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Formaldehyde Levels in Rain Water from Kobe City in Japan

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Recently, environmental pollution by formaldehyde has become a serious problem. Lower aldehydes may be present in the atmosphere of some industrial communities in higher concentrations than sulfer dioxide in Los Angeles and Cincinnati . Relatively high aldehyde levels have been found in the industrial section of Windsor, Ontario. Formaldehyde is irritating to the eyes of some persons in concentrations as low as about 0.25 ppm, although several ppm are required to affect the majority of persons exposed. Since few detailed reports have been made as to the assay of this substance in rain water, we investigated this and compared levels of this compound in rain water collected from three different locations in Kobe, Japan. The assayed values were compared to each other.

MATERIALS AND METHODS

Forty eight samples of rain water were collected through a year (January, 1992 - December, 1992) at the different points as shown in Figure 1. All the rainfalls were individually collected in funnel-bottle samplers (volume: 2000 ml). Sampling was started from the first rain droplets fell on the ground. The determination was made immediately on arrival of the water at the laboratory. The distances from the highway (Hanshin Highway) are 50 meter at the A point, 1,500 meter at the B point and 2,900 meter at the C point, respectively. Concentrations of formaldehyde in water samples were assayed by calorimetric method using 4-amino-3-hydrazino-5-mercapto-1,2,4-triazole reagent.

RESULTS AND DISCUSSION

The concentration of formaldehyde in water samples were assayed. As shown in Figure 2, formaldehyde levels showed daily variations. The respective amounts of rainfall were close to each other. Table1 shows

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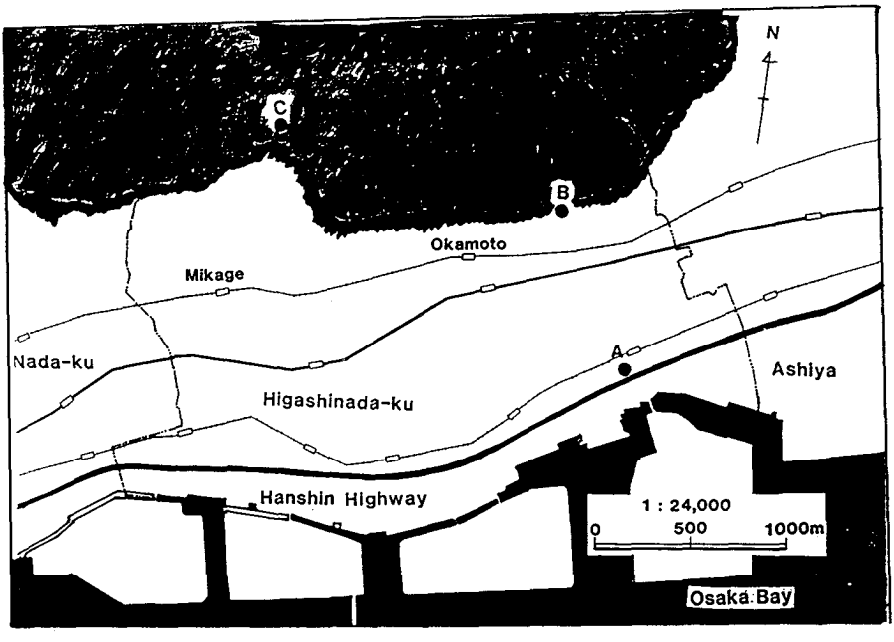

Figure 1 . Sampling points of rain water

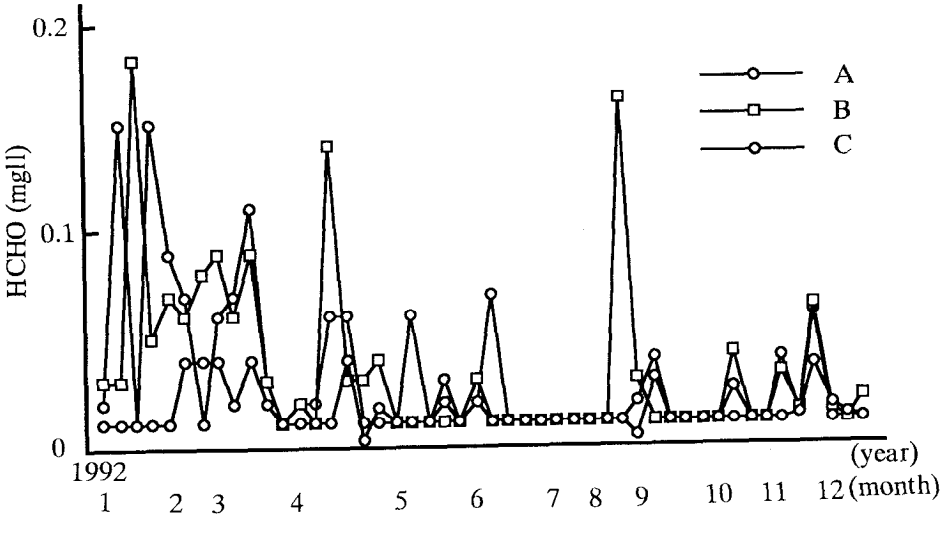

Figure 2. Formaldehyde variation in rain water collected from the three points

Table 1. Assayed values of formaldehyde in rain water at A, B and C from January of 1992 to December of 1992

Substance	A (mg/l)		B (mg/l)		C (mg/l)	
	Min - Max	M ± SD	Min - Max	M ± SD	Min - Max	M ± SD
HCHO	0.001-0.150	0.032 ± 0.036*	0.001-0.180	0.035 ± 0.040*	0.001-0.040	0.016 ± 0.011

* Significantly higher than the respective data of C, $p<0.01$

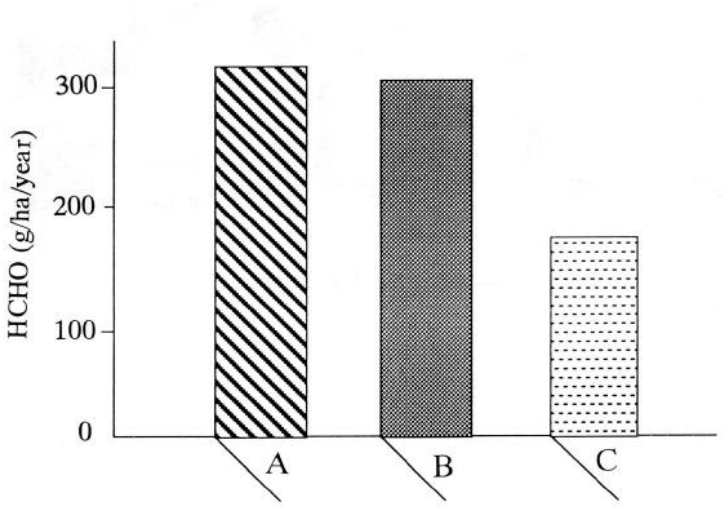

Figure 3. Cumulative amount of formaldehyde in rain water collected from the three points

Table 2. Correlation between the concentrations of HCHO and Ni^{2+} in rain water collected from the three points

	Correlation coefficient
A	0.493*
B	0.551*
C	0.076

* : There was a significant correlation between HCHO and Ni^{2+}, $p<0.01$.

the assayed values of sample waters from the three points. The average concentrations of formaldehyde at the A, B and C points were 0.032, 0.035 and 0.016 mg/L, respectively. The concentration of this compound at the A and B points were significantly higher than that at the C point, respectively ($p<0.01$). Figure 2 shows the yearly cumulative amounts of formaldehyde in rain water collected from the three points. These levels at the A and B points were about 2 times higher than that at the C point. Cholak(1952) has shown that aldehydes in the air vary not only with the nature of the activity of an area but also with the density of motor traffic. The incomplete oxidation of motor fuel and lubricating oils leads to the formation of aldehydes and organic acids. It is probable that atmospheric contamination by aldehyde is due to the exhaust of motor vehicles. We have previously reported that significant correlations were observed between the NO_3^- and Ni^{2+} levels in the rain water obtained from the A and B points (Adachi et al. 1992). Since these ions are usually included in motor vehicle exhausts, it was concluded that both A and B points were influenced by the air pollution due to motor vehicles (Adachi et al. 1992). Moreover, we suggested that the assayed values of Ni^{2+} in rain water can be used as one of indicators for air pollution by motor vehicle exhausts. Therefore, we tried to study the relation between the respective concentration of Ni^{2+} and formaldehyde in rain water collected from the three points. Table 2 shows the correlation between the concentrations of Ni^{2+} and formaldehyde in the rain water at A, B and C points. Significant correlations between the respective concentration of Ni^{2+} and formaldehyde in water samples from the A and B points were observed. These results suggest that formaldehyde obtained from A and B points might be derived from air pollution due to motor vehicles.

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