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LETTER TO EDITORS
(Pis'mo v redaktsiyu

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In the paper "Determination of the Optimum Volume of Air Required for Taking Samples for Pollution Analysis" by I. M. Trakhtenberg and M. N. Korshun, published in No. 1 of the journal in 1966, the authors write, "Experience gained in our own work leads us to agree that there is little point in reducing the sample volume of NTP." They also mention an absence of arguments in favor of reducing the sample volume to NTP. The editors added a footnote, evidently recommended by the internal reviewer of the paper. "We cannot agree with this conclusion since it means that results obtained under different conditions cannot be compared." This remark was apparently intended to supply the missing argument in favor of the necessity of reducing the volume of air sample to NTP.

However, practical workers investigate the aerial medium for the sole purpose of comparing results with the maximum permissible concentrations. The official list of maximum permissible concentrations of health hazards in the free atmosphere (No. 564, 1965) and in the air of working premises (SN 245-63) do not specify temperature and pressure. This means that the authors of the maximum permissible concentrations likewise consider the variations in the concentration of impurities in equal volumes of air as a result of differences in conditions to be so slight as to render the conversion of these volumes to NTP unnecessary.

The review of the book "Determination of Atmospheric Pollutants" (Opredelenie atmosfernykh zagryaznenii) by M. V. Alekseeva published in No. 9 of the journal for 1961 contains the sentence, "It is quite pointless to reduce the volume of the sample of investigated air to standard conditions." This sentence was likewise followed by the editorial footnote, "This remark is erroneous." Yet, even this editorial footnote does not constitute a conclusive argument for the necessity of reducing the sample volumes to standard conditions.

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CONCERNING THE PRINCIPLES AND METHODS OF TOXICOLOGICAL ASSESSMENT OF VOLATILE SUBSTANCES RELEASED BY SYNTHETIC POLYMERS

(K obosnovaniyu printsipov i metodov toksikologicheskoi otsenki letuchikh veshchestv, vydelyayushchikhsya iz polimernykh sinteticheskikh materialov)

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One of the complex and important stages in the hygienic assessment of synthetic materials is the determination of the toxicity and the nature of the

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effect on man of complexes of volatile substances and compounds released into the air from polymer materials. In staging the toxicological experiments, one must take account of the fact that the nature of the toxic effect of volatile substances released by polymer materials depends on the effect of the total complex, including compounds of unknown composition which are also present in the gas-air mixture. Consequently, in the toxicological assessment of complexes of chemical substances (that is to say in investigations of the combined effects of volatile components released by polymer materials), integral indices should be used. Another useful approach is the differentiated toxicological investigation of the mixture, providing for the simultaneous detection of the possible specific effects of its main component (or components)

We performed detailed analysis of the results of sanitary-chemical investigations of a large group of polymer materials (107 items in all), systematizing the information concerning the chemical composition of volatile substances released by various high-molecular compounds, including those based on phenol-formaldehyde, urea-formaldehyde, unsaturated polyester, polyamide, and epoxy resins, derivatives of acrylic and metacrylic acids, styrene, coumarone and indene, butadiene and its homologs, etc. The analysis of data on the chemical composition of the substances released by these synthetic materials made possible their categorization into separate groups. In every such group one or more substances were arbitrarily designated as the main components in the complex gas-air mixture.

The most common volatiles are formaldehyde, phenol, styrene, epichlorohydrin, amines, acrylates, isopropylbenzene hydroperoxide, phthalic anhydride, sulfides and disulfides, cyanides, fluorides, organochlorine and phosphor-containing compounds. Obviously, this list will expand as further data is accumulated and the chemical composition of new polymers is investigated.

In the planning of toxicological experiments and in determining which of the substances released are toxicologically the most significant, account must be taken of their physicochemical properties, their relative toxicities, the proportion of specific components in the gas-air mixture, and the duration of their presence.

This approach to the design of experiments enables the use of both integral indices for assessments of the effect of the complex of volatiles in its entirety, and specific tests for the effects of individual main components. By taking account of the specific effects of the main components of the complex of volatiles to be investigated, it is possible to make a well based choice of suitable methods.

In assessing integral indices and specific effects, there is often a necessity for relatively rapid experiments, on account of the rate at which new polymer materials are being introduced in different branches of the national economy. It is therefore necessary, whenever possible, to modify the conventional techniques of investigation. For instance, if the experimental techniques include conditioned reflexes, it is useful to start the training at the commencement of the experiment. In this case, the experimenter investigates the dynamics of conditioned reflexes and the degree of their establishment against the background of toxic effects, instead of the conventional technique of determining variation in previously established conditioned reflexes.

It is also possible to stop the experiment before the date originally planned, if statistically significant and stable changes occur. Furthermore, the experiment may be stopped, as recommended by Tolokontsev, if the experimental animals become "habituated" to the substances under investigation.

Toxicological experiments for the study of complexes of volatiles call for a special approach to the design of poisoning chambers, which should provide for the possibility of continuous exposure. The chambers must be of a relatively large capacity; they must be made of a material which does not adsorb chemical substances (stainless steel, glass, etc.),* and it should not release volatiles into the air. It is useful to provide remote control and automatic devices for the maintenance of the parameters of the gas-air medium in the chambers. When exposure to the volatiles is combined with exposure to high temperatures, the poisoning chambers should have provision for control of the microclimate.

Certain tests measuring thermoregulatory processes may also be used as indices of the functional state of the organism during combined exposure to chemical and thermal factors. Tests of this kind include, for instance, recording of changes in body and skin temperatures, and determination of the respiration and pulse rates.

A design for toxicological experiments can be outlined as follows. The experimental conditions (type of poisoning chamber, air temperature and humidity, "saturation" of the chamber with the material in question, air change, daily exposure, etc.) are determined in accordance with the purpose of the synthetic material under investigation and the conditions under which it is expected to be used. There are two possibilities for the placement of such material, depending upon temperature. For ordinary temperatures (up to 30 – 33°) the samples may be placed directly in the poisoning chamber, but for higher temperatures the samples must be placed in a separate generator chamber with suitable conditions. From this chamber the gas-air mixture is supplied to the poisoning chamber. A similar arrangement must be used for the control animals.

Then, depending on the chemical composition of the gas-air mixture, a selection is made of the integral and "specific" indices and tests, to be used, the timing of tests before and during the experimental period determined, and the experimental animals chosen.** During the experiment significant variations of the indices should be compared with the normal fluctuations physiological constants.

If the variations are within the normal physiological limits, loading tests should be applied in order to elucidate the stability of adaptive reactions, and the results of such tests should be compared with values obtained in control animals under similar loads. One of the principal criteria for the assessment of effects is the extent and timing of the animals' recovery. Here, account must be taken of differences in the dynamics of the recovery of functions, depending upon their physiological lability.

Since the experiments make use of a complex of integral and specific indices and tests, the assessment of results should provide for the

* At the same time, it should be remembered that stainless steel reacts with hydrogen chloride, while glass reacts with hydrogen fluoride.

** In addition to the small laboratory animals commonly used for experimental purposes, certain experiments may be usefully performed on other animal species possessing a high sensitivity to the substances under investigation.

simultaneous analysis of several indices simultaneously. This necessitates application of the X test (van der Waerden).

The principles and recommendations presented in this paper by no means exhaust pertinent problems. A more complete treatment is provided in our draft of methodological instructions for the toxicological assessment of complexes of volatile substances released by synthetic polymer materials. It is to be hoped that a certain measure of uniformity in the principles and methods of such investigations will make possible a more efficient solution of the specific problems of the hygienic assessment of new synthetic materials introduced into the national economy.

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"MAN CURIE-EQUIVALENT" AS AN ARBITRARY UNIT FOR RADIOACTIVE SUBSTANCES

(Biologicheskii ekvivalent kyuri kak edinitsa uslovnogo kolichestva radioaktivnogo veshchestva)

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The quantitative measurement of radioactive substances in curie or derivative units does not provide a complete idea of the degree of radiation danger with respect to internal irradiation, as the effects on man of radioactive substances differ with different isotopes.

The toxicity of radioactive substances depends upon several factors, including the kind of radiation, the energy of particles, the selective accumulation of radioactive isotopes in specific organs, the half life, the biological half life, etc. In accordance with these factors the maximum permissible concentrations have been established for radioactive isotopes in the air of working premises, sanitary-protective zones and the populated areas. Maximum permissible concentration of various isotopes differ widely. For instance, the maximum permissible concentration of rhodium-103 is $6 \cdot 10^{-6}$ curie/l, while that of protactinium-231 is only $1 \cdot 10^{-5}$ curie/l, i. e., less by a factor of $6 \cdot 10^{-7}$. Consequently, one curie of protactinium-231 is equivalent, as it were, to $6 \cdot 10^{7}$ curie rhodium-103 with respect to toxicity.

Sanitary Regulations No. 333-60 divided all radioactive isotopes into four groups according to their toxicities and their maximum permissible concentrations in the air of working premises. In accordance with the