

Airborne concentrations of asbestos onboard maritime shipping vessels (1978–1992)

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The exposure of shipyard workers to asbestos has been frequently investigated during the installation, repair or removal of asbestos insulation. The same level of attention, however, has not been directed to asbestos exposure of maritime seamen or sailors. In this paper, we assemble and analyze historical industrial hygiene (IH) data quantifying airborne asbestos concentrations onboard maritime shipping vessels between 1978 and 1992. Air monitoring and bulk sampling data were compiled from 52 IH surveys conducted on 84 different vessels, including oil tankers and cargo vessels, that were docked and/or at sea, but these were not collected during times when there was interaction with asbestos-containing materials (ACMs). One thousand and eighteen area air samples, 20 personal air samples and 24 air samples of unknown origin were analyzed by phase contrast microscopy (PCM); 19 area samples and six samples of unknown origin were analyzed by transmission electron microscopy (TEM) and 13 area air samples were analyzed by scanning electron microscopy (SEM). In addition, 482 bulk samples were collected from suspected ACMs, including insulation, ceiling panels, floor tiles, valve packing and gaskets. Fifty-three percent of all PCM and 4% of all TEM samples were above their respective detection limits. The average airborne concentration for the PCM area samples ($n = 1018$) was 0.008 fibers per cubic centimeter ($f\text{ cc}^{-1}$) (95th percentile of 0.040 f cc^{-1}). Air concentrations in the living and recreational areas of the vessels (e.g. crew quarters, common rooms) averaged 0.004 f cc^{-1} (95th percentile of 0.014 f cc^{-1}), while air concentrations in the engine rooms and machine shops averaged 0.010 f cc^{-1} (95th percentile of 0.068 f cc^{-1}). Airborne asbestos concentrations were also classified by vessel type (cargo, tanker or Great Lakes), transport status (docked or underway on active voyage) and confirmed presence of ACM. Approximately 1.3 and 0% of the 1018 area samples analyzed by PCM exceeded 0.1 and 1 f cc^{-1} , respectively. This data set indicates that historic airborne asbestos concentrations on these maritime shipping vessels, when insulation–handling activities were not actively being performed, were consistently below contemporaneous US occupational standards from 1978 until 1992, and nearly always below the current permissible exposure limit of 0.1 f cc^{-1} .

Keywords: asbestos, industrial hygiene, maritime, occupational exposure, retrospective exposure assessment, seamen