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H. C. Duecker

TO: M. E. Winyall

DATE: November 28, 1972

PROJECT NO. 2850

FROM: B. B. White

SUBJECT: Non-crystalline fibers from asbestos materials.
Literature Search LS - 828
(Project 2850)

In an effort to find information on the preparation of non-crystalline fibers from asbestos materials, I have searched Chemical Abstracts (1967 to present), Applied Science and Technology Index (1967 to present), Engineering Index (1967 to present) and Ceramic Abstracts (1967 to 1970). I have found no references directed specifically to the preparation of non-crystalline asbestos materials, and only two articles [27,36] suggesting a relation between crystallinity and toxicity.

A number of references were found to the dehydration, dehydroxylation and hydrothermal treatment of various forms of asbestos. The synthesis of asbestos has also been described.[6,11,12] The effect of such treatment on the crystal structure is discussed and it appears generally accepted that dehydration,[2,4,5,13] dehydroxylation[3] and various conditions of thermal[1,7] and hydrothermal[8,9,10] treatment lead to the formation of an amorphous phase, usually described as metastable.[3] Abstracts covering this aspect are included in Part I of the appended search.

A number of studies have been reported on the biological and toxic effects of asbestos breathed into the lungs or injected into laboratory animals. Abstracts of a number of these are included in Part II.

The undesirable effects of asbestos in the body has been related to the fiber length[15,16,22,29,31] (long fibers being more deleterious), the type of asbestos[20,23,24,25,28,30,35,37] the electromotive interaction of metals present,[18,19] dust chemistry, physics and mineralogy,[14,21,26] the crystallinity or order,[27,36] openness and surface area of fibers[32] and structural shape.[34] I have included abstracts of these studies for your evaluation as to their significance in your work.

B. B. White

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BBW:ol

Copy to: T. H. Cheavens

Non-crystalline fibers from asbestos materials

Part I
Treatments of asbestos affecting crystallinity

CA 75, 131602u (1)

131602u **Changes in serpentinites at high pressures and temperatures.** Bezrukov, G. N.; Gorokhov, S. S.; Davydchenko, A. G.; Lisitsyna, E. E. (USSR). *Tr. Vses. Nauch.-Issled. Inst. Sin. Miner. Syr'ya* 1970, 12, 112-15 (Russ). The effect of pressures and high temps. on the changes in serpentine is discussed. The changes occur in 3 stages, magmatic, crystn., and metamorphic, and during these 3 stages various minerals are formed. A. Linial

CA 68, 85717v (2)

85717v **Forsterite formation during heating of dunite.** P. P. Budnikov, L. B. Khoroshavin, V. A. Perpelitsin, V. M. Ust'yantsev, and E. P. Kosolapova. *Zh. Prikl. Khim.* 40(6), 1369-70 (1967)(Russ). The following phase transformations occur in dunite during heating. Dehydration of serpentine starts at ~400° and is completed at 620 ± 10°; at those temps. (400-620°), the cryst. lattice of the serpentine loses the $[OH]^-$ group without the formation of any new compd. A dehydrated amorphous (as established by x-ray diffraction) metaserpentine phase ($3MgO.2SiO_2$) exists between 620 and 650°. Gradual transformation of the metaserpentine into forsterite starts at 650°, and formation of clinoenstatite occurs at 1000-1300°. Intensive recrystn. of the forsterite takes place above 1300°, and it is accompanied by isomorphous substitution of Fe^{2+} for the Mg^{2+}. The substance existing at 1700° is $2(Mg_{2-x}Fe_{2-x})O.SiO_2$. The thermal expansion of forsterite between 800 and 1300° is anisotropic, and the increase in the interplanar distance in the direction of the [130] plane is greater by a factor of 2 than the increase in the directions of the [102] and [112] planes.

CA 66, 88306a (3)

88306a **Effects of dehydroxylation on morphology and texture of chrysotiles.** M. della Faille, C. de Kimpe, and J. J. Fripiat (Univ. Louvain, Belg.). *Silicates Ind.* 31,(11), 469-73(1966) (Fr). The differences observed, depending on the nature of the specimen, in the mechanisms of the transformation of chrysotile into forsterite can be explained on the basis of surface properties. A chrysotile of high specific surface and porosity dehydroxylates very rapidly and the resulting disorder retards the formation of forsterite. In this case, the dehydroxylation gives rise to a transitory amorphous phase. A fiber of small specific surface dehydroxylates very slowly and the transformation into forsterite takes place easily starting from a less disordered material. The dehydroxylation brings about bursting of the fibers and a significant increase in the surface. The zones of higher silica content formed by the silica expelled by the transformation reaction might be responsible for the budding, observed with the electron microscope, around the fibers pretreated at 740°.

CA 75, 54544x (4)

54544x **Possible modes of chrysotile-asbestos transformation during heating.** Drobyshev, L. A.; Govorova, Ya. Ya. (Nauchno-Issled. Fiz.-Khim. Inst. im. Karpova, Moscow, USSR). *Kristallografiya* 1971, 16(3), 544-7 (Russ). Thermogravimetric anal. and DTA of natural chrysotile-asbestos samples show an endothermic effect at 695° assocd. with the loss of 2 mols. of H_2O, and an exothermic effect at 840° not assocd. with wt. changes. The effect at 695° is assocd. with transformation to an amorphous structure, whereas that at 840° is assocd. with the formation of $MgSiO_3$ from MgO and SiO_2. T. Ordentlich

CA 76, 39968r (5)

39968r **Photoelectron and x-ray fluorescence spectroscopy of magnesium minerals.** Freund, Friedemann; Hamich, Monika (Mineral. Petrogr. Inst., Univ. Koeln, Cologne, Ger.). *Fortschr. Mineral.* 1971, 48(2), 243-58 (Ger). The Al K_α-excited photoelectron spectra of minerals with Mg in different coordinations were recorded. The energies of photoelectrons from the Mg 1*s*, 2*s*, and 2*p* levels showed strong shifts between 4-, 6-, and 8-coordinated Mg. A nearly linear relation was found between the electron-binding energy and the av. Mg-O distance. In the x-ray amorphous dehydration products of serpentine and chrysotile Mg appears to be in an unusual coordination with 4 O ligands and 2 unoccupied ligand sites. Gerhard Herzog

CA 75 155666u (6)

155666u **Electron-microscopic study of synthetic and natural chrysotile.** Khadzhi, I. P.; Tsinober, L. I.; Makarova, T. A. (Vses. Nauchno-Issled. Inst. Miner. Syr'ya, Moscow, USSR). *Dokl. Akad. Nauk SSSR* 1971, 200(4), 953-4 [Miner] (Russ). A comparative electron-microscopic study of synthetic and natural chrysotile asbestos revealed that the synthetic chrysotile, which was obtained under hydrothermal conditions at 350° and 900 kg/cm², consists of 2 phases: one is similar to that of natural chrysotile which consists of tubular fibers, and the other phase consists of laminar formations. The fibers of the synthetic chrysotile are shorter (~0.005 Å) than those of natural chrysotile (>0.1 mm). Unlike the natural chrysotile which consists of uniform fibers, the synthetic chrysotile consists of 2 morphol. different fibers, thick wall fibers (external diam. 450-500 Å and internal diam. 100 Å), and thin wall fibers (external diam. 200 Å and internal diam. 140-160 Å). Some of the tubular fibers are filled with a high-d. substance, the nature of which is unknown.

CA 73, 5901m (7)

5901m **Fibrillar structure and thermal reactions of serpentine asbestos.** Kheiker, D. M.; Gracheva, O. I.; Plantsbaum, I. M.; Bubeleva, L. V. (USSR). *Tr., Nauch.-Issled. Inst. Asbesta, Slyudy, Asbestotsem. Izdelii Proekt. Strout. Predpr. Slyudyanoi Prom.* 1968, No 23, 68-86 (Russ). Fibrillar structure and structural changes in serpentine asbestos at elevated temps. were studied by means of x-ray and thermal anals. and by the detn. of surface area by means of low-temp. N sorption. The mean wall thickness of the tubular fibers of Soviet serpentine asbestos was 144-70 Å, the mean inner diam. 25-35 Å, and at

CA 73, 5901m (contd) (7)

room temp. most of the pores corresponding to the detd. porosity of the material were filled with material of the same d. as that of asbestos. Thermogravimetric anal. proved that water released with the increasing temp. (up to 215°) was of hygroscopic character, that released up to 370° was adsorbed H_2O, and that released up to 420° could be completely readsorbed at room temp. in satd. water vapor atm. This readsorbed water penetrated inside the fibers. Water released >420° was chem. bonded and was released irreversibly. Up to 500°, the cryst. structure of serpentine asbestos was conserved, at 550° it was transformed to an amorphous phase in which forsterite appeared, the amt. of which increased with the increasing temp. up to 850°, when the formation of enstatite started. At 1000° and at higher temps., the amt. of enstatite increased while that of forsterite decreased, the latter compd. reacting with amorphous SiO_2 and yielding the former. Surface area of the heated samples 1st remained unchanged up to 400°, then sharply increased at 450–550° owing to the formation of the amorphous phase; beyond this temp., sharp decrease was obsd. resulting from the crystn. of forsterite.

CA 69, 98315d (8)

98315d **Conditions of crystallization of fibrous amphiboles from serpentine under hydrothermal conditions.** Korytkova, E. N.; Sipovskii, D. P.; Fedoseev, A. D.; Makarova, T. A. (Inst. Khim. Silikatov, Leningrad, USSR). *Zap. Vses. Mineral. Obshch.* 1968, 97(4), 500–7 (Russ). Fibrous alk. amphiboles were obtained by hydrothermal treatment of natural minerals of the serpentine group (ophite, antigorite, lizardite, and chrysotile) under high temp. and pressure conditions. The fibers were up to 3–4 mm. long and 0.05 to 0.3 μ thick. In addn. to temp. and pressure, the influences of the following factors are described: duration of autoclave treatment, degree of dispersion of the original mixt., character of the reaction medium, and the ratio of solid to liquid in the original mixt. The most important factor affecting both the crystn. and the morphologies of the fibers is the alkali concn. in the starting mixt. Don W. Shaw

CA 77, 22334d (9)

22334d **Preparation of synthetic asbestos.** Krleza, F.; Clausen, C.; Papo, A. (Inst. Kem., Prir.-Mat. Fak., Sarajevo, Yugoslavia). *Kem. Ind.* 1972, 21(2), 71–3 (Croat). Mg silicate products structurally related to chrysotile were prepd. by hydrothermal treatment of MgO and silica gel (cf. *CA* 44: 5753*b*) in an autoclave at 300–50° and 86–166 atm. Anal. showed that the reaction product compn. was $Mg_3(Si_4O_{11}).3Mg(OH)_2.2H_2O$, while electron diffraction diagrams matched those of chrysotiles reported in the literature. The x-ray diffraction patterns reproduced for the obtained products indicated the closest similarity to a chrysotile pattern of a product prepd. by steam treatment of 1.5 g Mg and 1.5 g silica gel (the latter prepd. by hydrolysis of Si ethylate) in 750 ml H_2O in a Hofer autoclave at 348° and 155 atm for 100 hr. Next in the order of resemblance to chrysotile was a product of 1 g MgO and 1 g silica gel (prepd. as above) in 300 ml H_2O in an Ag-plated vessel placed in an autoclave, at 300° and 86 atm for 100 hr. Less similarity was shown by products of equal amts. of MgO and com. silica gel treated under similar conditions. Expts. carried out at lower temps., particularly by dropwise addns. of a soln. of 6 g $MgCl_2.6H_2O$ in 100 g H_2O and a soln. of 2.1 g water glass and 10.08 g NaOH in 100 g H_2O, added over 8 hr to 100 ml H_2O followed by heating the system for 50 hr at 300°, gave products of poor crystn., and their x-ray diffraction patterns did not resemble that of chrysotile. The chrysotile-like products obtained at 300–50° and elevated pressures, using silica sol from Si ethylate, had 10^-4-cm long fibers.

Andrew L. Grocholski

CA 76, 107365u (10)

107365u **Effect of synthesis conditions on the crystallization of serpentine in a hydrothermal medium.** Kukliauskas, A.; Sasnauskas, K. (Kaunas. Politekh. Inst., Kaunas, USSR). *Liet. TSR Aukst. Mokyklu Mokslo Darb., Chem. Chem. Technol.* 1970, 12, 349–52 (Russ). Studies of the hydrothermal prepn. of serpentine at 200 and 100 atm and 364 and 309°, resp., for 4 and 24 hr and MgO/SiO_2 ratios of 1.0, 1.5, 2.0, 2.5, and 3.0, indicate that the physicochem. properties of serpentine depend on the MgO/SiO_2 ratio, temp., and the synthesis duration. By increasing the MgO/SiO_2 ratio, less dispersed serpentine is produced. The products were characterized by x-ray diffraction and thermogravimetry.

CA 77, 21423v (11)

21423v **Serpentine asbestos fiber.** Shimokawa, Yoshiharu; Saito, Hajime (Chiyoda Chemical Engineering and Construction Co., Ltd.) Japan. 71 25,883 (Cl. C 04b, C 03b), 28 Jul 1971, Appl. 67 74,328, 20 Nov 1967; 4 pp. LONG fibers of artificial *serpentine* [14567-68-9] asbestos were prepd. by heating an aq. slurry of $Mg(OH)_2$ (and optionally MgO) and SiO_2 in the presence of *magnesium bromide* [7789-48-2], *magnesium iodide* [10377-58-9], or *iodine* [7553-56-2] under high H pressure. For example, a slurry of $Mg(OH)_2$ 210, SiO_2 100, water 1000, and $MgBr_2$ 100 g in a 2-l. autoclave was pressured with 50 atm H and heated at 300–40° (~180 atm) for 30 hr to give a mixt. of 80 g powder, 60 g of 5–25 mm long fibers, and 70 g of 0.5–5 mm long fibers. The use of $MgCl_2$ in place of $MgBr_2$ gave mostly powder product contg. fibers of <1 mm length.

CA 76, 88431u (12)

88431u **Electron microscopic study of synthetic amphibole asbestos.** Stenina, N. G.; Kalinin, D. V.; Deniskina, N. D.; Doil'nitsyn, E. P. (Inst. Geol. Geofiz., Novosibirsk, USSR). *Geol. Geofiz.* 1971, (5), 144–8 (Russ). Relative content of SiO_2 in the charge, temp. of synthesis, nature of the fiber, av. diam., homogeneity, surface characteristics, inclusions, and phases ($Fe(OH)_3$, aegirite, magnetite) present are included. The synthetic amphibole asbestos fibers occur as single crystals compressed along the {100} plane. Electron photomicrographs of fine crystals (d <1000 Å) show one or more axial dislocations in the hollow tubes. A definite interrelation is established between the temp., duration, pressure, and chem. conditions of synthesis and size, sp. surface, morphol., and inclusions of the crystals. The av. diam. of the fibers increases from 0.1 to 3.5 μ in the 460–700° range. Length and diam. of the fibers increase with increasing duration of the synthesis. A decrease in the SiO_2 content of the charge at 460° leads to a sharp increase in the no. of fibers.

CA 69, 29830f (13)

29830f **Kinetics of the removal of water from chrysotile asbestos.** Vlasov, Yu. G.; Ostrovskii, V. V.; Kharitonov, N. P.; Nefedov, V. D. (Leningrad. Gos. Univ. im. Zhdanova, Leningrad, USSR). *Izv. Akad. Nauk SSSR, Neorg. Mater.* 1968, 4(5), 798–800 (Russ). The purpose of the present work was to study the mechanism of removing the chem. bonded (structural) and adsorbed water during thermal treatment of crysotile asbestos, a fundamental component of a no. of organosilicate materials. The necessity for this type of study was dictated by the requirement for more clearly understanding the processes of formation of organosilicate materials. The other reason for this study was to try to resolve certain controversies

CA 69, 29830f (contd) (13)

existing in the literature as to the mechanism of pptn. of structural water from chrysotile asbestos. Thermographic, x-ray, and ir spectroscopic methods were used. Two endothermic effects were observed, at 100–200 and 620–720°, and one exotherm effect at 790–810°. The 1st may be ascribed to the removal of adsorbed water, the 2nd effect to the dehydration of chrysotile asbestos with the removal of structural water, the 3rd effect characterizes the formation of the cryst. lattice of forsterite. Special attention was given to the processes taking place at the intermediate stage, within the temp. range 200–620°. The removal of structural water starts at a temp. <100°, with the pptn. of the principal amt. occurring within the temp. range 400–620°. In samples calcined at temps. higher than 620°, the presence of structural water was not detected. Within the temp. range 200–620°, a gradual increase in the amorphous phase was observed with increasing temp. S. A. Mersol

Part II
Toxic effects of asbestos

CA 75, 46769j (14)

46769j **Effects of chrysotile and acid-treated chrysotile on macrophage cultures.** Beck, B. G.; Holt, P. F.; Nasrallah, E. T. (Med. Inst. Lufthyg. Silikose Forsch., Univ. Duesseldorf, Duesseldorf, Ger.). *Brit. J. Ind. Med.* 1971, 28(2), 179–85 (Eng). The addn. of chrysotile asbestos dust to monolayer cultures of peritoneal and alveolar macrophages produced an increase in membrane permeability (as measured by eosin uptake) and in lactate dehydrogenase activity of the supernatant fluid. Biosynthesis of lactate was also increased, suggesting the absence of cell damage. The increase of permeability was apparently transient and only for the duration of the phagocytic process, which may take several hr if the particles are fibrous. Treatment of chrysotile with 0.1*N* HCl, which leaves a SiO_2 surface, resulted in a product that reduced lactate biosynthesis, implying cytotoxicity. This change was counteracted by poly(2-vinylpyridine 1-oxide). The polymer did not affect the properties of the native chrysotile. Andrew L. Reeves

CA 77, 43964z (15)

43964z Fibrous silicates in animal experiments and cell-culture-morphological cell and tissue reactions according to different physical chemical influences. Beck, Ernst Gerhard; Bruch, J.; Friedrichs, K. H.; Hilscher, W.; Pott, F. (Med. Inst. Lufthyg. Silikoseforsch., Univ. Duesseldorf, Duesseldorf, Ger.). *Inhaled Particles 3. Proc. Int. Symp., 3rd* 1970 (Pub. 1971). 1, 477–87 (Ger). Edited by Walton, W. H. Unwin Brothers Ltd.: Old Woking, Surrey, Engl. When asbestos (*chrysotile* [12001-29-5], *crocidolite* [12001-28-4]) prepns. of varying fiber lengths (95% <0.4–95% <39 μ) were administered i.p. to rats, the severity of asbestosis varied directly with the fiber length. After i.p. administration of std. dusts of *amosite* [12172-73-5], *anthophyllite* [17068-78-9], and crocidolite to rats, the percentage of long fibers in ashed sections of granulomas was higher than in the original dust, whereas mainly short fibers were deposited in the lymph nodes. This suggests that the short fiber fraction was readily transported by the lymphatic channels. Long chrysotile and glass fibers increased the permeability of monolayer or suspension cultured L cells, measured by loss of lactate dehydrogenase to the medium, to a greater extent than did short fibers, presumably owing to prolonged or incomplete phagocytosis of the fibers by the cells.

CA 76, 37112h (16)

37112h **Cytodynamic reactivity of the mesothelium. Pleural reaction to chrysotile asbestos.** Bryin, Samuel; Bertalanffy, Felix D. (Fac. Med., Univ. Manitoba, Winnipeg, Manitoba). *Arch. Environ. Health* 1971, 23(6), 460–72 (Eng). In rats injected intratracheally with 0.27 mg of natural chrysotile asbestos dust in 0.75 ml saline soln., the airways were obstructed after 7 and 14 days by bronchiolitis obliterans with proliferative nodular connective tissue covered by respiratory epithelium occupying the major proportion of the lumen of many bronchioles and bronchi. Few changes were obsd. in rats treated with synthetic chrysotile or with saline alone. The greater fiber length of natural chrysotile may be a significant factor in its greater irritant effect compared to synthetic chrysotile. Raymond Zahnofennir

CA 75, 32529u (17)

32529u **Alkalinity and coagulation produced by chrysotile asbestos.** Cossette, Marcel; Lemonde, Jean; Massey, Douglas G. (Serv. Pneumol., Univ. Sherbrooke, Sherbrooke, Que.). *Union Med. Can.* 1971, 100(4), 750–64 (Fr). The influence of alky. on the coagulation of human plasma by asbestos is evaluated. The structure of chrysotile asbestos is reviewed, and the development of a std. method for the measurement of pH is described. pH results on aq. suspensions of asbestos from several Canadian mines are reported. The pH of asbestos suspensions in water, in saline, and in human plasma are presented. The effects of atm. contact, temp., and other factors are established. The clin. implications are discussed in relation to asbestos (ferruginous) bodies. Dorothy J. Buchanan Davidson

CA 76, 108791s (18)

108791s **Electromotive phenomenon in metal and mineral particulate exposures. Relevance to exposure to asbestos and occurrence of cancer.** Cralley, Lewis J. (Natl. Inst. Occup. Saf. Health, Public Health Serv., Cincinnati, Ohio). *Amer. Ind. Hyg. Ass., J.* 1971, 32(10), 653–61 (Eng). A REVIEW with 26 refs. A hypothesis is presented with supporting epidemiol. data which relates the CARCINOGENICITY of *asbestos* to the electromotive interactions of the alloy metals from the abrasive action of the fibers on processing equipment and other metals and minerals already present.

CA 73, 53910k (19)

53910k **Role of trace metals in chemical carcinogenesis: asbestos cancers.** Dixon, Joseph R.; Lowe, Dorthy B.; Richards, Donald E.; Cralley, L. J.; Stokinger, Herbert E. (Environ. Contr. Admin., Bur. of Occup. Safety and Health, Cincinnati, Ohio). *Cancer Res.* 1970, 30(4), 1068–74 (Eng). Metals in trace quantities could stimulate or inhibit benzopyrene hydroxylase (I) in rat lung microsomes in vitro, indicating that metal-induced carcinogenesis may be due to delayed metabolism of the benzopyrene. Low concns. of Ca^{2+}, Mg^{2+}, Fe^{2+}, Zn^{2+}, Ni^{2+}, and Co^{2+} stimulated I, whereas higher concns. inhibited it. Be^{2+}, Fe^{3+}, and Cr^{3+} significantly inhibited I. As^{3+}, Se^{4+}, and Cr^{6+} had no effect. Trace metals extd. from chrysotile asbestos inhibited I by 73%, suggesting that the asbestos induces cancer by carrying the metals to the lung. FRJN

CA 73, 54085g (20)

54085g **Experimental tumors from asbestos** (chrysotile, crocidolite and amosite) **in the Sprague-Dawley rat.** Donna, A. (Ist. Anat. Istol. Patol., Univ. Torino, Turin, Italy). *Med. Lav.* 1970, 61(1), 1–32 (Ital). Neoplasm formation from asbestos dusts was studied in female Sprague-Dawley rats reported to have a low frequency of spontaneous tumors of the respiratory system. Lots of animals were given 1 cc intrapleural injections of chrysotile, amosite, or crocidolite asbestos (1 g/15 cc physiol. saline). Two animals from each lot were sacrificed every 2–6 months and examd. grossly and microscopically. Although various types of lesions were observed, only 12 (3 from chrysotile, 5 from amosite, and 4 from crocidolite) out of 102 animals (11.76%) had well defined neoplasm and these occurred after 13 months. Two fundamental types of tumors were observed: pleural neoplasm resembling mesothelioma in the lot treated with chrysotile, and undifferentiated lung cancer in the lots treated with the other fibers. The lesion was most frequently found near the site of the injection. L. Pagnotto

CA 77, 24418h (21)

24418h **Qualitative aspects of dust exposure in the Quebec asbestos mining and milling industry.** Gibbs, G. W. (Dep. Epidemiol. Health, McGill Univ., Montreal, Que.). *Inhaled Particles 3, Proc. Int. Symp., 3rd* 1970 (Pub. 1971), 2,783–99 (Eng). Edited by Walton, W. H. Unwin Brothers Ltd.: Old Woking, Surrey, Engl. Because recent epidemiol. studies of workers in the Quebec asbestos mining and milling industry showed a relation between dust exposure and health indexes, factors in the dust that might affect the exposure were studied. Dust mineralogy and the concns. of org. constituents, trace metals, and radioactivity were detd. Levels of airborne polycyclic aromatic hydrocarbons in mills and of Rn daughters in underground mines were both considered too low to play any significant role in lung cancer mortality. The trace-element content of com. fibers varied between mines and airborne concns. of these metals in the 3 mills exceeded those reported for textile plants. The importance of dust chemistry, physics, and mineralogy in producing exptl. and epidemiol. effects of asbestos is discussed. Richard Holtzman

CA 77, 24420c (22)

24420c **Health hazards of asbestos.** Gilson, J. C. (Pneumoconiosis Unit, Llandough Hosp., Penarth/Glamorgan, Engl.). *Composites* 1972, 3(2), 57–9 (Eng). Inhaled asbestos fibers can cause fibrosis of the lungs and mesotheliomas of the lung and gut. Fibrosis is thought to be caused by fibers between 5 and 100 μm in length and under 2μm in diam. For mesotheliomas it seems probable that the important fibers are straight and small (under 1 × 10 μm). Protection of workers calls for monitoring and controlling their working environment. Keeping improved health records is advised. L. W. Littau

CA 73, 18281j (23)

18281j **Pulmonary response to fibrous dusts of diverse compositions.** Gross, Paul; DeTreville, Robert T. P.; Cralley, Lewis J.; Granquist, William T.; Pundsack, Fred L. (Grad. Sch. of Public Health, Univ. of Pittsburgh, Pittsburgh, Pa.). *Amer. Ind. Hyg. Ass., J.* 1970, 31(2), 125–32 (Eng). Fibrous quartz, chrysotile asbestos, and tremolite talc dust of respirable size, injected intratracheally in the rat produced polypoid proliferative tissue inflammation within the smaller bronchi and bronchitis which was converted into collagenous scars which often caused permanent deformities of the bronchi and bronchioles. After intratracheal injection of a fibrous dust such as synthetic chysotile, ceramic Al silicate, SiC, glass, or brucite, the main pulmonary response was a macrophage reaction with minimal stromal participation. Within 4 days, there were foci of polypoid proliferative inflammation which was limited to the more peripheral repiratory bronchiole and alveolar ducts. Because these lesions did not collagenize, were reversible, and did not destroy the anatomic integrity of the air spaces, these dusts were classed as biol. inert. The lesions were considered to be artifactual since such lesions were not seen in animals inhaling high concns. of these dusts. Wm. MacL. Pierce

CA 72, 6013q (24)

6013q **Asbestos—a new hazard.** Gadian, T. (Laakro Chem., Ltd., Mancnester, Engl.). *Symp. Chem. Process Hazards Spec. Ref. Plant Des., Proc., 3rd* 1967, 61–5 (Eng). Edited by Pirie, J. M. Inst. Chem. Eng: London, Engl. This survey indicates a relation between the increase in the incidence of mesothelioma (a malignant growth of the pleura or peritoneum) and to ubiquitous asbestos exposures which in some cases were minimal in intensity and duration. User industries as well as manufg. industries were at risk and new legislation has been proposed. The controls proposed included: the lowering of max. time of exposure at which the exposure could be considered light to less than the present 8 hrs/week; the elimination of the use of the crocidolite form; and the considerable lowering of the max. acceptable concn. of 5 million particles/ft³ which was based on protection against asbestosis and lung cancer. 15 refs.

CA 75, 46429y (25)

46429y **Hemolysis by asbestos.** Harington, J. S.; Miller, Klara; Macnab, Gwen (Cancer Res. Unit, Natl. Cancer Assoc. South Africa, Johannesburg, S. Afr.). *Environ. Res.* 1971, 4(2), 95–117 (Eng). Chrysotile asbestos hemolyses erythrocytes within 10 min over a wide range of pH. Other forms of asbestos show varying hemolytic activities which are related to the Mg:Si ratio of each form studied. Erythrocytes from different species of animals show different degrees of hemolysis when exposed to chrysotile, amosite, and crocidolite. The length of time during which erythrocytes are exposed to relatively inactive forms of asbestos should also be considered. Amosite and crocidolite show greater hemolytic activities when allowed to react with erythrocytes over 4 hr instead of 1. EDTA effectively prevents hemolysis by chrysotile and other asbestiform materials contg. Mg as a formal part of the lattice. This prevention is pH dependent. Sialic acid is even more effective as a preventive agent than EDTA, suggesting that it may contribute the main anionic groups which react with the pos. charged Mg^{2+} on the surface of chrysotile during hemolysis. Poly-(2-vinylpyridine 1-oxide), an effective inhibitor of hemolysis by silica powder, has little effect on hemolysis by chrysotile. This again accords with the suggestion that Mg is the principal agent in hemolysis by asbestos. An assocn. exists between cytotoxicity and hemolytic activity of various forms of asbestos and other minerals although the significance of this is not yet clear.

CA 75, 116924g (26)

116924g **Relation between the physical and chemical features of asbestos and their pathogenic action.** Kogan, F. M. (Inst. Gig. Tr. Profzabol., Sverdlovsk, USSR). *Patog. Pnevmokoniozov, Tr. Vses. Simp.* 1968 (Pub. 1970), 18–34 (Russ). Edited by Velichkovskii, B. T. Sverdlovsk. Nauch.-Issled. Inst. Gig. Tr. Profzabol.: Sverdlovsk, USSR. A review. 63 refs.
B. Stroesberg

CA 72, 968670c (27)

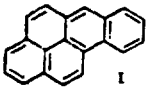
98670c **Biological and mineralogical studies on serpentine minerals in the heat-treated state.** Koshi, Kimiko; Hayashi, Hisato; Sakabe, Hiroyuki (Nat. Inst. Ind. Health, Kawasaki, Japan). *Ind. Health (Kawasaki, Jap.)* 1969, 7(1–2), 66–85 (Eng). The relation between the toxic action of heat-treated serpentine minerals and the structural changes caused by heat treatment was studied. Chrysotile (from South Africa, and the Yamabe mine, Japan), two-layer clino-chrysotile (Sanbagawa, Japan), and antigorite (Komori, Japan) were studied. Heat treatment of these serpentine minerals changed their biol. effects, and all serpentine specimens showed marked cytotoxic and hemolytic action in mice after treatment at ~650°. Most of the mice injected i.p. with minerals treated at this temp. died within 48 hr. after injection, while mice injected with original mineral specimens or minerals heated in other heat ranges did not. A mineralogical x-ray study and thermal differential and ir anal. showed that materials treated at ~650° showed a highly disorganized structure. The change of biol. action by heat treatment may be related to the disordered state of serpentines during transformation into forsterite.
V. N. Nekrassoff

CA 71, 6374n (28)

6374n **Cytotoxicity of asbestos dusts.** Parazzi, Elena; Pernis, Benuemuto; Secchi, Gian C.; Vigliani, Enrico C. (Univ. Milan, Milan, Italy). *Med. Lav.* 1968, 59(10), 581–76 (Eng). Asbestos dusts, Balangero chrysotile and South African crocidolite, were incubated in cultures of guinea pig macrophages to det. their cytotoxic action on these cells. Both dusts were found capable of stopping lactic acid production of the cells, but crocidolite was less active in this respect. The toxicity was largely attributable to the fibrous fraction of the dust samples. Impairment of cell membrane permeability was shown by the lack of fluorescein uptake by the cells. Chrysotile caused a rapid release of lactate dehydrogenase (LDH) from macrophages, but its effect on acid phosphatase was only slightly abnormal. Similar studies with crocidolite showed that it possessed a more toxic effect than chrysotile, and even greater than tridymite. Pretreatment of chrysotile fibers with EDTA or a synthetic polymer, PVPNO, did not modify the release of LDH or acid phosphatase thus suggesting that the toxic action may be related to the phys. rather than the chem. nature of the fiber.

CA 77, 110212t (29)

110212t **Tumors of rats after i.p. injection of powdered chrysotile and benzo(a)pyrene.** Pott, F.; Huth, F.; Friedrichs, K. H. (Med. Inst. Luftbyg. Silikoseforsch., Univ. Duesseldorf, Duesseldorf, Ger.). *Zentralbl. Bakteriol., Parasitenk., Infektionskr. Hyg., Abt. I: Orig., Reihe B* 1972, 155(5–6), 463–9 (Ger). The incidence of tumors in rats after i.p. injection of 100



I

CA 77, 110212t (contd) (29)

mg powd. *chrysotile* [25666-97-1] (asbestos) (fiber length 99% <3 μ) was ~40%, the same as that after injection of std. chrysotile (fiber length 95% <5 μ), but the latent period for tumor development was longer with powd. chrysotile. In both groups, tumor incidence was not significantly influenced by addn. of 1.25 mg *benzo[a]pyrene* (I) [50-32-8]. I without chrysotile induced tumors in 10% of the animals.

CA 77, 57411d (30)

57411d **Experimental asbestos carcinogenesis.** Reeves, Andrew L.; Puro, Henry E.; Smith, Ralph G.; Vorwald, Arthur J. (Sch. Med., Wayne State Univ., Detroit, Mich.). *Environ. Res.* 1971, 4(6), 496–511 (Eng). Guinea pigs, hamsters, rabbits, and rats were exposed to 1 of 3 types of asbestos dust: *amosite* [12172-73-5], *crocidolite* [12001-28-4], or *chrysotile* [12001-29-5]. Inhalation exposures were accomplished in chambers where ball-milled specimens of the dusts were disseminated for 4 hr daily, 4 days weekly, at a mean atm. concn. of ~48 mg/m³. Addnl. animals were injected with the dusts intratracheally, intrapleurally, or i.p. There was a fibrotic reaction in all species to all 3 types of dusts, with amosite evoking the strongest such response, esp. in guinea pigs. Two pulmonary cancers were produced in rats exposed to the inhalation of crocidolite. Local injection into the pleural or peritoneal cavities caused 5 mesotheliomas in rats after chrysotile treatment and 6 mesotheliomas in rats and rabbits after crocidolite treatment. Guinea pigs and hamsters developed no tumors in this expt., and with the dose used, there were no tumors in any species in the amosite group.

CA 77, 43963y (31)

43963y **Biological action of different asbestos dusts with special respect to fiber length and semiconductor properties.** Robock, K.; Klosterkoetter, W. (Steinkohlenbergbauver., Essen, Ger.). *Inhaled Particles 3, Proc. Int. Symp., 3rd* 1970 (Pub. 1971), 1, 465–75 (Eng). Edited by Walton, W. H. Unwin Brothers Ltd.: Old Woking, Surrey, Engl. *Chrysotile* [12001-29-5] was much more cytotoxic than *crocidolite* [12001-28-4] in tests with peritoneal macrophages. This result is inconsistent with epidemiological studies which show the health hazard of chrysotile to be lower than that of crocidolite, and is explained by fiber shape. The thin and straight crocidolite fibers can penetrate into the pleura during inhalation; but not the curved chrysotile fibers. The activation energies of the electron traps and intensities of thermoluminescence of various asbestos samples are given.

CA 72, 93145a (32)

93145a **Asbestos hemolysis.** Schnitzer, R. J.; Pundsack, F. L. (Environ. Sci. Lab., Mt. Sinai Sch. of Med., New York, N.Y.). *Environ. Res.* 1970, 3(1), 1–13 (Eng). Chrysotile fibers exert a marked hemolytic activity on suspensions of washed sheep erythrocytes, but amphibole asbestiform minerals such as crocidolite, amosite, tremolite, and anthophyllite possess only negligible hemolytic properties. The min. hemolytic concn. of chrysotile asbestos is dependent on the openness of the fibers as characterized by the air permeability surface area and decreases with increasing surface area. This fact was also observed in the evaluation of hemolysis of fibrous, nonasbestiform minerals, e.g.,

CA 72, 93145a (contd) (32)

serpolite and nemalite, Chrysotile hemolysis can be inhibited by EDTA and by certain acidic polymers particularly by polystyrene sulfonates, CM-cellulose ether Na salt, and the pyran-copolymer NSC 46015. These substances are not effective as inhibitors of silica (quartz) hemolysis, whereas polyvinylpyridine-*N*-oxide, a very potent antagonist of silica hemolysis, interferes with chrysotile only at high concns. The hemolytic action of chrysotile can be greatly reduced by repeated treatment with red blood cells. The mechanism of asbestos hemolysis cannot yet be satisfactorily interpreted. There is a marked correlation of hemolytic potency with the surface area and the degree of opening of the fibers which may be influenced by the action of the antagonistic polymers. The role of the $Mg(OH)_2$ surface characteristic for chrysotile is not yet elucidated, because $Mg(OH)_2$ is not hemolytic, although nemalite, a natural fibrous $Mg(OH)_2$, and a lightly burned MgO are active hemolytic agents. RCTT

CA 77, 15329c (33)

15329c Association of phagocytosed asbestos dust with lysosome enzymes. Smith, Beverly A.; Davis, J. M. G. (Dep. Pathol., Cambridge Univ., Cambridge, Engl.). *J. Pathol.* 1971, 104(3), 153–7 (Eng). Intrapleural injection of asbestos dust (25 mg) produced GRANULOMAS in guinea pigs. *Acid phosphatase* [9001-77-8] in the granulomas was confined to the lysosome series of organelles, but not all of these structures gave a pos. reaction. In dust-contg. macrophages and giant cells, often <50% of primary lysosomes and 10% of dust-contg. phagosomes contained acid phosphatase. When fibroblasts were present in the granulomas these usually contained small amts. of *chrysotile* [12001-29-5] dust. The implication of these findings on the toxicity of chrysotile asbestos dust is discussed.

CA 77, 30035x (34)

30035x Mechanisms of mesothelioma induction with asbestos and fibrous glass. Stanton, Mearl F.; Wrench, Constance (Lab. Pathol., Natl. Cancer Inst., Bethesda, Md.). *J. Nat. Cancer Inst.* 1972, 48(3), 797–821 (Eng). Application of 7 forms of 3 types of asbestos, 6 types of fibrous glass, 2 types of *silica* [7631-86-9] and nickel-chrome stainless steel and metallic *nickel* [7440-02-0] fragments on a coarse fibrous glass vehicle to the pleura of rats showed that CARCINOGENICITY of asbestos and fibrous glass seems primarily related to the structural shape of the material rather than physiochem. properties. In 2 years, *amosite* [12172-73-5], *chrysotile* [12001-29-5], and 4 different specimens of *crocidolite* [12001-28-4] yielded incidences of pleural mesotheliomas in the range of 58–75%. Hand-milled crocidolite fibers not exposed to extraneous oils or metallic milling yielded dose-related tumor responses comparable to those of a std. ref. milled crocidolite. Std. crocidolite, inducing a high incidence of mesotheliomas, caused fewer mesotheliomas (20–32%) when reduced to submicroscopic fibrils by excessive milling. Pulverized fragments of the steel mill and Ni metal at doses exceeding potential contaminating levels did not induce tumors. Microspheres of noncryst. silica resulted in a single mesothelioma among 48 rats. The intact fibrous glass vehicle did not yield tumors, nor did its absence alter the incidence of crocidolite-induced tumors. However, when the fibrous glass vehicle and 2 other types of fibrous glass, with a mean diam. of 5–10 μ, were reduced to short fibrous fragments and applied to the pleura, 4 mesotheliomas were induced among 91 rats. Two forms of an esp. fine fibrous glass, 0.06–3 μ in diam., further milled to approach the length of asbestos fibers, resulted in moderately high incidences of mesotheliomas (12–16%).

CA 73, 23333g (35)

23333g Formation of the asbestos body. Comparative study with three types of asbestos. Suzuki, Yasunosuke; Churg, Jacob (Mount Sinai Sch. of Med., City Univ. of New York, New York, N.Y.). *Environ. Res.* 1970, 3(2), 107–18 (Eng). Asbestos bodies were produced exptl. in the lungs of hamsters by intratracheal instillation of 3 types of asbestos: soft chrysotile, harsh chrysotile, and amosite. Though some differences were noted, harsh chrysotile and amosite fibers were converted into asbestos bodies by the same successive steps as soft chrysotile: phagocytosis of asbestos by alveolar macrophages and other phagocytic cells and incorporation into phagolysosomes; accumulation of Fe micelles around the fibers, possibly by fusion of asbestos-contg. phagosomes with hemosiderin granules; and compaction of the micelles and clearing of the peripheral zone to form a mature asbestos body. Formation of asbestos bodies seems to be a continuous process with old bodies growing in thickness and uncoated fibers being converted into bodies months or years after instillation of asbestos. Possible origins of hemosiderin granules were discussed. Striking hyperplasia of cell organelles was found. Dorothy J. Buchanan-Davidson

CA 73, 85993f (36)

85993f Pathogenesis of asbestosis. Szymczykiewicz, Konrad (Dep. Aerosols, Inst. Ind. Med., Lodz, Poland). *Pol. Med. Sci. Hist. Bull.* 1970, 13(3), 115–19, 138 (Eng). The cryst. structure of chrysotile asbestos (I) and quartz is responsible for their similar noxious biol. activities. Cryst. I caused pulmonary changes in guinea pigs characteristics for asbestosis whereas amorphous I did not. Cryst. I and quartz significantly increased the O consumption of lung sections of white mice and the γ-globulin fraction of rabbit blood serum compared with controls, amorphous I, coal dust, fiber glass, and (or) fine glass. Textile asbestos factory workers in the spinning and weaving depts., which have higher concns. of longer fibers, have a higher incidence of asbestosis than workers in preparatory depts., where the dust concn. is highest. BCIN

CA 76, 42511s (37)

42511s Pathogenesis of tumors following the intrapleural injection of asbestos and silica. Wagner, J. C. (Med. Res. Counc. Pneumoconiosis Unit, Llandough Hosp., Penarth/Glamorgan, Wales). *AEC Symp. Ser.* 1970, No. 21, 347–58 (Eng). A review on previous expts. and some new data on work in progress are given. All samples of *asbestos* tested produced MESOTHELIOMAS in rats. *Silica* [7631-86-9], which was used as a control dust in previous expts., also produced tumors. Asbestos dusts tested included *amosite, anthophyllite* [17068-78-9], *chrysotile A, chrysotile B,* and *crocidolite* [12001-28-4]. 8 Refs.