Inter Office Communication

Scientific Research Staff
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Subject: Preliminary Estimate of Airborne Asbestos Emissions from Brake Linings

Some experiments have been performed with the objective of assessing the quantity of asbestos fiber emitted to the atmosphere during automobile braking. A production Pinto disc brake assembly was used in the study. Samples of the lining wear dust were obtained during the lining burnish (break-in), during typical usage conditions (40 mph stops at 1/4 G deceleration and 350°F rotor temperature), and during abnormally severe usage conditions (~ 800° F rotor temperature). Only samples from the typical usage test have been examined to date. During these tests, the air flow over the brake, wheel and tire assembly was carefully matched to vehicle use conditions. For the typical usage test, all of the air flow from the brake was exhausted through a sampling grid network where multiple-stop samples were taken isokinetically at each grid center using a 0.45 micron Millipore filter. A matching filter was used to sample the air supplied to the brake. The quantity of asbestos fiber collected on the filters is in the process of being determined by electron microscope examination, using a fiber counting technique developed in the laboratory of Dr. I. J. Selikoff, et al., at the Mt. Sinai School of Medicine in New York. This procedure was developed specifically for the determination of asbestos content from atmospheric samples.

The filter examination experiments are not yet completed. Further replication of the fiber count remains to be done on the typical usage filters to obtain the precision of measurement desired. Appropriate quantitative reference samples have not yet been prepared and counted -- this obtains an estimate of actual asbestos fiber count required a reliance on Mt. Sinai laboratory experience to estimate asbestos losses from the samples during sample preparation. Nevertheless, a preliminary estimate may be made of the amount of asbestos fiber collected based on fiber counts made to date. Examination of these measurements indicates that asbestos fiber probably comprises less than 0.02% of the airborne wear dust and may be as low as 0.004% for typical brake usage. Expressed in terms of the amount of brake lining worn away, it appears that less than 0.01%, and perhaps as little as

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0.002% of the worn lining becomes airborne asbestos fibers.

The range of estimates results from the inherent difficulty of accurately measuring small quantities of such fine fibers (300 Å diameter) and from the relative similarity of asbestos count from the background and test filter samples. For example, the test filter from the typical usage test collected approximately 14.5×10^{-9} grams of asbestos fiber per cubic meter of air sampled downwind of the brake, while the corresponding background filter collected about 13.5×10^{-9} grams per cubic meter of air supplied to the brake. Our records reveal that asbestos insulation had been used on a steam pipe in the dynamometer area about a week prior to our tests and that other asbestos insulation was installed elsewhere in the building at the same time. This may account for the relatively high background level of asbestos, which is at the upper end of the range measured by the Mt. Sinai laboratory in the ambient air of the Detroit area (0.5 to 13.4×10^{-9} grams per cubic meter). The report of their findings has not yet been published.

In conclusion, although only preliminary results are available at this time, the concentration of asbestos in the effluent air from a Pinto disc brake undergoing typical brake usage appears to be less than 0.01% of the brake lining worn away. The lining was found to contain about 42% asbestos, hence the airborne asbestos collected was less than 0.03% of the original asbestos content.

Our laboratory studies have shown that all visible asbestos fibers at an active rubbing interface are heated to incandescence at typical braking velocities. The glow temperature (approximately 1450°F) is more than sufficient to decompose the asbestos to a nonfibrous form. This probably explains the extremely low amount of fibrous asbestos emitted from the brake.

The amount of fibrous asbestos remaining within the confines of the brake and wheel assembly was not determined in this experiment.

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