

ESTIMATING EXCESS LIFETIME CANCER RISK FOR THE VICINITY OF A PETROCHEMICAL COMPLEX IN TAIWAN

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In Taiwan, petrochemical industry plays an important role in economical development and contributes about 29% of the national total manufacture revenue. However, emission of toxic chemicals, especially hazardous air pollutants (HAPs), from petrochemical industry has been a serious pollution and health problem. Chemical such as benzene from the industry has been widely known as carcinogen. Accordingly, a national program was set up to regulate the emission of volatile organic compounds (VOCs) in 1997.

A major petrochemical complex (PC) in southern Taiwan was selected for this study so that the level of cancer risk developed within the residential areas of the PC could be estimated. Twelve factories have been under operation in the complex since 1975 with yearly chemical production capacity of 2.8 million tons in recent years. In this study, we selected 6 HAPs (benzene, carbon tetrachloride, chlorobenzene, chloroform, formaldehyde, and methylene chloride) which are regulated under the priority list by Taiwan EPA. The emission rate of total VOCs from the complex was first estimated every year for 70 years (1975 to 2044). Consequently, the emission rate of individual chemical was estimated using SPECIATE (Version 3.2) developed by U.S. EPA. ISC3 model was used to simulate the concentration distribution of these HAPs in the vicinity of the selected site. Cancer risks for the 6 HAPs were then estimated by using a conservative exposure scenario by assuming that residents stay 20% a day outdoor. The exposure frequency was assumed to be on daily basis and lasted for 70 years. The landscape of the site was a simple terrain of total area of 8 km×8 km which was divided into 1680 grid points for appropriate concentration gradient. The origin of

the simulation was selected at the center of the PC.

The results of this study show that the excess lifetime cancer risks (ELCR) for the 6 selected HAPs were in the order of formaldehyde (3.75×10^{-4}) > chlorobenzene (2.44×10^{-4}) > carbon tetrachloride (1.87×10^{-4}) > benzene (3.41×10^{-5}) > chloroform (3.65×10^{-6}) > methylene chloride (7.02×10^{-8}). In addition, the estimated ELCR values were compared with a set of epidemiological data obtained from a separate study for the same site and the closeness was within one order of magnitude. With the high ELCR ($10^{-4} \sim 10^{-6}$) for this study, a remediation program must be enforced for the site as early as possible.