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**DYNAMICS OF HYGENIC WORKING CONDITIONS
AND OCCUPATIONAL DISEASE INCIDENCE
AMONG WORKERS IN SUSPENSION POLYVINYL
CHLORIDE PRODUCTION OVER A NUMBER OF
YEARS**

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16. Abstracts The occupational disease incidence in workers resulting from vinyl chloride air pollution was studied over a period of 17 years (1955-1972). Although industrial conditions have improved, there still occurs new cases of chronic occupational poisoning. Various clinical manifestations of chronic vinyl chloride poisoning, as a function of environmental air pollution have been established. A series of measures designed to improve air quality in work areas is suggested.		
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developed on chronic occupational poisoning over 16 years (1953-1968). The data of more than 5000 air sample analyses, carried out by the Institute, sanitary epidemiological stations and laboratories of the industry, were used. Vinyl chloride determination was carried out by the method developed by Ye. Sh. Gronsberg.

Replacement of manual polymer unloading by centrifuges, semiautomatic chamber driers by "fluidized bed" driers and "tube drier" systems, the introduction of pneumatic transport of the raw resin, reconstruction of all ventilation systems, with systems of local exhaust from the reactors, precipitators from the centrifuge housing and in the polymer bagging section, facilitated improvement in hygienic working conditions in the production of suspension polyvinyl chloride. Beginning in 1955, vinyl chloride air pollution fell for several years in the old resin production buildings. Thus, while the number of samples exceeding the maximum permissible concentration (30 mg/m^3) was 80% in 1953, and 53.5% in 1954, there were 11.4% of these samples in 1956, 10% in 1957 and 2% in 1958. The maximum concentrations of vinyl chloride decreased considerably (by 900 times and more).

In a new building, in which better sealed precipitators and semiautomatic horizontal centrifuges, with screw conveyor precipitate unloading, were installed, a system for trapping the unpolymerized vinyl chloride was provided, and the state of the air during the first years of operation of the plant was mainly favorable (V.S. Filatova and colleagues).

In accordance with the improved hygienic working conditions in the old buildings, the level of chronic occupational poisoning with vinyl chloride decreased considerably in 1955-1959. No new cases of poisoning were disclosed in 1956 and 1958. However, a radical improvement in sanitary working conditions was not successfully achieved, since certain manufacturing operations remained hygienically defective: loading the initiator and removing samples for chemical control of production through the apparatus hatches, cleaning (manually) the reactors and centrifuges and resin packaging. There also were faulty seals in the packing gaskets of the connecting fittings installed in the apparatus and utilities. All this leads to sharp fluctuations in the indices of air pollution by vinyl chloride around the equipment on various days of the study, from permissible values ($22\text{--}24.5 \text{ mg/m}^3$) to concentrations exceeding the maximum permissible concentrations by many times.

The 1 1/2 times increase in polymer output, which required the installation of additional equipment in the same production area, had a definite unfavorable effect. In the old buildings, the percent of samples with a vinyl chloride content

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DYNAMICS OF HYGIENIC WORKING CONDITIONS AND
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by

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Summary

The dynamics of vinyl chloride air pollution in work areas of the polyvinyl chloride industry over a period of 17 years (1953-1969) and of occupational disease incidence therein for 16 years (1953-1968) was studied. Introduction of improved machinery and equipment and arrangement of an effective mechanical ventilation system in work areas have contributed to the betterment of hygienic conditions in the work areas. The clinical picture of poisoning has changed accordingly, with development over a longer period. However, the existence of technological operations which as yet do not meet hygienic requirements, faulty sealing of the equipment, shortages of up-to-date gasket-free fittings and increased output of the resin, produced within the same production area, led to a subsequent rise in air pollution with vinyl chloride and to the appearance of new cases of chronic occupational poisoning, although their severity has diminished. Considerable variability in clinical manifestations of chronic vinyl chloride poisoning, as a function of environmental air pollution, has been established. A series of measures designed to improve the air quality in work areas is suggested.

For the purpose of finding out the effectiveness of measures to improve sanitary conditions in the production of suspension polyvinyl chloride, pollution of the air by vinyl chloride was studied dynamically over 17 years (1953-1969) and materials were

¹Ye. Sh. Gronsberg, O. F. Kudriavtseva, L. A. Alekseeva and A. I. Fadeeva participated in the work.

This type of change usually appeared on an astheno-neurotrophic background, after 3-5 years of work. Angiospastic paroxysms were not discovered clinically during this period.

Beginning in 1961, when the discovery of higher concentrations of vinyl chloride began again in the air of the working premises, single cases of poisoning appeared again, proceeding with mildly expressed angiospastic reactions, limited to the distal sections of the limbs, without a tendency towards spreading to the vascularization zone of the vital organs. Superimposed over the sensory, vegetative and neurotrophic disorders, angiospastic symptoms usually aggravated the clinical picture of the polyneuritis syndrome. A tendency towards spastic reactions began to be discovered during this time, after 3-6 years of work under conditions of the action of vinyl chloride.

Dynamic observation of the state of health of the workers over a period of many years also permitted a group of persons to be distinguished, in whom an asthenic symptom complex dominated, which, in the initial stages of development, were superimposed within the framework of an astheno-neurotrophic syndrome, with symptoms of vegetative dysfunction. However, the subsequently joining organic microsymptomatology was evidence of the formation of an astheno-organic symptom complex. The latter was detected in persons with greater length of service (9-20 years) in contact with vinyl chloride. The data presented are evidence of a considerable variability in the clinical manifestations of vinyl chloride poisoning. Its characteristics depend on both the degree of air pollution and on individual sensitivity of the workers to the action of vinyl chloride.

Measures for reduction of air pollution by vinyl chloride come down to strengthening control of equipment and utilities sealing, the introduction of enameled reactors, continuous operation centrifuges, to the accomplishment of vacuum degassing of the suspension polyvinyl chloride, improvement in the method of taking samples for analytical control of production and resin packaging, and increasing the effectiveness of the mechanical exhaust ventilation from the packing boxes of the precipitator mixers and from the reactors.

higher than the maximum permissible concentration has been increasing over 1957-1958 since 1961, especially significantly in 1965, 1966 and 1968 (60.5, 62 and 61.2). Hygienic working conditions deteriorated in the new building. The percent of samples exceeding the maximum permissible concentrations was 40.5-57.4 in 1967-1968, and 76 in 1969, against 17-37 in 1961-1964. However, the maximum vinyl chloride concentrations in all resin production buildings in 1968-1969 were 8-40 times lower than in 1954 and 1961.

Air pollution around the centrifuges and in the resin drying building was caused by desorption of the monomer from the polymer. Purging of the unpolymerized vinyl chloride from the suspension was not carried out completely enough, as a consequence of defects in the method used. The time was reduced in the conditions for removal of vinyl chloride changed in the process of alkali treatment and resin drying. Therefore, the monomer content in the polymer increased to 0.05-1% (data of our investigations and of the plant laboratory). Previously (1953), vinyl chloride was not detected in the dry resin. The action of vinyl chloride, in the concentrations specified above, leads to development of occupational pathology. Beginning in 1959, cases of chronic poisoning again began to appear in the old buildings and, in 1964, 1965 and 1968, in the new building, although they proceeded in a less pronounced form.

There is interest in the dynamics of clinical manifestations of chronic vinyl chloride poisoning over a period of a number of years. While in 1953-1955 (when vinyl chloride was detected in concentrations many times exceeding the maximum permissible concentrations in the air of the production premises), chronic poisoning was characterized by the presence of an expressed local angiospastic syndrome ("dead" finger phenomenon, Reynaud syndrome), in which, in the more serious cases, the angiospastic reactions also spread to the area of vascularization of the vital organs (brain, heart), and these symptoms could arise as early as the first year of work in the shop. In the succeeding years (1956-1960) (with the vinyl chloride content in the air of the working premises at considerably lower concentrations), the clinical picture of poisoning changed considerably. In this case, first and foremost, only sensory disorders were detected, with the characteristic algic syndrome and disturbances of the sensitivity to pain (hyper or hypoalgesia), most often spreading to the distal sections of the limbs. Combinations of this type of sensory disorder with distal vegetative vascular insufficiencies (acrohypothermia, acrocyanosis) and neurodystrophic changes (trophic disorders of the skin and legs, foci of osteosclerosis and osteoporosis in the distal sections of the limbs, detectable by X-ray) created a picture of the so-called vegetative-sensory polyneuriti

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