Polyvinyl chloride

transfer surface-ionizable constituents to the surface within times of 10^{-6}–10^{-2} sec, depending on the filament temp. These surface-ionizable constituents then become ionized and are released from the surface as a burst of ions. For particles of similar compns., the no. of ions/pulse is related to the particle size. This technique is used in the continuous monitoring of submicron urban particulate matter.

144443n Volume resistivity-fly ash composition relation. Bickelhaupt, Roy E. (South. Res. Inst., Birmingham, Ala.). *Environ. Sci. Technol.* 1975, 9(4), 336–42 (Eng). This research was undertaken to establish a relation between elec. resistivity and chem. compn. for fly ash. Com. produced ashes having a wide variation in chem. compns. were used. The ashes were characterized and made into sintered-disk specimens for resistivity and chem. transference expts. Characterization revealed that the ashes were principally spherically shaped, glassy particles. The results confirmed that vol. conduction was controlled by an ionic mechanism in which the alkali metal ion, mainly Na, served as charge carriers. The Fe concn. of the ash affected the magnitude of resistivity in an inverse manner. Chem. transference and other ancillary expts. suggested that the presence of Fe influenced the no. of alkali metal ions capable of migration. Relations were established between resistivity and specimen porosity, temp. Li–Na concn., and Fe concn. These relations were combined to give an expression which can predict vol. resistivity.

144444p Effect of carbon monoxide on atmospheric photooxidation of nitric oxide–hydrocarbon mixtures. Glasson, William A. (Environ. Sci. Dep., Gen. Mot. Res. Lab., Warren, Mich.). *Environ. Sci. Technol.* 1975, 9(4), 343–7 (Eng). This study was undertaken to assess the importance of CO in photochem. smog formation. The effect of CO concns. up to 424 ppm on the photooxidn. of an ethylene–NO mixt. was studied in a long-path ir cell. The NO_2 rate, O_3 rate, and O_3 yield increased with CO concn., while ethylene oxidn. was unaffected. The effect of CO on the photooxidn. of mixts. of NO with various hydrocarbons was also studied. Of the 6 hydrocarbons studied, CO had effects in the presence of ethylene, isooctane, and mesitylene. The effect of CO concn. on the photooxidn. of a simulated atm. hydrocarbon mixt. was studied. The results were consistent with the conclusion that the effect of CO, at ≤35 ppm, on photochem. smog formation would be minimal.

144445q Dependency of polynuclear aromatic hydrocarbon content on size distribution of atmospheric aerosols. Pierce, Ronald C.; Katz, Morris (Cent. Res. Environ. Qual., York Univ., Toronto, Ont.). *Environ. Sci. Technol.* 1975, 9(4), 347–53 (Eng). An examn. was made of the dependency of polynuclear arom. hydrocarbon (PAH) content on the particle size distribution of atm. suspended particulate matter. Ambient aerosols were collected in specific time periods during 1972 and 1973 using size-fractionating cascade impactors (Anderson "Hi-Vol" samplers) at 5 sites in Toronto, Ontario. Collected particulate matter was extd. with benzene in a Soxhlet app. Eight PAH and 2 oxygenated arenes were sepd. by thin-layer chromatog. and identified and analyzed by absorption and fluoresence spectrophotometry. The efficiency and accuracy of the procedures involved were studied. The size distribution of PAH-contg. particulates followed approx. a log-normal relation for suburban and rural sampling sites with the majority of PAH content assocd. with particles <3.0 μ diam. Significant variations were discovered in PAH content between downtown-urban, urban, suburban, and rural areas. PAH concn. in submicron particles increased during the winter months.

144446r Vertical distribution of nitrogen monoxide, nitrogen dioxide, and nitric acid as derived from stratospheric absorption infrared spectra. Fontanella, Jean C.; Girard, Andre; Gramont, Louis; Louisnard, Nicole (Off. Natl. Etud. Rech. Aerosp., Chatillon, Fr.). *Appl. Opt.* 1975, 14(4), 825–39 (Eng). NO, NO_2, and HNO_3 were detd. in the low stratosphere (16 km) in June–July, 1973, at medium north latitudes. The integrated amt. of NO along the optical path is $(4 \pm 1.5) \times 10^{16}$ mol/cm³ for a solar elevation of +2° to −1° above the horizontal plane; 6×10^8 mol/cm³ is the upper limit for concn. at the flight altitude. There is no significant difference in the integrated amt. obsd. at sunset and sunrise. NO_2 concn. at 15.5 km is $(1.1 \pm 0.2) \times 10^9$ mol/cm³, in sunset conditions, and does not vary significantly between 15 km and 30 km. HNO_3 concn. at 15.5 km is $(1 \pm 0.3) \times 10^{10}$ mol/cm³ and increases between 15 and 20 km to a max. at 20 km of $(2 \pm 1) \times 10^{10}$ mol/cm³.

144447s Applications of bioassay of uranium. Alexander, R. E. (Directorate Regul. Stand., AEC, Washington, D. C.). *Report* 1974, WASH-1251, 209 pp. (Eng). Avail. Dep. NTIS. From *Nucl. Sci. Abstr.* 1974, 30(6), 16018. The criteria for a U bioassay program are given. A bioassay program is necessary if air sampling is needed for purposes of personnel protection. The extent of the bioassay program is detd. by the magnitude of air sample results. It must be shown that air sample results used for this purpose are representative of personnel exposure. Under the min. program, bioassays are performed semiannually or annually for all workers to monitor the accumulation of U in the lung and bone. More frequent bioassays are performed for a sample of the most highly exposed workers as a check on the air sampling program, and these bioassays are performed at sufficient frequency to assure that a significant single intake of U will be identified before biol. elimination of the U renders the intake undetectable. A model is used which correlates bioassay measurement results with radiation dose or with uptake of U in the blood (chem. toxicity). Actions are specified, depending upon the dose or uptake indicated by bioassay results. Guidance is provided for detg., from individual data rather than models, the quantity of U in body organs, the rate of elimination, and the dose commitment. Data are appended on mass limits for U in blood, urinary excretion factors, biol. models for the tissue distribution and excretion of inhaled U, and in vivo measurement capability for mixts. of U isotopes.

144448t Chromium as an occupational health hazard in production of alumina from bauxite. Budanova, L. F.; Trofimov, V. A.; Eremeeva, L. A.; Mamchenko, M. S.; Naidenov, N. I. (Inst. Gig. Tr. Prof., Leningrad, USSR). *Gig. Tr. Prof. Zabol.* 1974, (10), 47–8 (Russ). During the prodn. of Al_2O_3 from a charge contg. ground bauxite and limestone by sintering in a tubular furnace, the insol. compds. of Cr^{3+} are transformed into the Cr^{6+} form by redn. These Cr^{6+} compds. are present in the dust of sintered products and in alk. aerosols. Otolaryngol. studies indicate that workers exposed to the dust and aerosols develop symptons of atrophic rhinitis, allergic rhinotomy, and bronchial asthma. The removal of Cr from the raw materials in the initial stages of Al_2O_3 prodn. is recommended. J. Suschka

144449u Determination of the class of danger of vapors of industrial toxic liquids. Kurlyandskii, B. A.; Zav'yalov, N. V. (Mosk. Gorodskaya Sanepidstants, Moscow, USSR). *Gig. Sanit.* 1975, (2), 90–2 (Russ). An equation is proposed for classifying toxic substances into exceedingly, highly, moderately, and slightly dangerous categories. It uses the product of both the oral and inhalation classifications of S. D. Zaudol'nikov (1967), the sq. root of the max. permissible concn., and the b.p. A classification is made of 38 substances and the data on which they are based. J. H. Scott

144450n Carbon monoxide in the urban atmosphere. Hazards to the pedestrian and the street worker. Wright, Geoffry R.; Jewczyk, Stephan; Onrot, Jack; Tomlinson, Paul; Shephard, Roy J. (Sch. Hyg., Univ. Toronto, Toronto, Ont.). *Arch. Environ. Health* 1975, 30(3), 123–9 (Eng). The CO levels in downtown Toronto were 10–50 ppm in the summer and fall of 1973, varying with wind speed and direction, traffic d., and the height of nearby buildings. Av. concns. in poorly ventilated underpasses and underground garages were much higher. Street closures for a pedestrian mall reduced mall levels to the general urban background without large increases in concns. on adjoining streets. M. Allen

144451p Changes in pulmonary function in workers exposed to vinyl chloride and poly(vinyl chloride). Miller, Albert; Teirstein, Alvin S.; Chuang, Ming; Selikoff, Irving J.; Warshaw, Raphael (Mt. Sinai Sch. Med., City Univ. New York, New York, N. Y.). *Ann. N. Y. Acad. Sci.* 1975, 246, 42–52 (Eng). Spirometry and max. expiratory flow–vol. curves of 348 workers in a vinyl chloride polymn. plant show a diminution in air flow in 200 (57.5%) workers. This correlated with age and duration of exposure. A relation with smoking was noted only in younger workers with exposures of <10 yr. When age is >40 yr or exposure >20 yr, the prevalence was similar in both smokers and nonsmokers, indicating that occupational or other environmental factors were operative.

144452q Safety measures and optimal solution of accident situations. Kopelent, Zdenek (Chem. Zavody, Cesk. Sovetskeho Pratelstvi, N. P., Zaluzi, Czech.). *Chem. Prum.* 1975, 25(2), 96–8 (Czech). Accident prevention in chem. plants is discussed. Emphasis is given to fire extinguishment. J. Strnad

144453r Microclimatic conditions in coal preparation plants. Akhlyustin, V. K.; Prasolov, Yu. K. (Sverdl. Gorn. Inst. im. Vakhrusheva, Sverdlovsk, USSR). *Izv. Vyssh. Uchebn. Zaved., Gorn. Zh.* 1974, 17(10), 139–40 (Russ). For economical use of elec. installations, the probability d. curves were detd. for dust concn., CH_4 concn., and air humidity for various sections of coal prepn. plants of 3 coal fields. P. Skrabanek

144454s Future implications of some long-lived fission product nuclides discharged to the environment in fuel reprocessing wastes. Bryant, Pamela M.; Jones, J. A. (Natl. Radiol. Prot. Board, Harwell/Didcot/Berks., Engl.). *Natl. Radiol. Prot. Board, (U. K.), [Rep.]* 1972, NRPB-R8, 15 pp. (Eng). ^{85}Kr is discharged into the atm. and its crit. human organ is the gonads, T is discharged as water and its crit. human organ is the gonads, and ^{129}I is discharged mainly into water and its crit. human organ is the thyroid. Upper limits for cumulative amts. of each of these present in the environment up to the year 2000 are estd. based on predicted fuel reprocessing programs, and forecasts of somatic and genetic radiation exposure from each nuclide for populations of different proximity to the fuel

of agents are used which could contribute to the haemolytic effect of the dust. Therefore, samples (7.5 mg) of KM 1 PVC were washed once, twice and three times (5 s each wash, in 3 ml veronal buffer on a whirlimix; followed by centrifugation, 2,000 r.p.m. for 20 min) and the haemolytic potency of the washed dust samples and the supernatant fluid were compared with the lytic potential of an untreated PVC sample (Fig. 2). After a single wash, the haemolytic potency of KM 1 PVC is reduced by over 60% and subsequent washes reduce the activity of the dust even further. Thus the removal of some surface-associated material, which must exist in a reasonably soluble form, considerably reduces the biological potency of this PVC dust. It is also evident that this material, once removed from the dust surface and diluted out in solution, has very limited haemolytic activity (Fig. 2).

The effect of KM 1 PVC was studied on the levels of cell mat DNA, RNA, protein and hydroxyproline (assessment of collagen) in lung fibroblast cultures maintained *in vitro* for 24 d. The methods of isolation and cell culture and the analyses for DNA, RNA protein and hydroxyproline have been detailed previously[4,5]. Before addition of different concentrations of KM 1 PVC (50–200 μg ml^{-1} culture medium or 0.5–2.0 mg per culture) the dust sample was first washed in a balanced salt solution containing antibiotics (see legend to Fig. 3). Other methods of dust sterilisation (heat, autoclaving, radiation)

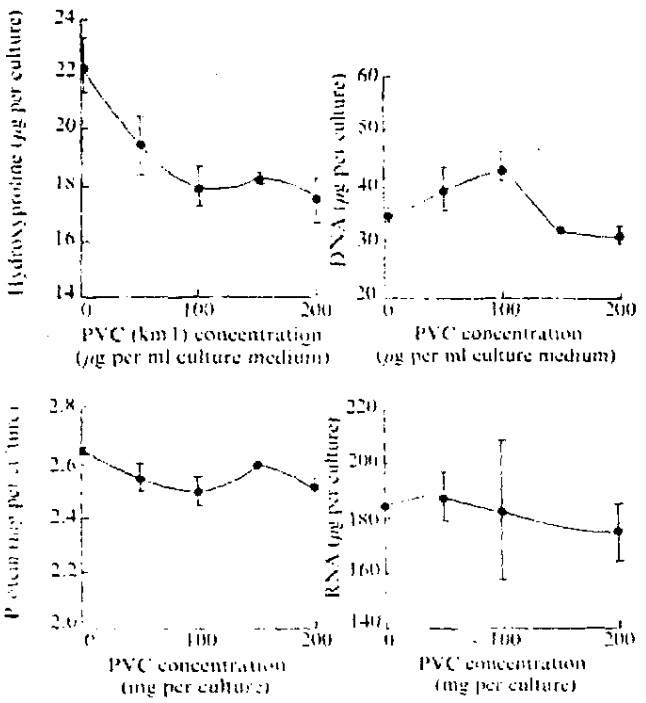

Fig. 3 The effect of different concentrations of KM 1 PVC on lung fibroblast cultures. The PVC sample was first washed with an antibiotic solution (penicillin (100 units) streptomycin (100 μg) in 1 ml) and then added as a single dose to 3-d-old cultures (in logarithmic growth). Cultures were maintained in 10 ml of 20% foetal bovine serum plus Waymouth's medium containing additional ascorbic acid[5], changed twice weekly and removed for analysis on day 24.

were not considered to be feasible and while the washing procedure undoubtedly reduces the ability of this PVC sample to damage cell membranes (Fig. 2) fibroblast cultures treated with the dust all had lower levels of cell mat hydroxyproline after 24 d (Fig. 3). Some fluctuation in DNA levels was apparent with different dust concentrations but the significance of these is doubtful without further experimentation. There is little change in the level of total protein or RNA in the PVC-treated cultures.

From these preliminary findings we conclude that certain forms of PVC dusts exhibit a high haemolytic potential because of the presence of a readily soluble, surface-associated agent. Exposure to this type of PVC dust may thus constitute an additional health hazard because of the increased biological activity of the dust. Work is in progress to determine the nature of the haemolytically-active agent by assessing a wide range of PVC dusts of which complete knowledge has been obtained of the chemical processing. The possibility that VCM is the active agent has been explored, but both samples tested were found to contain immeasurable amounts of VCM (< 1 p.p.m.). Nevertheless, the present study indicates that the introduction of a washing procedure after the processing of KM 1 PVC dust would certainly reduce or abolish the haemolytic activity of this material.

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Mechanism of induction of haemolytic anaemia by phenylhydrazine

A compound with the optical spectrum of a ferrihaemochrome was produced when ferricyanide-oxidised phenylhydrazine was added to a solution of ferrihaemoglobin[1]. The three isomers of methylphenylhydrazine similarly resulted in ferrihaemochromes, but 4-hydrazinobenzoic acid did not[2]. The induction of haemolytic anaemia by a substituted phenylhydrazine was related to the reactivity of its oxidised form with ferrihaemoglobin to produce a ferrihaemochrome[2,3]. Further studies of the reaction of oxidised arylhydrazine with ferrihaemoglobin have established that the formation of a ferrihaemochrome-like product and the character of the optical spectrum of this product depend on the nature and position of substituents on the benzene ring of phenylhydrazine.

Substituted phenylhydrazine hydrochlorides were obtained from commercial sources or were synthesised by standard procedures. Each compound was purified by recrystallisation from 2 N HCl or ethanol, and the structure and purity of the recrystallised product were confirmed by its NMR spectrum, infrared spectrum, melting point, and analyses for C, H, N, and Cl. Oxyhaemoglobin solutions were deoxygenated by the passage of oxygen-free[4] nitrogen or helium, and the resulting ferrohaemoglobin was oxidised to ferrihaemoglobin by the addition of excess ferricyanide. To a solution of ferrihaemoglobin in excess ferricyanide, a solution of arylhydrazine hydrochloride in water or ethanol was added, and the optical spectrum that resulted was recorded with the Cary Model 17 instrument. The spectra obtained with 3- and 4-chlorophenylhydrazine were similar to that previously reported with unsubstituted phenylhydrazine[2]. The spectra obtained with 3,4- and 3,5-dichlorophenylhydrazine were distinguished by a more prominent absorption band in the red than the others. 2-Chloro- and 2,3-, 2,4-, and 2,5-dichlorophenylhydrazine resulted in spectra with a single broad maximum at around 540–550 nm and without a band in the red. 2-6-Dichlorophenylhydrazine, 2,6-dimethylphenylhydrazine, 2-hydrazinobenzoic

regrowth) of a peripheral nerve leads to a remarkable overproduction of Schwann cells in the distal nerve stump reaching a point at which these cells are applied in multiple layers around each single axon. Also, in crush lesions of the abnormal peripheral nerve roots of dystrophic mice, where a paucity of Schwann cells and myelin segments provides much less degenerating material than in normal nerve, an increase in the number of myelin segments and, presumably, Schwann cells is induced by crush injury[7]. The importance of the axon in provoking Schwann cell proliferation is also indicated by observations, on the proximal stump of severed or crushed sciatic nerve, that proliferation occurs independently of widespread nerve fibre or myelin degeneration and in conditions in which nerve regeneration is most actively occurring[8].

Our observation of the axon–Schwann cell interaction resulting in mitogenesis illustrates one use of cultures containing either 'pure' Schwann cell populations or bare neurite preparations. These preparations may be useful in further analysis of the interaction between neurite and Schwann cell, as well as in studies of the basic properties of the Schwann cell itself.

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Biological reactivity of PVC dust

CONCERN has been expressed about the biological potential of polyvinyl chloride (PVC) and its associated monomer vinyl chloride monomer (VCM)[1]. During the industrial processing of PVC, workers can be exposed to varying quantities of this material in the form of a dust. At the present time, however, there is little detailed biological or biochemical information on the effects of inhaled or ingested PVC, or on the reactivity of this dust material. The biological reactivity of other dusts (silica, asbestos) have been studied by a haemolysis technique[2] which is useful for assessing the degree of membrane-induced damage by a variety of toxic materials. Other *in vitro* screening systems using lung[3] and other cells[4] have also provided useful information on structural and biochemical changes induced by particulate matter. Here we report on the haemolytic potential of PVC dust, comparison of which is made with the highly haemolytic and biologically reactive chrysotile asbestos A (UICC standard reference sample) and the effect of PVC on lung fibroblast cultures.

The haemolysis technique used has been described in detail previously[2]. The degree of haemolysis was expressed as a percentage of the totally lysed sample and the results presented as the means and ranges (if any) of, at least, quadruplicate assays. Two samples of PVC were tested (KM 1 and KM2) both of which were obtained as finely-divided dried powders which had been formed by standard processing procedures for use in fabrication work.

The first sample (KM 1) was highly haemolytic at relatively low concentrations, 100% haemolysis (over 50 min) being achieved by between 7.5 and 10 mg of dust (Fig. 1*a*). With increasing concentrations of PVC, haemolysis seems to be reduced but this effect is most likely the result of some of the released haemoglobin binding to the dust, which is then spun down into the pellet. Sample KM 2 PVC was found to be practically non-

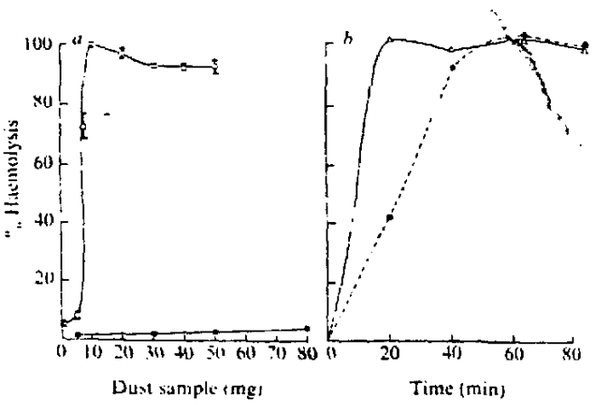
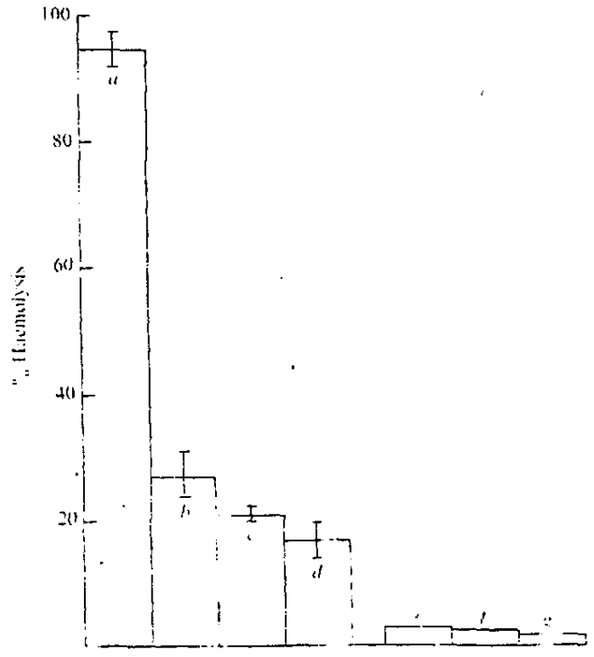


Fig. 1 Haemolysis by PVC dusts and chrysotile asbestos. *a*, Haemolytic potency of KM 1 (○) and KM 2 (●) PVC samples after 50 min; *b*, change in haemolysis with time by 7.5 mg samples of UICC chrysotile asbestos A (△) and KM 1 (●) PVC. Briefly, a 1% (v/v) suspension of packed rabbit erythrocytes in veronal buffered saline, pH 7.4, was used in all the experiments. The incubation mixture normally consisted of dust sample with 1 ml 1% erythrocyte suspension + 3 ml veronal buffered saline. After incubation and agitation for 50 min (or varying time intervals) at 37 °C the samples were centrifuged at 2,000 r.p.m. for 20 min and the extinction of the supernatant read at 541 nm. Controls consisting of a totally lysed sample (1 ml 1% erythrocyte suspension + 3 ml water) and a fragility control (1 ml 1% erythrocyte suspension + 3 ml veronal buffered saline) were treated identically in each experiment.

haemolytic. A sample of 100 mg of KM 2 PVC gave an equivalent haemolytic effect to 1 mg of sample KM 1. The haemolytic activity with time of a sample of KM 1 PVC (7.5 mg) was compared with an equivalent mass of chrysotile asbestos A (Fig. 1*b*). It is evident that the asbestos is a faster haemolytic agent, although total lysis is achieved by PVC after 1 h.

During the processing of different forms of PVC, a variety

Fig. 2 Haemolysis by washed samples of KM 1 PVC dust (7.5 mg) and the resulting supernatant fluids from these washings compared with the haemolytic activity of the untreated dust sample. KM 1 PVC: *a*, Untreated; *b*, washed once; *c*, washed twice; *d*, washed three times; *e*, wash 1; *f*, wash 2; *g*, wash 3.



Vinyl acetate

TOXICOLOGY AND APPLIED PHARMACOLOGY 68, 43–53 (1983)

Chronic Toxicity Studies of Vinyl Acetate in Fischer Rats[1,2]

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Chronic Toxicity Studies of Vinyl Acetate in Fischer Rats. LIJINSKY, W., AND REUBER, M. D. (1983). *Toxicol. Appl. Pharmacol.* 68, 43–53. A chronic toxicity test was carried out in groups of 20 male and female F344 rats with vinyl acetate dissolved in drinking water at two concentrations, 2500 and 1000 mg/liter. Treatment lasted for 2 years and did not lead to early death of the animals compared with untreated controls. The incidence of most types of neoplasm was similar in the treated and control groups. However, six females receiving the higher dose of vinyl acetate had adenoma or carcinoma of the thyroid and five had carcinoma of the uterus; the latter were not seen in the controls.

The discovery that vinyl chloride is carcinogenic was made first in experimental animals (Viola *et al.*, 1971), followed some years later by epidemiological observations in man (Creech and Johnson, 1974). More recently the closely analogous acrylonitrile (vinyl cyanide) was reported to be carcinogenic in rats (Maltoni *et al.*, 1977), and this report raises the question whether carcinogenicity is a general property of vinyl compounds or whether, as is more likely, carcinogenic activity is restricted to only certain compounds containing the vinyl group, perhaps only the two mentioned above. Indeed, styrene (vinylbenzene) is not carcinogenic as demonstrated in a chronic bioassay in rodents at maximally tolerated dose (NCI, 1979).

One vinyl compound which, in addition to vinyl chloride, acrylonitrile, and styrene, is manufactured in very large quantities (1 million tons a year) is the ester vinyl acetate used for treating textiles. This compound has been tested by chronic administration in the vapor phase by inhalation (Maltoni, 1977) which resulted in no significant increase in tumor incidence. The dose received by the animals was necessarily limited by the small volumes they can breathe. The lack of mutagenicity of vinyl acetate in *Salmonella* (Lijinsky and Andrews, 1980) gives only limited indication of safety.

We undertook an experiment in which vinyl acetate was administered to rats in drinking water for 2 years at concentrations of 2500 and 1000 mg/liter (parts per million) which resulted in doses much higher than can be given by inhalation. Because of resource limitations we could not establish that 2500 mg/liter was the maximally tolerated dose of vinyl acetate, but we felt that it was sufficiently high to ensure a positive result if the compound were significantly carcinogenic to rats.

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