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MVMA INFORMATION BULLETIN

MOTOR VEHICLE MANUFACTURERS ASSOCIATION OF THE UNITED STATES INC • 300 NEW CENTER BUILDING • DETROIT MICHIGAN 48202 • [illegible] AREA [illegible]

PLAINTIFF'S EXHIBIT

FD-2080

May 21, 1984

TO: Engineering Policy Committee

FROM: Fred W. Bowditch, Secretary

SUBJECT: Discussion Paper on Asbestos

In response to the assignment the Engineering Policy Committee approved at its meeting of February 2, 1984, the Vehicle Engineering and Safety Standards Committee developed the discussion paper, "Alternatives to the Uses of Asbestos in Motor Vehicles" (copy attached). The paper has been provided to the MVMA Occupational Safety and Health Committee for inclusion with possible MVMA comments on the Occupational Safety and Health Administration rulemaking proposing further limitations on permissible levels of airborne asbestos fibers.

VESS recommends this discussion paper be filed with OSHA even if MVMA files no other comment on the Notice.

Further, we have asked the OSHC to advise VESS of the decision on the MVMA filing.

FWB:cr
Attachment
Copies to:
Occupational Safety and Health Committee
Vehicle Engineering and Safety Standards Committee (VESS)
Company Counsel

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ALTERNATIVES TO THE USES OF ASBESTOS IN MOTOR VEHICLES

DISCUSSION PAPER

MOTOR VEHICLE MANUFACTURERS ASSOCIATION
OF THE
UNITED STATES, INC.

- MAY, 1984 -

This report identifies applications for which asbestos has been or is used in motor vehicle systems and components and discusses the performance and customer acceptance criteria that led to the selection of asbestos for those applications. Alternative materials for those applications are examined in relation to selection criteria, vehicle design changes necessary to accommodate the substitution and the effect on vehicle performance including compliance with safety and other governmental regulations.

I. General Discussion

A. Characteristics of Asbestos and the Difficulties of Finding Acceptable Substitutes

The advantageous characteristics asbestos imparts to products used in the motor vehicle industry include:

- fire resistance
- thermal and chemical stability
- structural and flex strength
- moisture resistance
- dielectric strength
- low cost

There are few alternate materials which have the total combination of these desirable characteristics. Developing and approving acceptable substitute materials is a task requiring extensive research and testing programs. The many different potential substitute materials must be evaluated over the wide range of environmental conditions under which a motor vehicle operates. In addition, the "ripple effect" of a substitution must be investigated to be sure the performance of other vehicle components is not adversely affected. This is further complicated by the variety of materials used on our many different vehicles and the many customized applications.

B. Need for Systems Evaluation of Potential Substitutes

For the majority of current applications (other than brakes), many substitutes for asbestos may be available. This is a generalization and is conditioned by product- and application-specific constraints. In most cases, the asbestos-containing material was part of a larger system (e.g., asbestos head gaskets are a portion of the larger system, the engine). Thus the question of suitable substitutes must be approached on a total system basis. A direct substitution of some other fiber for asbestos is often not feasible without modification of a larger system. While substitutes exist, there is still a substantial research/design/testing effort required before substitute materials can be released for full production. Further, substitution must be approached on a product-by-product, function-by-function basis. In this way, the asbestos substitute can be fully evaluated for performance in the vehicle (including safety-related concerns and consumer acceptability). Health, safety and environmental factors related to substitute usage during vehicle manufacture must also be fully evaluated. MVMA cautions against inadequate consideration of all factors involved with a substitute material. A substitute which results in unacceptable vehicle performance or safety, or is more harmful than asbestos to workers, is an unacceptable substitute.

Asbestos offers a unique combination of properties in a single material. Not all of the properties can be matched with a single substitute, therefore, total system redesign may be required to achieve the desired result. For example, in electrical applications where a plastic with structural strength and a high dielectric constant are required, some substitutes which provide acceptable, but not identical, strength are weak electrical conductors. Other materials may be electrically non-conductive but do not possess the required strength. To meet all the requirements, that part must be redesigned to accommodate a different plastic composition and reinforcing material. Additionally, the reinforcing material must be chemically and physically compatable with the plastic

matrix. Ripple effects must also be considered, i.e., if the new part has a different size or shape, must other components or subassemblies be redesigned to accommodate the new part? Once a potential system is designed, it must be performance tested and, if the substitute meets the performance criteria mass production methods must be devised. All this necessitates a considerable design engineering and testing effort.

C. Status of Substitute Availability

- Clutch facing and automatic transmission applications -

Substitutes are available at reasonable cost; reported that conversion over next several years likely.

- Reinforced plastics -

Non-asbestos reinforced plastics are currently being used in several vehicle applications. Some problems with machining and forming the non-asbestos materials have been reported, however these appear to be relatively minor. For the majority of the reinforced plastics applications, non-asbestos substitutes do exist. It remains to select the proper material for a specific function and to perform the required product testing.

- Gasketing -

Several non-asbestos gasketing materials are currently available. The results of testing and evaluation reports are mixed for the various types of non-asbestos gaskets. For some applications, asbestos-containing gaskets have been replaced, e.g., room temperature vulcanizing (RTV) and chemical gaskets.

However, for some of the critical engine gaskets, fully acceptable substitutes have not yet been widely developed. These critical applications are second only to brakes as an example of the need for a total systems approach to substitution.

- Sealers, Adhesives and Acoustic Materials -

Although substitutes for asbestos-containing sealers, mastics, adhesives and underbody sprays are reportedly available, compromises are required in material properties when fiber substitutions are made. Problems were reported in the areas of material strength, sag resistance, material handling characteristics (flow and spread) and resistance to attack by hydrocarbons. Engineers report "disappointing" test results with many types of alternate binder materials. like sawdust, clays and glass fibers. Although substitutes may exist for these applications, product development work is still needed to provide fully acceptable materials for the motor vehicle industry.

- Brakes -

Vehicle manufacturers are virtually totally dependent upon brake and lining suppliers to develop, produce and initially screen new materials. The rate of development of these new materials is not only limited to available expertise, but to the laboratory and vehicle equipment as well as manpower at vendors. Until these materials are developed, the vehicle manufacturers can do little. Substitution will lead in disc brake pads. Drum brake linings for passenger cars and light trucks can probably be asbestos free in the next several years. Heavy truck drum brake systems however have as yet no practical asbestos alternative.

One of the primary applications for asbestos in our industry is brake lining materials. The suitability of brake linings to the great variety of cars, multipurpose passenger vehicles, light trucks, vans, medium and heavy duty trucks, tractors and buses requires extensive development. Brake systems are required to meet a variety of Federal and State regulatory requirements including FMVSS-121 (Air Brakes) and 105 (Hydraulic Brakes), BMCS regulations and various State laws.

In addition to the obvious need to stop the vehicle safely, each supplier and manufacturer has requirements which he deems to be important and must be met. Among these criteria are:

1. Acceptable lining life - Lining materials must provide the customer with acceptable lining life in the great variety of uses to which vehicles are put.

2. Acceptable drum and rotor life - Brake materials must be compatible with drums or rotors they contact and not cause excessive wear, grooving or cracking.

3. Structural strength - Linings must have sufficient strength to prevent cracking, chipping, flaking and delamination (shearing) in their various strenuous uses. The capability to tolerate flexure of its supporting elements is an essential requirement.

4. Green or preburnish performance - Linings must provide reasonable performance and stability when new.

5. Water recovery - Lining materials must be able to provide adequate performance when exposed to water and to recover to initial performance and stability within a short time.

6. Fade resistance - Linings must provide adequate performance and stability when subjected to high temperatures and then cooled. They should provide approximately their original ambient performance after being exposed to temperatures as high as 1200°F.

7. Parking capability - Linings must provide sufficient static retarding force to support grade holding demanded of the parking brake system.

8. Lining swell - Lining material must not swell at high temperatures or when exposed to moisture.

9. Performance consistency - Lining material performance must be relatively consistent over a wide range of temperatures and operational conditions.

10. Low temperature - Materials must provide acceptable performance and durability at low ambient temperatures and on the first daily brake application.

11. Lining attachment (to its support element) - Current methods may not be suitable for new materials. This interface could require additional development and testing.

In addition, the customer demands a number of things from brakes and linings, including:

1. Absence of noise - Noisy brakes and linings generate driver and community complaints and therefore cannot be tolerated.

2. Modulation and control - Drivers demand brakes and linings which provide performance and control with reasonable pedal efforts under all conditions of load and traction.

3. Lining and drum/rotor life - Customers demand long service life in a variety of vocational uses, environmental conditions, duty cycles, and geographical locations.

To meet all of these real needs and requirements is an extremely difficult, laborious task involving many development hours. Materials must be subjected to a great variety of test conditions. The problem is complicated further by the variety of brakes - both in size and type - that this industry uses in many different vehicles and customized applications.

Government regulations have further increased the need on heavy trucks to customize brakes and brake systems. Prior to FMVSS-121, manufacturers used one brake size and torque capacity for many axle capacities and applications. That practice has been curtailed by FMVSS 121's dynamometer requirement and the possibility of reimposed stopping distances as part of this regulation. FMVSS 105/75 subjects passenger car, MPV and light truck brake systems to severe duty cycles and temperatures which result in very rigorous demands on the brake lining materials.

Lining material selection involves trade-offs of many engineering, consumer and regulatory considerations. Governmental Regulatory agencies such as OSHA must realize that many differing materials will be required to replace the great variety of asbestos linings manufacturers currently use. There appear to be a few acceptable non-asbestos lining materials available today for disc brake pads and some passenger car drum brake linings. The processing of non-asbestos materials requires different manufacturing equipment and techniques because of clumping and chemistry changes, mixture speeds have to be varied and pressure changes made. It will take time to develop these techniques, controls and the machines to support industry volumes. However, the majority of disc pads used by vehicle manufacturers still incorporate an asbestos backing for reasons explained later in the General discussion on brake friction materials.

Brake components such as linings have high exposure in the safety compliance, recall and product liability areas. Therefore, vehicle manufacturers must be certain they are not correcting one problem and creating another. It should be pointed out that this was exactly the case with FMVSS-121. The performance levels and effective date mandated by that Standard generated the hasty development of components which were unacceptable to the consumer and which introduced new performance problems. If justification is found for a change of this magnitude, sufficient time must be provided to assure that existing linings will not be replaced with others the consumer will not accept.

Linings are a key factor in any brake design and asbestos is a key factor in many lining materials. If asbestos is eliminated from brake linings, manufacturers must retest and requalify every vehicle brake application they have, had or plan to have. There are more than five hundred brake and brake lining sizes*/ designed for vehicles still in use that must be serviced. It would be a monumental task with substantial economic involvement for service part suppliers to develop non-asbestos replacements for those applications.

D. Summary and Conclusions

For the majority of the asbestos applications in motor vehicles, acceptable substitute materials are in varying stages of development. It is possible that many substitutions, i.e., fillers and sealers, can be accomplished in the next few years. However, there are certain critical uses of asbestos for which finding acceptable substitutes will take considerably longer. These are heavy truck brake linings and engine preformed gaskets. These special applications will require system redesign to accommodate the properties of non-asbestos materials.

*/ See Friction Materials Standards Institute Automotive Data Book

II. Specific Vehicle Applications

A. Friction Products - Clutches

Discussion

Classifications are wet (as automatic transmission bands) and manual transmission clutches. Economical asbestos substitutes have been readily found for the wet clutch (paper), not especially asbestos property sensitive. Conversion to non-asbestos wet clutches is reported to range from complete to well underway.

As a rule, normal transmission clutch friction plates are purchased as part of a clutch assembly package from specialized suppliers. The vehicle engineer develops and tunes (engagement feel and damping) a clutch package with the supplier, then releases a performance specification fixing facing material source/compound and key operating characteristics accordingly. The specification defines wear rate, operating feel, etc. validated in development tests.

Clutch friction facings traditionally use heavy amounts of asbestos, although metallic and ceramic materials have long been available for heavy duty operations. Starting point is long fibers woven to cloth, slit in ribbons and helically wound into disc, resin coated and compression molded into flat friction facing. The face is then ground flat and square producing dust. Cost of non-asbestos facings have not been excessive, possibly because the long fiber textile grade asbestos is itself expensive.

Substitute Materials

Proprietary fiberglass and synthetics have been used. No trend is noted to ceramic or metallic facings.

Design/Performance Considerations

Wear, burst strength, smooth engagement and tendency of the facing material to adhere to the pressure plate are most prominent.

B. Friction Products - Brakes, Passenger Cars & Light Trucks

Discussion

Friction materials for automotive brakes are complex composites containing three general types of ingredient materials: reinforcing fibers; modifiers that adjust or maintain friction level, wear rate and noise properties; and organic resin binders. Historically, the foundation or major constituent of automotive friction materials has been asbestos fiber, so chosen because of thermal stability, friction level, reinforcing properties, availability and relatively low cost. Semi-metallic non-asbestos friction materials were originally developed to meet higher capacity and temperature requirements for heavy-duty and front wheel disc brakes. Disc brake systems using semi-metallic lining with asbestos backing are now successfully used for a wide range of vehicles. Passenger cars, light trucks and multi purpose passenger vehicles with completely non-asbestos brakes will require further development of non-asbestos drum brake shoes, a much more difficult set of design, materials and manufacturing problems that existed for disc pads. Substitution is expecially difficult for dual servo type drum brake systems which are predominant on rear wheel drive vehicles (because these systems require highly consistant friction coeficient for smooth application.

The vast majority of all hydraulic disc brake shoe and lining assemblies contain an asbestos backing material. The primary reasons are to minimize heat transfer and to aid in attachment of the lining to the metal shoe. Eliminating the asbestos backing material requires considerable development in order to maintain attachment strength and minimize heat transfer to the brake fluid.

Control of the various materials in a lining is critical. Wear problems are currently being encountered due to impurities found in a key ingredient. Control of materials and processes continues to be a challenge.

Considerable resources are currently being expended to correct field problems with noise and low temperature wear.

Heavy Trucks - Air Brake Liners and Blocks

Non-asbestos blocks have been found to crack and laminate. This condition causes user concern. In addition, since non-asbestos materials do not have the flexure strength of asbestos materials, shoe rigidity and dimensional accuracy become new challenges to be resolved from a manufacturing, assembly and user standpoint.

Advertised claims of appreciably better drum and lining life do not appear justified in all applications. This causes customer concern since a premium is paid for non-asbestos materials.

Substitute Materials

Major types of non-asbestos brake formulations are:

1. Organics using fiberglass & mixed compounds of calcium silicate, aramids, graphite reinforcing fibers as substitutes for asbestos.

2. The semi metallics - consisting of steel wool, sponge iron, graphite, ceramic powder and other substances in a phenolic resin binder.

3. Sintered metal and ceramic powders as well as inorganic friction modifiers fused together under extremely high temperature and pressure.

Organic materials have the least cost, the easiest lining attachment and the greatest structural strength. However, their wear rate and fade resistance are the poorest. Lining swell can also be a problem. Organic materials are used primarily for drum brake systems.

Semi-metallic linings have better wear and fade characteristics than organic materials. However, they cost more and have less static retarding force and generally require an asbestos backing material in order to insure adequate attachment shear strength. Lining swell generally is not a concern.

Sintered metal materials are very costly, extremely difficult to attach to a shoe, and have the poorest flexure tolerance. However, they have the best wear rate and fade resistance at high temperatures. Static retarding and pre-burnish performance are also problems with these materials.

Design and Performance Considerations

In addition to the obvious need to stop safely, each vehicle manufacturer has requirements which he deems to be important and therefore must be met. Among these criteria are: acceptable life - lining and rotor, structural strength, fade resistance and performance consistency. These criteria were noted in detail earlier in the report.

C. Reinforced Plastics - Fillers for Plastic Molding Compounds

Discussion

Asbestos was widely used in plastic material to impart strength, and to provide oil and heat resistance. Also it is electrically non-conducting, low cost and very compatible with various plastics and molding processes. Aside from the combination of reinforcing strength and insulating properties of asbestos filled phenolic essential to certain uses like small high speed electrical machinery. There appears no real need or cost advantage for asbestos as a molded plastic reinforcement (in new designs). Many molded parts are subsequently machined making asbestos a very undesirable ingredient.

Substitute Materials

Fiberglass is the primary reinforcing fiber. Other less expensive fillers are used (e.g., clay) where strength is not needed.

D. Gaskets

Discussion

Gaskets are classified variously, general duty and high performance (over 1,000 PSI and/or 200°C requirement) or as soft, hard (metallic inserts) and high temperature (600°C). Other than the very high temperature types, gaskets consist of fiber, filler and elastomer binder. Typically, 80% of a gasket by weight might be asbestos. General duty gaskets (oil pan, covers, etc.) are die cut from sheet material. High performance types are usually a composite construction, often with metal inserts. Economical non-asbestos materials are available for general duty including altogether different gasketing systems - room temperature vulcanizing and anaerobics (chemical gasket). Non-asbestos gaskets are being offered and evaluated successfully (cost and performance compromises) in high performance applications such as head gaskets, exhaust, intake, exhaust gas recirculation valve (EGR) and turbocharger seals where asbestos fibers traditionally provided required strength, heat resistance, stability, chemical resistance.

Substitute Materials

There is no single fiber that will replace asbestos. A blending on the following types, however, can develop equivalent properties as when tailoring a gasket to a specific performance need: cellulose, aramids, glass, ceramic, mineral wool, carbon, phenolic. High performance and multi function gaskets may require metal inserts, embossment or printed sealing beads.

Design and Performance Considerations

For general duty, die cut gasket end cost is highly dependent on cutting waste so standardization on material specification and simultaneous conversion of all uses is desirable. Concurrent with conversion to non-asbestos, one manufacturer is upgrading durability, quality, and reliability via stainless steel inserts, elastic sealing beads, etc. The tendency also (in exhaust gaskets) is to add metal grommet reinforcements as insurance. Result is that cost of asbestos substitution per se is often not certain. Total package is more, to much more costly but economy from competition and experience is expected. Diesels are expected to be no problem. Higher pressures are controlled by metal inserts - not gasket fiber material.

E. Sealers, Adhesives & Acoustic Materials

Discussion

Bulk sealers, adhesives, etc. are primarily body specified with some application in heating and A/C, engine and electrical systems. Range of uses and property requirements is huge. Body uses weld-through sealers are structural adhesives (applied prior to weld), paintable sealers (no bleed thru), after paint adhesives and sealers. Grades are thumbable, pumpable, knife grade, sprayable, tape form. Cure can be heat or chemical. Other types of thread locking (engine), plastic fillers, rust preventers, etc. Asbestos fibers uniquely provided the strength in heat and bridging properties, thixotropic properties for high speed application and sag resistance, etc. required by the automobile industry of these materials. Sealers may contain 12% asbestos to as much as 30%.

Substitute Materials

Substitutes are generally proprietary combinations of clay, talc, bentons, man-made fibers.

Design/Performance Considerations

A typical substitution problem is butyl rubber tape sealer where asbestos provides thixotropic stabilizer, important to application and hot weather flow. Plant tryouts of non-asbestos versions show (tackiness, bonding, elongation, sag temperature and shelf life) are also asbestos content sensitive, even though product performance function, once installed, is met.

/lb