

<473> COST.

predicted, and sarcosis was the most important effect for ten times the threshold limit. Lung-injuring halogen compounds evolving from vinyl chloride on pyrolysis or contact with hot metal also present a hazard. The recommendation for the standard remained the same in 1956.

STANDARDS: LUNG; OCCUPATIONAL EXPOSURE; REVIEW; DEGRADATION

<474>

Sobels, P.M. Induction of genetic damage by chemical mutagens. University of Leiden, Leiden, Netherlands (sponsor: NIKES) Ongoing Research Project

Studies on *Drosophila* of suspected mutagens, including vinyl chloride, include preliminary screening, investigation of effects on male germ cell stages, and determination of mutagenic mechanisms.

MUTAGENICITY; RESEARCH ONGOING; DROSOPHILA

<475>

Society of Plastics Engineers, Inc.; Occupational Safety and Health Administration VCH - The OSHA Standard and its interpretation. Technical Papers, Regional Technical Conference (10/31 - 11/1, 1974), Society of Plastics Engineers, Inc., New York City 49-63 (1974).

A question and answer conference session via telephone was held between the Society of Plastics Engineers Conference in New York City and the Occupational Safety and Health Administration (OSHA) Standards and Compliance Groups in Washington, D.C. In addition to this transcription, 122 questions which were not answered by OSHA are listed. OSHA feels that their forthcoming "Program Directive" should answer a majority of these questions. Further communications should be addressed to Ms. Flo Byer, Office of Compliance Programming, OSHA, 1726 "B" Street, N.W., Washington, D.C. 20210.

REGULATIONS; STANDARDS

<476>

Society of Plastics Engineers, Inc., Palisades Section, Vinyl Plastics Division VCH -- The processors' perspective. Technical Papers, Regional Technical Conference (10/31 - 11/1, 1974), Society of Plastics Engineers, Inc., New York City 204 pp., 2 appendices (1974).

This two-day technical conference was scheduled by the Society of Plastics Engineers to disseminate information relative to the new vinyl chloride (VC) regulation, with emphasis on the effect on the PVC processor. Featured were the history of the VC situation; summaries of OSHA, FDS, and EPA regulations -- both current and proposed; explanations of the regulations; analytical devices and methods for detection and monitoring; protective equipment; techniques to minimize VC exposure; analysis of future needs of the industry; and educational displays pertinent to the technical papers. Questions and answers follow most papers.

CONFERENCE; MANUFACTURE; REGULATION; INDUSTRIAL HYGIENE

<477>

Spector, W.S., (Ed.) Vinyl chloride Handbook of Toxicology, Vol. 1. Acute Toxicities of Solids, Liquids and Gases to Laboratory Animals. W.B. Saunders and Co., Phil., PA. Table II: 351-353 (1956).

Guinea lethal concentration of vinyl chloride for mice is 625-750 mg/liter or 233,000 - 280,000 ppm administered continuously for 10 minutes. Lethal concentration for the guinea pig is 1024 mg/liter or 400,000 ppm administered continuously for 10-20 minutes.

MICE; GUINEA PIG; LETHAL CONCENTRATION (LC)

<478>

Spiras, E.; McMichael, A.J.; Gamble, J.; Van Ert, B. The association of vinyl chloride exposures with morbidity symptoms. Amer. Ind. Hyg. Assoc. J. 36(10): 779-789 (1975).

Self-reported symptoms relating to job type and calendar year were collected through a mail questionnaire survey of a population of vinyl chloride (VC) polymerization workers, and is identical to those from a population of rubber workers as controls. Information was sought on 8 symptoms: dizziness, passing out, nausea, headache, cardiovascular disturbance, neuromuscular disturbance, local irritation, and generalized anesthesia. The exit of observation was reported as a person-job in order to dispense the effect of individual variability. Answers were recorded according to symptom category, and were analyzed according to a Categorical Linear Data Model procedure. A clear dose-response pattern appeared for five symptoms: dizziness, nausea, headache, cardiovascular disturbance, and general fatigue.

EPIDEMIOLOGY; STATISTICS; INDUSTRIAL HYGIENE; OCCUPATIONAL EXPOSURE

<479>

Stankevich, K.I.; Kravchenko, T.I.; Antonyuk, D.K.; Kharchenko, T.F.; Reising, I.S. (Effect of the microclimate of test conditions on volatile compound migration from polyvinyl chloride materials). Gig. Sanit. 6: 11-14 (1974).

Emission of volatile compounds into the air by polyvinyl chloride in test premises depended on air temperature, time, humidity, and static electricity.

Mass.; Eng. Sans.

DEPOLYMERIZATION; NON-OCCUPATIONAL EXPOSURE

<480>

Steiner, P.G. (Ed.) Vinyl chloride. The Merck Index: An Encyclopedia of Chemicals and Drugs. Merck & Co., Rahway, N.J. 8th ed., p 1108 (1968).

Chloroethylene (CH₂=CHCl) is a synonym for vinyl chloride. The gaseous chemical was first prepared by Regnault in 1835. A patent for its

<480> CONT.

preparation by halogenation of ethylene was granted to National Distillers and Chemical Corp. in 1958. The colorless gas liquefies in a freezing mixture. Melting point is -160 degrees C; boiling point is -14 degrees C. Vinyl chloride is soluble in alcohol and polymerizes in light or in the presence of a catalyst. The main uses are in the plastics industry, as a refrigerant, and in organic syntheses. It causes necrosis in high concentrations and frostbite by rapid evaporation if spilled on the skin.

PROPERTIES

<481>

Stein, G.; Juehe, S.; Lange, C.-E.; Veltman, G. Skelettveränderungen bei der sogenannten Vinylchlorid-Krankheit (Skeletal alterations in the so-called vinyl chloride illness.) Roentgen Bl. 26: 350-355 (1973).

Roentgenological examination of 10 patients with so-called vinyl chloride illness confirms the typical osteolysis appearing as bands in the terminal phalanges. Appearance of bandlike osteolysis represents a positive diagnosis for the existence of "vinyl chloride disease".

Ger.

HUMAN; BONE; CASE STUDY; ACROOSTEOLYSIS; OCCUPATIONAL EXPOSURE; OSTEOLYSIS

<482>

Stein, G.; Juehe, S.; Lange, C.-E.; Veltman, G. Bandförmige Osteolysen in den Endphalangen des Handgelenkes. (Band-like osteolysis of the terminal phalanges of the hands.) Fortschr. Roentgenstr. 118(1): 60-63 (1973).

Two polyvinyl chloride autoclave cleaners exhibited band-like osteolyses of the terminal phalanges of the hands. These specific scleroderma-like changes are reversible. The disease is linked specifically to occupational causes.

Ger.

HUMAN; BONE; RAYNAUD'S PHENOMENON; ACROOSTEOLYSIS; OCCUPATIONAL EXPOSURE

<483>

Stringer, W. Epidemiological study of workers exposed to vinyl chloride (mortality studies). PHS Center for Disease Control, Cincinnati, Ohio (Sponsor: NIOSH) Ongoing Research Project (1975).

Retrospective mortality studies begun in 1975 as a result of the discovery of several cases of angiosarcoma in a polyvinyl chloride processing plant are being continued.

EPIDEMIOLOGY; MORTALITY; OCCUPATIONAL EXPOSURE; RESEARCH ONGOING

<484>

Stalova, Z.A. (Characteristics of the state of thermoregulation in chronic vinyl chloride poisoning.) Gig. Tr. Prof. Zabol. 17(3): 53-55 (1973). (BA 57: 23156)

Workers -- 40 men and 56 women from 25 to 45 yrs of age -- exposed chronically to vinyl chloride for 3 to 15 yrs exhibited both subnormal and increased body temperatures. Acrocyanosis, decreased arterial flow, and spasm of capillaries and reduce caliber arteries could not be attributed entirely to the state of the peripheral circulation. Clinical physiological analysis indicated that these disturbances, and those of heat production, were due to functional impairment of the hypothalamic brain structures. Thermoregulation should be studied for early detection of chronic vinyl chloride poisoning.

Russ.

OCCUPATIONAL EXPOSURE; DIAGNOSTIC; THERMOREGULATION

<485>

Sucia, I.; Drejsan, I.; Valaskai, E. Etude des maladies dues au chlorure de vinyle. (Study of illnesses due to vinyl chloride.) Med. Lavoro 58(4): 261-271 (1967).

Clinical and biochemical findings in 168 workers engaged in the production of polyvinyl chloride allowed clarification of the clinical pattern of the induced diseases by such a substance. Besides the narcotic-type syndrome, symptoms of acroesthesia were observed after repeated exposures. Liver enlargement was present in 30.2% of the cases; Raynaud's syndrome was observed in 6%. Skin manifestations were chemical and allergic dermatitis and scleroderma. In 50% of cases with scleroderma, thyroid impairment was also observed. The skin and muscle biopsy, performed in 3 cases, showed a pattern of collagenosis. All skin manifestations had disappeared within a year after stopping work, except in one case. The initial appearance of nervous manifestations and of digestive, angioneurotic, and cutaneous phenomena suggests that cerebral cortex damage, and later on diencephalic and endocrine damage, play an important role. (Modified author abstract)

FR.; Eng. Summ.

SARCOSIS; NEUROLOGICAL; LIVER; SKIN; RAYNAUD'S PHENOMENON; EPIDEMIOLOGY; ANGIONEUROSIS

<486>

Sucia, I.; Drejsan, I.; Valaskai, E. Contributii la studiul bolnavilor produse de clorura de vinil. (Contributions to the study of diseases caused by vinyl chloride.) Med. Internu 15(8): 967-978 (1963).

Toxic symptoms in a group of 168 employees from 2 polyvinyl chloride plants included the narcotic syndrome and angioneurotic disturbances. Hepatomegaly was present in 30.2% of the cases and Raynaud's syndrome in 6%. Cutaneous manifestations consisted of chemical and allergic dermatitis as well as scleroderma. Biopsy revealed collagen disease in 3 cases. All cutaneous manifestations (except in one case) disappeared within one year after interrupting work in the polyvinyl chloride plant. Cortical

<186> CONT.

dynamic disturbances and, later, the diencephalic centers and endocrine system play a role in causing these symptoms.

Rom.; Eng. Summ.

LIVER; SKIN; GASTROINTESTINAL; NEUROLOGICAL; ANGIOMYOSIS; BIOCHEMISTRY; HUMAN; BAYNARD'S PHENOMENON; OCCUPATIONAL EXPOSURE

<187>

Sachs, I.; Prodan, L.; Ilea, S.; Paduraru, A.; Pascu, L. Clinical manifestations in vinyl chloride poisoning. Ann. N.Y. Acad. Sci. 246: 53-69 (1975).

In 1961, the study of clinical and biological manifestations in workers of vinyl chloride (VC) manufacturing plants was begun. Examinations were repeated by the same staff from 1962 through 1969. Acute and subacute poisonings occurred with high concentrations of VC, but when concentrations were decreased by 22 times, acute poisonings disappeared and chronic manifestations occurred. Changes in the nervous, cardiovascular, digestive, cutaneous, endocrine, and hematologic systems were recorded and studied. Measures such as hermeticization, reduction of hours of exposure, vitamin therapy, change in job, and a 22-fold reduction in toxic substance in the air reduced symptoms by two-thirds. The results and discussion section is subdivided into nervous manifestations, cardiovascular manifestations (arterial hypertension), digestive manifestations, respiratory manifestations, cutaneous manifestations, endocrine alterations, hematologic changes, and prophylactic and therapeutic measures.

SKIN; LUNG; CARDIOVASCULAR; NEUROLOGICAL; LIVER; ENDOCRINE; EPIDEMIOLOGY

<188>

Sagisato, F. Air pollution resulting from vinyl chloride and ethylene dichloride in Fukuoka City. Proc. Conf. Environ. Health, 18th, Oct. 3-8, 1974, Fukuoka, Japan p. 80-81 (1974). (Air Pollution Abstracts, 1975: 44457; APIC No. 67685).

Pollution of the Fukuoka area, one of the leading industrial areas in Japan, by vinyl chloride type compounds is characteristic of the area. Concentrations ranged from 0.9 to 24.8 ppb, decreasing with distance from industrial pollutant sources.

Japan.

ENVIRONMENT

<189>

Sullivan, L.; Union Carbide Comparative metabolism of vinyl chloride in various species including man. Carnegie-Mellon Institute (Sponsor: Union Carbide Corp.) Ongoing Research Project (1975).

RESEARCH ONGOING; HUMAN; METABOLISM

<190>

Suskind, R.R. (Analysis of low ambient levels of vinyl chloride). University of Cincinnati. (Sponsor: National Institutes of Environmental Health Sciences) Ongoing Research Project

Center for the Study of the Human Environment Methods in being developed for analysis of low ambient levels of vinyl chloride and for evaluating permeation tubes for preparing accurate gaseous vinyl chloride standards.

RESEARCH ONGOING; ANALYSIS

<191>

Fabernshaw, I.R.; Gaffey, R.R. Mortality study of workers in the manufacture of vinyl chloride and its polymers. J. Occup. Med. 16(8): 509-518 (1974).

A mortality study of 8384 men who had at least one year of occupational exposure to vinyl chloride demonstrated that cancers of the digestive system, respiratory system, brain, and cancers of unknown site occurred more often than expected in those workers with the greatest exposure. There was an unexplained inverse relation of buccal cavity and pharynx cancers to exposure. The overall mortality of the study population was approximately 75% of the expected, with an statistically significant cause of death other than that expected in a comparable population. No cases of angiosarcoma of the liver were found which had not been previously identified. There was a consistent pattern of increased mortality from cancer with an increase of exposure or estimated exposure to vinyl chloride.

CANCER; ANGIOSARCOMA; OCCUPATIONAL EXPOSURE; STATISTICS; EPIDEMIOLOGY; MORTALITY

<192>

Fabernshaw, I.R.; Gaffey, R.R. Reply to Robert B. Sager's Letter. J. Occup. Med. 16(12): 772-773 (1974).

This reply to the Sager polemic (J. Occup. Med. 16: 772 (1974)) defends the conclusions in the Fabernshaw-Gaffey vinyl chloride mortality study (J. Occup. Med. 16(8): 509-518 (1974)). To wit, common sense must mediate any generalization from a study population to the population-at-risk, if a purely statistical process is impossible; secondly, that the complexity of facts in the epidemiology of vinyl chloride requires a temperate conclusion from the data at hand.

STATISTICS; EPIDEMIOLOGY; LETTER

<193>

Takenuchi, Y.; Sabeuchi, C. A case of occupational acropostolysis, presumably caused by vinyl chloride. Jap. J. Ind. Health 15: 385-394 (1973).

Japan is second to the United States in production of vinyl chloride. Baynard's phenomenon was reported among workers in a vinyl chloride (VC) manufacturing plant in 1954. Three of these workers were reexamined in 1970 but neither Baynard's phenomenon nor acropostolysis

<493> CONT.

was found. The case study of a 36-yr old man who had worked as a VC polycleaner for 4 1/2 years revealed acroosteolysis, Raynaud's phenomenon, sclerodermas, and induration of both hands. The epidermis of the skin of the left hand was normal, but collagen fibers were edematous, and thickened wall and infarction of vessels was present in the corium. Certain sequelae to the vinyl chloride poisoning persisted after 9 yrs away from the job as polycleaner. Present serious acceptable concentration of VC in Japan is 500 ppa.

Japan.; Eng. Sum.

ACROOSTEOLYSIS; RAYNAUD'S PHENOMENON; SKIN; OCCUPATIONAL EXPOSURE; HUMAN; CASE STUDY

<494>

Taylor, K.J.B.; Williams, D.E.J.; Smith, P.B.; Duck, B.B. Grey-scale ultrasonography for monitoring industrial exposure to hepatotoxic agents. *Lancet* 1(7918): 1222-1224 (1975).

Grey-scale ultrasonography, a non-invasive method involving only skin contact with a metallic transducer and a coupling agent, provides a diagnostic procedure for monitoring liver changes from exposure to hepatotoxic industrial chemicals such as vinyl chloride (VC). Grey-scale modifications to the current models of ultrasound machines allow the internal consistency of liver, portal vein, and spleen to be displayed with fine resolution. The portability of the equipment and absence of ionizing radiation are other attractive features.

DIAGNOSTIC; LIVER; OCCUPATIONAL EXPOSURE

<495>

Technology Conference Association The vinyl chloride monomer and PVC problem. Conference of El Segundo, California February 27, 1975.

The conference heard reports on 1) Regulatory Concepts for VCM Exposure, 2) SPI Assessment of the Vinyl Chloride and PVC Problems, 3) What SPI is Doing about the Challenge Facing the VCM/PVC Industry, 4) The Enigma of OSHA's VCM Rule, 5) Measurement and Monitoring of VCM in Plant Atmospheres, 6) Detection and Analysis of VCM, 7) The Use of Respiratory Equipment Against Vinyl Chloride, 8) Economic Aspects and Technical Problems of the PVC Producer and Fabricator, 9) Reduction and Control of VCM in PVC by Advanced Mixing and Compounding Techniques, 10) How Will the Federal Regulations Affect the Supply of PVC, and 11) How do the Federal Regulations Affect the Fabricator and Can He Ensure Compliance?

CONFERENCE

<496>

Thain, W. (Ed.) The determination of vinyl chloride, a plant causal. 2nd Ed. Chem. Ind. Assoc. Ltd., London, England 122 pp. (1975). (CAS: 155581k)

ANALYSIS; MONITORING

<497>

Thiess: Fleig Chromosome investigations after exposure to VC. Berufsgenossenschaft der Chemischen Industrie, Verarbeitliche Abteilung der BASF AG, Federal Republic of West Germany (Sponsor: Professional Cooperative Society of the Chemical Industry) Ongoing Research Project

This investigation centers on whether or not a correlation pertains between mutagenicity and carcinogenicity.

RESEARCH ONGOING; MUTAGENICITY; CARCINOGENICITY

<498>

Thiess, A.B.; Prentzel-Beyne, B. Retrospective survey of the alleged diseases associated with vinyl-chloride in the Federal Republic of Germany. *J. Occup. Med.* 17(7): 430-432 (1975).

In 1974, seven plants in the Federal Republic of Germany were engaged in manufacturing polyvinyl chloride (PVC). Production in 1974 was approximately 1.06 million tons of PVC and 1.15 million tons of vinyl chloride (VC) with 2,100 people employed in VC production, 12,000 in PVC production, and up to 50,000 in PVC processing. A total of 180 cases of VC disease had been registered by the end of 1974 -- 132 in VC/PVC production and 48 in PVC processing factories. Five cases of haemangio-endotheliosarcoma had been established. General principles for epidemiological investigations should include: exact details of the population at risk, categorized according to age; information on the period of exposure, including concentration data if available; determination of exposure to confounding factors; comparison with both internal and external control groups; confirmation of actual cause of death; and prospective studies as well as retrospective studies. A standard of 10 ppa was recommended and anticipated by mid-1975.

EPIDEMIOLOGY; OCCUPATIONAL EXPOSURE; STANDARDS

<499>

Thomas, D.L. Explosive controversy. The dispute over PVC sends shock waves throughout industry. *Saffron's* 54(9): 3 ff (Dec 9, 1974).

This popular review on vinyl chloride is comprehensive but without references. It includes a history of events leading to the setting of a standard, the requirements of the standard, the reactions of industry and labor to the standard, projected economic effects of the standard, and political pressures which might have influenced the standard.

STANDARDS; REVIEW

<500>

Thomas, L.B.; Popper, H. Pathology of angiosarcoma of the liver among vinyl chloride-polyvinyl chloride workers. *Ann. N.Y. Acad. Sci.* 246: 268-277 (1975).

Pathologic materials from a limited number of vinyl chloride-polyvinyl chloride (VC-PVC) workers, some of whom had angiosarcomas of the liver, were reviewed for gross and microscopic features of hepatic angiosarcoma. Based on microscopic observations, a continuous spectrum

<500> CONT.

of changes were manifest initially by multifocal areas of stimulated sinusoidal cells, followed by increasing degrees of sinusoidal cell atypia and proliferation associated with sinusoidal dilatation, culminating in a progressively growing, infiltrative angiosarcoma with a sinusoidal growth pattern. The series of changes appears to be multicentric but only some of the lesions progress to fully developed angiosarcomas. Earliest histologic changes of sinusoidal cell atypia and proliferation which would characterize definite and progressive angiosarcoma were not identified. Neither was it possible to determine by microscopic observation whether angiosarcomas in organs other than the liver represent metastases or primary neoplasms. Proliferation of the hepatocytes apparently inflames angiosarcoma development. Histologic features varied considerably in different portions of the angiosarcoma in the same liver and in the angiosarcomas of the liver from different patients, but many features were similar such as sinusoidal, papillary, and cavernous growth patterns coincident with the precursor lesions of proliferation and atypia of sinusoidal lining cells.

ANGIOSARCOMA; LIVER; PATHOLOGY; HISTOLOGY

<501>

Thomas, L.B.; Popper, H.; Berk, P.D.; Sellikoff, I.J.; Falk, H. Vinyl-chloride-induced liver disease. From idiopathic portal hypertension (Banti's syndrome) to angiosarcoma. *See Engl. J. Med.* 292(1): 17-22 (1975).

A study of hepatic tissues from 20 workers exposed to vinyl chloride (VC) for periods of 2 to 18 years showed hepatic angiosarcoma in 15 and progressive portal-tract, inconspicuous intrahepatic and conspicuous capsular fibrosis in the other five. This same fibrosis was found in the tumor-free portions of the liver of patients with angiosarcoma, and appears to be a second hepatic lesion attributable to VC exposure. A transition from the fibrotic stage to angiosarcoma is suggested by the focal proliferation, both of sinusoidal lining cells and of hepatocytes, which becomes more pronounced in the initial stages of angiosarcoma. In further progression, proliferated hepatocytes in the areas of sinusoidal dilatation are enveloped in atypical, sarcomatous-appearing sinusoidal and perisinusoidal cells. This pattern of enveloping growth of the tumor cells is so typical of VC-exposure angiosarcomas that its absence militates against VC as the origin of the tumor. Similar features are noted in angiosarcomas induced by Thorotrast or inorganic arsenicals. Some VC workers exhibit Banti's syndrome with splenomegaly and portal hypertension as well as hepatic fibrosis. It is possible that chronic exposure to VC still produce either Banti's syndrome or hepatic angiosarcoma or both.

ANGIOSARCOMA; BANTI'S SYNDROME; LIVER; SPLEEN; OCCUPATIONAL EXPOSURE; HISTOLOGY; RUSS

<502>

Tomingas, R. (Chlorinated hydrocarbons. Vinyl chloride). *Lufthg. Silikonforsch.* 7: 122-129 (1978). (CA 83: 164036d)

This review with 33 references pertains to the toxicity and carcinogenicity of vinyl chloride with emphasis on industrial exposure.

Ger.

TOXICITY; CARCINOGENICITY; INDUSTRIAL HYGIENE**<503>**

Fortelson, T.R.; Oyes, P.; Howe, V.K. The toxicity of vinyl chloride as determined by repeated exposure of laboratory animals. *Anaer. Ind. Hyg. Assoc. J.* 22(5): 354-361 (1961).

Rats showed micropathological changes after repeated, daily 7-hour exposures to vinyl chloride at 500 ppm for 8.5 months. Repeated 7-hour exposures at 200 ppm for six months resulted in liver changes in rabbits and rats, but no detectable changes in dogs and guinea pigs. All species studied tolerated repeated daily 7-hour exposures to 50 ppm for six months with no detectable injury. The available human experience indicates that injury is not likely while operating under a threshold limit value of 500 ppm. A time-weighted average for all exposure however should probably not exceed 50 ppm.

TOXICITY; RAT; RABBIT; DOG; GUINEA PIG; LIVER; LUNG; HEART; KIDNEY; SPLEEN; TESTES; STANDARDS

<504>

Toshire, K.; Kasou, Y.; Kondo, H. Poly (vinyl chloride) composition with decreased vinyl chloride monomer content. *Japan. Kokai* 75,148,452 *Appl.* 74 30,176, *Mar.* 15 (1974); *Granted Nov.* 28 (1975). (CA 80: 90904k)

A polyvinyl chloride (PVC) composition subjected to evacuation in the sizer, cooling bath, and/or transfer pipe gave a resin with less than 20 ppm vinyl chloride (VC). A copolymer air evacuated 8 hr in the sizer, 1 hr in the transfer pipe, and 15 hr in the cooling bath gave a composition with 0 to 1 ppm VC.

Japan.

PATENT; MANUFACTURE; EMISSION CONTROL

<505>

Prizhva, S.L.; Fikhmireva, N.P.; Levina, S.V.; Kozlov, L.I. (Working conditions and measures for their improvement in production and use of vinyl chloride plastics.) *Gig. Sanit.* No. 10: 38-44 (1969). (CA 44: 1744a)

Chlorinated hydrocarbons in the atmosphere of vinyl chloride production plants average between 0.005 and 0.27 mg/l. with a large proportion of chlorinated biphenyls. In fabrication plants, similar or somewhat higher amounts of chlorides are found. Ventilation needs are stressed. A tendency for respiratory and circulatory disorders, and some cases of hepatitis, were found. Skin eruptions were caused by the chlorinated biphenyl plasticizers. Pressure rolling above 120 to 130 degrees was not recommended.

Russ.

OCCUPATIONAL EXPOSURE; LUNG; CARDIOVASCULAR; SKIN; LIVER

<506>
Trief, W.D.; Corrigan, G.E. Contemporary
work-related environmental diseases. Texas Rep.
Environ. Med. 33(1): 108-144 (1975).

This review of occupational/environmental
diseases includes a brief summary (128-130) with
14 pertinent references on vinyl chloride (VC).
The time period encompasses the Goodrich
announcement of angiosarcoma among its workers
through the National Institute for Occupational
Safety and Health announcement of the change in
occupational standard to 1 ppm about 1 year later.

REVIEW; ENVIRONMENT; OCCUPATIONAL EXPOSURE

<507>
Turoski, V. The determination of vinyl chloride
in aerosol formulations and can linings.
Abstracts of Papers, American Chemical Society,
169th National Meeting, April 6-11 (1975).
Analytical Section, Abstract No. 122 (1975).

Using two methods of gas-liquid-chromatography,
vinyl chloride (VC) standards in tetrahydrofuran
were prepared and compared. Stability and
analysis time are discussed. Methods given
enable the analysis of one-tenth ppm vinyl
chloride in pure tetrahydrofuran, and to 3 ppm if
interfering substances are present.

ANALYSIS; AEROSOLS

<508>
Turoski, V. The determination of vinyl chloride
in aerosol formulations and can linings.
Division of Analytical Chemistry, 169th National
Meeting of the American Chemical Society,
Philadelphia, PA Abstract ANAL 122 (April 6-11,
1975).

Preparation of gas-liquid-chromatography (GLC)
standards of vinyl chloride (VC) in
tetrahydrofuran (THF) was done by two methods: a)
by direct weight and b) by perfect gas law.
Using standard solutions, as little as 0.1 ppm VC
can be distinguished from a THF blank.
Interfering substances may limit detection to 3
ppm. Aerosol formulations containing 3, 10,
12.5, and 20 ppm VC in the propellant and
polyvinyl acetate can linings were analyzed on a
Chromosorb 101 column. Recommended is a short
well-conditioned column to reduce analysis time.

ANALYSIS; AEROSOLS; CAN

<509>
Iverskaya, A.Ya.; Saffris, E.S.; Katsova, S.R.
(Hygienic aspects of the use in the food industry
of packaging compounds prepared from polyvinyl
chloride plastisols). Gig. Sanit. 1975 (11):
28-32 (1975).

Access to assorted brands of polyvinyl chloride
(PVC) packaging resins of confusing variation in
quality, composition, and quantitative content of
the separate components made it necessary to
examine the utilization of various brands of
these materials coming in contact with foods.
Use is permitted in bottling mineral water, beer,
and non-alcoholic beverages stored at temperature
no higher than 18 to 20 degrees C, and for
linings in hermetically sealed glassware with
food products containing not more than 15% oil.

Use of PVC in contact with oils and alcoholic
liquids is no longer permitted. Packaging covers
and stoppers with applied PVC compound of proper
manufacture is permitted no earlier than 15 to 20
days after application. A hygienic appraisal is
demanded for each new brand.

Russ.; Eng. Sum.

FOOD; POLYVINYL CHLORIDE; MANUFACTURE

<510>
U.S. Coast Guard Vinyl chloride (Inhibited)
Chemical Data Guide for Bulk Shipmate by Water.
U.S. Coast Guard, Department of Transportation
CG-388: 199 (1973).

Synonyms, formula, appearance, odor, specific
gravity, and physical properties are listed for
vinyl chloride (VC). The gas is listed as
flammable with the warning that heat causes
decomposition to paraffins, as well as
heat-induced polymerization with explosive force.
Respiratory protection for fire-fighting
personnel is necessary; unless the flow of gas is
stopped, putting out a VC fire can cause
accumulation of explosive vapor concentrations
with increased danger of re-flash. The liquid or
cold gas may cause skin or eye injury similar to
frostbite, dizziness, and drowsiness. Victims
should be removed to fresh air, given artificial
respiration, and the eyes flooded with water if
affected. Medical assistance should be summoned
immediately.

HAZARD; EXPLOSIVE; TRANSPORTATION; NON-OCCUPATIONAL EXPOSURE

<511>
Ueda, K. (Disturbance of human health by
chemical substances - Toxicity of organochlorine
compounds.) Nippon Ishikai Gasshi (J. Jap. Soc.
Assoc.) 69(2): 207-216 (1973). (PESTAS 73:
01170)

Organochlorines are soluble in fats, accumulate
in fat tissues and the liver, are damaging to the
liver, are narcotic, and produce acne. Metabolic
and detoxification mechanisms include the action
of glutathione-S-alkyltransferase on alkylhalogen
compounds, glucuronate conjugation and excretion
of chlorophenolic compounds, and mercapturic acid
formation and excretion of partially
dechlorinated compounds and those bonded to
glutathione compounds. Monomeric vinyl chloride
is one of the compounds reviewed.

Jap.

PROPERTIES; BIOCHEMISTRY; LIVER; SKIN; HUMAN

<512>
United States International Trade Commission
Plastic and resin materials. In: Synthetic
organic chemicals: United States production and
sales, 1973. ITC Publication 728 pp. 127-128,
131-134, 205 (1975).

In 1973 production of polyvinyl chloride and
copolymers amounted to 4,594,313,000 pounds.
Amount sold equaled 3,973,748,000 pounds with a
sales value of \$597,909,300 at \$0.15/lb. Similar
statistics for vinyl chloride monomer production

<512> COYT.
 wt 5,351,056,000 lbs, sales of 3,554,276,000
 lbs, and sales value of \$147,418,000 at \$0.04/lb.
 Manufacturers of the plastic and resin are
 listed.

PRODUCTION; ECONOMICS; MANUFACTURE

<513>
 Valisova, V.D.; Stalova, E.A.; Goryacheva, L.A.;
 Zadaneva, G.S. (Gastric function in chronic
 vinyl chloride poisoning). Gig. Tr. Prof.
 Zabol. 31: 20-23 (1975). (CA 82: 174796x)

In the early stages of vinyl chloride (VC)
 poisoning, gastric secretions increase, but in
 patients with chronic vinyl chloride poisoning
 the volume of gastric juice, hydrochloric acid,
 pepsin, and proteins are markedly lower. The
 disorder appears to be functional and is
 attributed to the effect of VC on the
 hypothalamus.

Russ.

GASTROINTESTINAL; TOXICITY; HUMAN

<514>
 van Duuren, B.L. On the possible mechanism of
 carcinogenic action of vinyl chloride. Ann.
 N.Y. Acad. Sci. 246: 258-267 (1979).

Relevant information bearing on the possible
 mechanism of action of the carcinogen vinyl
 chloride is reviewed. Indirect-acting alkylating
 carcinogens are related with their direct-acting
 counterparts. Based on earlier studies,
 covalent binding to serum albumin, microsomal
 membranes, or other target sites may precede
 activation to a carcinogenic intermediate. Serum
 albumin binding may be related to the site of
 origin of osteosarcoma, a disease associated
 with exposure to vinyl chloride.
 Trichloroethylene is structurally similar to
 vinyl chloride and known information concerning
 its metabolism in animals and man, suggest an
 alpha-chloro ether or -onium ion as an important
 intermediate in its metabolism. It is probably
 carcinogenic, particularly to the liver but this
 remains to be established.

BIOCHEMISTRY; METABOLISM; CARCINOGENICITY

<515>
 Van Duuren, B.L.; Goldschmidt, R.B.; Seidman, I.;
 Sivak, A.; Vits, G. Carcinogenic intermediates
 of vinyl chloride and analogs. New York
 University School of Medicine (Sponsor: NIEHS)
 Ongoing Research Project (1975).

Commercial polyvinyl chloride (PVC) and its
 fabricated products have been found to contain
 from 2 to 75 free vinyl chloride (VC). These VC
 may be a widely distributed environmental
 carcinogen. In vitro and in vivo studies on the
 metabolism of VC are being conducted on rat liver
 homogenates, intracellular fractions and
 components as well as on human liver samples in
 vitro. The activated carcinogenic intermediate
 is presumed to be chloroethylene oxide or
 chloroacetaldehyde, and the carcinogenicity of VC
 and these two metabolites will be determined.

LIVER; RAT; HUMAN; CARCINOGENICITY; METABOLISM;
 CHLOROACETALDEHYDE; CHLOROETHYLENE OXIDE;
 RESEARCH ONGOING

<516>
 Van Esch, G.J.; Van Logten, H.J. Vinyl
 chloride: a report of a European assessment.
 Toxicology 4: 1-4 (1975).

Article also appeared in Pd. Cosmet. Toxicol. 13:
 121-139 (1975). See listing under these authors
 for annotation.

CONFERENCE

<517>
 Van Esch, G.J.; Van Logten, H.J. Vinyl
 chloride: a report of a European assessment.
 Pd. Cosmet. Toxicol. 13: 121-139 (1975).

Toxicologists representing Denmark, United
 Kingdom, Italy, The Netherlands, Switzerland,
 France and the Federal Republic of Germany met on
 March 26, 1974 at The National Institute of
 Public Health, Bilthoven, The Netherlands, to
 discuss the vinyl chloride problem. Existing
 data were summarized, the current situation
 defined, and data needed to determine probable
 solutions listed. Information is summarized on
 epidemiological studies, exposure levels, oral
 feeding effects in animals, metabolism and
 alkylation studies, types of liver dysfunction
 associated with liver tumors, percutaneous
 absorption, and amounts of VC in food, potable
 water, and PVC products.

CONFERENCE

<518>
 Vasis, A.E.; Plokhova, E.I. (Obtaining an
 experimental model of the toxic angioneurosis
 arising under the chronic effect of vinyl
 chloride vapor on the organism.) Gig. Tr. Prof.
 Zabol. 12: 47-49 (1968).

Rabbits exposed chronically to vapors of vinyl
 chloride in concentrations of 9 to 10 mg/l showed
 disturbances in the cardiovascular system. A
 pathology model based on a description of these
 functional changes could be useful in the study
 and experimental therapy of toxic angioneurosis.

Russ.

RABBIT; CARDIOVASCULAR; ANGIONEUROSIS; ANIMAL;
 DIAGNOSTIC

<519>
 Vasis, A.E.; Plokhova, E.I. (Changes in the
 rate of inhibition of conditioned reflexes in
 rats on prolonged exposure to vinyl chloride
 vapor in concentrations approaching the maximum
 permissible concentration.) Gig. Sanit. (Sov.
 Sanit.) 35(4/6): 434-435 (1970).

Twenty albino rats (10 experimental, 10 controls)
 required an average of 10 and 10.4 presentations,
 respectively, to acquire a stable conditioned
 reflex to a stimulus (acetone). Latent time
 required to respond to the stimulus was 4.5 and

<519> CONT.

4.6 seconds, respectively. After the experimental rats had been exposed to "3-4 vinyl chloride vapor/air" (sic) daily for 4 months in a hermetically sealed 100-liter chamber, 11 presentations of a new stimulus (bell) were required to arrive at a stable conditioned reflex. No increase in latent period of response was detected. It was concluded that prolonged exposure to vinyl chloride at concentrations approaching the maximum permissible concentration may produce alterations in the functional state of the higher divisions of the central nervous system.

RAT; NEUROLOGICAL

<520>

Vezin, A.E.; Plokhova, E.I. (Changes of cardiac activity in rats chronically exposed to vinyl chloride vapors.) *Parazit. Toksikol.* 32(2): 220-222 (1969).

Albino rats exposed to vinyl chloride vapors - 0.03 to 0.04 mg/l for 5 months - exhibited cardiac rhythm disturbances, developed bradycardia, and showed reduced I-II and T-II sound intervals without marked changes in the Q-T interval. Cardiac rhythms returned to normal within 15 days after termination of exposure whereas the I-II and T-II intervals continued significantly below the control level for 15-30 days. Resultantly the maximum permissible concentration of vinyl chloride at 0.03 mg/l appears to have been overestimated.

Russ.; Eng. Sum.

TOXICITY; RAT; CARDIOVASCULAR; STANDARDS

<521>

Vezin, A.E.; Plokhova, E.I. (Changes in adrenaline-like substances in rabbit blood following chronic exposure to vinyl chloride fumes.) *Gig. Tr. Prof. Zaboi.* 13(6): 46-47 (1969).

Chinchilla rabbits were exposed to 0.02 mg to 0.03 mg/l vinyl chloride in air for 4 hours daily over a period of 5 months. After 40 days the level of adrenaline and adrenaline-like substances in the blood stream had risen from 3.5 mg % to 6.6 mg % where it remained constant. Hypertension was attributed to this effect of vinyl chloride.

Russ.

RABBIT; HYPERTENSION; ADRENAL

<522>

Vezin, A.E.; Plokhova, E.I. (Pathogenic effect of chronic vinyl chloride exposure to rabbits.) *Parazit. Toksikol.* 31(3): 369-372 (1968).

Chronic poisoning in rabbits with 9 to 10 mg/l vinyl chloride produced changes in the bioelectric activity of anterior and posterior groups of the hypothalamic nuclei. Cardiovascular changes included alterations in pulse, arterial pressure, and circulation rate.

Russ.; Eng. Sum.

NEUROLOGICAL; CARDIOVASCULAR; RABBIT;

<523>

Veltman, G.; Lange, C.-E.; Juehe, S.; Stein, G.; Bachner, J. Clinical manifestations and course of vinyl chloride disease. *Ann. N.Y. Acad. Sci.* 246: 6-17 (1975).

Seventy patients were examined who had been employed through a range of 6 moa to 21 3/4 yrs with an avg of 7.7 yrs, in cleaning polyvinyl chloride (PVC) autoclaves; in centrifuging, drying, and sifting processes in PVC manufacture; and with wrapping PVC as an end product. Initial symptoms included upper abdominal complaints (in 60% of the cases), tiredness, dizziness, numbness in fingers and toes, increased perspiration, cold fingers or hands, arthralgia, impotency, and head- and leg-aches. Outstanding objective symptoms were thrombocytopenia in 81%, increased BSP retention in 67%, splenomegaly in 57%, and reticulocytosis in 41%. Skin changes consisted of club-like swelling and shortening of the fingers, and coarse white to ivory-colored infiltrates ranging from grains to small nodules. Histologically there was hyperorthokeratosis and thickening of the epidermis, endothelial swelling and lymphocytic infiltrate in the subepidermal boundary layer, and swollen or homogeneous collagen bundles, with the elastic fibers showing evidence of rarefaction, fissionation, and fragmentation. No direct correlation was found between these findings and the severity of internal findings. Vascular changes ranged from slight narrowing of the vascular lumen to complete absence of filling of the arteries along the whole length of the finger. Slight to severe thrombocytopenia was found with such frequency as to make the platelet count an obligatory test in all PVC workers. Improvement of platelet count was observed in only 6 of 29 patients in 1 to 1 1/2 yrs after quitting their job. Improvement in skin and bone changes was more frequent.

ACROOSTEOLYSIS; SKIN; BONE; THROMBOCYTOPENIA; OCCUPATIONAL EXPOSURE; HUMAN; CARDIOVASCULAR; CASE STUDY

<524>

Villalobos, R. Process gas chromatography. *Anal. Chem.* 47(11): 983A 22 (1975).

Continuous on-line automatic analysis of process streams is possible with gas chromatography. Apparatus, including detectors, programmer-controller, auto-zero circuit, computer interfacing, and data presentation are reviewed. An interference-free measurement of vinyl chloride (VC) is achieved by use of a flame ionization detector and a single column stripper configuration, in a cycling time of 3 min per sample point. Sampled air can be drawn from a 400 ft distance to the monitoring station.

CHROMATOGRAPHY; ANALYSIS; MONITORING

<525>

Viola, P.L. Carcinogenic effect of vinyl chloride. Abstracts. 78th Int. Cancer Conf., Houston, Texas (May 22-29, 1970) Session J: 782 Abstract No. 29 (1970).

Male Wistar rats, weighing 150 g, were exposed to

<525> CONT.

3 vol % vinyl chloride at the rate of 4 hr/day, 5 days/week, for 12 months. After 10 months, 70 percent developed squamous cell carcinoma of the external auditory meatus. Thirty-two percent developed carcinomas and adenocarcinomas showing typical signs of squamous metaplasia in the lungs. Twenty-five percent showed chondroid metaplasia of bone tissue with intense periosteosis particularly located in the tarsal and sesamoid bones.

CANCER: RAT; LUNG; BONE; EAR

<526>

Viola, P.L. Pathology of vinyl chloride. Med. Lavoro 61(3): 174-180 (1970).

Twenty-five rats were exposed to vinyl chloride (VC), 3% by weight or 30,000 ppm, 4 hr/day, 5 days/week for 12 months. The animals were sacrificed at first; at 10 months some showed decreases in weight, in aggressiveness, in reaction to external stimuli, and often disturbed equilibrium. Thirteen died from cardio-respiratory complications, 2 from hepatoperitonitis. Most showed brain, liver, kidney, and thyroid degenerative changes; 6 showed histopathological alterations of bones similar to acroostolysis in man, with periosteal proliferation and chondrial metaplasia. The connective tissue was dissociated; elastic reticulus was reduced and fragmentary; walls of the derma vessels were hypertrophied with lesser sometimes obliterated; and nerve endings were surrounded and infiltrated by fibrous tissue. Reduction of the threshold limit value for VC, and elimination of nasal cleaning of autoclaves were recommended.

STANDARDS: RAT; BONE; LUNG; BRAIN; LIVER; KIDNEY; THYROID; ACROOSTOLYSIS

<527>

Viola, P.L. La malattia da cloruro di vinile (vinyl chloride disease). Med. Lavoro 65(3/4): 81-99 (1974).

Manifest in recent years, the syndrome of vinyl chloride (VC) disease is characterized by alterations of skeleton, skin, nervous, digestive, and circulatory systems, and hepatic and endocrine functions. The severity of the disease is in direct relation to amount and duration of exposure. Rats exposed to VC have developed tumors of the skin, lungs, bones, liver, intestines, and other organs.

Ital.: Eng. Sum.

REVIEW: CANCER; ACROOSTOLYSIS; RAT; HUMAN; OCCUPATIONAL EXPOSURE

<528>

Viola, P.L.; Bigotti, A.; Caputo, A. Oncogenic response of rat skin, lungs, and bones to vinyl chloride. Cancer Res. 31: 516-522 (1971).

Rats (19/102 Wistar strain) were exposed to a constant flow of air containing 3% v/v vinyl chloride monomer for 12 months, 4 hours a day, 5 days a week. The cutaneous system proved most susceptible to oncogenic effects, with epidermoid carcinomas located preferentially in the area of

subaxillary and parotid glands. Tumors also developed in the lungs and bones. Other effects were noted in brain, liver, kidneys and intestinal mucosa. The role of cancer-producing cells is conjectured.

CANCER: SKIN; LUNG; BONE; RAT

<529>

Volzard, A.C. Respiratory protection for vinyl chloride monomer. Technical Papers, Regional Technical Conference (10/31 - 11/1, 1974), Society of Plastics Engineers, Inc., New York City 172-184 (1974).

The two major types of respiratory equipment used by industry are air-purifying respirators and air-supplying respirators. The purifying type removes contaminants from inhaled air either by mechanical filtration or chemical sorption. The supplying type may operate on pure air from an external source, be self-contained, or be a combination of the two. Chemical cartridges and canisters are purifying respirators which may be used in areas where the hazard is known, the potential exposure is of relatively low concentration, the proper canister is chosen, and the wearer trained for proper use. Gas masks are worn in areas of higher concentration. Air-supplying respirators are either open-circuit type (exhalation is not reused) or closed-circuit (recirculation). Open circuit type is more commonly used because of comfort, simplicity, and ease of recharging and maintenance. Equipment is described for various concentrations of vinyl chloride with notations on availability, NIOSH and/or Bureau of Mines approval, costs, and conditions of use.

OCCUPATIONAL EXPOSURE; RESPIRATORY; EQUIPMENT

<530>

Von Oettingen, W.F. Halogenated olefinic hydrocarbons. Vinyl chloride. The halogenated aliphatic, olefinic, cyclic, aromatic, and aliphatic-aromatic hydrocarbons including the halogenated insecticides, their toxicity and potential dangers, Department of Health, Education and Welfare PHS Pub. No. 414: 195-197 (1955).

This comprehensive 1955 review of hydrocarbons surveys the literature concerning the toxicity of vinyl chloride to humans and to test animals from 1930 (Fetty, Vant, and Saito) through 1947 (Oster, Carr, Erastz, and Sassevald), and notes that the American Conference of Government Industrial Hygienists accepted 200 ppm as the Threshold Limit for continued exposure in 1953.

REVIEW: STANDARDS

<531>

Wagner, E.E.; Huelder, W.E.; Watanabe, P.J.; Refaer, E.E. Jr.; Brass, V.E.; Gehring, P.J. A gas-chromatographic method for the preparation of ¹⁴C-labeled vinyl chloride. J. Label. Compounds 11(4): 535-542 (1975).

This modification of a previous method (Wagner, E.E. and Huelder, W.E.) for preparing ¹⁴C-labeled vinyl chloride makes use of an analytical size chromatographic column. The precursor is 1,2-dichloroethane-¹⁴C₂ which is stable, relatively inexpensive, and commercially

<531> CONT.

available. Radiochemical purity was determined by trapping samples directly in scintillation vials containing a toluene-based scintillator. Spectrophotometric analysis indicated that samples were identical to a VC standard, with a product of 96 to 97% radiochemical purity. The contaminant appears to be 14C-acetylase, but the estimated concentration was below the detection limits of the infrared analysis.

LABELING; SYNTHESIS

<532>

Hayner, E.R.; Buehler, W.W. A procedure for preparing 14C-labeled vinyl chloride. *Ann. N.Y. Acad. Sci.* 246: 152-153 (1975).

To prepare the labeled vinyl chloride, 1,2-dichloroethane-1,2-14C was injected into an 8 foot x 1/4 inch diameter U-shaped glass chromatographic column, packed with 80-90 mesh 255 Dow Corning 410 Gas on acid-washed Chromosorb W except for the top 35 cm, packed with a catalyst prepared by mixing 20 g of Chromosorb W and 10 g of Darco G-60 charcoal. The catalyst portion of the chromatograph was heated to 440-450 degree C, but the remainder of the column was held at 150 degree C. The second peak (retention time: 1.4 min) was 75-85% of the product mass and was shown to be vinyl chloride by infrared and gas chromatographic analysis.

LABELING; SYNTHESIS

<533>

Walker, A. Occupational Acro-osteolysis (Two cases). *Proc. Roy. Soc. Med.* 68: 343-344 (1975).

Two case studies of vinyl chloride (VC) polycleaners are described. One man, age 39 years, had worked at the plant 22 1/2 yr, with 1 yr as a polycleaner before manifesting symptoms of acroosteolysis with severe Raynaud's phenomenon. The second man, age 28 years, had worked at the plant 3 yrs, 2 years as a polycleaner before being diagnosed with acroosteolysis. In a postscript, twenty men from the same plant were noted with similar clinical findings but without bone changes.

ACROOSTEOLYSIS; RAYNAUD'S PHENOMENON;
POLYCLEANER; CASE STUDY; RUMER; POLYCLEANER;
OCCUPATIONAL EXPOSURE

<534>

Warren, S.S.; Huff, J.E. Health effects of vinyl chloride monomer: An associated literature collection. *Environ. Health Perspect.* 11: 251-319 (1975).

This bibliography of 264 references spans the literature on vinyl chloride (VC) from its discovery in 1835 through 1974. The compilation is directed toward the health aspects of the monomer. References are listed alphabetically with abstracts and keywords. Author, Key Term, and Permutated Title indices are included.

BIBLIOGRAPHY

<535>

Warren, S.S.; Huff, J.E. Vinyl chloride monomer: A literature collection. *Proceedings 8th Annual Conference, Environmental Chemicals: Human and Animal Health*, July 7 to 11, 1975 17: 11-32 (1975).

This overview of vinyl chloride chronicles historical developments, summarizes the reference literature, reviews physical and chemical properties, lists production and use data, sketches biologic aspects, and examines proposed standards.

REVIEW; STANDARDS; PROPERTIES; PRODUCTION; USES;
CARCINOGENICITY; TOXICITY

<536>

Satanabe, Y.; Sato, K.; Yoshida, S.; Sawa, S.; Fujii, T. (Hygienic chemical studies on poly(vinyl chloride) containers and packages.). *Tokyo Foritss Eisei Kenkyusho Isakya Seiso* 26-1: 230-235 (1975). (C184: 178350a)

Of 135 samples tested by thin-layer chromatography followed by polarography, 22 samples failed to meet the standards for residual vinyl chloride in polyvinyl chloride food packaging. Six samples contained more than 10 ppm.

Japan.

FOOD; POLYVINYL CHLORIDE

<537>

Warzeiler, R.J.; Striager, E.; Falk, H.; Carter, C.D.; Jones, J.; Nequater, J.K. Neoplastic risk among vinyl chloride polymerization workers. *Ann. N.Y. Acad. Sci.* In Press.

The magnitude and spectrum of neoplastic effects in vinyl chloride (VC) workers were assessed by the National Institute for Occupational Safety and Health and the Center for Disease Control. Four facilities engaged in the polymerization of VC for 15 years yielded a study cohort of 1,294 workers. Each worker had achieved 5 or more yrs of employment and has had 10 yrs since the onset of initial employment in departments directly related to VC use--polymerization, monomer production, maintenance and compounding. This cohort analysis showed a slight excess in total deaths with malignant neoplasms and other respiratory diseases showing the two largest standard mortality ratios (SMR). The SMR for all malignant neoplasms was statistically significant at the 0.05 level; excesses were found in 4 organ systems--brain, respiratory, biliary and liver, and lymphatic and hematopoietic. When the cohort of persons achieving ten years since onset of exposure is compared to the 15-yr group, the excess risk increases in every case; in cases of respiratory system cancer and brain cancer the excesses were statistically significant at the 0.05 level. The evidence points to VC as the causal agent for excess malignant neoplasms.

EPIDEMIOLOGY; CARCINOGENICITY; RUMER;
OCCUPATIONAL EXPOSURE

<538>

Reichardt, H. Die Hautgefährdung in der

<538> CONT.
Kunststoffindustrie. (Endangering the skin in the plastics industry.) Berufskrankheiten 18 (1): 25-34 (1970).

Toxic substances used without appropriate protective measures are particularly dangerous in the plastics industry. A review of the literature on skin lesions produced by synthetic materials includes epidemiological studies in Japanese and English polyvinyl chloride industries.

Ger.; Eng. Sum.

REVIEWS; ACROOSTYLOSIS; RATHA00'S PHENOMENON;
SKIN; SORE; EPIDEMIOLOGY; CASE REPORT

<539>
Veigen. Feeding studies. Bochum AG, Federal Republic of West Germany (Sponsor: West German Government and Professional Cooperative Society of the Chemical Industry) Ongoing Research Project (1975).

Feeding vinyl chloride (VC) monomer in alcoholic solutions stored in polyvinyl chloride (PVC) flasks stimulated oral toxicity testing. Previous studies indicated a "no effect level" of 30 mg/kg VC (in sesame oil administered by gavage) to the rat. Further research is required to determine the carcinogenic effect of VC through feeding experiments.

RAT; CANCER; FOOD; INGESTION; RESEARCH ONGOING

<540>
Weisberg, J.E. Toxic surprises from the plastics industry. Sci. News 106(10): 154-155, 157 (1974).

Two and one-half million workers produce more than 29 billion pounds of plastics yearly in the United States. Many plastic components are toxic. Fifteen vinyl chloride workers died this year reportedly from liver cancer which was chemically induced. Still, still undefined amounts of vinyl chloride cause fibrotic lesions on the liver after only a year or so of exposure. Unpolymerized vinyl chloride is metabolized to monochloroethylene oxide, the probable carcinogen that acts upon liver cell membranes. It is more damaging in fasting animals, probably because of depletion of a membrane protective substance. Current regulation of the plastics industry is fractionated. The Toxic Substances Control Act passed by both houses of Congress is now in conference committee. Much data needed for setting effective standards lies within industry. There is consensus on need for research on new and existing components of plastics.

STANDARDS; OCCUPATIONAL EXPOSURE; CANCER;
ASTIOSARCOMA

<541>
Wheeler, R.E. Jr.; Sutherland, R.E. VC Emission control: Control of is-transit VCM. Chem. Eng. Progr. 71(9): 48-53 (1975).

Most vinyl chloride (VC) transport is via tank cars or pipelines. Government regulations require reduction of emissions. Gauging devices which

require no emission vent be installed on tank cars, tank trucks, and barge tanks. All new tank cars must be insulated or have steel safety shields on the ends, and be limited to 25,500 gallons capacity. Pipelines offer the ultimate potential emission reduction, but pipelines carrying suspected carcinogens will be subject to a new set of rules. Buried pipelines will require above-ground warning signs, a foolproof system for leak monitoring, and cathodic protection. Permission to cross property lines with VC pipeline may pose problems. Scavenging systems will be necessary so that all equipment can be stripped of VC in the event of failure, prior to maintenance work, or prior to routine disassembly. Maintenance of facilities requires inert gas supplies with equipment for scrubbing VC from the inert gas. Decontamination of vent gases may be done by carbon adsorption or incineration followed by scrubbing the incinerated gas with water. Monitoring is essential; data must be filed for up to 30 years if personnel exposure is involved.

INDUSTRIAL HYGIENE; TRANSPORTATION; MONITORING;
EMISSION CONTROL

<542>
Shittenberger, J.L.; Little, J.B.; Murphy, S.D.; Ferris, B.G.; Peters, J.S.; Burgess, V.L.; Brink, J.D.; Hatchison, G.B.; Sorokin, S.P.; Underhill, D.W.; Scrandy, S.S.; Hosson, R.E. Occupational and environmental health. Harvard University School of Public Health (Sponsor: NIOSH) Ongoing Research Project (1975).

This research and research training program emphasizes toxicological and epidemiological approaches to the effects of environmental factors on human health. Vinyl chloride and other plastics-related compounds are being studied.

EPIDEMIOLOGY; CARCINOGENICITY; OCCUPATIONAL EXPOSURE; RESEARCH ONGOING; ENVIRONMENT; TOXICITY

<543>
Wilks, P.A.; Lavery, D.S. Monitoring ambient vinyl chloride with infrared analyzers. Technical Papers, Regional Technical Conference (10/31 - 11/1, 1974), Society of Plastics Engineers, Inc., New York City 134-145 (1974).

Infrared analysis can be used for both qualitative identification and quantitative analysis with a minimum detectable level for vinyl chloride (VC) in the neighborhood of 0.2 ppm. Continuous and instantaneous indication of concentrations of VC gas is possible with a sensitivity and accuracy equal to gas chromatographic systems. The sampling system is simple without metering valves or back-flushing cycles, and no services other than power are required. Battery operation is adequate, and several types of infrared systems are available.

INFRARED; ANALYSIS; MONITORING; AIR

<544>
Wilks, P.A.; Lavery, D.S. Measurement of vinyl chloride monomer in air using the infrared analyzer. In EI To Fortna 15(11): 7-12 (1975). (C184: 180091q)

Apparatus is described for the infrared analysis

<544> CONT.
of vinyl chloride in air with a sensitivity of
less than 0.2 ppa.

Japan.

ANALYSIS: AIR; MONITORING

<545>
Williams, D.T.; Miles, W.P. Gas-liquid
chromatographic determination of vinyl chloride
in alcoholic beverages, vegetable oils, and
vinegars. J. Assoc. Offic. Anal. Chem. 58(2):
272-275 (1975).

Vinyl chloride (VC) leaching into vinegars and
alcoholic beverages from polyvinyl chloride (PVC)
bottles packaged in Canada was determined by
direct injection of gas-liquid chromatographic
(GLC) columns and confirmed by gas
chromatography-mass spectrometry. Levels found
were 0.0 to 1.6 ug/ml for alcoholic beverages,
and 0.0 to 8.8 ug/ml for vinegars. Peanut oil
showed levels of 0.3 to 3.3 ppa VC in headspace
GLC analysis. It was not possible to compare
susceptibilities of the foodstuffs to VC
contamination because no two foodstuffs were
packaged in bottles made from the same type of
PVC resin; but the problem is not restricted to
alcoholic beverages. Experimental methodology is
detailed.

ANALYSIS: FOOD; PACKAGING

<546>
Wilson, B.H.; McCoslick, W.L.; Yates, C.F.;
Creech, J.L. Occupational acroosteolysis.
Jama 201(8): 577-581 (1967).

Among 3,000 personnel involved in vinyl chloride
manufacturing and polymerization, 31 cases of
hand acroosteolysis were diagnosed--particularly
osteolysis specific to the distal phalanges of
hands. Raynaud's symptoms were associated
frequently with this disorder. This condition
results primarily from three conditions: 1) a
chemical insult, 2) a physical insult, and 3) a
personal idiosyncrasy. Twenty-seven of the 31
had a positive correlation to the
"polycleaner" job assignment.

ACROOSTEOLYSIS; OCCUPATIONAL EXPOSURE; RAYNAUD'S
PHENOMENON; SKIN; BONE; CASE STUDY; HUMAN;
EPIDEMIOLOGY; POLYCLEANER

<547>
Winell, G. An international comparison of
hygienic standards for chemicals in the work
environment. Ambio 4(1): 34-36 (1975).

Hygienic standards in the USA, the Soviet Union
(USSR), the Federal Republic of Germany, the
German Democratic Republic (DDR), Sweden, and
Czechoslovakia are tabulated for 169 substances.
In other countries, for example, Great Britain,
Norway, and Peru -- USA standards are applied.
Wide discrepancies exist in standards between
countries. The Occupational Safety and Health
Administration (OSHA) time-weighted average
standards in the USA for vinyl chloride was set
at 1 ppa or 3 eq/cu meter in 1974. Sweden
followed with the same standard in 1975. The DDR
Standard was set at 500 eq/cu meter in 1973, and
the USSR Standard allows a ceiling value of 30

eq/cu meter as set in 1972. Standards of other
countries were not given.

STANDARDS: INDUSTRIAL HYGIENE; OCCUPATIONAL
EXPOSURE

<548>
Withey, J.E. Pharmacodynamics and uptake of
vinyl chloride monomer administered by various
routes to rats. J. Toxicol. Environ. Health
1(3): 381-394 (1976).

Vinyl chloride (VC) monomer has been found at
concentrations up to 20 ppa in food packaged in
polyvinyl chloride. Aqueous solutions containing
up to 2,700 ppa VC (wt/vol) or Hexola core oil
solutions containing up to 100 ug/ml (10% wt/vol)
were administered to male Wistar rats via an
indwelling jugular cannula. Uptake was very
rapid, with peak blood concentrations appearing
in less than 10 minutes. However, no uniform
pattern of absorption, distribution, and
elimination was discernible after either aqueous
or oil solution administration. Gas phase
studies with concentrations of VC up to 7,000 ppa
for 5 hr showed that equilibrium blood levels
were established after 30 min. A trend toward
decreases in distribution and elimination rate
coefficients with increases in VC exposure
concentrations was attributed to a probable
expansion of the peripheral volume of the tissue
compartment for higher exposures. On removal
from VC atmosphere, blood levels fell to barely
detectable levels within 2 hr. Precise kinetic
coefficients describing distribution and
elimination of vinyl chloride after bolus
intravenous injection of both aqueous and oil
solutions were determined. The data presented
show that VC diffuses rapidly through body
tissues. Subsequent monitoring following removal
from exposure would not provide a reliable
indication of extent of exposure.

KINETICS; FOOD; PHARMACODYNAMICS; RAT

<549>
Withey, J.E. Uptake and pharmacodynamics of
vinyl chloride administered to rats by different
routes. Abstracts of Papers for 13th Annual
Meeting of Society of Toxicology, Williamsburg,
Virginia, March 9-13 (1975) Abstract No. 60: p.
49 (1975).

To assess the hazard presented by the oral
ingestion of vinyl chloride monomer, rats --
surgically prepared with an indwelling jugular
cannula -- were dosed by intragastric intubation
with solutions containing up to 2 ug/ml of
aqueous vinyl chloride; sequential samples of
blood allowed time concentration curves to be
obtained. Uptake of vinyl chloride by this route
is extremely rapid, peak concentrations being
achieved less than 10 min after administration.
Elimination from the blood compartment appears to
be biphasic, the slower terminal phase
having a half-life of about 6 min. Studies with
the same animal model, in a single restraint
cage, exposed to concentrations of vinyl chloride
of up to 2000 ppa in the gas phase have shown a
similar rapid uptake followed by a plateau blood
concentration during several hours of exposure.
On removal from the vinyl chloride atmosphere,
blood concentrations fall rapidly to barely
detectable concentrations after 30 min.

BIOCHEMISTRY; RAT; INGESTION

<550>
 Wolf, F.; Kreter, E. Zur Diffusion von
 monomeren Vinylchlorid in Polyvinylchlorid.
 (Diffusion of vinyl chloride monomer in polyvinyl
 chloride.) Plaste Kaut. 21(1): 27 (1974). (CA
 80: 146581p)

The diffusion coefficient of vinyl chloride in
 polyvinyl chloride was inversely proportional to
 the K-value, probably as a result of greater
 chain mobility. Diffusion was lower at 50
 degrees than at 20 degrees, and attainment of
 equilibrium was slower at 50 degrees. Neither
 particle size nor plasticization time
 systematically affected the diffusion.

Ger.

PROPERTIES

<551>
 Woods, J. Mutagenic prescreening using
 Salmonella typhimurium with vinyl chloride.
 National Institutes of Environmental Health
 Sciences Ongoing Research Project

A mutagenesis prescreen with vinyl chloride is
 being conducted to test systems for handling gases
 in tier-one testing using Salmonella typhimurium.

MUTAGENICITY: RESEARCH ONGOING

<552>
 Wyatt, R.H.; Kotchen, J.H.; Hochstrasser, D.L.;
 Buchanan, J.W., Jr.; Campbell, D.R.; Slaughter,
 J.C.; Doll, R.H. An epidemiologic study of
 blood screening tests and illness histories among
 chemical workers involved in the manufacture of
 polyvinyl chloride. Ann. N.Y. Acad. Sci. 246:
 80-87 (1975).

An epidemiological comparison of workers in the
 polyvinyl chloride (PVC) production unit with
 workers in other parts of the Louisville S.P.
 Goodrich plant was undertaken in order to discern
 any detectable blood screening test or illness
 history differences between the two groups.
 Employment and medical histories were obtained
 from company records. Allergic problems and
 liver-spleen disease were reported more
 frequently in the PVC production workers, but
 genitourinary illnesses were more frequent in the
 other group of workers. Twelve blood screening
 tests were administered. The production workers
 had a greater percentage of abnormal albumin
 levels, while the control group had a greater
 percentage of clinically elevated SGOT and
 alkaline phosphatase levels. The effect of age
 on cholesterol levels was significantly different
 for the two groups.

EPIDEMIOLOGY; OCCUPATIONAL EXPOSURE; BLOOD; DIAGNOSTIC

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 Zado, F.H.; Samsamo, J.O. Monitoring for VCM
 at Western Electric Company. Technical Papers,
 Regional Technical Conference (10/31 - 11/1,

1974), Society of Plastics Engineers, Inc., New
 York City 107-121 (1974).

Two complementary methods for vinyl chloride (VC)
 monitoring were developed at Western Electric.
 The first was direct, on-site monitoring by gas
 chromatograph and flame ionization detector. The
 monitor was inexpensive, could be moved around
 the plant by lab cart or moving platform, took
 only 3 min for analysis cycle, was accurate, and
 was calibrated to standards which were freshly
 prepared. It could not provide time-averaged
 concentration analysis, and high transient
 concentrations could be missed. Interfacing the
 monitor with integral sampling techniques
 provided precise and accurate determinations as
 low as 0.1 ppm. The second method consists of
 trapping VC onto a solid adsorbent (Porapak or
 Carbowave 8) and thermal desorption onto a gas
 chromatograph for analysis by either mass
 spectrometer or flame ionization detector. The
 second method offers the ability to sample a
 large number of locations quickly, and is
 adaptable to personnel monitoring. Sensitivity
 is less than 1 ppb.

ANALYSIS; AIR; MONITORING; PERSONAL; INDUSTRIAL HYGIENE

<554>
 Zielhuis, R.L. (Vinylchloride: questionable
 safety). Ned. Tijdschr. Geneesk. 119(2):
 63-66 (1975). (TOXIS 75: 175318)

Toxic effects considered chemically induced
 include adenoma, angiosarcoma, liver neoplasms
 and lung neoplasms. Mice, rats, and hamster
 experiments were done.

Dut.

TOXICITY; OCCUPATIONAL EXPOSURE; HUMAN; ANIMAL; ANGIOSARCOMA

<555>
 Zimmermann, H.; Eck, H. Zur pathologischen
 Anatomie der Vinylchlorid-Krankheit (Pathological
 anatomy of vinyl chloride disease). Virchows
 Arch. A Path. Anat. Histol. 368: 51-59 (1975).

This detailed case study of a
 vinyl-chloride-related angiosarcoma (the fifth
 reported in West Germany) in a 38 yr old chemical
 laboratory assistant who had been exposed to
 vinyl chloride (VC) for 3 1/2 yrs includes
 morphology. The cancer had metastasized into
 many other organs, but no thrombocytopenia was
 seen. Further VC caused tumors are to be
 anticipated in the population, including
 extrahepatic tumors.

Ger.; Eng. Sum.

CASE STUDY; ANGIOSARCOMA; LIVER; HUMAN; CANCER; OCCUPATIONAL EXPOSURE

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SPI-02516

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 al. ibid. pp 135-148).
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Country	Percentage of population aged 65 and over in 1990
Japan	19
Germany	17
Italy	16
France	15
Australia	14
Sweden	13
Switzerland	12
United States	11

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**A Literature Compilation
1976 - 1977**

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INTRODUCTION

Proliferation of the literature on vinyl chloride continues. The references in this portion (Part III) of the report were gleaned chiefly from the published literature of 1976 and 1977. The list of sources searched was expanded to include the following:

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TOXICOLOGY INFORMATION RESPONSE CENTER



The Toxicology Information Response Center (TIRC) was founded in 1971 to establish a national and international center for toxicology information. TIRC provides information to all individuals on a variety of chemicals such as food additives, pharmaceuticals, industrial chemicals, environmental pollutants, heavy metals, and pesticides; and other topics of toxicologic concern.

ORGANIZATION—TIRC is sponsored by the National Library of Medicine's Toxicology Information Program. Located at the Oak Ridge National Laboratory, TIRC is part of the Information Center Complex, a major scientific and technical unit within the Information Division. This Complex coordinates the functions and activities of several information units at the Laboratory. These associations provide a unique opportunity for scientific and technical interactions.

INFORMATION SERVICES—As an information analysis center, TIRC acquires, selects, stores, retrieves, evaluates, analyzes, and synthesizes comprehensive literature packages according to a user's specific request or a current need. TIRC provides extensive toxicology information assistance and reference services to the scientific, administrative, and public communities—health science students, educators, practitioners, scientists, and administrators. Interested persons may request: (1) specific published toxicology data, (2) individualized literature searches, (3) topical bibliographies, (4) annotated and/or key-worded bibliographies, (5) state-of-the-art overviews, (6) custom searches of computerized data bases, (7) SDI service, (8) access to over 650 bibliographic collections generated annually, (9) in-Center use of the toxicology reference library, and (10) selected reports available from the National Technical Information Service.

INFORMATION RESOURCES—TIRC utilizes a variety of information sources. On-line access is available to several computerized data systems: MEDLINE and TOXLINE, RECON, and the diversified files of commercially available data systems such as DIALOG (Lockheed), ORBIT (Systems Development Corporation), and BRS (Bibliographic Retrieval Services, Inc.). The ORNL data files are searchable in batch mode and also provide SDI service.

Hard copy secondary sources used by TIRC include *Biological Abstracts*, *BioResearch Index*, *Chemical Abstracts*, *Current Contents*, *Excerpta Medica*, *Index Medicus*, *ATOMINDEX*, *Science Citation Index*, *Energy Research Abstracts*, *Nutrition Abstracts and Reviews*, *Air Pollution Abstracts*, and others. In addition, the ORNL library system provides an abundance of valuable resources with more than 200,000 bound volumes and 600,000 reports. Of the 3,500 subscription journals, about 1,200 are biologically or environmentally oriented.

As part of the Information Center Complex, TIRC maintains ready access to consultation and information exchange with other distinct, discipline-oriented entities which specialize in: (1) preparing evaluative multimedia

monographs, state-of-the-art reviews and overviews, (2) building an interactive computerized Toxicology Data Bank, (3) constructing and maintaining computerized reference and data files on mutagens and teratogens, (4) compiling environmentally oriented data files, and (5) collecting and distributing published energy information as well as ongoing research and development data.

SEARCH REQUEST INFORMATION—Literature searches are initiated after receiving from the requester certain background information: (1) definition of the search request in detail, (2) subject, scope, time and literature coverage, languages, suggested completion date, and (3) agreement on the cost estimate of the completed search.

COST—Searches are accomplished for requesters under a direct full-cost recovery system. The rate is \$30/hour with a minimum charge of \$35 for domestic search requests. Charges for search requests from foreign countries are \$35/hour with a \$40 minimum charge. Computer-associated charges, reproduction costs, as well as use fees for copyrighted materials, are assessed in addition to the hourly rate.

Following agreement between TIRC and the requester, a thorough literature search is conducted utilizing on-line computerized data bases and traditional library sources. Scope, time coverage, and search parameters determine the overall search cost.

Payment is collected by the National Technical Information Service in Springfield, Virginia 22161, either by direct billing or through deposit accounts.

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