

Drinking Water Fluoridation in New Zealand

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Over the last couple of years fluoridation of drinking water has been in the news a lot. It is a controversial subject, with the battles mainly between the oral health fluoridation advocates and the implacably opposed. For those in the industry responsible for drinking water, it is easy to feel caught in the middle. In this article, we describe some of the background facts about the practice of water fluoridation, summarise the recent significant events surrounding the science and politics of fluoridation, and introduce the responses of the water industry to ensuring that it is practised in a safe way.

Introduction

Fluoridation is the process of adding the micronutrient fluorine to drinking-water (in the form of the fluoride ion) to raise its concentration above the level it occurs naturally in the source water. New Zealand source waters tend to have relatively low levels of natural fluoride.

The Ministry of Health recommends the adjustment of fluoride to between 0.7 and 1.0 mg/L (parts per million) as the most effective and efficient way of helping prevent dental caries (tooth decay) in communities receiving a reticulated water supply.

Fluoride is usually added during the final stages of water treatment. There are three chemicals used for the fluoridation of drinking water. These are:

- Fluorosilicic acid (FSA) – formerly known as hydrofluorosilicic/hydrofluosilicic acid (HFA), and also known as hexafluorosilicic acid
 - Sodium fluoride
 - Sodium fluorosilicate (SFS) – also known as sodium silicofluoride
- Sodium fluoride and SFS are supplied as powders that are dissolved in water to make a solution that is then added to the water supply, while FSA is supplied as a liquid.

Fluoride is added to the water at a controlled rate relative to the flow through the treatment plant to achieve a target concentration in the treated water. The fluoride concentration in the water that leaves the treatment plant needs to be closely monitored.

Legislation and Standards

There is no legislation in New Zealand that requires the addition of fluoride to a water supply. Fluoridation is undertaken by drinking-water suppliers at their discretion. There are a few acts and standards that impose regulations on drinking-water suppliers that choose to fluoridate.

The *Drinking-water Standards for New Zealand 2005 (revised 2008)* (DWSNZ) specifies a Maximum Acceptable Value (MAV) of 1.5 mg/L for fluoride. Fluoride is classified as a Priority 2 determinand in the DWSNZ. This means that fluoridated drinking water supplies must be sampled at least weekly to monitor the fluoride levels in the water leaving the treatment plant.

The Health Act 1956, as amended by the Health (Drinking Water) Amendment Act in October 2007, aims to protect public health by improving the quality of drinking water provided to communities. The Act requires drinking-water suppliers to take all practicable steps to ensure they provide an adequate supply of drinking water that complies with the DWSNZ and that they introduce and implement water safety plans (WSPs).

WSPs document what can go wrong in the water supply (source, treatment plant and distribution system) and present a risk to public health, what might cause them, what measures should be in place



to reduce the likelihood of them happening, and what actions should be undertaken if something does go wrong.

Fluoridated Supplies

There are currently 46 water treatment plants in New Zealand that add fluoride to the water supply and these plants supply 2,133,434 people with fluoridated water (ESR, 2013¹). This means that approximately 48% of New Zealand's population has access to fluoridated water².

Fluoride Sources

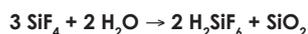
All three of the chemicals used for fluoridation (FSA, sodium fluoride, SFS) are used in New Zealand, but FSA predominates.

FSA (chemical formula of H_2SiF_6) is a co-product from the manufacture of superphosphate fertiliser. It is generally not economic to produce in its own right, and so is only manufactured when there is production of fertiliser.

Superphosphate is manufactured by mixing finely ground phosphate rock and sulphuric acid. There are gases given off in this reaction, which are mainly steam and carbon dioxide, but there is also a small quantity of silicon tetrafluoride released. To control the release of this gas to atmosphere a gas scrubber is used as an integral part of the manufacturing process.

Silicon tetrafluoride reacts readily with water, so it is removed from the other gases by a gas scrubber that is essentially a means of

contacting the gas stream with finely divided droplets of water. The reaction with water hydrolyses the silicon tetrafluoride according to the equation:



Impurities in the FSA arise from trace metals present in the phosphate rock and the acid.

All FSA used in New Zealand is manufactured here.

Selection of Fluoridation Chemical

The three chemicals available for fluoridation have advantages and disadvantages. A water supplier has to balance a number of factors when selecting the chemical to use:

- Supply cost of chemical
- Availability and security of supply of chemical
- Capacity of plant (i.e. how much chemical needs to be dosed)
- Capital cost of fluoridation system (different for each chemical)
- Capital costs of providing reception facility for chemical (if one does not already exist)
- Capital costs of providing building to house the system (modifications to existing or new)
- Health & safety of operational and maintenance personnel

The nature of the health & safety risks for the liquid and powder systems are different. The systems present different challenges for effective mitigation of those risks. For example, operators are likely to wear personnel protective equipment (PPE) more often and for longer periods for powder systems because of the greater handling required and the hazardous nature of the dust. If reactive maintenance is required, this is also true for maintenance personnel.

To mitigate the corrosive risks of FSA a greater emphasis needs to be placed on proactive maintenance of FSA systems: the tanks, piping, dosing pumps, electrical and control systems.

Fluorosilicic acid is a Class 8 (corrosive) dangerous good which can cause severe injury if mishandled. Protective clothing is dependent on specific health & safety requirements, but would typically include a face shield, impervious coveralls, full length butyl gloves and boots. Due to the ability of the acid to form corrosive vapours, safe work practices need to be developed for safely dealing with all vapours and spills. Respiratory protection must be worn if there is an inhalation risk.

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Sodium fluoride and sodium fluorosilicate are both Class 6.1 (toxic) dangerous goods. Protective clothing is again required, and would typically include overalls or apron, goggles, impervious gloves and boots. Both chemicals are supplied in powder form and pose a dust hazard. All equipment must be fitted with dust extraction systems, and a dust respirator must be worn if there is a risk of dust inhalation.



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Community Decision-Making

While both district health boards and local authorities have responsibilities for the health of the populations they serve, the decision to adjust the level of fluoride in water supplies is made by local authorities. The requirements are set out in the Local Government Act 2002 and the Health Act 1956. Specifically, under Section 23 of the Health Act, territorial authorities have a duty to improve, promote and protect public health, and under Section 25, to provide sanitary works including drinking water supplies.

“The discussion and debate around the value of community water fluoridation is an on-going issue for local government in New Zealand.”

The Local Government Act 2002 also provides a framework for local authority decision-making and community consultation. It contains a greater emphasis on community involvement in decision-making than the 1974 Act it replaced and requires councils to take account of:

- Diversity of the community, and the community's interests, within its district
- Interests of future, as well as current communities
- Likely impact of any decision on each aspect of well-being (social, environmental, economic and cultural)

Most areas in New Zealand with fluoridated water supplies commenced fluoridation prior to the Local Government Act 2002.

Under the Local Government Act, decision making by a council can be influenced by persons living outside the city/district as s.78 of the Act requires “A local authority [to] give consideration to the views and preferences of persons likely to be affected by, or to have an interest in, the matter”. In relation to fluoridation, this means that the views of people outside the water supply area who have neither a financial or public health stake in the water supply system have to be considered. A referendum seems to be the only way to confine influence to those directly affected as outsiders can make submissions to hearings, Annual Plans or other decision making processes. It is important, however, that there is good quality information available to inform the referendum process.

The discussion and debate around the value of community water fluoridation is an on-going issue for local government in New Zealand. Various community engagement techniques have been used to assist in the decision-making process including:

- Council's Annual and Long Term Plan consultation processes – community participation is traditionally low and the views expressed may therefore not be representative of the community as a whole
- Telephone interviews using specialist market research organisations – targets the users within the area of benefit
- Tribunal hearings – community participation is low and process is usually driven by lobby groups, both for and against - provides a platform for non-affected parties to participate in the discussion
- binding and non-binding referendum – there is often a low voter turnout and results may therefore not be representative of the community as a whole

Table 1 summarises the various decision-making processes that have been recently used by a number of local authorities when considering the fluoridation issue (compiled from material sourced from the National Fluoridation Information Service and media releases).

Table 1 – Summary of Recent Decision-Making Processes

Local Authority: Water Supply	Status	Process
Whakatane District Council: Whakatane & Ohope	Currently fluoridated	District wide non-binding referendum held in conjunction with 2013 local body election in response to submissions during the Annual Plan process. About 60% voted in favour of fluoridation.
Ruapehu District Council: Taumarunui	Fluoridation ceased in 2011	Responses to submissions on the draft 2011–2012 Annual Plan were 16 for and 18 opposed. During the Council hearings the majority of Councillors were in favour as were the Council management, but after an impassioned plea from one Councillor the Council voted to discontinue fluoridation.
Hamilton City Council: Hamilton City	Fluoridation ceased in June 2013, recommenced in March 2014	Council decided in December 2012 to hold a tribunal style hearing. Submissions were received during March 2013 and subsequently heard during May and June. In June 2013 Council voted 7 – 1 to cease fluoridation, but when a referendum on the issue was held in conjunction with the October local body election just under 70% of the voters supported the addition of fluoride. A decision to recommence fluoridation was deferred until the outcome of the South Taranaki case was known (refer below). In March 2014: Council made the decision to re-commence fluoridation.
Thames Coromandel District Council: Thames	Currently fluoridated	In response to submissions during their 2012–2022 Long Term Plan process and after extensive community consultation the Council voted to continue fluoridation.
New Plymouth District Council: New Plymouth, Waitara, Lepperton and Urenui	Fluoridation ceased in 2011	Fluoridation ceased in 2011. Fluoridation budget now being used to fund a community dental health education programme throughout the District.
Central Hawke's Bay District Council: Waipukurau	Fluoridation ceased in 2012	In response to submissions during their 2012–2022 Long Term Plan process the Council voted to cease fluoridation.
Hastings District Council: Hastings, Havelock North and Flaxmere	Currently fluoridated	In response to presentations to Council from an international anti-fluoride campaigner, and the District Health Board (in support of continuing fluoridation), a binding referendum was held in conjunction with 2013 election. 63% voted in favour of fluoridation.
Hutt City Council: Lower Hutt (excl. Petone/ Korokoro)	Fluoridated	In response to submissions to Council, and presentations from an international anti-fluoride campaigner, and the District Health Board (in support of continuing fluoridation) the Council has voted to continue fluoridation.
South Taranaki District Council: Patea and Waverley	Currently fluoridated	New Health New Zealand took South Taranaki District Council to the high court arguing that fluoridating water in Patea and Waverley was illegal. Justice Rodney Hansen rejected this and ruled that fluoridation does not constitute medical treatment.



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The referenda in Whakatane, Hamilton and Hastings in conjunction with last year's local body elections showed that when the public are presented with the scientific evidence about the risks and benefits of fluoridation, rational outcomes do result.

South Taranaki District Council was taken to court by an anti-fluoridation organisation called New Health New Zealand. They argued that adding fluoride to drinking water is illegal as they believed that it is in breach of the right to refuse medical treatment. In March of this year Justice Rodney Hansen ruled the fluoridation does not constitute medical treatment. He likened it to adding iodine to salt or chlorinating water. As a result, South Taranaki District Council has continued to fluoridate its Patea and Waverley water supplies.

In July this year Local Government New Zealand (LGNZ) voted to urge the Government to amend the legislation so that the addition of fluoride to drinking water supplies is a decision made by the Director-General of Health rather than a local authority. LGNZ is currently advocating for this change to government.

Currently, New Health New Zealand is seeking a judicial review to force the Ministry of Health to treat fluoridation of drinking water as a medicine and regulate the amount added to tap water.

The Royal Society of New Zealand

In August of this year, The Royal Society of New Zealand and the Office of the Prime Minister's Chief Science Advisor released a major review titled *Health Effects of Water Fluoridation: a Review of the Scientific Evidence*. This document summarised an assessment of the scientific evidence for and against fluoridation of drinking-water. The review found that the levels of fluoride used in New Zealand create no health risks and is beneficial in the prevention of dental decay.

It was also found that there are cost savings that can be achieved particularly in communities of more than 1,000 people with a high prevalence of dental caries. Evidence has shown that drinking-water fluoridation is most cost effective in communities with a high proportion of children, Maori, or people of low socio-economic status. The study concluded that water fluoridation is a good use of taxpayer funds as the savings in dental costs are likely to be more than the cost of fluoride addition.

Good Practice Guide for Supply of Fluoride for Use in Water Treatment

With the help of Ministry of Health funding, Water New Zealand published the third edition of the Good Practice Guide titled *Supply of Fluoride for Use in Water Treatment* in May of this year. The aim of the guide is to provide purchasers, manufacturers and suppliers with minimum physical, chemical and testing requirements for the three fluoride chemicals used for drinking-water fluoridation in New Zealand. The principle for setting limits in treatment chemicals is that



no contaminant in a particular chemical should add more than 10% of that allowable under the maximum acceptable value for that contaminant by the DWSNZ, based on the expected maximum dose of the particular chemical. It covers good practice procedures and equipment use to do with delivery, safety, test methods and quality assurance. The guide can be referenced when providing specifications for the purchasing and receiving of the fluoride chemicals.

Code of Practice for Fluoridation of Drinking Water Supplies in New Zealand

A Water New Zealand produced *Code of Practice for Fluoridation of Drinking Water Supplies in New Zealand* is currently being prepared, with funding once again provided by the Ministry of Health. The document will detail best practice for addition of fluoride to drinking-water to help prevent dental caries, while also minimising the risk of overdosing. It has been predominately based on the *Code of Practice for Fluoridation of Drinking Water Supplies* which is published by the Department of Health, Victoria. In August the draft Water NZ document was circulated for review by fluoride chemical suppliers, equipment suppliers and the larger councils who fluoridate drinking-water. The response from this consultation process was significant and the responses are currently being incorporated into the final version.

The Code will apply to new and upgraded fluoridation plants. It provides a guideline to the legislative requirements, safety-in-design, design, operation and maintenance, documentation as well as reporting and auditing. It includes the introduction of a system of independent checks which are used as a method for monitoring the fluoride addition. This system allows smaller suppliers to use a simplified and lower cost system, while suppliers that serve a larger population must have a more rigorous monitoring system.

The Code will be published and available for use by the end of the year. ■

Footnote References

- ¹ESR, 2014. <<http://www.drinkingwater.esr.cri.nz/supplies/priority2plantsfordet.asp?detcode=B23>> Accessed 30 September 2014.
- ²Based on a total residential population of 4.47 million at 30 June 2013, from Statistics New Zealand http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalPopulationEstimates_HOTPA130Jun13.aspx

