

Airborne Asbestos Concentrations Associated with Heavy Equipment Brake Removal

Madl, A.K., Gaffney, S.H., Balzer, J.L., Paustenbach, D.J.

Asbestos-containing brake linings were used in heavy-duty construction equipments such as tractors, backhoes, and bulldozers prior to the 1980s. While several published studies have evaluated exposures to mechanics during brake repair work, most have focused on automobiles and light trucks, not on heavy agricultural or construction vehicles. The purpose of this study is to characterize the airborne concentration of asbestos to workers and bystanders from brake wear debris during brake removal from 12 loader/backhoes and tractors manufactured between 1960 and 1980. Asbestos content in brake lining (average 20% chrysotile by polarized light microscopy) and brake wear debris [average 0.49% chrysotile by transmission electron microscopy (TEM)] was also quantified. Breathing zone samples on the lapel of mechanics ($n = 44$) and area samples at bystander ($n = 34$), remote ($n = 22$), and ambient ($n = 12$) locations were collected during 12 brake changes and analyzed using phase contrast microscopy (PCM) [National Institute for Occupational Safety and Health (NIOSH) 7400] and TEM (NIOSH 7402). In addition, the fiber distribution by size and morphology were evaluated according to the International Organization for Standardization method for asbestos. Applying the ratio of asbestos fibers:total fibers (including non-asbestos) as determined by TEM to the PCM results, the average airborne chrysotile concentrations (PCM equivalent) were 0.024 f/cc for the mechanic and 0.009 f/cc for persons standing 1.2–3.1 m from the activity during the period of exposure (~0.5 to 1 h). Considering the time involved in the activity, and assuming three brake jobs per shift, these results would convert to an average 8-h time-weighted average of 0.009 f/cc for a mechanic and 0.006 f/cc for a bystander. The results indicate that (i) the airborne concentrations for worker and bystander samples were significantly less than the current occupational exposure limit of 0.1 f/cc; (ii) ~2% of respirable fibers were >20 μm in length; and (iii) ~95% of chrysotile in the brake linings degraded in the friction process. The industrial hygiene data presented here should be useful for conducting retrospective and current exposure assessments of individuals, as well as hazard assessments of work activities that involve repairing and replacing asbestos-containing brakes in heavy construction equipment.

Keywords. asbestos • brakes • heavy equipment • industrial hygiene