

Population Exposures to Anthropogenic Sources of Ethylene Gas: A Survey of the Literature

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Abstract

Industrial production of ethylene in the United States was estimated to be nearly 150 million pounds/day in 2013. It is one of the most abundant hydrocarbons in ambient air and can emanate from a variety of anthropogenic, biogenic, and natural sources. Background concentrations in ambient air are generally 200-600 ppt, but can be appreciably higher in the vicinity of an Olefin plant due to fugitive and flare emissions. It is also photochemically reactive in air and has a relatively short tropospheric lifetime, which has prompted concerns over its ozone formation potential.

This project was aimed at determining what portion of human ethylene exposures can be attributed to manufacturing and product use. To accomplish this goal it was necessary to identify the various sources of ethylene in ambient air and quantitatively estimate what fraction of the exposure profile could be attributed to Olefin plant operations. Although the primary focus was on “manufactured” ethylene, it was also necessary to evaluate other dominant sources to establish a baseline for evaluating the relative contribution of anthropogenic exposures. The exposure assessment focused on the collection of all available exposure information for three semi-independent population subgroups: workers, consumers, and the general public.

The project was undertaken in two stages: (i) the preparation of a comprehensive and exhaustive literature review, and (ii) the development of an exposure assessment strategy focusing on those population subgroups in the upper range of the exposure distribution. The results from the first stage of this work are highlighted. Using the information from published and unpublished literature sources, an exposure database was created to compile and document ambient air levels in different regions of the world. Particular interest was placed on the results from ambient air monitoring networks located in the vicinity of major manufacturing sites. Three different search engines (Web of Science, Google Scholar, and PubMed) were used to identify publications that contained exposure-related information that could be entered into the database. In addition to the literature search, available data from air monitoring networks, dispersion models, TRI databases, and source apportionment studies were mined for pertinent facts.

Distribution profiles were then created to allow a breakdown into low, medium, and high exposure categories. The three population subgroups were examined independently but aggregate exposures were also evaluated when feasible. The data compilation allowed an assessment of those physiological, behavioral, and societal factors that impact the magnitude of anthropogenic ethylene exposures.