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Retrospective Exposure Assessment of Airborne Asbestos Related to Skilled Craftsmen at a Petroleum Refinery in Beaumont, Texas (1940–2006)

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Despite efforts over the past 50 or more years to estimate airborne dust or fiber concentrations for specific job tasks within different industries, there have been no known attempts to reconstruct historical asbestos exposures for the many types of trades employed in various nonmanufacturing settings. In this paper, 8-h time-weighted average (TWA) asbestos exposures were estimated for 12 different crafts from the 1940s to the present day at a large petroleum refinery in Beaumont, TX. The crafts evaluated were insulators, pipefitters, boilermakers, masons, welders, sheet-metal workers, millwrights, electricians, carpenters, painters, laborers, and maintenance workers. This analysis quantitatively accounts for (1) the historical use of asbestos-containing materials at the refinery, (2) the typical workday of the different crafts and specific opportunities for exposure to asbestos, (3) industrial hygiene asbestos air monitoring data collected at this refinery and similar facilities since the early 1970s, (4) published and unpublished data sets on task-specific dust or fiber concentrations encountered in various industrial settings since the late 1930s, and (5) the evolution of respirator use and other workplace practices that occurred as the hazards of asbestos became better understood over time. Due to limited air monitoring data for most crafts, 8-h TWA fiber concentrations were calculated only for insulators, while all other crafts were estimated to have experienced 8-h TWA fiber concentrations at some fraction of that experienced by insulators. A probabilistic (Monte Carlo) model was used to account for potential variability in the various data sets and the uncertainty in our knowledge of selected input parameters used to estimate exposure. Significant reliance was also placed on our collective professional experiences working in the fields of industrial hygiene, exposure assessment, and process engineering over the last 40 yr. Insulators at this refinery were estimated to have experienced 50th (and 95th) percentile 8-h TWA asbestos exposures (which incorporated 8-h TWA fiber concentrations, respirator use and effectiveness, and time spent working with asbestos-containing materials) of 9 (16) fibers/cc (cubic centimeter) from 1940 to 1950, 8 (13) fibers/cc from 1951 to 1965, 2 (5) fibers/cc from 1966 to 1971, 0.3 (0.5) fibers/cc from 1972 to 1975, and 0.005 (0.02) fibers/cc from 1976 to 1985 (estimated exposures were <0.001 fibers/cc after 1985). Estimated 8-h TWA exposures for all other crafts were at least 50- to 100-fold less than that of insulators, with the exception of laborers, whose estimated 8-h TWA exposures were approximately one-fifth to one-tenth of those of insulators. In spite of the data gaps, the available evidence indicates that our estimates of 8-h TWA asbestos exposures reasonably characterize the typical range of values for these categories of workers over time.