PA42) Risk Assessment of Exposure to Volatile Organic Compounds in Different Outdoor Environments in Gumi City, Korea

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1. Introduction

Exposure to Volatile Organic Compounds(VOCs) can lead to many acute and chronic health effects(Lee et al., 2000). As their adverse effects on human health, great concerns have been focused on VOCs. Industrial complex is an important source resulting in air pollution, therefore, regulations and management attention is required. This study evaluated the emissions of VOCs in Gumi industrial complex, and then calculated cancer risk of carcinogenic VOCs and hazard index of non-carcinogenic VOCs.

2. Experimental methods

This study selects VOCs samples from five representative monitoring sites in Gumi(including industrial complex zones, urban area and residential area etc). Canister method is used to collect VOCs samples in this study. And GC(HP6980N)/MSD(HP5973) that attached with pre-concentrator system(Entech 7100) is used for the analysis of VOCs. The sampling data are used to evaluate the risk assessment(Choi et al., 2004).

The approach for assessing the lifetime cancer risks includes four stages, namely, hazard identification, dose-response assessment, exposure assessment, and risk characterization. In the hazard identification and dose-response assessment process, carcinogenic risk of VOCs in Gumi is assessed based on the USEPA carcinogenicity assessment section of the integrated risk information system (IRIS). In exposure assessment process, carcinogenic risk and chronic hazard index are assessed using the lifetime average daily dose(LADD). The LADD can be calculated according the following Eq. 1.

$$LADD = \frac{C * IR * EF * ED}{BW * AT} \tag{1}$$

Cancer risk of individual VOC can be calculated as Eq. 2.

$$CR = C * UR \tag{2}$$

Cancer risks for individual VOCs that exceeded a 1.0×10^{-6} risk level are then summed for acumulative cancer risk as shown in Eq. 3.

$$CumulativeCancerRisk = \sum IndividualCancerRisk \tag{3}$$

Hazard index of individual VOC is shown in Eq. 4.

$$HI = \frac{LADD}{chronic RfD} \tag{4}$$

Hazard indexes for VOCs exceeding 1.0 are summed to calculate a total hazard index as shown in Eq. 5.

$$allHI = \sum_{j=1}^{p} \sum_{i=1}^{n} \frac{LADDij}{chronic\,RfCij} \tag{5}$$

3. Results and Discussion

The lifetime cancer risk assessment of exposure to VOCs has been obtained. The results have been shown in Table 1. Using the mean carcinogenic risk assessments of all 5 designated sites, the expectation of death number is about 27 according to the target population of Gumi city. Annually the expected death number is 0.386 or so, and then expected death for every 10 years is evaluated as 4. The hazard indexes of non-carcinogenic VOC contaminants are less than 1; thereby, the hazard doesn't occur here.

Table 1. Average carcinogenic risk by VOCs from inhalation exposure in Gumi city.

Compounds	Ind1	Ind2	Urban area	Residential	Transition	Average	Population risk	Annual population risk
Benzene	2.90E-05	3.15E-05	3.68E-05	3.06E-05	3.75E-05	3.31E-05	8.94E+00	1.28E-01
Chloroform	4.77E-05	1.19E-04	1.77E-05	5.31E-05	5.90E-05	5.93E-05	1.60E+01	2.29E-01
Dichloro methane	2.87E-06	4.92E-06	9.54E-07	8.28E-07	2.36E-06	2.39E-06	6.45E-01	9.22E-03
1,2-dichloro ethane	6.06E-06	4.85E-06	5.45E-06	4.85E-06	5.45E-06	5.33E-06	1.44E+00	2.06E-02
Total cancer risk	8.56E-05	1.60E-04	6.09E-05	8.94E-05	1.04E-04	1.00E-04	2.70E+01	3.86E-01

4. Conclusions

The carcinogenic risk for every monitored carcinogenic VOC in all 5 designated sites is more than the benchmark concentration and the mean carcinogenic risk of total is 1.0×10^{-4}. Particularly, the carcinogenic risk in industrial complex 2 is up to 1.60×10^{-4} which is 100 times larger than the benchmark concentration. Aiming at non-carcinogenic VOCs, the hazard indexes in all sampling sites are less than 1. This research made precise investigation and multi-pronged risk assessment based on the identified concentration of VOCs and exposure assessment. The results can be used as the basic information for regulating and management in Gumi city.

References

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