

This report contains the collective views of an international group of experts and does not necessarily represent the decisions or the stated policy of the United Nations Environment Programme, the International Labour Organization, or the World Health Organization

## Environmental Health Criteria 36

# FLUORINE AND FLUORIDES

Published under the joint sponsorship of  
the United Nations Environment Programme,  
the International Labour Organisation,  
and the World Health Organization



INVENTARIO N. 39



World Health Organization  
Geneva, 1984

Other titles available in the ENVIRONMENTAL HEALTH CRITERIA series include:

1. Mercury
2. Polychlorinated Biphenyls and Terphenyls
3. Lead
4. Oxides of Nitrogen
5. Nitrates, Nitrites, and N-Nitroso Compounds
6. Principles and Methods for Evaluating the Toxicity of Chemicals, Part 1
7. Photochemical Oxidants
8. Sulfur Oxides and Suspended Particulate Matter
9. DDT and its Derivatives
10. Carbon Disulfide
11. Mycotoxins
12. Noise
13. Carbon Monoxide
14. Ultraviolet Radiation
15. Tin and Organotin Compounds
16. Radiofrequency and Microwaves
17. Manganese
18. Arsenic
19. Hydrogen Sulfide
20. Selected Petroleum Products
21. Chlorine and Hydrogen Chloride
22. Ultrasound
23. Lasers and Optical Radiation
24. Titanium
25. Selected Radionuclides
26. Styrene
27. Guidelines on Studies in Environmental Epidemiology
28. Acrylonitrile
29. 2,4-Dichlorophenoxyacetic Acid (2,4-D)
30. Principles for Evaluating Health Risks to Progeny Associated with Exposure to Chemicals during Pregnancy
31. Tetrachloroethylene
32. Methylene Chloride
33. Epichlorohydrin
34. Chlordane
35. Extremely Low Frequency (ELF) Fields

CONTENTS

	<u>Page</u>
ENVIRONMENTAL HEALTH CRITERIA FOR FLUORINE AND FLUORIDES	
PREFACE . . . . .	9
1. SUMMARY AND RECOMMENDATIONS FOR FURTHER RESEARCH . . . . .	11
1.1 Summary . . . . .	11
1.1.1 Analytical methods . . . . .	11
1.1.2 Sources and magnitude of exposure . . . . .	11
1.1.3 Chemobiokinetics and metabolism . . . . .	12
1.1.4 Effect of fluoride on plants and animals . . . . .	12
1.1.5 Beneficial effects on human beings . . . . .	13
1.1.6 Toxic effects on human beings . . . . .	13
1.2 Recommendations for further research . . . . .	14
2. PROPERTIES AND ANALYTICAL METHODS . . . . .	15
2.1 Chemical and physical properties of fluorine and its compounds . . . . .	15
2.1.1 Fluorine . . . . .	15
2.1.2 Hydrogen fluoride . . . . .	16
2.1.3 Sodium fluoride and other alkali fluorides . . . . .	16
2.1.4 Fluorspar, cryolite, and fluorapatite . . . . .	17
2.1.5 Silicon tetrafluoride, fluorosilicic acid, and fluorosilicates . . . . .	17
2.1.6 Sodium monofluorophosphate . . . . .	18
2.1.7 Organic fluorides . . . . .	18
2.2 Determination of fluorine . . . . .	19
2.2.1 Sampling and sample preparation . . . . .	19
2.2.1.1 Air . . . . .	20
2.2.1.2 Soil and rocks . . . . .	20
2.2.1.3 Water . . . . .	21
2.2.1.4 Animal tissues . . . . .	21
2.2.1.5 Plants . . . . .	22
2.2.2 Separation and determination of fluoride . . . . .	22
2.2.2.1 Colorimetric methods . . . . .	23
2.2.2.2 The fluoride selective electrode . . . . .	23
2.2.2.3 Other methods . . . . .	24
3. FLUORIDE IN THE HUMAN ENVIRONMENT . . . . .	25
3.1 Fluoride in rocks and soil . . . . .	25
3.2 Fluoride in water . . . . .	25

The **International Programme on Chemical Safety (IPCS)** is a joint venture of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization. The main objective of the IPCS is to carry out and disseminate evaluations of the effects of chemicals on human health and the quality of the environment. Supporting activities include the development of epidemiological, experimental laboratory, and risk-assessment methods that could produce internationally comparable results, and the development of manpower in the field of toxicology. Other activities carried out by IPCS include the development of know-how for coping with chemical accidents, coordination of laboratory testing and epidemiological studies, and promotion of research on the mechanisms of the biological action of chemicals.

FLUORINE AND FLUORIDES

ISBN 92 4 154096 6

©World Health Organization 1984

Publications of the World Health Organization enjoy copyright protection in accordance with the provisions of Protocol 2 of the Universal Copyright Convention. For rights of reproduction or translation of WHO publications, in part or *in toto*, application should be made to the Office of Publications, World Health Organization, Geneva, Switzerland. The World Health Organization welcomes such applications.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.



PRINTED IN FINLAND  
84/6150 - VAMMALA - 6000