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Asbestos Emissions from Brake Dynamometer Tests

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ASBESTOS HAS BEEN A MAJOR constituent of automotive friction materials for more than 50 years. It is used to impart strength, flexibility, and heat resistance to a brake lining and to enhance friction and wear properties. Most present brake linings use resin or rubber binders and chrysotile asbestos, together with organic and inorganic friction modifiers and fillers. The asbestos content varies with formulation, from a low of 25% to about 65% by weight. Minimum asbestos levels are found in some high performance European disc brake linings which are highly filled with metals and inorganic constituents. Brake linings in the United States average about 50% asbestos content.

Of a total United States annual asbestos consumption of 800,000 tons (730 Mkg), about 28,000 tons (25 Mkg) of chrysotile asbestos are purchased annually for friction materials of all types (1)*. (Ref. 9 suggests 59,000 tons (53 Mkg) is more correct.) Of this, it has been calculated that brake lining wear consumes about 12,000 tons (11 Mkg) of asbestos per year. Roughly an equal amount remains on brake shoes at the time of replacement or is manufacturing wastage.

*Numbers in parentheses designate References at end of paper.

Recent tests have shown that densely populated urban atmospheres often contain significantly higher asbestos concentrations than surrounding areas (2). Background asbestos levels in the atmosphere result from the natural weathering of asbestos-bearing rock and soil, as well as from mining, farming, and excavating. The generally higher urban concentrations suggest commercial and industrial sources. Brake lining and clutch facing wear was suggested by Thomson (3) as a possible source for higher asbestos levels in the urban atmosphere.

Lynch (4), in a study undertaken by the Public Health Service, reported the findings of several brake dynamometer and friction machine tests in which wear debris was trapped on a filter and subsequently examined by means of a transmission electron microscope (TEM). He concluded that "free fibers from brake lining wear seem to be an inconsequential health factor in urban air pollution." Lynch detected no free fiber from an automobile clutch and a bus drum brake, but some free fibers were found in one test of an experimental disc brake.

With mounting concern over air quality in general, and asbestos pollution in particular, this study was initiated in 1970 to provide additional data on the asbestos emissions from disc brakes.

ABSTRACT

Dynamometer tests of a production disc brake provided new information on asbestos fiber emissions during break-in, normal use, and high temperature use conditions. Both ambient air and brake cooling air were sampled isokinetically, using 0.45 μm filters. Examination of test and background filters required a clarification process to maximize fiber detectability, the use of transmission electron microscopy (at 40,000X) for detection, and electron diffraction for positive identification of asbestos fibers. Most of the lining asbestos was found to be converted to a nonfibrous material by the high flash temperatures of the braking surface. Less than 0.02% of the lining wear was released as asbestos fibers. The concentration of asbestos fibers in the urban atmosphere, due to brake usage, was conservatively estimated at less than 0.07×10^{-9} g/m^3. Based on this upper bound, the use of brakes was judged to be not significant as a source of atmospheric asbestos.