Industrial Health, 1986, **24**, 63—66

LETTERS TO THE EDITOR

n-Hexane and Benzene Contents in Gasoline for Industrial Purpose

Key word: Benzene—n-Hexane—Gasoline for industrial purpose—Occupational exposure limit—Toxicity

Although industrial gasoline is widely used as a solvent in various fields, its toxicological evaluation has not been well established probably because it is, by nature, a mixture of unidentified low-boiling point components and its chemical composition is difficult to define.[1)]

In a preceding report on motor gasoline,[2)] trials were made to selectively determine n-hexane and benzene contents and to evaluate gasoline toxicity in terms of these two probably most insidious intoxicants among gasoline constituents.[1)] The same idea is applied in the present study to evaluate the toxicity of gasoline for industrial purpose (to be abbreviated as GIP), and 8 samples of the Kind 1 to 5 GIP (qualified with Japanese Industrial Standard K 2201) were analyzed by means of capillary gas chromatography as previously described.[2,3)]

Typical chromatograms of these GIP samples are shown in Fig. 1 together with that of an authentic mixture of n-hexane, benzene, toluene, ethylbenzene, and o-, m-, and p-xylenes (mixing ratio: 2, 2, 2, 1, 1, 1 and 1, by volume) for comparison of retention times. The chromatograms were different not only among gasoline samples of the different kinds as expected, but also between the two samples of the same kind (i.e., B versus, C, F versus G, and H versus I in Fig. 1) reflecting the fact that Japanese Industrial Standard identifies gasoline products in each category by physical properties as to be discussed later. The most remarkable point is the fact that no peak was found in the chromatograms of the Kind 4 and 5 GIP samples (Fig. 1-F to I) in the retention time range of shorter than 5 min (where peaks of both n-hexane and benzene would appear; Fig. 1-A). In contrast, numerous peaks appeared in this retention time region (including those for n-hexane and benzene) in the chromatograms of the Kind 1, 2 and 3 GIP samples (Fig. 1-B to E). Such results are in good agreement with the JIS classification of GIP by the boiling point range (Table 1). As the boiling points of n-hexane and benzene are low, it is reasonable that these solvents would not be present in the fraction of the high boiling point range set for the Kind 5 GIP. Although no lowest limit is given to the boiling point range for the Kind 4 GIP, the same reason may be applicable also to the products in this category. The present findings indicate that the strategy to evaluate the toxicity of gasoline as a function of both n-hexane and benzene contents can be applied not only to motor gasoline[2)] but also to the GIP[4)] as far as the Kind 1, 2

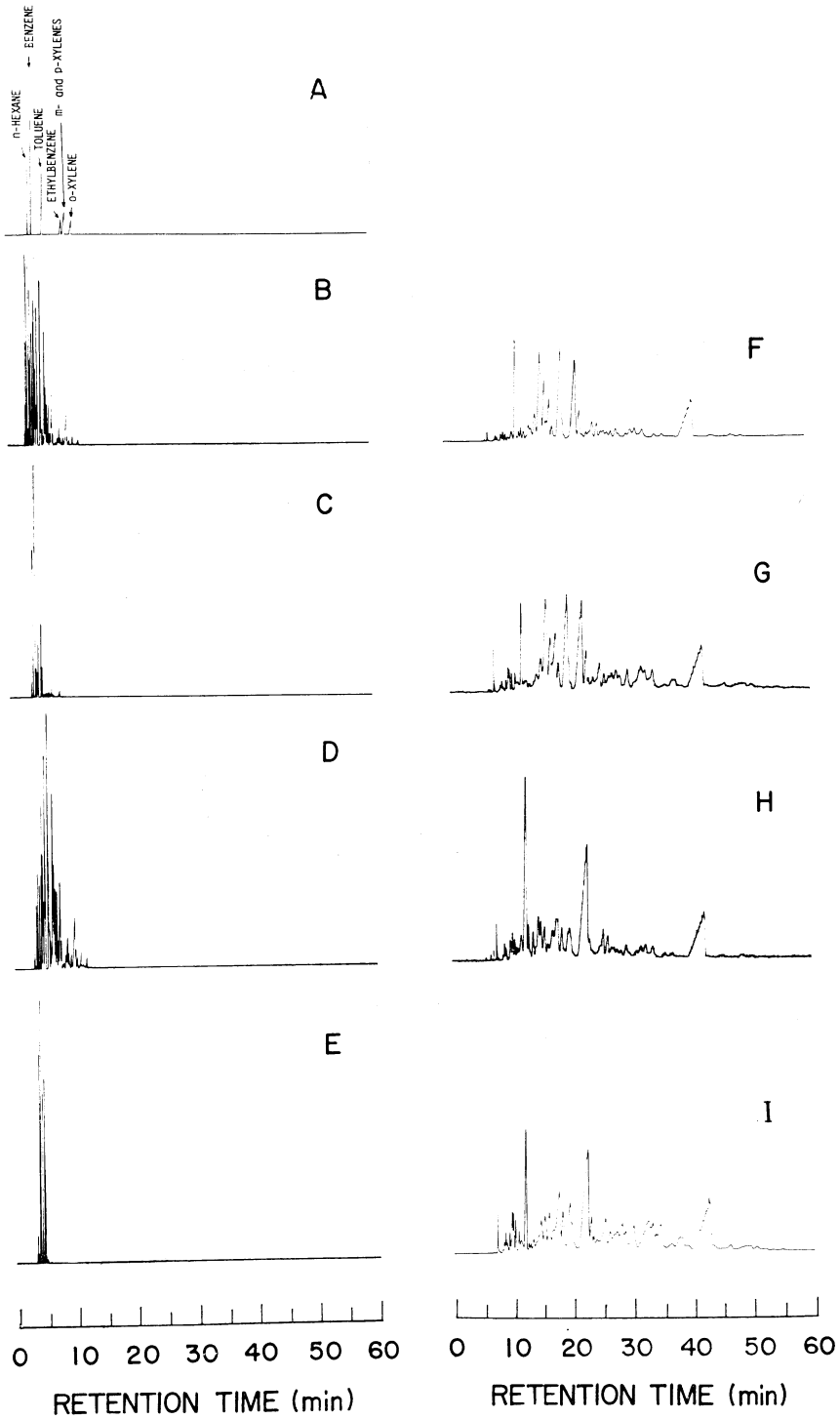
n-HEXANE
BENZENE
TOLUENE
ETHYLBENZENE
m- and p-XYLENES
o-XYLENE
A
B
C
D
E
F
G
H
I
0 10 20 30 40 50 60
RETENTION TIME (min)
0 10 20 30 40 50 60
RETENTION TIME (min)

Table 1. Boiling points of gasoline and related solvents

Substances	Boiling Points (°C)[a]
Gasoline for industrial purpose (JIS K 2201)	
Kind 1	30 to 150
Kind 2	80 to 160
Kind 3	60 to 90
Kind 4	—[b] to 205
Kind 5	150 to 210
Motor gasoline (JIS K 2202)	70[c] to 205[d]
Solvents	
n-Hexane	69
Benzene	80.1
Toluene	110.6
Ethylbenzene	136
o-Xylene	144
m-Xylene	139.3
p-Xylene	137–138

a For gasoline, ranges of boiling point are given.
b Not specified.
c The 10% distillation temperature.
d The 97% distillation temperature.

and 3 are concerned, and further suggest that such approach will not be possible to the Kind 4 and 5. A new strategy would be needed to evaluate the toxicity of the gasoline without n-hexane and benzene as constituents.

This preliminary analysis disclosed that the n-hexane and benzene contents in the 4 samples of the Kind 1, 2 and 3 GIP in the present study ranged from 0.4 to 9.0% and from 0.5 to 3.3%, respectively, roughly in agreement with the description in a review that n-hexane and benzene contents are 8.2% and 0.7%, respectively, in a typical "low-boiling point-solvent" (boiling point range: 30–160°C).[1] It is, however, apparently premature to conclude that the contents of n-hexane and benzene in the Kind 1, 2 and 3 GIP are within these ranges, because the analyzed samples are too limited while the contents may vary from products to products depending on, e.g., the origin of crude oils as well as the process of gasoline production.

Fig. 1. Typical chromatograms of gasoline for industrial purpose (GIP) in comparison with that of n-hexane, and benzene and other aromatics.

Sensitivity for the analyses of cases F to I was 10 times higher than that of cases B to E.

A An authentic mixture of n-hexane, benzene, toluene, ethylbenzene, and o-, m-, and p-xylenes (mixing ratio; 2, 2, 2, 1, 1, 1, and 1 by volume).

B GIP, Kind 1 (A).
C GIP, Kind 1 (B).
D GIP, Kind 2.
E GIP, Kind 3.
F GIP, Kind 4 (A).
G GIP, Kind 4 (B).
H GIP, Kind 5 (A).
I GIP, Kind 5 (B).

(A) and (B) were different samples.

REFERENCES

1) International Programme on Chemical Safety (1982). *Environmental Health Criteria* **20**, Selected Petroleum Products, p. 36 and p. 53, WHO, Geneva.
2) Ikeda, M., Kumai, M. Watanabe, T. and Fujita, H. (1984). Aromatic and other contents in automobile gasoline in Japan, *Ind. Health*, **22**, 235.
3) Kumai, M., Koizumi, A., Saito, K., Sakurai, H., Inoue, T., Takeuchi, Y., Hara, I., Ogata, M., Matsushita, T. and Ikeda, M. (1983). A nationwide survey on organic solvent composition in various solvent products: Part 2. Heterogeneous products such as paints, inks and adhesives, *Ind. Health*, **21**, 185.
4) Japan Association of Industrial Health (1985). Documentation of recommended occupational exposure limit for gasoline, *Jpn. J. Ind. Health*, **27**, 215 (in Japanese).

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(Received August 26, 1985 and in revised form November 5, 1985)