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General Motors Corporation

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Ms. Margaret Stasikowski
Director of Chemical Control Division
Office of Toxic Substances
U. S. Environmental Protection Agency
401 "M" Street, S.W., Room E-513
Washington, DC 20460

Reference: OPTS-211015

Dear Ms. Stasikowski:

Attached is the General Motors Corporation (GM) statement on the referenced matter: Asbestos; Response to Citizens' Petition.

Since the issue of asbestos substitutes in motor vehicle brake systems is highly complex, technical representatives from General Motors would be pleased to meet with the Agency's technical work group to discuss the issue in detail. Please contact me at GM's Washington, D.C. office or call (202) 775-5082, to arrange such a meeting.

Thank you for the opportunity to comment on this issue.

Sincerely,

William C. Chapman

William C. Chapman

Att.

cc: Public Information Officer (TS-793)
OPTS-211015

General Motors Corporation
Statement on
Asbestos in Brake Systems
April 17, 1985

INTRODUCTION

"Asbestos" is a generic name used to describe several naturally occurring minerals which have a similar fibrous crystal habit but not necessarily the same crystal structure or chemical composition. Since there is a definite chemical and crystallographic difference between the minerals, there are significant differences in their toxicological properties.

Standards for the protection of workers' health from asbestos promulgated by most other industrialized nations, including members of the European Economic Community and Canada, recognize the differences in toxicity between the various minerals comprising the substances generally called "asbestos." This is not true in the U.S.

Of those that have economic importance, chrysotile is the mineral form shown by scientific studies to be the least toxic of the asbestos family. Attached to this statement is a document submitted to the Occupational Safety and Health Administration by the Motor Vehicle Manufacturers Association of the United States, in May of 1984, which discusses the toxicological differences between the various types of asbestos.

Chrysotile is the only form of asbestos used by GM in vehicle and automotive brake production.

DISCUSSION OF FRICTION MATERIALS AND BRAKES

Scientific studies have shown that the decomposition products of chrysotile subjected to the high temperatures and pressures of brake applications are, for the most part, not fibrous, i.e., not asbestos. See references cited on page 7. This distinction is significant for auto mechanics who reline brakes and who use improper methods which create airborne dust. They are thus exposed to dust which, except for less than one percent, is not in a fibrous form. The quantity of remaining fibres is minimal (less than one percent) and is non-hazardous (submicron size) so that for the time it routinely takes to complete brake service operations it does not present a significant or unacceptable health risk.

Chrysotile possesses both primary and secondary properties which make the mineral well suited for use in motor vehicle brakes. The primary properties are related to the characteristics of the mineral itself. These include, for example, high coefficient of friction, thermal stability, and resistance to chemical attack. Secondary properties are more closely related to how the fibre-containing mixture behaves during use. Examples of secondary properties are flexing, bulking, and dispersive characteristics.

BRAKE SYSTEMS

The function of a brake system is to slow, stop, and hold a vehicle stationary. In general, brake systems operate by pressing stationary friction elements against a rotating drum or disc. The friction generated at the contact interface converts the kinetic energy of the moving vehicle to heat which is then dissipated to the atmosphere.

Most motor vehicle brake systems have certain elements in common:

- Metal drums or discs attached to the rolling wheels;
- Devices (i.e., caliper or wheel cylinder pistons) for pressing the stationary friction elements (or linings) against the rotating drum or disc;
- A linkage system (i.e., mechanical, pneumatic, or hydraulic) to transfer inputs from the driver to the caliper or wheel cylinder pistons.

In the United States and many other nations, motor vehicle braking systems are required by law to meet certain performance standards including: stopping distance from several different speeds using both new and burnished brakes on both fully and lightly loaded vehicles; fade resistance and recovery; hill holding capability; and water recovery. All vehicle brakes must also meet partial system performance requirements which assure the ability to stop within prescribed limits should part of the system fail to operate for any reason.

In addition to these legal requirements, brake design must meet the rigorous demands of customer expectations. They must be long lasting; they must not be noisy; they must not be "grabby" or create vibrations during stops; and they must provide adequate performance when subjected to certain levels of abusive driving, such as what might be encountered during mountain descents.

Engineers also impose technical requirements on brake linings in an effort to avoid failure in use and minimize warranty costs and customer dissatisfaction. These requirements include compatibility with drums and discs, structural strength, flexibility, freedom from swelling when subjected to high heat or moisture, low temperature performance, and reliability of attachment to backing material.

In general, chrysotile asbestos in combination with organic binders, fillers, and various other additives has been remarkably well suited as a brake lining friction material to meet all of the design objectives.

The search for better brake performance, however, has led the industry to use disc brakes on front wheels of most passenger cars and light trucks. Vehicle downsizing programs have also emphasized the need for higher performance in much smaller packages to realize weight and fuel economy savings. As a result of these demands, chrysotile based front disc brake lining materials were limited in their ability to meet the established design criteria in the more demanding environment created by the vehicle downsizing programs. The most significant limitation on the continued use of chrysotile linings for front disc brakes was its thermal, or heat capacity.

The disc brakes on some vehicles may encounter temperatures beyond the heat capacity of chrysotile based linings. The need for a friction material which could withstand these temperatures led to the development of a lining composed of metallic fibres in various binders, fillers and additives. These brake linings are called semi-metallic.

Today virtually all domestically built GM passenger cars and light trucks have front disc brakes with semi-metallic linings. Some medium and heavy trucks are equipped with disc brakes using semi-metallic linings and their use in these truck classes is expanding.

However, semi-metallic pads created a new set of problems for the brake designer, for example:

- They are more susceptible to corrosion.
- They can be noisy, particularly when hot.
- They are generally less effective on the first few cold stops.
- They are good heat conductors. As a result, in some brake configurations, the brake fluid can be vaporized by the intense heat generated during repeated hard braking. To help alleviate this, some semi-metallic pads include an asbestos backing which serves as a thermal insulator.
- They are more expensive than chrysotile linings.
- They are more difficult to manufacture than chrysotile linings.

Approximately nine years of production experience has resulted in solutions to most of these problems for front disc brake applications, but similar successes have not been accomplished on applications for rear drum brakes.

Since semi-metallic lining materials have successfully supplanted asbestos in disc brakes, there has been some hope that these materials could lead to the elimination of asbestos from vehicle brakes altogether. Thus far, attempts to develop drum brake linings using semi-metallic materials have had very limited success. One reason for limited success in this area is the relative inflexibility of semi-metallic linings.

The rear brake drum is a curved surface, so the rear brake shoe is curved to fit the drum. The flexible, resilient nature of chrysotile fibres in the brake lining mix allows the shoe to be fabricated and curved in an arc shape, as opposed to the flat configuration of a disc brake pad. Since the stresses on a lining are not equally distributed over the arc of the shoe, it is important that the shoe and lining remain flexible over their life. Attempts to develop drum linings from semi-metallic materials, which are less flexible than chrysotile, have often been set back by cracks that appear in the lining.

The challenges in developing passenger car non-asbestos drum brake linings are compounded in heavy duty truck brakes -- the brakes are larger, the energy dissipation requirements are greater, and the stresses on the lining are far more severe.

Although use of disc brakes on the rear for passenger cars and light trucks has the potential for asbestos elimination, rear disc brake usage has been limited by a number of factors. These include the fact that rear disc brakes are generally more expensive and heavier than drum brakes because both the mechanical and hydraulic mechanisms that apply force in a disc brake must apply higher forces than those required in a drum brake. Also, although a disc brake by itself is inherently self-adjusting, when it also functions as a parking brake (e.g., when used as a rear brake) an adjuster mechanism must be added. An additional problem is that rear disc brakes which perform the parking brake function, which relates to the entire mass of the vehicle, must be made large enough for this purpose. On some vehicles this may make them too effective for service brake applications for which only the rear mass is important. Furthermore, in a rear disc brake the higher forces required for parking brake applications can require more complicated and costly apply mechanisms, such as ratcheting foot brakes and more efficient cable systems. Another consideration is that when rear disc parking brakes are applied while hot, they are subject to loss of hill-holding capability when they cool down. Because of these factors, the likelihood of universal usage anytime in the immediate future is unrealistic, although GM is in the process of increasing usage of rear disc brakes.

The above difficulties notwithstanding, General Motors maintains strong programs to seek alternatives to asbestos in brakes, being careful to assure comparable or improved performance when substitutes are considered. One reason we are investigating alternatives is to find materials that will withstand high braking temperatures as well as asbestos. Most recently, a new generation of brake lining materials, known as "non-asbestos, non-metallic," has entered the testing programs. However, these linings contain materials for which there is very little information on their potential health effects. Future use of these materials must be contingent upon favorable results of extensive health studies, as well as tests for mechanical durability and performance.

Our statement has dealt with the issue of original equipment brake linings, but the Citizens' Petition also addressed the aftermarket issue. In the opinion of General Motors engineers, it is not a sound idea to substitute non-asbestos linings in a brake system designed for asbestos linings, and vice versa. Because of differences in the design and operating parameters between asbestos and non-asbestos brake linings, only service linings meeting the manufacturer's original equipment specifications should be used.

Some have suggested that non-asbestos lining can be used on older vehicles if the application system is altered to make it compatible with different materials. The engineers also advise against altering the vehicle brake system (such as changing proportioning valves or wheel cylinder sizes) in an attempt to make it compatible with a lining material for which it was not designed. Such alterations can result in unacceptable braking characteristics if the brake balance intended in the design is disturbed.

General Motors brake linings are pre-ground at the factory and need no additional grinding during installation as replacement linings. The packaging box containing the linings has a cautionary label indicating that the linings contain asbestos fibres, that the user should avoid creating dust, and that breathing asbestos dust may cause serious bodily harm. This warning is provided despite the fact, as explained previously, that chrysotile is the least toxic mineral of the asbestos family.

AVAILABILITY OF SUBSTITUTES

It has been alleged that for nearly all purposes, including motor vehicle brakes, asbestos substitutes are currently available on a commercial basis. This is a gross over-generalization and must be conditioned by product-specific and application-specific constraints.

In motor vehicles an asbestos-containing material or component is usually part of some larger system. For example, chrysotile-containing friction materials (brake linings) are part of the larger brake system, which includes many interconnected parts like the front discs and the hydraulic cylinders. Thus, the overall question of suitable asbestos substitutes must be addressed with a view to the performance of that total system, not just the performance of the asbestos-containing part. Direct substitution of some other fibre for chrysotile requires modification of the larger system. Therefore, a substantial research, design, and testing effort would be required before a substitute material could be released for full production. This effort is necessary even though there may be existing substitute materials for other, similar (but not identical) applications.

Within a total systems concept, substitution must be approached on a product-by-product, function-by-function basis long before a vehicle design is released for production tooling. Thus, substitute materials must be fully tested for performance in the vehicle. Safety, consumer acceptability, health, and environmental considerations all must be evaluated well before production can begin. When considering chrysotile substitutes an overriding consideration is that no material will be acceptable if it (1) compromises vehicle safety, (2) results in unacceptable vehicle performance, or (3) would result in an unacceptable public health hazard at expected levels of exposure.

Chrysotile offers a unique combination of properties in a single material. In spite of extensive research and development efforts to resolve the problems referred to previously, General Motors is not aware of any substitute material that matches adequately the properties of chrysotile for drum brake usage.

SUMMARY

Developing and approving acceptable substitute materials is a task requiring extensive research and testing programs. Potential substitute materials and component configurations must be evaluated for safety, durability and consumer acceptability over the wide range of environmental conditions under which motor vehicles operate.

The "ripple effects" of a substitution must also be investigated to be sure the performance of other vehicle components will not be adversely affected.

Redesigned braking systems using non-asbestos brake lining materials are in varying stages of development and testing. Some engineers predict that many of the non-asbestos systems can be brought on-line within a short--three to five year--time frame. However, many other engineers agree there are certain applications for which the prospects of finding acceptable chrysotile substitutes are not bright.

Any health risk from asbestos, even in the chrysotile form, <u>in factories where brakes (linings, etc.) are manufactured</u>, is controlled by requirements of the Occupational Safety & Health Administration (OSHA). Auto mechanics who reline brakes and take no steps to protect themselves from dust are exposed at most to a minimal quantity of asbestos, in a form and for such a brief period of time, that no significant health risk is presented. The general public sustains even less risk. Consequently, no threat to health which would justify EPA intervention seems evident.

Finally, we believe it would be unwise to mandate use of substitute materials, where the health effects of these materials are unknown. With respect to chrysotile, extensive use has demonstrated its acceptable performance under many conditions, and no significant threat to public health because of that use has been shown.

General Motors agrees with the Agency's plan to assemble data on, and review the current status of, substitutes for asbestos in motor vehicle brake systems. We also agree with the Agency's conclusion that current data do not support a finding of "unreasonable risk," justifying an immediate ban on use of asbestos in brakes.

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Attachment: "Motor Vehicle Manufacturers Association of the United States Comments on Proposed Asbestos Standard of the Occupational Safety and Health Administration," dated May 24, 1984.

References:

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(3) M. G. Jacko and R. T. DuCharme, "Brake Emissions: Emission Measurements from Brake and Clutch Linings frorm Selected Mobile Sources," Bendix Research Laboratories, Southfield, MI, Report 68-04-0020, March 1973

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