

Environmental aspects of water fluoridation

KEY POINTS

- Fluorides are very common in the environment.
- Reviews of the literature and environmental impact assessments have found no evidence of any adverse environmental effects resulting from water fluoridation.
- Water fluoridation could be described as *environmentally friendly* since it ensures maximum utilisation of natural resources, and reduces waste.



1. Sources of fluoride in the environment

The element fluorine, chemically combined in the form of fluorides, is abundant in the earth's crust. Drinking water and virtually all foodstuffs contain at least trace amounts of fluoride, and all organisms are exposed to fluoride originating either from natural processes or human activity. Fluoridation of drinking water supplies, however, is not a major source of fluoride in the environment.

Fluorides are to be found everywhere in the environment. Their occurrence is as a result of:

- natural processes - the erosion of fluoride-containing minerals and the rain cycle, and emissions from volcanoes;
- industrial processes - principally steel, glass, brick and ceramics manufacture; aluminium, copper and nickel production; phosphate ore processing; phosphate fertiliser production and use; the use of fluoride-containing pesticides; industrial and domestic coal burning; and, finally,
- fluoridation of drinking water supplies.



Fluoride levels in surface waters, the air and soil depend on the natural rock, geothermal and volcanic activity, and discharges and emissions resulting from human activity, the main sources of which are industrial - in particular, phosphate ore production and use and aluminium production (1). The route of exposure and the ability of the species to absorb fluoride influence its uptake by organisms and plants. The environmental impact of fluorides has been well documented since at least 1937.

2. Recent reviews

More recent reviews of the environmental impact of water fluoridation include:

The World Health Organisation

The World Health Organisation (WHO) has reviewed the literature (1-3) identifies the principal sources of fluoride pollution as industries and mining. The WHO notes that, in the absence of adequate emission control in such settings, environmental pollution can be a problem. Such pollution has been a problem in the past in industrialised countries, and the WHO warns that unless proper environmental safeguards are adhered to, there is a danger of it occurring in developing countries with increasing industrialisation (3).

In areas not in the direct vicinity of emission sources, the mean concentrations of fluoride in ambient air are generally less than $0.1 \mu\text{g}/\text{m}^3$. Levels may be slightly higher in urban than in rural locations; but, even in the vicinity of emission sources, the levels of airborne fluoride usually do not exceed $2\text{--}3 \mu\text{g}/\text{m}^3$. However, in some provinces of China where fluoride-rich coal is used as a source of fuel and for drying and curing food, reported indoor air concentrations of fluoride have reached $6 \mu\text{g}/\text{m}^3$ (1).

Fluoride pollution is recognised by the World Health Organisation primarily as an *industrial* hazard; the World Health Organisation does not consider the fluoridation of water supplies to improve dental health to be a potential source of fluoride pollution.

In 1973, the WHO Environmental Health Criteria Programme (EHC Programme) was initiated “to assess information on the relationship between exposure to environmental pollutants and human health, and to provide guidelines for setting exposure limits”. Since being set up, the EHC Programme has widened its scope and, increasingly, the importance of environmental effects in addition to health effects is emphasised in the total evaluation of chemicals. Nowadays, the purpose of the programme is “to provide critical reviews on the effects on human health and the environment of chemicals and of combinations of chemicals and physical and biological agents”.

The World Health Organisation does not consider the fluoridation of water supplies to improve dental health to be a potential source of fluoride pollution.

In 2002, the EHC Programme published *Environmental Health Criteria 227: Fluorides* under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation and the World Health Organisation, and within the framework of the Inter-Organisation Programme for the Sound Management of Chemicals.

Tacoma-Pierce County Health Department, Washington, USA August 2002

Under Washington's State Environmental Protection Act (SEPA), the Tacoma-Pierce County Health Department commissioned an independent investigation of the potential environmental consequences of a proposal by the Health Department to fluoridate all water systems serving 5,000 or more people.

The investigation looked at the proposal in terms of its impact under the following 16 headings standardised by the State: Earth; Air; Water including surface, ground, and water runoff; Plants; Animals; Environmental Health; Land and Shoreline Use; Housing; Aesthetics; Light and Glare; Recreation; Historic and Cultural Preservation; Transportation, Public services; and, Utilities.

The study provided detailed confirmation that "fluoridation of the public drinking water will not negatively impact the environment". (4)

Environment Agency and the Scotland and Northern Ireland forum for Environmental Research

An environmental risk assessment conducted for the Environment Agency and the Scotland and Northern Ireland forum for Environmental Research comprehensively reviewed the aquatic toxicity of fluoride and proposed environmental quality standard (EQs) for fluoride (5). In a personal communication, one of the report's authors (Wendy Young, 18 August 1999) said: "On the basis that water systems are fluoridated at 1mg l^{-1} , the theoretical maximum in wastewater effluent (before dilution) could potentially be 1 mg l^{-1} . This is in line with EQS value for surface water." (The fluoride content of seawater is fairly constant at levels between 1.2 – 1.4 mg/l, which is higher than the theoretical maximum in wastewater effluent).

Osterman, McGill University Montreal, 1990

Focusing on the effects of fluoridation on aquatic environment, Osterman's investigation evaluated the impact of water fluoridation on the aquatic environment.

He found that "...fluoridated water loss during use, dilution of sewage by rain and groundwater infiltrate, fluoride removal during secondary sewage treatment, and diffusion dynamics at effluent outfall, combine to eliminate fluoridation related environmental effects". (6)

In the US, where well over 60% of water supplies are fluoridated, Osterman found the fluoride concentration in most rivers averaged 0.33ppm.

A literature review by Osterman did not reveal any examples of municipal water fluoridation causing recommended environmental concentrations to be exceeded, although excesses occurred in several cases of severe industrial water pollution not related to water fluoridation.

SCHER report, 2011

In May 2011 a report by the EU Commission's Scientific Committee on Health and Environmental Risks (SCHER) concluded on the basis of the latest available evidence that "exposure of environmental organisms to the levels of fluoride used for fluoridation of drinking water is not expected to lead to unacceptable risks to the environment". (7)

Conclusion

As has been described in the section of *One in a Million* on Technical Aspects of Fluoridation, the chemicals used for water fluoridation are manufactured as a co-product of the manufacture of phosphate fertilisers, and the raw material for that process is a natural resource (rocks excavated for their mineral content). Water fluoridation could therefore accurately be described as *environmentally friendly*, since it ensures maximum utilisation of these natural resources, and reduces waste.

References

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3. World Health Organisation Expert Committee on Oral Health Status and Fluoride Use (1994): *Fluorides and Oral Health. WHO Technical Report Series No. 846*. Geneva: World Health Organisation.
4. Tacoma-Pierce County Health Department (2002): *News Release: Fluoridation/SEPA Study*. Tacoma-Pierce County Health Department: Tacoma.
5. Dixon E, Sutton A, Young W (2000): *Proposed Environmental Quality Standards for fluoride in water. WRc R&D Technical Report P99*. Bristol: Environment Agency.
6. Osterman JW (1990): Evaluating the impact of municipal water fluoridation on the aquatic environment. *American Journal of Public Health*, 80: 1230-1235.
7. European Commission Scientific Committee on Health and Environmental Risk (SCHER) (2011): *Critical review of any new evidence on the hazard profile, health effects, and human exposure to fluoride and the fluoridating agents of drinking water*. Directorate General for Health and Consumers, Brussels, Belgium.