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:uring process combines medium long to medium short fibers with ilica, and water, thoroughly mixed to produce the maximum open the fibers. The solids are drawn from the slurry on a fabric belt sited in successive layers on a rotating mandril. The chrysotile rve the function of tiny reinforcing rods in the finished product. ıg on the product, the proportion by weight of asbestos to cement from 15 to 90 per cent.

e variety of chrysotile grades are used in the manufacture of materials and packings. Chrysotile asbestos is used in friction s for the following basic reasons, and serves in the following ways: ause of its heat stability; (2) as a reinforcing agent; (3) as a) as a regulator or inhibitor of the resin flow in molding; (5) as ing agent for the metal chips and other particles during formation; because it is less abrasive than other heat stable fillers in the same e range.

are five major types of friction materials that contain chrysotile, woven, dry mix, sheeter, profile calender, and extruded. Basically, osition of friction materials includes binder, metal chips, friction , chrysotile asbestos, filler, and solvent. The asbestos content may m 30 to 80 per cent of the total composition. Most of the excellent materials in use today would not be possible without the contribu- hrysotile.

elationship between packings and friction materials is that pack- developed to produce the least amount of friction between surfaces friction materials require high friction without too much wear. s may contain from 40 to 75 per cent of chrysotile and are essential strength, toughness, resiliency, durability, and heat resistance of product.

at variety of paper products are made from chrysotile, including d, roofing felts, pipe covering, fine quality electrical papers, insu- apers, asbestos-latex flooring felt, and many others. Asbestos pa- the need for a paper that has the inorganic properties of chryso- h as heat resistance, chemical inertness, and electrical and insulat- perties. The asbestos content in most papers in this category is 80 er cent. The manufacture of asbestos papers involves mixing in o form a slurry, followed by laminating on cylinder molds or Four- machines.

ugh the floor tile industry is the second largest user of chrysotile s, it is far down the list in dollar value. This is due to the fact that y short chrysotile fibers, which serve as fillers and reinforcement are used in the manufacture of floor tile. The floor tile formulation s from 10 to 30 per cent chrysotile together with vinyl resin or as-

phalt together with various other fillers. The ingredients are mixed, pressed into a blanket, calendered, and cut to size.

The use of short chrysotile fibers in the paint, roof coating (aluminum and blackline) caulks, sealants, and joint filler industries has been developed to a high degree in the U.S. and Canada. In these uses chrysotile serves the purpose of an inexpensive filler as well as a reinforcer.

Chrysotile is an important component in a wide range of plastic products, including cold molded, thermoplastic, and thermosetting plastics. Usually, the very short grades of chrysotile are used to impart toughtness, increase hardness, retard the burning rate and reduce molding costs, and control the flow of the material under pressure.

Finally, the miscellaneous uses of chrysotile cover a wide field including sprayed insulation, asphalt paving and curbing, welding rod coatings, filter mediums, chlorine cell diaphragms, acetylene cylinder packings, and many others.

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Discussion of the Paper

G. W. H. SCHEPERS (*Bureau of Laboratories, Dept. of Health, Washington, D.C.*): This review of the natural and industrial ecology of asbestos was most fascinating. Obviously the growing exploitation of this natural, useful, but also dangerous fibrous mineral has presented industry with major medical challenges. Industry should, however, be commended for the excellent safeguards which it has introduced. This has conserved many lives.

I believe, however, that it should also be stressed that the medical or health problem originating through exposure to asbestos dust may come about equally through minor uses of asbestos. In this paper emphasis was logically placed on major uses. However, there are thousands of individuals who are exposed to asbestos dust on account of participation in minor asbestos industries. The major asbestos industries have the technical personnel and knowledge that generally ensure reasonable protection for their

workers. In the minor industries, hazardous exposures to asbestos may occur without the hygiene problem being recognized. A good example is the carpenter who uses asbestos-reinforced plaster board and asbestos-impregnated corrugated roofing materials. These men often spend long hours machine-sawing such boards and seldom take any precautions against excessive inhalation of the asbestos dust, having long been assured that the dust generated in sawing plaster or gypsum board is harmless. One of the varieties of gypsum, however, has tremolite asbestos as a filler or reinforcing agent. As I have demonstrated experimentally (Archives of Industrial Health, 1955), prolonged exposure to such admixtures of gypsum and asbestiform minerals can induce pulmonary asbestosis. In this respect the dilution of asbestos fibers by the gypsum does not modify the action of the asbestos component. When gypsum is mixed with quartz dust, the potential injurious action of the latter on living tissue is reduced. This was proven experimentally by myself and colleagues. (Archives of Industrial Health, 1955).

The trouble with these minor asbestos industries is that the health problems they create are seldom recognized for what they are. Since the practicing physician is not likely to recognize the etiologic role of an asbestiform ingredient of dust in "nonasbestos" industries, his diagnosis is likely to be one of "idiopathic lung pathology." This not only introduces a diagnostic error for the individual victim, but also leads to faulty epidemiology. It would be greatly advantageous if a detailed directory of asbestos uses were more generally available, or if industrial products carried appropriate labelling, as do drugs.