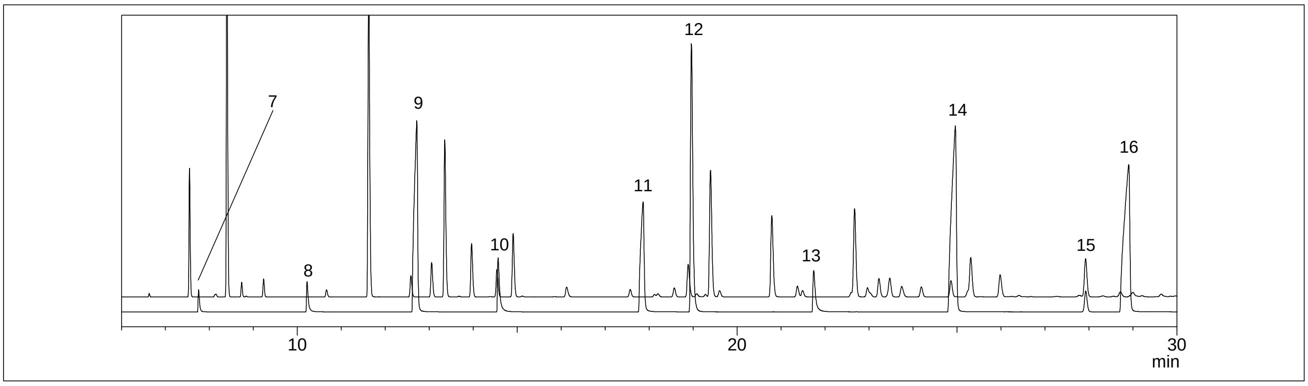

Fig.6 Chromatograms of Gasoline and Alcohols

Table 2 Repeatability of Retention time

ID	1	2	3	4	5	6
Components	1C5=	2M1C4=	3MC6	224TMC6	1M3EB	124TMB
data1	15.8771	16.3884	35.9951	38.0724	69.3066	71.7265
data2	15.8776	16.3888	35.9942	38.0722	69.3049	71.7250
data3	15.8788	16.3903	35.9961	38.0738	69.3060	71.7263
data4	15.8805	16.3919	35.9990	38.0760	69.3077	71.7275
data5	15.8798	16.3914	35.9977	38.0757	69.3062	71.7257
S.D.	0.0014	0.0015	0.0020	0.0018	0.0010	0.0009
Average	15.8787	16.3902	35.9964	38.0740	69.3063	71.7262
CV(%)	0.0091	0.0093	0.0054	0.0047	0.0014	0.0013

Table 3 Separation of alcohols

ID	Alcohol	Overlapping components
7	MeOH	
8	EtOH	
9	i-PrOH	1C5=
10	t-BuOH	c2C5=
11	n-PrOH	
12	MTBE	
13	s-BuOH	
14	i-BuOH	3Mt2C5=
15	Bz	
16	n-BuOH	5M1C6=,CyC6 (Note)

Note: Separated when concentration is low.

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