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TECHNICAL ASPECTS OF A CONVENTION ON CHEMICAL WEAPONS

INTRODUCTION

During the meetings of the Ad Hoc Working Group on Chemical Weapons of the Committee on Disarmament held in 1981 and 1982, substantive progress was achieved, particularly with regard to the technical issues affecting the various clauses of the Convention under study. Problems do, however, persist, but solutions will emerge, thanks to the spirit of collaboration of all the countries concerned, which will contribute their experience and information to the obviation of the difficulties.

Spain, which gave up the manufacture of chemical warfare agents on an industrial scale some time ago, is very interested in the success of the Ad Hoc Working Group on Chemical Weapons, for it would enable a convention to be drafted in the very near future.

In the Report of the Chairman to the Working Group on Chemical Weapons on the consultations held with experts on technical issues on 10 August 1982 (1) suggestions were made for the agenda of the meeting of experts in the spring of 1983. We submit in this working paper a series of considerations and suggestions on some of the topics concerned.

I. Material for lists of agents in the category of "other harmful chemicals" and for the list of important precursors to be considered

The technological progress of the last century has brought with it great advances in chemistry, with the result that numerous chemicals can now be produced synthetically. What with these and natural substances, there exist in the world today more than 4 million chemicals, of which more than 60,000 are in common use in agriculture, forestry, industry, the home, medicine, cosmetics and so on. Approximately 1,000 new products are put on the market each year.

Along with the considerable positive element, however, toxic products have meant new dangers and risks for man and his environment. These risks are not easily assessed because their consequences take a long time to appear; because those who enjoy the benefits of the new products are not the same as those who are exposed to the risks; because of the incipient state of research in this field and because of the many lacunae in our knowledge of it.

In all countries, questions of the harmful nature of chemicals are usually the responsibility of the institutes of hygiene and labour safety and the health and environmental organizations.

In this regard, there is wide-ranging international collaboration with various national and international bodies which study the toxic effects and maximum admissible doses in the working environment of, and the symptomatology and treatment of poisoning by, industrial chemicals.

For example, the American Conference of Governmental Industrial Hygienists annually publishes a list of chemicals containing all the data referred to above.

The interesting thing about this publication is that it constitutes an open list, with values subject to annual review, and that proposals may be made for its amendment.

These proposals and the annual acceptance of substances for inclusion in the list must be accompanied by substantive evidence and tests.

It would be interesting to study the possibility of setting up a similar "open list" system for other harmful chemicals and important precursors, with annual registrations (and possibly exclusions) at the proposal of the countries concerned by the treaty, and with a technical report which would cover the synthesis of warfare agents containing the substances and possibly toxicity tests (of the precursors of the end products of organic synthesis of which they are part, or of the final physical mixture produced).

II. Elaboration of recommendations for methods of aerosol inhalation toxicity determination

The toxicity of a chemical increases when it is administered by inhalation in the form of an aerosol.

Particles which are normally physiologically inert become aggressive when they are the carriers of toxic gases by adsorption. The gases are carried deep into the respiratory system, where they are deposited, producing centres of high toxin concentration.

The danger from chemicals is different when they merely pollute the environment and when their vapours are mixed with aerosols.

Although it is of interest for toxicological studies of aerosols to cover, in addition to the danger from inhalation, the danger deriving from contact with the mucous membranes, eyes or skin, and the dangers of ingestion and its local and systemic effects, tests for the quantitative determination of LTC 50 should be independent so as to permit the calculation of the proportion of aerosol actually absorbed by respiration. Responses of a psychological nature due to alarm or fear should not be omitted, although they are less important for the purposes of a convention (incapacitating and psychochemical agents).

For a study of the acute toxicity of aerosols, the methods recommended by the National Research Council of North America (2) or the World Health Organization (3) can be used.

The Federal Hazardous Substances Labelling Act (4) recommends the use of a test chamber containing rats, rabbits and guinea pigs at three levels, with constant humidity and temperature. The quantity of aerosol injected into the chamber together with filtered air and the concentration of the substances inside the chamber are determined by experiment. The lethal dose for 50 per cent (LD 50) of the animals is determined.

The systemic response to the quantity of aerosol reaching the bloodstream can be studied by sophisticated instruments (polygraphs, etc) or detected by elementary observation.

Sachsse, Ullmann and others (5) have designed a device comprising four independent units, each constituted by two cylinders of rigid polyvinyl placed one above the other. The upper cylinder is approximately 650 mm high and 308 mm in diameter; the lower cylinder is 300 mm high and under it is placed a rotating disc. This lower cylinder has, at 120 mm and 240 mm from its base, two equidistant threaded orifices of a diameter of 50 mm to which are connected the tubes (160 x 152 mm for rats) containing the animals.

The entire lower cylinder is contained in a protecting box.

The atomizer is placed at the upper end of the top cylinder, while the lower cylinder contains a cascade impactor, a hygrometer, a flow-meter and a vacuum pump which extracts the air from the entire apparatus at a rate of approximately 13 litres per minute; the exiting aerosol is neutralized by being passed through a 10 per cent solution of sodium hydroxide with 0.5 per cent hydrogen peroxide and a final filter.

The technical difficulty of the inhalation experiments led Clark (6) to draw up a protocol for the study of the toxic effects of an aerosol at stages of increasing complexity:

Stage I: Acute toxicity.

Determination of the LD 50 by oral, intravenous, and intra-tracheal means.

Simple irritation studies (eyes, etc.).

Stage II: Acute inhalation.

Determination of the LC 50 (lethal concentration) in four hours of "breathable" atmosphere, with particles of an aerodynamic size of 1-5 μ.

Stage III: Sub-acute inhalation.

Determination in two species (rat, dog) of the MPD (maximum permissible dose) in a "breathable" atmosphere, increasing the doses every three to four days until clinical indications appear. A histopathological examination is then made.

Stage IV: Chronic inhalation.

(This, like the succeeding stages, would not be important for the purposes of the treaty).

The use of two types of animal, rodents and non-rodents (such as dogs or monkeys) is recommended.

Stage V: Teratology.

The use of rats and rabbits is recommended for this stage (foetal mortality, foetal development or growth).

Stage VI: Special studies.

(Possible synergisms between propellants, adjuvants; hypertensive or sympathomimetic activity, etc.).

Since the variety of toxicological methods described in the literature and used by toxicologists is very considerable, it would be of interest to adopt a standardized method for the purposes of the treaty and to homologate a group of methods which each State could use and which would be contrasted with that adopted, using reference substances, with a statistical analysis of differences in means and the homogeneity of variances.

In this way, the national verification bodies would be at liberty to use their own toxicological methods for the purposes of the convention on chemical weapons with homologation and contrast with the international method as the only requisites.

III. Technical evaluation of the use of specialized information-gathering systems (black boxes) as components of a CW verification system

Owing to the technical limitations of present-day specialized systems (black boxes) for the gathering of information on chemical processes and installations, it would be helpful if as many countries as possible took part in the planning and the development of suitable sensors for chemical verification, so that the latter can in the near future and in very specialized cases replace on-site inspections.

The "black box" might be defined as "a system capable of capturing and displaying with specified precision and reliability data for the verification of compliance with a chemical weapons convention".

Defining the desired levels of data precision and system reliability is a prerequisite for implementing the projects appropriate to each specific case considered in the convention and for determining the type of sensors and degree of redundancy necessary for their implementation.

IV. Elaboration of methods for the protection and monitoring of the environment during the destruction of chemical weapons; planning of destruction

The contamination of the environment during the destruction of the stockpiles and arsenals of chemical weapons depends:

On the constituents to be destroyed;

On the method selected;

On the location of the destruction in space and time.

Whatever the method selected, it has its price and produces a polluting discharge. It would, therefore, be helpful to use a model to evaluate the alternatives, linking their selection to the various types of contamination existing and produced in the environment and the limits established as permissible maxima.

By reason of their nature, the <u>emissions</u> produced as a result of the various forms of human activity disperse in the atmosphere in a form mainly determined by <u>meteorological factors</u>. The resulting air composition or "<u>air quality</u>" is harmful above certain limits for the elements of the local ecosystem. Atmospheric pollution simulation models link the following three concepts:

<u>The emissions</u> existing in an area can be assessed by means of emission factors, which relate to the quantity of pollutant emitted to an index based on the type of activity in the area, amount of fuel burned, etc., like the indices prepared by the United States Environmental Protection Agency.

<u>The typical meteorological situation</u> in each basic time period and area is estimated by means of a statistical analysis of the recorded meteorological data and is shown as an n-dimensional probability matrix.

Air quality is expressed by two parameters per pollutant:

Maximum permissible concentration of the pollutant in the atmosphere;

Number of occasions over a given period of time on which it is permissible to exceed this concentration (maximum permissible probability that the concentration in the area will exceed the absolute limit).

Using the classic method of diffusion models, it is possible to simulate short-period atmospheric pollutant concentrations by zones, situating the destruction alternative model on the various space-time co-ordinates. This shows whether some problem area will occur which exceeds the established limits.

Other models are used for the treatment of solid residues.

This type of model can also be used to determine the most probable location of the pollution focus by means of the data collected from the environment (7).

Some models developed by the research centre of the Universidad Autónoma de Madrid have been successfully tested in the industrial zone of Bilbao (8).

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