LEGAL AND REGULATORY IMPLICATIONS OF BRAKE LINING SUBSTITUTES *

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INTRODUCTION

The floodgate of litigation concering the dangers of exposure to asbestos has evoked world-wide concern regarding its myriad uses. Asbestos has been used extensively in the manufacture of brake linings. The public concern over exposure to asbestos-containing products has coerced many brake lining manufacturers into producing asbestos-free brake linings. This paper will address many of the issues presented be the current controversy over asbestos brake lining. Unfortunately, little is known about the asbestos substitutes currently being used in the manufacture of brake linings; therefore, no definitive answer can be reached until adequate research has been completed regarding these substitute products.

ASBESTOS GENERALLY

Asbestos is a generic term given to various groups of naturally occurring mineral silicate fibres. The names of these fibres are as follows : chrysotile, a fibrous serpentine, and actinolite, amosite, anthophyllite, crocidolite and tremolite, fibrous amphilboles(1)

Asbestos, the "magic mineral", has tremendous resiliency to heat and acid. Because of its resiliency, asbestos has over three thousand uses(2). Although asbestos has been used for thousands of years, the commercial use of asbestos dates only from the late 1800s to the present.

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(1) Castleman and Fritsch, Asbestos And You, 1974 Center for Science in the Public Interest (2d. Ed. Apr. 1974)

(2) Theodore and Selikoff, Asbestos fibres In Human Lung, Forensic Significance, The Amer. Jour. of Forensic Medecine and Pathology, Vol. 2, No.1 (March, 1981).

An important class of asbestos-containing products are the friction materials which are commonly used in brake linings. Friction material is composed of chrysotile asbestos fibre, by far most abundant form of asbestos[3] It is estimated that the level of chrysotile in friction material is approximately fifty percent[4].

CARCINOGENIC EFFECT

The commercial forms of asbestos, when tested in mice, hamsters, rats and rabbits, have all been found to be carcinogenic[5]. In humans, occupational exposure from chrysotile, amosite, anthophyllite, and mixed fibres containing crocidolite has been associated with an increased incidence of lung cancer[6]. Mesothelioma (a rare, malignant tumor of the mesothelial linings of the body, most commonly involving the peritoneal linings of the abdomen and pleural linings of the lung) has been observed in humans following occupational exposure to crocidolite, amosite and chrysotile[7].

Mesothelioma has also been diagnosed in people who did not work with asbestos but lived near factories, crocidolite mines or had daily household contact with an asbestos worker[8]. There is controversy over whether exposure to asbestos increases the incidence of gastrointestinal cancer[9]. An increase in cancer of larynx and esophagus has been associated with asbestos exposure[10]. Whether asbestos exposure is the sole cause or one of many contributing factors to the development of cancer is not known.

ASBESTOS AND THE BRAKE REPAIR WORKER

Until recently, the presence of asbestos-related illnesses in brake repair workers attracted little, if any attention. Asbestos-related illnesses have been reported in cases involving factory workers who manufactured asbestos brake linings and garage workers engaged in the repair, maintenance and

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(3) Castleman, Camarota, Fritsch, Mazzocchi and Crowley, The Hazards Of Asbestos For Brake Mechanics, Public Health Reports, Vol. 90, No.3 May-June 1975 (Ninety-five percent of world's asbestos production is chrysotile).
(4) Rohl, Langer, Klimentidis, Wolf, Selikoff, Asbestos Content Of Dust Encountered In Brake Maintenance And Repair, Prol. Foy. Soc. Med., Vol. 70 (Jan. 1977)
(5) IRC Monographs On The Evaluation Of Carcinogenic Risks of Chemicals to Man, Asbestos, Vol. 14.
(6) Id.
(7) Id
(8) Id
(9) Id
(10) Id

installation of brake linings in automobiles and trucks(11). In the U.S., a case of asbestosis in a brakeline worker was reported in 1940(12). The British Industrial Injuries Act of 1948 recognized asbestosis as a disease common to brakeline workers(13). Among brakeline workers, the asbestos-related illnesses initially recorded were generally confined to workers who manufactured and fabricated friction materials which contained asbestos. Subsequently, reports of lung cancer and mesothelioma were recorded for workers who simply installed or repaired friction materials(14). There was little concern regarding exposure to brakeline workers since it was believed that the asbestos fibres remained locked in the brakelining matrix or were decomposed by the heat generated from the brakes(15). Light microscopy initially indicated that dust remaining in brake drums was asbestos-free(16). Subsequent tests revealed that sub-microscopic chrysotile fibres were present in the drum dust(17). These later studies also showed that unaltered chrysotile fibres were released in the bevelling, refurbishing and refitting of brake pads; therefore, there was ample opportunity during brake maintenance and repair for brake workers to be exposed to chrysotile fibres in the drum debris(18). Additionnal studies showed that brakeline workers were also exposed to unaltered chrysotile fibres when machining brake parts(19)

It is estimated that at least 900,000 United States citizens are currently employed as auto mechanics or garage workers and, therefore, exposed to asbestos brake linings(20). It is also speculated that the asbestos released from brakes during normal automobile use may contribute to the presence of asbestos fibres in the air(21). The amount of brake material worn away from brake linings each year is a staggering ninety million pounds(22). Eighty to ninety

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(11) See, e.g., Mancuso, (1963) Methodology of Industrial Health Studies: The Cohort Approach With Special Reference To An Asbestos Compagny, Arch Environ Health 6, 210-226 (4 Peritoneal Mesotheliomas); Newhouse and Thomson, (1965): Mesothelioma of Pleura and Peritoneum Following Exposure To Asbestos In The London Area, B.R. J. Med. 22:261-269; Lorimer, Rohl, Miller, Nicholson and Selikoff, (1976): Asbestos Exposure Of Brake Repair Workers In The United States, Mt. Sinai Journal of Medicine (N.Y.) 43(3): 207-218 (twenty percent (18) of experienced vehicular maintenance workers studied showed x-ray findings consistent with asbestosis while six percent (5) had pleural thickening or calcification; Mancuso, Mesothelioma Among Machinists And Railroad And Other Industries, Amer. Jour. Of Ind. Med., 4:501-513 (1983)

(12) Mesothelioma In a Brake Repair Worker, The Lancet (Nov. 13, 1982).

(13) Id.

(14) Id.

(15) Id.

(16) Id.

(17) Id.

(18) Id.

(19) Id.

(20) Lorimer, Rohl, Miller, Nicholson and Selikoff, Asbestos-Exposure of Brake Repair Workers In The U.S., The Mt Sinai Journal of Medicine, Vol 43, No. 3 (May-June, (1976).

(21) Id.

(22) Id.

percent of this brake lining drops to the road or is emitted into the atmosphere[23].

If chrysotile has carcinogenic qualities, its use in the manufacture of brake linings presents three potentially dangerous situations: (1) Exposure to factory workers who manufacture friction materials; (2) Exposure to mechanics who repair or replace brake linings; and (3) Exposure to the general population when asbestos is released into the air.[24]

Notwithstanding the statistical data noted above, considerable controversy remains regarding the carcinogenic effects of the various forms of asbestos[25]. It is generally agreed that amphibole asbestos forms (predominantly amosite and crocidolite) play some unknown role in the development of mesothelioma[26]. From statistical data, it appears that crocidolite is the most dangerous of the amphiboles[27]. There is considerable thought among the medical community that exposure to chrysotile asbestos from brake linings has no harmful effect[28]. To date, there has been no recorded case of occupational mesothelioma where chrysotile ore components only were found in the lung tissue[29]. The cases implicating chrysotile also noted the presence of crocidolite and amosite components in the lung tissue[30]. There is evidence that certain amphiboles, more specifically, tremolite, actinolite, and anthophyllite, contaminants of chrysotile ore, may play some role in the development of mesothelioma; therefore, contaminants of chrysotile and not chrysotile itself may be the carcinogenic elements responsible for the development of cancer in humans[31].

The amount of chrysotile asbestos emitted from brake linings into the atmosphere is extremely small when compared to other asbestos sources[32]. Although brake linings are composed of at least fifty percent asbestos, the asbestos particles emitted during braking are only composed of .029 percent asbestos[33]. The remaining asbestos fibres are decomposed during the braking

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(23) Id.

(24) Ehrenreich and Selikoff, Environmental-Occupational Diseases, The American Journal of Forensic Medicine and Pathology, Vol.2, No.1 (1981).

(25) Churg, Wiggs, Depaoli, Kampe and Stevens, Lung Asbestos Contact In Chrysotile Workers With Mesothelioma, Offic. Jour. of Amer. Thoracic Society, Vol.130, No.6 (Dec. 1984).

(26) Id.

(27) Id.

(28) Id.

(29) Id.

(30) Id

(31) Id.

(32) Muhlbaier and Williams, Characterization of Asbestos Emissions From Brakes, Environmental Science Department, General Motors Research Laboratories.

(33) Id.

process[34].Recent atmospheric samples taken downwind of freeways showed no significant increase in asbestos over upwind atmospheric samples[35]. Despite the low asbestos emissions from braking, some studies have shown that areas near the roadways and toll booths have higher levels of asbestos in the atmosphere; and the roadway debris near roadways and toll booths also exhibits a higher level of asbestos[36]. The statistics indicate that the excessive asbestos level near toll booths is probably the result of increased braking[37].

ALTERNATIVES TO ASBESTOS CONTAINING FRICTION MATERIALS

Faced with the statistical data regarding potential hazards from the use of asbestos in brake linings, the feasibility of alternatives to the use of chrysotile asbestos in brake linings is being explored. The replacement of chrysotile asbestos with asbestos-free friction materials presents many complications. The replacement materials must be sufficient to withstand the wear and tear imposed upon brake lining. It is readily apparent that substitution of improper friction materials in new vehicles or in after-market vehicles poses a tremendous safety threat. Currently, no required performance test for after-market friction materials exists since most after-market non-asbestos material suppliers do not have facilities capable of properly evaluating their asbestos-free materials[38].

The essential requirement of any braking system is the ability to provide a controlled deceleration[39]. A vehicle must have the ability to be decelerated rapidly with control since most emergency situations do not allow much time for reaction[40]. The vehicle's response to the driver's braking must be predictable[41]. The effectiveness of a braking system is strongly influenced by the effectiveness of the frictional properties in the lining material[42]. Unfortunately, after-market friction materials from the various manufacturers exhibit much diversity in friction characteristics[43].

The most significant factors affecting proper braking are wear and thermal distortion[44]. Wear shifts the center of the pressure location; therefore,

(34) Id.
(35) Id.
(36) Id.
(37) Id.
(38) Final Report On Analysis Of The Feasibility Of Replacing Asbestos In Automobile And Truck Brakes, The American Society of Mechanical Engineers, EPA (April 15, 1987).
(39) Id. at 13.
(40) Id. at 16.
(41) Id.
(42) Id. at 18.
(43) Id.
(44) Id. at 21.

asbestos-free friction materials with wear rates different from asbestos friction materials might decrease stability by changing the center of pressure[45]. This shift in the center of pressure might lead to a reduction in brake effectiveness or an increase in brake effectiveness which might lead to a wheel lock-up[46].

The various forces generated during braking cause stress to the brake components and also the vehicle-associated components such as axles and suspension elements[47]. These stresses can promote fractures or fatigue failures which might result in dangerous operating conditions[48]. Generally, friction materials are attached to the brake shoe by the use of riveting, bonding or integral molding[49]. Asbestos-free linings are generally stiffer than asbestos linings and are generally anistropic (sensitive to orientation)[50]. It is also believed that the asbestos-free fibres (fibreglass, aramid fibre (Kevlar), steel wool and wollastonite) create more noise than their asbestos-counterparts since they are single solid elements as opposed to the multi-strand make-up of asbestos friction materials[51]. It is believed that the strand like appearance of asbestos provides an inherent dampening of the vibration and noise[52].

(a) **Asbestos Lining** — For approximately the last eighty years, chrysotile asbestos has been a critical component in friction materials, and its characteristics are well known[53]. Chrysotile is the perfect element for friction materials since it offers a combination of physical, mechanical, thermal, tribological, processing and economic attributes[54]. Generally, two or more grades of chrysotile asbestos are blended together to produce the desired effects in the brake lining[55]. The vast majority of non-asbestos friction materials combine a blend from several hundred potential fibre and structural agents[56]. Basically, the non-asbestos friction materials represent a "fibre cocktail" that has been assembled to provide the necessary attributes for the brake lining while maintaining an acceptable cost level[57].

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(45) Id.
(46) Id.
(47) Id. at 23.
(48) Id.
(49) Id. at 24.
(50) Id.
(51) Id.
(52) Id.
(53) Id. at 53.
(54) Id. at 54.
(55) Id.
(56) Id.
(57) Id.

(b) Asbestos-Free Brake Lining — Unlike the impressive history behind the use of chrysotile asbestos in friction materials, the use of non-asbestos friction materials has a scant twenty-year history; the vast majority of research conducted on these materials was done in the last ten years[58].

The asbestos-free friction materials have four developmental classes: Non-Asbestos Organic, Semi-Metallic, Sintered Metallic and Carbon-Carbon[59].

The **Semi-Metallic** and Resin Bonded Metallic friction materials utilize steel wool, iron powder, graphite, binder resin and other ingredients in their formulations[60]. The Semi-Metallics have been used for disc brake linings on passenger cars and light trucks for approximately ten years[61]. Semi-Metallics are the most common friction material used with disc brakes in the United States[62]. Unfortunately, at present, Semi-Metallic Linings have little usage in heavy truck drum and disc brakes[63]. Although water has little effect on Semi-Metallic friction materials, water combined with oil tends to reduce the friction potential of these materials[64]. Road water generally contains some oil; therefore, there is a potential danger of loss of friction if excessive road water splashes on these linings during operation of the vehicle[65]. Cool and humid air conditions also cause a temporarily low brake effectiveness in Semi-Metallic Linings[66].

The **Non-Asbestos Organic** Friction Materials are composed of fibres and other ingredients. Aramid, fibreglass, mineral wool, wollastonite, steel wool, and processed mineral fibre are among the reinforcement fibres used with binder resin and other fillers and friction modifiers in these brake linings[67]. Non-Asbestos Organic Materials are currently used for passenger cars and light trucks and are becoming increasingly popular in brake blocks on heavy truck drum brakes[68].

One drawback to the use of the Non-Asbestos Organic Friction Materials is that hundreds of fibres and reinforcing agents are available and generally used

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(58) Id. at 56.
(59) Id.
(60) Id. at 57.
(61) Id.
(62) Id.
(63) Id.
(64) Id. at 58.
(65) Id.
(66) Id
(67) Id.
(68) Id.

in combination with each other[69]. It is difficult to determine the best combination for the lining process, friction level, friction stability, wear life, fade resistance, recovery, contamination sensitivity, and mechanical properties since there is essentially no technical communication or cooperation among the various lining manufacturers, each working independently of the other[70]. At present, the Non-Asbestos Organic Friction Materials tend to be hard, brittle, low in permeability, highly anistropic, and prone to hot spot, blister and crack; therefore, there is some question as to their effectiveness[71]. Although Non-Asbestos Organic Friction Materials may someday prove to be more effective than asbestos-containing friction materials, this day will not be realized until additional research is completed on these materials.

Sintered Metallic Friction Materials contain an iron or copper base with inorganic filler and friction modifiers[72]. These friction materials have been used extensively in heavy duty brakes and clutches for approximately thirty years[73]. These materials are environmentally sensitive and cause severe galvanic corrosion in moist environments if the typical cast-iron counter surface material is also used[74]. Sintered Metallic Friction Materials are very expensive in addition to their extreme sensitivity to environmental conditions[75].

Carbon-Carbon Friction Materials are space-age components of carbon fibre held in a matrix of morphous carbon[76]. This material is very costly and is extremely difficult to manufacture[77]. Military aircraft, race cars and commercial aircraft use these materials for both stationary and rotating elements in disc brakes[78]. Unfortunately, the high cost of manufacturing and extreme environmental sensitivity give Carbon-Carbon Friction Materials limited use[79].

HAZARDS FROM REPLACEMENT

Many automobile and truck manufacturers contend that vehicle safety may be compromised if vehicle tested friction products containing asbestos are

(69) Id. at 59.
(70) Id.
(71) Id.
(72) Id.
(73) Id.
(74) Id. at 60.
(75) Id.
(76) Id.
(77) Id.
(78) Id.
(79) Id.

replaced with untested asbestos-free friction products[80]. Whether on new vehicles or after-market vehicles, asbestos-free friction materials must be capable of providing friction levels and friction stability to achieve proper braking performance[81].

Section 570 of the Code of Federal Regulations was promulgated to insure, among other things, safe braking performance standards under normal and emergency braking conditions for vehicles which are currently in use[82]. Section 571 of the Code of Federal Regulations was promulgated to insure, among other things, safe braking performance standards under normal and emergency braking conditions for motor vehicles and motor vehicle equipment[83]. Each of these sections prescribes stringent performance standards which braking systems should meet[84].

As indicated *supra,* many of the asbestos substitutes currently proffered by the various manufacturers may perform satisfactorily for a short time but then begin to disintegrate due to the friction placed upon them by constant braking. Unfortunately, the tests prescibed by Sections 570 and 571 measure the braking system's performance at a given time and simply measure the overall performance of the braking system[85]. The performance of the individual components of the braking system, including, but not limited to, brake lining, is not analysed[86]. It is quite possible that the overall braking system might be satisfactory at one point in time, but then became unsatisfactory after potentially inferior asbestos-free substitutes become worn away by constant braking. In any event, it is readily apparent that the asbestos-free substitutes may not measure up to the stringent requirements necessary to provide a safe and efficient braking system. At present, there is not enough information regarding the capabilities of these substitutes.

Although the prescriptions of Section 570 apply to the vehicle owner and the prescriptions of Section 571 apply to the manufacturers of motor vehicles and motor vehicle equipment, prudent owners and manufacturers will require competent evidence that individual components used to construct the braking system are safe and effective. Once manufacturers of the asbestos-free substitutes warrant that their products are fit for the purpose intended, they will be subject to liability if theses products are unable to handle the task.

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(80) Id. at 85.
(81) See 49 C.F.R. §§ 570 et seq., 571 et seq. (1986).
(82) 49 C.F.R. § 570, et seq. (1986).
(83) 49 C.F.R. § 570, et seq. (1986).
(84) 49 C.F.R. §§ 570, et seq., 571, et seq. (1986).
(85) Id.
(86) Id.

Without uniform standards, the manufacturers of asbestos-free friction materials face an incalculable risk of liability. If the substitute products are not suitable for braking systems, the litigation resulting against the manufacturers of these products will be staggering. At present, little research has been completed regarding the ability of the substitute products to withstand the tremendous friction placed upon them by constant braking. Furthermore, the various manufacturers of these substitute products conduct their research independently; therefore, there is no uniformity among the manufacturers regarding the quality of these substitute products. It is suggested that the manufacturers of these substitute products pool their existing knowledge concerning safety standards. Without guidelines to follow, many manufacturers will produce an inferior product which will subject them to liability from myriad claimants.

Another issue presented is whether the asbestos-free friction material used to replace asbestos-containing friction material will have harmful effects on those exposed to it. Unfortunately, the Environmental Protection Agency has no regulations regarding the safety of asbestos-free substitutes. Reports of increased lung cancer among mineral wool factory workers and glass fibre workers are prevalent and there is also concern regarding the effect of exposure to ceramic fibres, for which the health data is sparse(87). Any small, inhalable fibre can lodge in the human lungs. Glass-fibre and other insulation products have been shown to cause skin rashes and respiratory irritation(88). Many of the proposed replacement materials share a potentially fatal trait with asbestos, they contain fibres which can be inhaled and become lodged in the human lungs. For example, the United States Navy recently banned shipboard use of ceramic fibres after animal studies suggested that ceramic fibres produced cancerous tumors in animals(89). In a 1986 study by Brown-Ferris Industries, a Houston based waste-management company, printed in The Wall Street Journal on Tuesday, May 12, 1987, it was stated that ceramic fibres used to line industrial furnaces break down into cristobalite, a form af silica, which is linked to silicosis (lung disorder caused by continued, long term inhalation of dust from inorganic compounds)(90).

It stands to reason that many of these substitute materials may be hazardous to humans when they are exposed to these materials. At present, there is no way to ascertain the latency period between exposure to any of these products and the resulting harm. As shown by the tidal wave of litigation regarding exposure to asbestos-containing products and research regarding potentially harmful effects of asbestos exposure, the latency period between exposure to asbestos and any harm resulting therefrom may be as great as 40 years. It is not

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(87) Meier, Insulation Peril? Health Studies Suggest Asbestos Substitutes Also Pose Cancer risk, The Wall St. J., (May 12, 1987).

(88) Id.

(89) Id.

(90) Id.; See Supra Note 87.

unlikely that substitute products, if indeed harmful, may also have latency periods equalling, if not exceeding 40 years. To market these substitute products without adequate research is simply an invitation to future litigation which is likely to bring about the financial death of many manufacturers of these substitute products.

Conclusion

The number of asbestos cases currently filed in the United States is staggering. These cases range from personal injury lawsuits to property damage lawsuits. At present, there is no proven substitute for asbestos-containing friction materials. The use of asbestos-free friction materials will undoubtedly lead to lawsuits against countless parties if, indeed, theses untested materials are unable to withstand the pressure generated by constant braking. With the number of fatalities annually resulting from driver negligence alone, it is ludicrous to suggest that potentially inferior brake lining should be placed into the market. The end result of this action would be more collisions and increased fatalities.

Until recent times, it was not known that asbestos posed a serious health risk to those exposed. The same can be said for the asbestos-free products which are currently being proffered as replacements to the asbestos friction materials. Studies already suggest that exposure to some of these replacement products causes cancer in laboratory animals. At present, the only valid evidence suggesting that chrysotile asbestos may be hazardous to humans is that chrysotile causes cancer in laboratory animals. In today's litigious society, it stands to reason that the manufacturers of these untested asbestos free friction materials stand to lose far more than they might possibly gain if, indeed, these friction products prove to be improper for the task presented.

Research in the dilemma of the replacement of asbestos containing friction materials with asbestos-free friction materials is in its earliest stages. Additional research is needed to determine whether asbestos-free materials will provide adequate braking control and whether exposure to these products will be safe for humans. Research regarding possible dangers to humans from exposure to chrysotile must also be continued. Presently, it is not known whether the asbestos-free friction materials will provide a safe alternative to asbestos-containing friction materials; therefore, the more prudent course is to fund additional research to answer this question. Replacement of asbestos-containing friction materials with the asbestos-free friction materials, at this time, will simply be replacing one unknown with another. Replacement may pose a far greater health risk than that presumably present with the use of the asbestos-containing friction materials, thereby resulting in floodgates of litigation which can probably be avoided with adequate research and development of proper substitutes.