

ence. It is believed by Wilson et al. that the condition is the result of three factors all of which must be present for occurrence: (1) a chemical insult, (2) a physical insult, (3) a personal idiosyncrasy. The *chemical* insult could occur from one or more of the monomers, catalysts and/or intermediate reaction products existing in polymerizers. A low degree of exposure to these could occur from contact with the solid, slightly moist, residue in the polymerizer or to small quantities of vapor, absorbed either percutaneously or by inhalation. The *physical* insult is present in all "polycleaners" to some degree through the prolonged hand scraping operations as well as the occasional use of hammers to remove the residues. *Personal idiosyncrasy* appears to be an important factor because of the low incidence of occurrence of the disorder and because of the fact that although all polycleaners are subjected to essentially similar chemical and physical insults, relatively few of them develop the disorder.

A point of general interest is the possible relationship of this condition to collagen disease. One patient of Harris and Adams (1967) two cases, had in fact, been diagnosed as a case of scleroderma on clinical grounds 10 years previously. Cordier et al. (1966)¹ mentions an unusual skin condition seen in their cases. Several of the cases of Wilson et al. (1967)³ also had external skin lesions on the dorsal surfaces of the hands and forearms. Finally Suciu et al. (1963)⁴ in a paper describing conditions produced by vinyl chloride also referred to a skin lesion resembling scleroderma, but acro-osteolysis was not mentioned.

Epidemiological Study

Late in 1966 after the first information about occupational acro-osteolysis became available, the Manufacturing Chemists' Association arranged with the University of Michigan to carry out a large epidemiological study both for the MCA and for the industry. This study was carried out in the vinyl chloride industry and included questionnaires, x-ray examinations of the hands, job history and industrial hygiene studies. There were 5011 employees in 32 plants of 19 corporations in the United States and Canada in the survey. Controls totalling 2407 were drawn from the Tecumseh, Michigan, epidemiologic study. Of the 5011 workers, 1302 were found to have an x-ray abnormality of the hands. Most were found to be unrelated to acro-osteolysis. The roentgen findings were correlated with the

history of Raynaud's phenomenon, and diagnostic categories established. Raynaud's phenomenon and characteristic x-ray changes establish the diagnosis of acro-osteolysis. An additional category involves severe roentgen changes of several fingers and is believed to represent the end stages of the disease.

The investigators established a total of 25 cases with an additional 16 "possibles" in whom x-ray changes were seen but Raynaud's phenomenon was not. The ratio of patients with clinical disease to those exposed to the chemical hazard was 1:31.

Esso Pappas PVC Operation

Esso Pappas has operated a PVC plant since early 1967, with a work force of about 35 persons. Our PVC plant consists of 8 reactors and was originally designed to produce 12,000 metric tons/year. It is a batch operation and the vinyl chloride monomer used in the process is received through pipeline from the supplier. During the past 18 months after continuing experiments in improving PVC processing, a capacity of 20,000 mt/year was reached.

Figure 1 is a view of the reactor room. The reactors are installed in two rows. The greater part of the 5.5 meter long reactor lies below the floor as you can see in Figure 2.

Figure 3 gives you an idea of the shape and the dimensions of each reactor.

After the process is completed the product is transferred from the bottom of the reactor to the finishing section where it is dried, screened and then fed into a bin for subsequent bagging.

Figure 4 shows a close up view of the reactor.

Although the materials of industrial hygiene concern in PVC production include vinyl chloride, methanol, catalyst, bisphenol A, carbon monoxide and PVC dust, vinyl chloride monomer seems to be the most important.

Since the polymerization operations are carried out in closed process, this provides little opportunity for employee exposure. The first industrial hygiene survey done by ER and E group on Dec. 1967 demonstrated that during normal operations the level of vinyl chloride throughout the plant is relatively low.

ACRO-OSTEOLYSIS IN PVC WORKERS

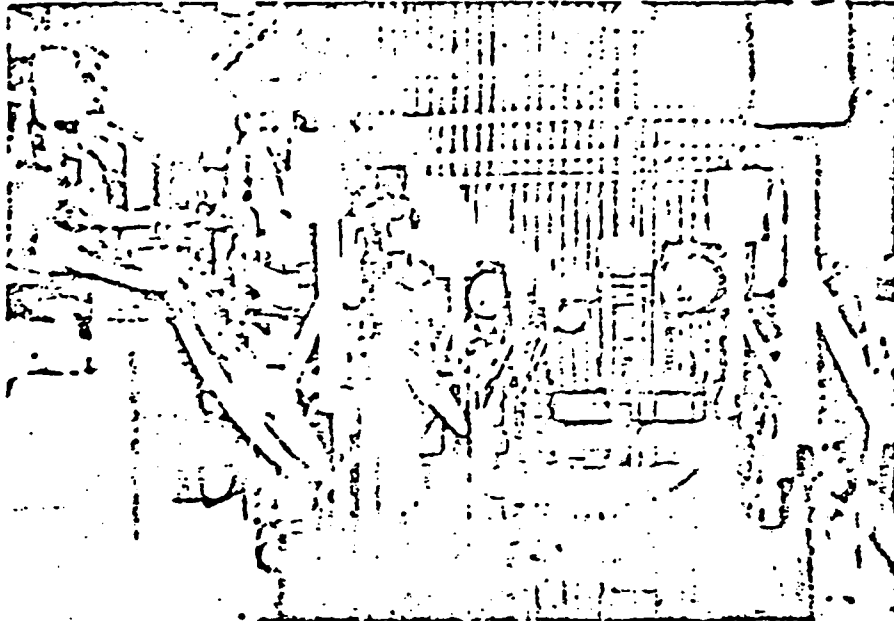


FIGURE 1 - PVC REACTOR ROOM

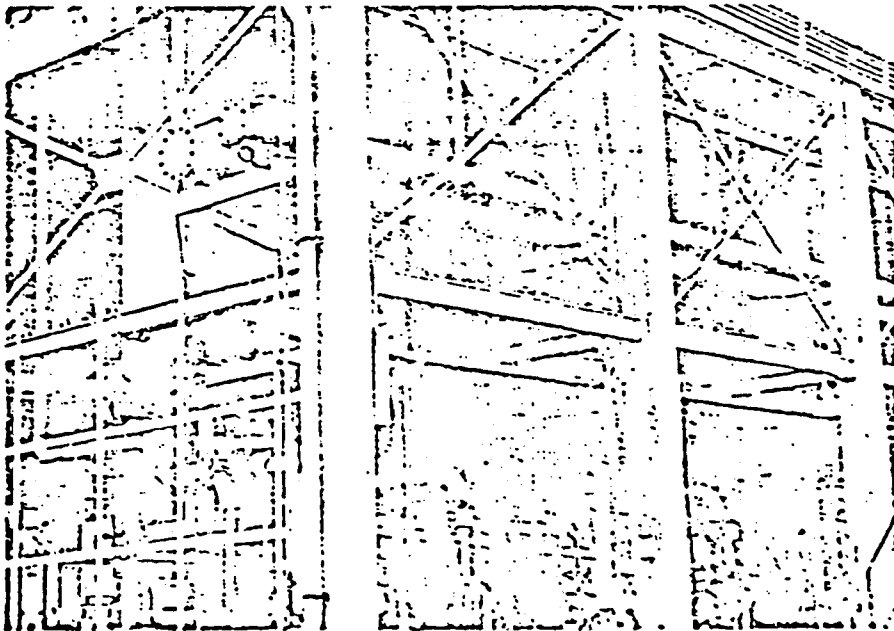


FIGURE 2 - LOWER PART OF PVC REACTORS

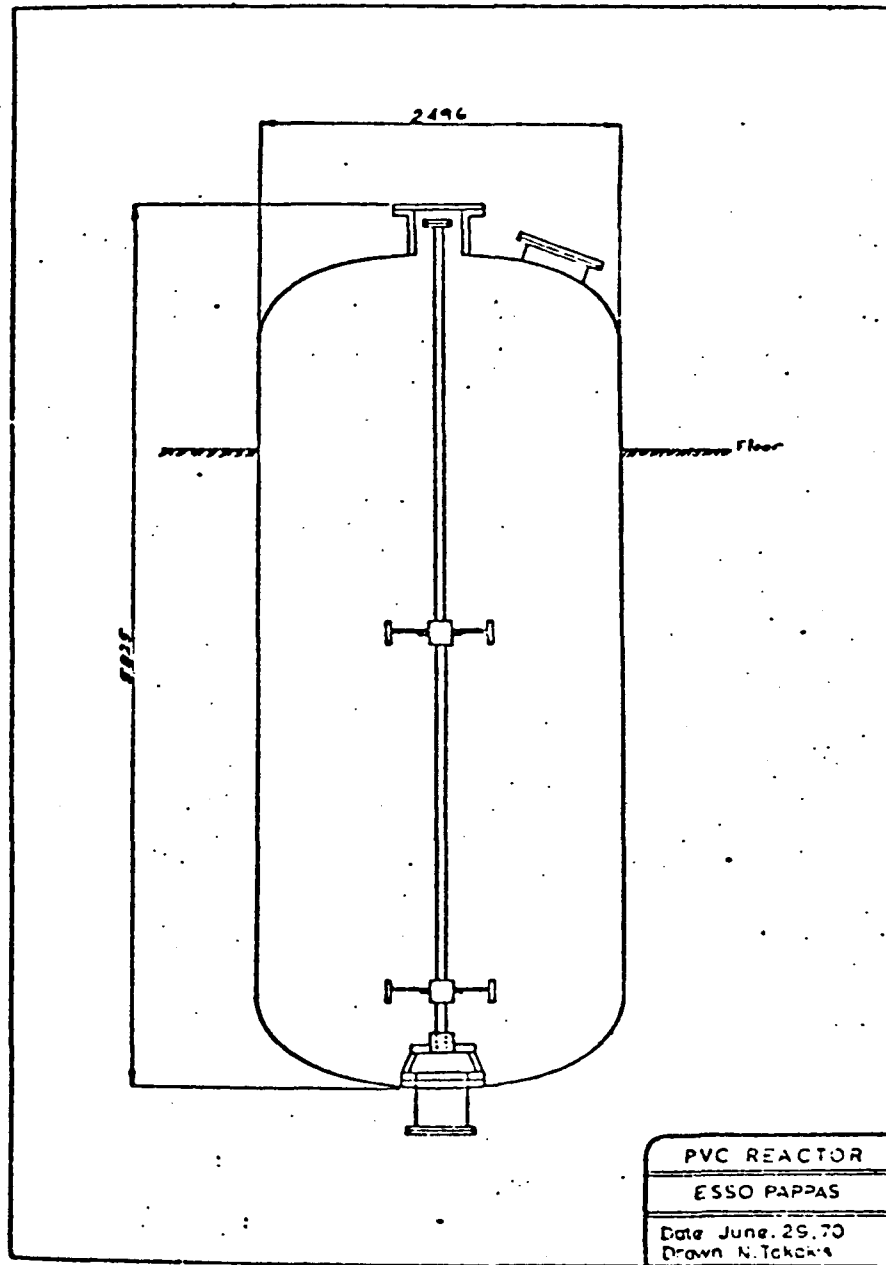


FIGURE 3

There were stages in the production process, however, which resulted in brief exposure to high concentrations, for example: (a) During the addition of water to the reactors the air displaced from the reactor contained as much as 10,000 ppm of vinyl chloride. This was due to a leakage at the manual control valve on the vinyl chloride monomer feed line and was corrected. (b) Vinyl chloride monomer was released to the workroom when the reactor was opened to obtain a sample of the PVC following completion of the reaction. (c) Polymer removed from the reactors following cleaning was originally placed in open waste drums. The concentration of V.C.M. in these drums was as high as 600 ppm. This was a source of airborne contamination and was eliminated by covering the drums and emptying them at the end of each shift.

Following transfer of the product from a reactor to the finishing section the reactor is washed out with water and following this an air mover is attached by flexible duct to the reactor discharge outlet and operated until the concentration of V.C.M. inside the reactor is 50 ppm or less. This determination is made by using colorimetric

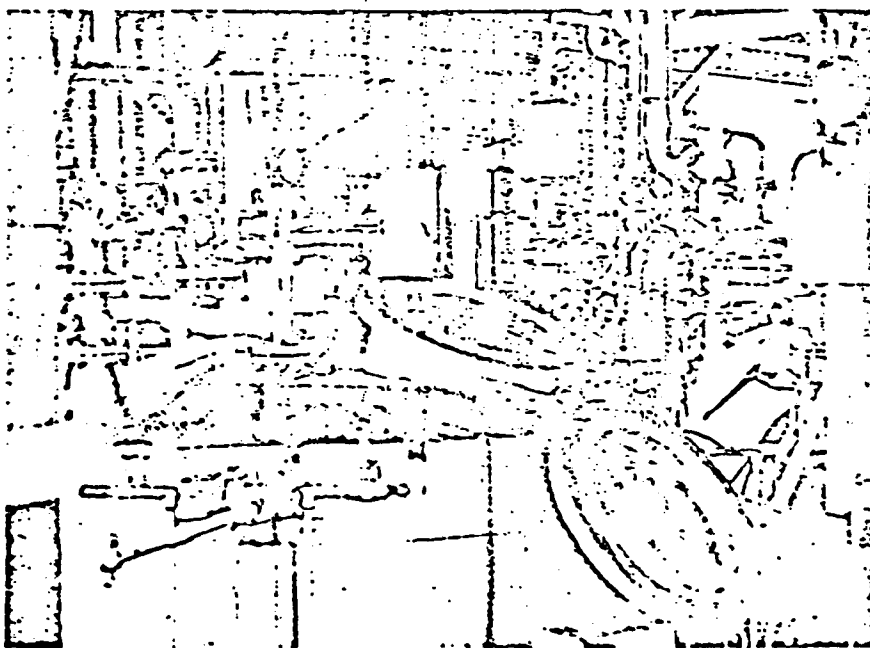


FIGURE 4 - TOP OF PVC REACTOR - ENTRY HATCH OPEN

detector tubes. Entry of the technicians for cleaning is not permitted until this level is reached. Reactor clean-out men are supposed to wear coveralls (plastic-coated or neoprene), work gloves and hard hats during this procedure.

Following the ER and E hygiene inspection the recommendation was made that neoprene gloves should be used by the polycleaners because through experiments it was found that this type of gloves was less permeable to V.C.M. In practice, however, these gloves were not found satisfactory for two reasons. First, they would tear easily, so that most of the time the gloves had holes and secondly, they were very uncomfortable to the technicians whose hands at the end of a reactor cleaning session were moist and the skin wrinkled. As a consequence the technicians were happy to see the gloves being torn and were not eager to change them. It was obvious that in this way the protection they were getting was minimal, if any, and so we had to return to the old canvas type work gloves. After all some protection was better than none.

In addition to the industrial hygiene measures outlined we have established the following program of medical check-ups for all people engaged in PVC production, testing and handling:

1. Yearly x-ray's of the hands.
2. A yearly periodic examination.

Up to this time we have had no abnormal x-ray findings nor have there been any clinical findings related to the above disorder.

References

1. Cordier, J. M. et al: Acroosteolysis et lesides cutanees, associees chez deux ouvriers. Affectes au nettoyage d'autoclaves. Cah. Med. Travail 4: (Jan.) 1966.
2. Harris, D. K. and Adams, W. G. F.: Acro-osteolysis occurring in men engaged in the polymerization of vinyl chloride, Brit. Med. J. 3:712, 1967.
3. Wilson, R. H. et al: Occupational Acroosteolysis, J.A.M.A. 201:577, 1967.
4. Suci, L. Drejman J. Valaskai, M: Contributii Studiul Imolnavirilor Produce de Clorura de Vinil. Med. Intern. 15:967, 1963.

1 puti ce profilaktiki. [Characteristics and prevention of vibration disease in workers handling high-frequency rotary tools. GIG TR PROF ZABOL 15(12): 15-18, 1971 [Russ. 1972]. [Engl. summ.]]--Vibration disease was diagnosed in 19.5% of 296 fitters. The disease manifested itself after a service record of 5-7 yr. Its characteristic features were a mildly pronounced vegetative-sensory polyneuritis or angiodystonic syndrome and degenerative-trophic changes in the bones and vertebral column with no concomitant lesion of the internal organs. Most patients were able to continue their occupational activities. Neurotrophic disturbances of the hands prevailed, with a marked pain component and reduced muscle performance. Workers handling abrasive discs for processing developed vibration pathology after a lapse of 9-12 and 16-19 yr. In this group the angiodystonic syndrome was of moderate intensity with a mildly expressed pain component. A new pneumatic tool provided with vibration damping arrangement was devised and a rational work schedule recommended.--J. F. L.

28415. SOLOV'eva, V. P. and A. S. YURCHENKO. (Inst. Ind. Hyg. Occup. Dis., Acad. Med. Sci. USSR, Moscow, USSR.) Fiziolicheskaya kharakteristika napryazhennosti truda pri rabote za pul'tami upravleniya. [Physiological characterization of the intensity of work at control desks.] GIG TR PROF ZABOL 15(4): 13-17, 1971. [Engl. summ.]--Results of a comparative investigation into physiological shifts (EEG, ECG, rate of information processing, speed of oculo-motor reaction, etc.) occurring under the effect of work at control desks when on duty and in a laboratory are reported. A relationship between changes of physiological functions and the intensity of work, determined by the amount of the incoming information, the sense of responsibility and the emotional stress, was discovered. The data was used in elaborating criteria of the intensity of work at control desks.--J. F. L.

28416. FILATOVA, V. S. and V. A. ANTONYUZHENKO. (Inst. Ind. Hyg. Occup. Dis., Gorki, USSR.) Gigienicheskie usloviya truda i professional'naya zabolevaemost' rabochikh proizvodstva suspenzionnogo polivinilkhlorida v dinamike za ryad let. [Hygienic conditions of work and occupational disease incidence among workers engaged in the production of suspension polyvinyl chloride.] GIG TR PROF ZABOL 15(4): 32-34, 1971. [Engl. summ.]--Disease incidence in workers in contact with polyvinyl chloride was studied for 16 yr (1953-1968). Introduction of improved machinery and ventilation in the premises contributed to the improvement of hygienic conditions. The clinical picture of the poisoning changed accordingly, with a longer period of development. However, the existence of technological operations which do not yet meet hygienic requirements, led to a subsequent rise in the air concentration of vinyl chloride and to the appearance of new cases of chronic occupational poisoning. A considerable variability in the clinical manifestations of chronic vinyl chloride poisoning as a function of the environmental air contaminations was established. A series of measures designed to improve the air of work premises are suggested.--J. F. L.

28417. LOMAREV, P. I., S. N. POPOV, A. M. TYURIN and Y. M. SHAPKATIS. (P. F. Lesgaft Inst. Phys. Cult., Leningrad, USSR.) O vliyaniy zanyatii sportom na chastotu i dlitel'nost' nekotorykh zabolevaniy. [Effect of sporting activities on the incidence and duration of some diseases.] SOV MED 34(2): 100-103, 1971. [Engl. summ.]--The frequency and duration of acute affections were studied in sportsmen and in non-athletic persons. Severe colds were much less frequent in the former while diseases of the locomotor apparatus were more frequent. This is attributed to the stress sportsmen are subjected to during training and performance. In sportsmen diseases last for a shorter time. Sporting activities do not change in the incidence of "acute" morbidity.--J. F. L.

28418. RETNEV, V. M. (S. M. Kirov Inst. Postgrad. Med., Leningrad, USSR.) Nekotorye voprosy gigeny truda v svyazi s kompleksnoi avtomatizatsiei. [Industrial hygiene in relation to complex automation.] GIG TR PROF ZABOL 15(4): 9-12, 1971. [Engl. summ.]--Complex automation generally leads to improved working conditions. Hygienic advantages include: favorable working conditions in most premises accommodating control desks, reduction of the number of operators engaged at work places presenting occupational hazards, and a decrease of physical efforts. Hygienic shortcomings attending complex automation are of a temporary and avoidable nature. They comprise a considerable nervous and psychic stress owing to a large volume of information and adverse working conditions at the control desks. In individual instances these factors tend to increase the sick-rate among the operators.--J. F. L.

28419. KRYZHANOVSKI, N. V. Gigienicheskie usloviya pri zachistke nefteprodnykh sudov i ikh vliyaniye na zdorov'e rabochikh. [Hygienic conditions in cleaning oil tankers and their effect on the workers' health.] GIG TR PROF ZABOL 15(3): 14-17, 1971. [Engl. summ.]--When cleaning oil tankers the hydrocarbons in the air exceed the maximum permissible concentration in 54.3% of cases handling crude oil and in 64.1% of cases dealing with diesel oil. The hydrocarbon concentration increases parallel to the rising temperature inside the tanks undergoing cleaning. The disease-incidence among female workers is elevated by comparison with those doing ship repair work.

There is a higher rate of cardio-vascular diseases, reproductive system disorders and respiratory disorders. Recommendations for the improvement of work conditions are given.--J. F. L.

28420. SOETHER, HALVARD. Yrkesskader under hogst. [Injuries in forest work.] TIDSSKR SKOGBRUK 79(1): 35-41, illus, 1971. [Engl. summ.]--In forestry there are more registered accidents/1000 man-years worked than in any other Norwegian trade or industry. A total of 101 cutters were studied in Østlandet and Trøndelag. Every 7th cutter suffered from injuries during the season 1969/70. This was 143 injuries/1000 man-years worked. Many failed to use safety equipment, especially the older cutters. Only about 1/2 had first aid equipment with them.--J. F. L.

28421. MC BRIDE, M. E. (Baylor Coll. Med., Houston, Tex., 77025, USA.), L. F. MONTES, W. J. FAHLBERG and J. M. KNOX. Microbial flora of nurses' hands: I. Quantitative differences in bacterial population between nurses and other occupational groups. INT J DERMATOL 11(1): 49-53, 1972. [Fr. and Span. summ.]--The microbial flora of the palms and interdigital areas of the hands in nurses was determined quantitatively and compared with a control group. The numbers of bacteria/cm² on the palm ranged between 0-log 3.81 in nurses and log 1.54-5.03 in controls with means of log 1.94 and 2.79 and medians of 2.00 and 2.69 for each respective group. The bacterial counts from the webs ranged from 8 to log 3.47/cm² in nurses and log 0.48-3.43 in controls. Mean values were 0.10/cm² for the nurses and 1.69 for the controls. Medians were log 0.94 and 1.67 for each group respectively.--J. F. L.

28422. OLDER, HARRY J. and BERNARD J. CAMERON. (Bio-Technol. Inc., 3027 Rosemary Lane, Falls Church, Va., 22042, USA.) Human factors aspects of air traffic control. NASA (NATL AERONAUT SPACE ADM) CONTRACT REP CR(1957): 1-163, illus, 1972. --This report presents an overview of human factors problems associated with the operation of present and future air traffic control systems. A description is included of those activities and tasks performed by air traffic controllers at each operational position within the present system. Judgmental data obtained from controllers concerning psychological dimensions related to these tasks and activities are also presented. The analysis includes consideration of psychophysiological dimensions of human performance. The role of the human controller in present air traffic control systems and his predicted role in future systems is described, particularly as that role changes as the result of the system's evolution towards a more automated configuration. Special attention is directed towards problems of staffing, training, and system operation. A series of 10 specific research and development projects are recommended and suggested work plans for their implementation are included.--J. F. L.

RADIATION HEALTH

See also: Radiation Biology

† 28423. MORGAN, K. Z. and E. G. STRUXNESS. (Health Phys. Div., Oak Ridge Nat. Lab., Oak Ridge, Tenn., 37830, USA.) Criteria for the control of radioactive effluents. INT J ENVIRON STUD 2(2): 111-119, illus, 1971. --The risks to the population from the U.S. nuclear energy industry are considered to be very small in comparison with other environmental risks. However, they are not zero and, on the assumption that radiation damage increases linearly with the accumulated dose, they can be expected on a statistical basis to result in a few deaths in the exposed population. Thus, the routine operation of these nuclear power plants may cause about 18 deaths/yr and the serious accidents, which may occur at a frequency of once every 50 yr, may add another 6 deaths/yr on the average. This is considered to be a small price to pay relative to the real but less-well-defined environmental risks from atmospheric pollution caused by fossil fuel power plants. Assuming the proper selection of a reactor site and all practicable precautions in the design and operation of a nuclear power reactor, adequate radiation protection for nearby populations can be assured by concentrating health physics attention on the critical radionuclides, critical pathways and critical segments of the population.

28424. GARNIER, ARLETTE. (Comm. Energ. Atom., Fontenay-Aux-Roses, Fr.) Evaluation des doses d'irradiation interne délivrées aux individus du public par suite de la pollution des aliments par le ⁹⁰Sr et le ¹³⁷Cs, en vue de la détermination des niveaux de rejet des radionucléides dans le milieu ambiant. [Evaluation of the internal radiation doses undergone by the general public as a result of ⁹⁰Sr and ¹³⁷Cs pollution of food and determination of the levels of radionuclide discharge into the environment.] HEALTH PHYS 22(3): 267-277, illus, 1972. [Engl. summ.]--This study is aimed at the investigation of models for the determination of levels of discharge of radioactive substances into the environment. For this purpose, it is proposed to estimate the average internal radiation dose resulting from contamination of the food-chain by ⁹⁰Sr and ¹³⁷Cs, taking into account the conditions and transfer mechanisms of the environment, the various links in the food-chain, and the characteristics of the population groups con-