PLAINTIFF'S EXHIBIT

UC-2421

UNION CARBIDE

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April 7, 1987

Document Control Officer
ICF, Inc.
1850 K Street NW
Washington, DC 20037

Attention: Tony Bansal
Project Manager

RE: Asbestos Substitute|Packings and Gaskets - Flexible Graphite

Dear Tony:

This letter's purpose is to address the subject issues, more specifically to provide information relevant to Union Carbide's GRAFOIL® Brand Flexible Graphite, which is a functional substitute for asbestos based packing and gasketing materials. Packings are generally used to seal various fluids when some movement (dynamic) occurs between members of a fluid containing device. Examples include valves and pumps employed in the electric power, petroleum refinery, petrochemical, chemical, and pulp and paper industries. Gaskets are cut and fabricated from gasketing materials and are generally used to effect a static seal, for example between pipe flanges, vessels, or within a valve design (body to bonnet) used in these industries. Gaskets and other semi-static seals, such as those in an exhaust gas recirculating valve (EGR) and transverse engine flexible exhaust connection, also are employed extensively to seal fluids in internal combustion engines. Examples include head gaskets and exhaust manifold gaskets used in automobiles, trucks, auxiliary electrical power systems, lawn mowers, and other internal combustion engines.

The present memorandum will focus on packings.

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Packing

The non-metallic materials that comprise the bulk of past "high performance" packing technology have been based on various compositions and configurations of braided yarn. Historically, the dominate yarn fiber has been asbestos, but more recently other organic and inorganic yarns and combinations of yarns have been introduced, primarily for insurability, legal, regulatory, health, and environmental reasons. The high performance braided asbestos packings included an alloy wire reinforcement, various lubricants, a zinc powder corrosion inhibitor, and a graphite powder coating on the yarn itself. Asbestos yarn usually is braided around a core composed of the inhibitor, asbestos and binders with or without lubricants. Other compositions contain various binders, fillers, and dry lubricants such as metal sulfides. These braided packings generally have been applied where service pressures do not exceed 4000 psi (28 MPa) or temperatures 1200°F (650°C). Braided asbestos has been the performance standard for packings used in valves and pumps for a wide range of industrial applications. Except for the carbon and graphite yarns, the other braided "non-asbestos" replacements generally have not approached the breadth of performance of braided asbestos.

GRAFOIL® Flexible Graphite is a relatively new, non-fibrous packing material. It was introduced over 20 years ago by Union Carbide and has been applied extensively, worldwide, in the laminate and ribbon form, but primarily as a preformed ribbon packing ring, with and without a suitable carbon or graphite braided end-ring. Sweden has one of, if not the, most advanced National Policy on ban of asbestos products with total exclusion implemented on January 1, 1987. Based on extensive testing and experience, the Swedish Electrial Power Board has standardized on flexible graphite packings to replace the braided asbestos product. Proposed technical revisions to the API Refining Division valve standards will show flexible graphite with braided graphite yarn "end rings" as the listed non-asbestos packings in gate valve standards API-600 and API-603, where braided asbestos was listed.

Appendix I provides a detailed overview comparing flexible graphite with braided asbestos packings.

Many independent studies by research agencies, original equipment manufacturers, and ultimate users have verified the superiority of flexible graphite valve packing over conventional braided asbestos. As shown in Appendix II, the Fluid Sealing Association (FSA), a trade association which includes manufacturers of packing and gasketing materials, currently lists flexible graphite as the only valve packing material that equals and exceeds temperature and pressure ratings of braided asbestos packings (See Table V, page 8 of Appendix II.) The same applies for temperature, pressure, and velocity ratings for pump packing (see Table IV, Page 7 of Appendix II).

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Extensive studies of valve packings for steam service in Nuclear Power Plants have been on-going as the result of research studies funded by the Electric Power Research Institute (EPRI). Results of one of these earlier studies, Project 1623-1, is enclosed as Appendix III. This 1982 Final Report, EPRI NP-2560, clearly states the conclusion that flexible graphite packing is superior to braided asbestos for this service (see Page 5-1 Appendix III). More recent EPRI funded studies, e.g., "Valve Stem Packing Improvements EPRI NP-4255, Project 2233-3, Interim Report, February 1986, concentrates on only one packing material, flexible graphite, because of its proven superiority over braided asbestos.

Appendix IV written by a major oil company, Exxon, basically draws the same conclusion relative to flexible graphite valve packings for refinery and petrochemical service. Appendix V reports results of an exhaustive study by a major valve manufacturer, Rockwell, to establish a viable non-asbestos packing. Again the conclusion is that flexible graphite is the only viable replacement for asbestos based packings.

Economic Impact

Currently there are two major domestic U.S. manufacturers of braided asbestos packings, Chesterton, and Inter Tech Group|RM Industrial Products (formerly Raybestos Manhatten). The largest manufacturer, John-Crane Houdaille, discontinued sales of their Grade 187I in August, 1985. This was the grade of braided asbestos used in largest volume in the U.S. Major moves to replace braided asbestos packings were underway since the discontinuance of John-Crane 187I. Prices of remaining braided asbestos packings have been increasing during this period which makes economic comparisons difficult and the general issue of price comparisons a moot one.

Current "first cost" prices of flexible graphite ring die formed from tape are 1.5 - 2 times that of braided asbestos on a volume basis, when adjustments for small density differences are made. Typical densities for braided asbestos are 100 lbs.|ft.^{3}, while that for die formed flexible graphite rings are 90 lbs|ft.^{3}. However, because of their superior sealing characteristics, only one-third to one-half as many GRAFOIL® die formed rings are required to provide an effective seal. (Multiple ring sets are typically used to fill the stuffing box of a valve. Some are designed to accommodate as many as 10 - 15 individual rings.) The reduction in packing volume possible with die formed flexible graphite is discussed in Appendix V as well as other independent studies. Generally, for in-service valves, a metal spacer can be used to displace the vacant space in the stuffing box, while more cost effective new valve designs incorporate a smaller stuffing box for fewer and smaller cross section flexible graphite rings. Because of these improvements, even "first cost" prices for replacing braided asbestos packings with flexible graphite present essentially no penalty. As indicated in Appendix IV, valves are presently being sold with flexible graphite packings at the same price as with braided asbestos. The added durability of the flexible graphite provides packing life significantly greater (e.g. from 2 to over 10 times) than that of asbestos. Examples of life improvements can be found in Appendix VI.

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A major value benefit from use of flexible graphite is reduced emissions. Industries are moving to this product because of this and many other economic value benefits. These include inherent fire safety, greater than double life improvement over asbestos, reduced energy losses, greater tolerance to changes in fluid conditions, and unlimited shelf life. Flexible graphite is, therefore, not just a replacement for asbestos-based packings but the only material proven via industry experience to have superior, long term sealing characteristics.

Best estimates indicate that current penetration of flexible graphite into the total asbestos-based packing market is in the order of 5%. This is projected to grow to 30% within five years assuming a ban on asbestos. This penetration will be complemented by displacement of asbestos packings with other materials, principally Polytetrafluroethylene (PTFE), and aramid for temperatures under 500°F. Incremental capacity for GRAFOIL® is being added by Union Carbide to accommodate this scenario. The same applies to the other products which are made by other AMI Members. Therefore, the replacement of asbestos packing by flexible graphite will not be capacity limited.

This assessment addressed only the asbestos packing material issue since gasketing represents a different technology. A more detailed assessment of the important roll GRAFOIL® Flexible Graphite is and will serve as a replacement for asbestos based gasketing products was forwarded in my prior memorandum of March 4, 1987.

Very truly yours,

P.S. Petrunich
Customer Service Manager

llw
Attachments

cc: T.D. Finnigan
E. Rosenberg
W.J. Burroughs
C.H. Pelanne

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1. J. F. Sanders
2. CC Neely - (Chuck)
FYI pot

Suppliers of asbestos substitutes form institute

Manufacturers of materials to replace asbestos fiber have formed the Alternative Materials Institute (AMI) to strengthen their case in the Environmental Protection Agency's mandate to replace and phase out asbestos in cases where workable substitutes exist.

In addition to Du Pont, manufacturer of aramid fiber, initial membership in AMI includes the Carborundum division of Sohio, a ceramic fiber manufacturer; carbon fibers division of Ashland Oil; Union Carbide, manufacturer of expanded graphite sheets; and Rhodes American, a metal fiber manufacturer. All of these companies supply substitutes for asbestos for uses including friction materials, gaskets, adhesives, and cements.

In recent years, asbestos has been labeled a carcinogen because the tiny asbestos fibrils have a tendency to attach themselves to lung tissue. However, use of asbestos has persisted because the fiber is economical, durable, and thermally stable.

According to Richard Gould, a senior Du Pont marketing specialist and chairman of the new group, "Our principal function is to provide EPA with information on alternatives to asbestos. We are not trying to start another trade association. Once EPA promulgates rules on asbestos replacements, we'll go out of business."

It is not clear how long it will take EPA to formulate rules regarding asbestos replacements. EPA started hearing testimony in July on a proposal made Jan. 29, 1986, to ban asbestos immediately in certain uses and phase out others over the next 10 years.

Ernest Rosenburg, who acts as AMI's executive director in Washington, D.C., insists that "Our job is not to attack asbestos." Instead, says Rosenburg, AMI wants to be sure EPA has access to information on asbestos alternatives. Rosenburg is a lawyer who once worked for EPA and now works for public affairs concern E. Bruce Harrison Co.

On the other side of the issue is Bob J. Pigg, president of the Asbestos Information Association (AIA),



Gould: data on asbestos alternatives

an organization of asbestos mining and milling companies. Pigg says that AIA takes no position in opposition to alternate asbestos materials, but it does "hope EPA will be evenhanded in its approach." He says that AIA has "demonstrated that asbestos does not pose an unusual health risk" where the fiber is encapsulated within another material as it is in friction materials, roof coatings, gaskets, and cement.

"We have called on EPA to withdraw its proposal," Pigg says, because the documents EPA has drawn up are faulty with regard to both the health threats posed by asbestos in encapsulated materials and the cursory review EPA has made of potential health effects posed by asbestos substitutes.

Union Carbide carbon products division manager of customer technical service Peter S. Petrunich believes AIA's argument over the health threats posed by asbestos substitutes is a red herring. For one, Carbide's Grafoil graphite sheet for gaskets and valve packings is a solid, not a fibrous material, and so is not respirable. In addition, he says, a reason for AMI's formation is to ensure that safety studies of fibrous substitutes conducted both by members and independent laboratories get to EPA.

Marc Reisch, New York

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