

## RECONSTRUCTION OF BENZENE EXPOSURE FOR THE PLIOFILM COHORT (1936–1976) USING MONTE CARLO TECHNIQUES

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*The current cancer slope factor and occupational standards for benzene are based primarily on studies of the rubber hydrochloride (Pliofilm) workers. Previous assessments of this cohort by Rinsky et al. (1981, 1987), Crump and Allen (1984), and Paustenbach et al. (1992) relied on different assumptions about the available industrial hygiene data and workplace practices and processes over time, thereby yielding significantly different estimates of annual benzene exposures for many jobs. Given the inherent limitations and uncertainties involved in estimating historical exposures for this cohort, a probabilistic approach was used to better characterize their likely degree of benzene exposure. Ambient air exposures to benzene were based, in part, on the distribution of air sampling data collected at the Pliofilm facilities and assumptions about how workplace concentrations probably decreased over time as the threshold limit value (TLV) was lowered. The likely uptake of benzene from dermal exposures was estimated based on probability distributions for several exposure factors, including surface area, contact rate and duration, and skin absorption. The assessment also quantitatively accounts for improved engineering controls, extended work hours, incomplete Pliofilm production, and the use and effectiveness of respirators over time. All original data and assumptions are presented in this assessment, as is all new information obtained through additional interviews of former workers. Estimated benzene exposures at the 50th and 95th percentiles are reported as equivalent 8-h time-weighted average (TWA) airborne concentrations for 13 job categories from 1936 to 1965 (Akron I and II facilities) and 1939 to 1976 (St. Mary's facility). Data indicate that estimated equivalent airborne benzene concentrations for St. Mary's workers were highest for four job categories (Neutralizer, Quencher, Knifeman, Spreader), typically ranging from about 50 to 90 ppm during 1939–1946 (lower during 1942–1945), and 10 to 40 ppm during 1947–1976 at the 50th percentile. These estimates are 2–3 times greater than for other jobs in the Pliofilm process, and about 1.5 times less than those estimated at the 95th percentile. Estimates of equivalent airborne benzene concentrations for Akron I and II were about 1.5 times higher than for St. Mary's, but there is less confidence in these estimates, given the lack of industrial hygiene monitoring data for these facilities. Study results suggest that Paustenbach et al. (1992) generally over-estimated exposures for those job categories that had the highest exposure by about a factor of two to four. On the other hand, it was concluded that Rinsky et al. (1981, 1987) under-predicted benzene exposures for most jobs, and Crump and Allen (1984) both under- and over-predicted benzene exposures, depending on the specific job category and time period. The new estimates presented in this analysis incorporate what is considered to be the most likely*