

exposure of asbestos from various sources. Added to these are the many international and state regulations, and the regulatory situation is certainly challenging.

Another disadvantage of asbestos is its scarcity. Compared to oil, the U.S. is more completely dependent on foreign sources for asbestos than it is for petroleum. Although general asbestos supplies seem adequate, the long grades such as number 4 and 5 fiber lengths used extensively for gasket materials have been in tight supply for the past four years.

The final disadvantage of asbestos is that it does not always solve all the problems that it is asked to solve. In short, better heat resistance sealability and crush resistance are often required. Asbestos has served us well and will continue to do so but there are more and more demands for better solutions. At present, the majority of gaskets in the U.S. do contain asbestos. Most of them contain 80% asbestos in their composition with the rest being polymer binder systems and fillers.

The problem of replacing asbestos is of very large magnitude. However, before we get into reviewing what is being done to replace asbestos, we should probably consider what the asbestos suppliers are currently saying about the situation. They state very simply, that once the material reaches the consumer, the asbestos is locked-in by the various processes used in manufacture. Granted, this may be true, but it is very difficult for most gasket suppliers to verify that this condition continues throughout the use of the product when they consider the asbestos-contained material is typically sheared, torn, calendered, scraped, sanded, punched, burned, formed, compressed, and ground in its further manufacture and use as a gasket.

Because of the disadvantages mentioned and the lack of technical verification of the safety of the material when processed and used as gasketing, several major domestic users have embarked upon programs to eliminate asbestos gaskets from their product lines. Let's examine what asbestos-free materials will have to do when they replace asbestos products in gaskets. Replacement materials will have to have high-heat resistance, excellent crush resistance, dimensional stability, and homogeneity. As another reference point, we should examine those products currently available in the marketplace. These are cellulose, anaerobics, RTV, and rubber-coated steel.

A number of companies have eliminated asbestos gasketing, and gaskets in general, from their current assemblies. The General Motors Corporate V-6 has only two gasket applications in the engine: the cylinder head gasket and the intake manifold gasket. Both of these applications are with asbestos containing materials. Many transmission manufacturers are also eliminating gaskets from their assemblies and replacing them with liquid sealant to reduce the tolerances required for assembly. This permits them to develop quieter-running transmissions and gear boxes — another upcoming regulation.

Asbestos seems to be used in the majority of cylinder head applications and intake manifold applications, exhaust manifold applications, and a large number of extremely heavily loaded flanges. However, the critical requirements of these various applications are not the same from application to application. Cylinder head and intake manifold applica-



Anaerobic and other liquid sealants are one way to solve the problem of eliminating asbestos from many sealing products. Shown here is a 28 in. long housing with a liquid gasket seal ready for assembly.

tions require materials having good homogeneity and the resulting conformability that permits a good fluid seal. Exhaust manifold applications require the high-heat resistance characteristics of asbestos and heavily loaded flanges require the crush and extrusion resistance of asbestos. So it is possible to replace asbestos in different ways for different applications. More importantly, it appears that if we could improve certain properties in certain applications, we could present design engineers and the marketplace with an improved product with greater appeal.

For years gasket material producers and designers have attempted to improve the binder systems in gaskets. This work was done because the binder system appeared to be the limiting ingredient in gasket functional design. Little was done to improve the fiber characteristics and to obtain increased functional characteristics through this method. We are now looking at that 80% of the gasket which represents the fiber to see what can be done in replacing asbestos to improve its functional characteristics. However, to do this, one quickly finds that no single man-made fiber or other high temperature material approaches asbestos in its crucial physical properties. It is therefore necessary to blend materials to obtain the desired properties. The types of materials blended are mainly various fibers and fillers, although rubber coated steel is also considered an alternative.

Clay is one such filler. It is inexpensive, compressible in bulk, and fills the voids between the larger fibers of glass, nylon, or aramid. Clays are easily dispersed in mixtures of water. From a sealing point of view, the clay reduces the spring rate of the facing, and improves the load bearing capabilities. Temperature resistance is above 3000 F (1649 C).

Clay, when added to most materials, increases the surface area to the magnitude of asbestos. Clay has better conformability properties than asbestos.

Mica is basically a filler, also, and has been used for years in the paper industry. Vermiculite is the thermal or chemically expanded form of mica which is very economical, has high surface area, and good temperature resistance (above 2000 F). It has relatively low strength, but good slip characteristics, caused by the low coefficient of friction of the particle. Mica has better torque and heat resistant properties than asbestos.

Graphite has the highest heat resistance of the materials presently under consideration with the tensile strength increasing until 4000 F and heat resistant above 5000 F. The material is very costly but can be used in layers. The unique low frictional characteristics of the platelets help where motion is a problem.

Glass fiber is another candidate. It normally endures heat to 1100 F, where softening and fusing takes place. However, it has good strength and the thinnest diameter or highest surface area of any man-made fiber. It will be used to reinforce mica, clay or barytes based compounds in the same way as aramids and nylons will be used.

In some applications cellulose fiber may be favored. But it is used very sparingly, if at all, in materials requiring high temperature resistance because of its low charring temperature. In applications where heat is not above 300 F, however, the fiber can be used as a successful carrier web or matrix for a variety of fillers.