

Environmental Health Criteria 8

SULFUR OXIDES AND SUSPENDED PARTICULATE MATTER

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INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY

ENVIRONMENTAL HEALTH CRITERIA 8

SULFUR OXIDES AND SUSPENDED PARTICULATE MATTER

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NOTE TO READERS OF THE CRITERIA DOCUMENTS

While every effort has been made to present information in the criteria documents as accurately as possible without unduly delaying their publication, mistakes might have occurred and are likely to occur in the future. In the interest of all users of the environmental health criteria documents, readers are kindly requested to communicate any errors found to the Division of Environmental Health, World Health Organization, Geneva, Switzerland, in order that they may be included in corrigenda which will appear in subsequent volumes.

In addition, experts in any particular field dealt with in the criteria documents are kindly requested to make available to the WHO Secretariat any important published information that may have inadvertently been omitted and which may change the evaluation of health risks from exposure to the environmental agent under examination, so that the information may be considered in the event of updating and re-evaluation of the conclusions contained in the criteria documents.

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ENVIRONMENTAL HEALTH CRITERIA FOR SULFUR OXIDES AND SUSPENDED PARTICULATE MATTER

A WHO Task Group on Environmental Health Criteria for Sulfur Oxides and Suspended Particulate Matter met in Geneva from 6 to 12 January 1976. The meeting was opened by Dr B. H. Dieterich, Director, Division of Environmental Health, who welcomed the participants and the representatives of other international organizations on behalf of the Director-General. Dr Dieterich briefly outlined the history and purpose of the WHO Environmental Health Criteria Programme and the progress made in its implementation, thanks to the active collaboration of WHO Member States and the support of the United Nations Environment Programme (UNEP).

The Task Group reviewed and revised the second draft criteria document and made an evaluation of the health risks from exposure to these substances.

The first and second drafts were prepared by Professor B. G. Ferris, Jr, Harvard University School of Public Health, USA. The comments on which the second draft was based were received from the national focal points collaborating in the WHO Environmental Health Criteria Programme in Belgium, Bulgaria, Canada, Czechoslovakia, the Federal Republic of Germany, Greece, Japan, New Zealand, Poland, Sweden, USA, USSR and from the Food and Agriculture Organization of the United Nations (FAO), the United Nations Educational Scientific and Cultural Organization (UNESCO), the United Nations Industrial Development Organization (UNIDO), the World Meteorological Organization (WMO), the International Atomic Energy Agency (IAEA), and the Commission of European Communities (CEC). Comments were also received from Professor H. Antweiler and Dr B. Prinz (Federal Republic of Germany), Professor K. Biersteker and Dr R. van der Lende (Netherlands), Professor F. Sawicki (Poland), and Professor W. W. Holland and Professor P. J. Lawther (United Kingdom).

The collaboration of these national institutions, international

organizations and individual experts is gratefully acknowledged. The Secretariat also wishes to thank Professor B. G. Ferris, Jr and Mr R. E. Waller for their invaluable assistance in the final stages of the preparation of the document.

In view of the substantial amendments made to the document (particularly within sections 2 to 5) since the meeting of the Task Group, a revised version was circulated to all members in February 1978. At the same time, copies of a newly-produced review of the health effects of particulate pollution (Holland et al., in press), that had been submitted for consideration, were distributed to the members. Comments were sought on the draft of the criteria document

itself, and on any amendments or additions considered necessary in light of the new report. These comments, together with others received from the International Petroleum Industry Environmental Conservation Association, and the International Iron and Steel Institute, were then considered by a small group consisting of the Chairman of the Task Group meeting, the Rapporteur and some members of the Secretariat. The alterations suggested (mainly within section 9) were circulated again to the original members of the Task Group prior to publication.

The document has been based, primarily, on original publications listed in the reference section. However, several recent reviews of health aspects of sulfur oxides and suspended particulate matter have also been used including those by Katz (1969), Committee on the Challenges of Modern Society (1971), Organization for Economic Cooperation and Development (1965), Rall (1974), Task Group on Lung Dynamics (1966), Task Group on Metal Accumulation (1973), US Department of Health, Education and Welfare (1969a), US Environmental Protection Agency (1974), World Health Organization (1976a), and World Meteorological Organization (1974).

The purpose of this document is to review and evaluate available information on the biological effects of sulfur oxides and suspended particulate matter including suspended sulfates and sulfuric acid aerosols, and to provide a scientific basis for decisions aimed at the protection of human health from the adverse consequences of exposure to these substances in both occupational and general environments. Although there are various routes of exposure, such as inhalation, ingestion (World Health Organization, 1971, 1974) and contact with skin, attention in this report has been concentrated upon the effects of inhalation of these substances, since this is the most important route of exposure. The discussion has also been limited to sulfur dioxide, sulfur trioxide, sulfate ions, and particulate matter primarily resulting from the combustion of fossil fuels. The sulfate ion has been considered in the variety of forms in which it occurs in the atmosphere, e.g., sulfuric acid and various sulfate salts.

The vast literature on these pollutants has been carefully evaluated and selected according to its validity and relevance for assessing human exposure, for understanding the mechanisms of the biological action of the pollutants and for establishing environmental health criteria, i.e., exposure-effect/response relationships in man. Environmental considerations have been limited to elucidating the pathways leading from the natural and man-made sources of these substances to the sites of toxic action in the human organism. The non-human targets (plants, animals, ecosystems) have not been considered unless the effects of their contamination were judged to be of direct relevance to human health. For similar reasons, much of the published information on the effects of these pollutants on experimental animals has not been included.

Details concerning the WHO Environmental Health Criteria Programme

including some terms frequently used in the document may be found in the general introduction to the Environmental Health Criteria Programme published together with the environmental health criteria document on mercury (Environmental Health Criteria 1, Mercury, Geneva, World Health Organization, 1976), now also available as a reprint.

The following conversion factors have been used in the present document:^a

Sulfur dioxide	1 ppm = 2856 $\mu\text{g}/\text{m}^3$
Ozone	1 ppm = 2140 $\mu\text{g}/\text{m}^3$
Carbon monoxide	1 ppm = 1250 $\mu\text{g}/\text{m}^3$

^a When converting values expressed in ppm to $\mu\text{g}/\text{m}^3$, the numbers have been rounded up to 2 or, exceptionally, 3 significant figures, and concentrations higher than 10 000 $\mu\text{g}/\text{m}^3$ have been expressed in mg/m^3 .

1. SUMMARY AND RECOMMENDATIONS FOR FURTHER RESEARCH AND ACTION

1.1 Summary

1.1.1 Chemistry and analytical methods

Procedures in common use for the sampling and determination of sulfur dioxide, sulfates, sulfuric acid, and suspended particulate matter have been discussed, noting their limitations and stressing the need to specify the method of measurement when quoting results in relation to studies on the effects of health.

Several alternative methods, already in common use, can be recommended for the determination of sulfur dioxide using manually operated sampling and, providing the extent of interference from other pollutants is taken into account, results are reasonably comparable with one other. A wide range of continuous automatic instruments is available and, where the expense is justified, they can provide additional information on short-term variations in concentrations^b of sulfur dioxide.

Methods for the determination of particulate sulfate do not present any special problems, but, at present, there does not appear to be any wholly satisfactory way of determining sulfuric acid separately from sulfates and other interrelated components.

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