WATER FLUORIDATION IN AUSTRALIA SOMETHING TO GET YOUR TEETH INTO

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ABSTRACT

Artificially increasing the fluoride content of drinking water to the optimal level of one part per million has been shown to significantly improves the dental health of the consuming population.

Water Fluoridation was introduced in Australia, in Beaconsfield, Tasmania in 1953, and currently Australia has over 60 water treatment plants fluoridating, with a further 20 or so in the planning stages. In Queensland, no large scale fluoridation occurs, with the exception of Townsville, and for thirty years Brisbane has been the only capital city to forgo this public health initiative.

While water shortage issues continue to plague most states including Queensland, in 2006 the state government set aside $6m to fund Water Fluoridation infrastructure, and set a time frame of 5 years for implementation at major population centres.

This paper outlines the three products permitted to be used for water fluoridation in Australia, the unique characteristics of each, and from an operator perspective, the three products are analysed from the perspectives of safety and ease of use.

KEY WORDS

Fluoridation, Water Treatment, Queensland,

INTRODUCTION

In the early part of the 20th century tooth decay in the western world reach epidemic proportions, leading to infections and even death, in the period prior to antibiotics. During the same period, significant research was conducted to determine why seemingly similar cities and towns suffered markedly different levels of tooth decay. During the 1930s, analysis in the USA indicated that differing levels of naturally occurring Fluoride in the water supply seemed to be the influencing factor.

When the first artificially fluoridated water supply was implemented in the USA in 1945, Australian water engineers and dentists were relatively quick to recognise the potential. Over the following fifty years, most of the Australian population gained access to fluoridation. One region that didn't immediately follow was Queensland, however this may be due to change during the next few years.

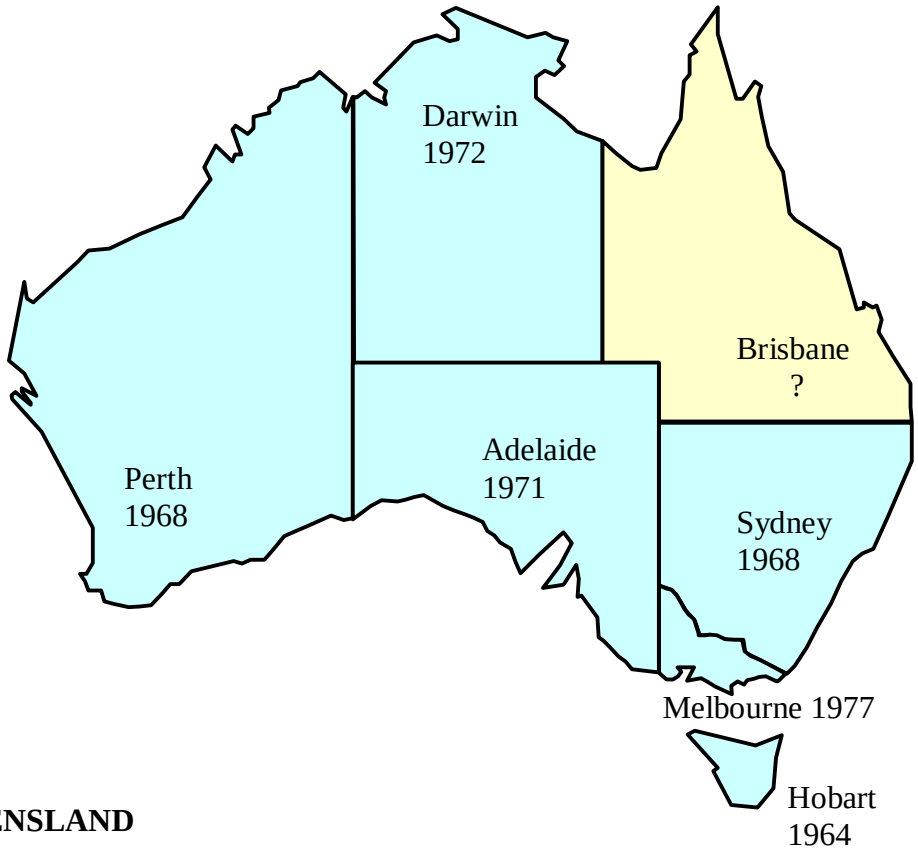
Artificial water fluoridation, raises the natural level of Fluoride in tap water to approximately one part per million, enabling the provision of passive dental benefits to entire populations for very little relative cost.

Fluorine is an element that sits in the periodic table with a group of other “medical elements”, including Chlorine, Bromine and Iodine, all used in different ways to protect or enhance human health.

AUSTRALIAN CAPITALS

Between 1964 and 1977 every capital city in Australia except Brisbane commenced water fluoridation.

Some regional areas in these states are still un-fluoridated, however recent programs over the past 10 years has seen significant “infill” of mid sized to smaller populations. Currently over forty major WTPs in Australia have fluoridation, with at least 20 further planned, primarily in NSW and Victoria.



QUEENSLAND

Queensland is relatively unique in the Australian water industry in that virtually all of the water treatment infrastructure has never been owned or controlled by the State government, but at the local government level. By it’s nature in Australia, local government has traditionally been more fragmented and with less resources.

When viewed from a cost benefit perspective, most other State’s water treatment is owned or operated by the State, who also wear the burden of providing public dental services. With the cost and benefit from the same “pocket” a larger incentive has previously existed in other states for fluoridation.

During 2005/06 the Queensland government announced funding for the installation of fluoridation plants, and proposed a five year window for all major population centres to achieve fluoridation. Given that the relationship between local and state government has at

times been difficult, and more urgent issues have occurred recently with the severe drought, it remains to be seen whether the State achieves it's target.

INTRODUCTION OF FLUORIDATION AT WATER TREATMENT PLANTS

Several levels of process occur when fluoridation is first proposed for an existing WTP. Usually a consultant prepares an initial report for the water authority. Even at this early stage, the most fundamental question is probably which fluoridation product should be used.

As with any change to a process, and introduction of a new reagent it is strongly advisable, and in some states a legal requirement to consult with operators and have them involved in the decision making process **before** introducing the changes. Having input from the operation end often heads off unforseen problems before they become expensive to fix. Wider community and supplier consultation is also important, - there are several examples of fluoridation plants in Australia that have been built then never used, due to lack of community acceptance and/or limited availability of the chosen product and package combination.

CHOICE OF PRODUCT

There are numerous fluoride compounds available, but only three of them are permitted for use for water fluoridation in Australia. Others are used in smaller quantities in dental treatments such as toothpaste. From a dental benefits perspective there is no difference between the permitted compounds, with each provide F- (Fluoride Ion) dissolved in the finished water.

Of the existing plants fluoridating in Australia, approximately 45 use Fluosilicic Acid and 20 use one of the two powdered product options. The largest plant in Australia, Prospect, in Sydney uses Sodium Silicofluoride.

From an operational, storage and logistics perspective there are major differences, with none of the three products being the ideal choice for all water treatment circumstances.

Sodium Fluoride

Sodium Fluoride powder is most suitable for small water treatment plants, up to about 10 ML per day capacity. It has a unique property with it's solubility, in that it dissolves into a constant 4% solution, regardless of water temperature, making it ideal in producing a relatively uniform dosing reagent. Various suppliers produce a "saturator" system, in which a mixing tank of the product contains undissolved product and saturated liquid, allowing the liquid to be siphoned off for water fluoridation.

One supplier utilises dissolvable plastic bags for addition of the powder to the saturator, in order to minimise operator contact with dust.

Sodium SilicoFluoride

Sodium SilicoFluoride is the most concentrated form of Fluoride available for water treatment. It is supplied in bags capable of being manually handled, up to one tonne bags for larger plants, however in storage can suffer "caking" in the bags as a result of either humidity, time, or pressure on the packages.

Unlike Sodium Fluoride the product solubility varies significantly with water temperature, and is relatively low at 0.6%. m/m.

Due to it's relatively low cost, Sodium SilicoFluoride traditionally has tended to be used at medium and larger water treatment plants, which could justify the materials handling equipment and dust extraction required for safe operation.

Several large water treatment plants have previously operated by having a subcontractor mix the product into a slurry with water, and delivered to the plant in a mixing tank, to avoid dust related risks for operators.

Due to their high concentrations, both powdered products are classified as Dangerous Goods class 6, Toxic, and operator physical handling of the product physically involves a disposable suit, boots, gloves, and fully enclosed face mask and respirator.

Fluosilicic Acid

Fluosilicic Acid is ideal for mid sized to larger plants, that can take full sized bulk deliveries of 20 kl. Smaller bulk deliveries are currently limited to southern states, and therefore the product is not the recommended choice for smaller and remote plants.

The product has the lowest concentration of Fluoride (16%) , and therefore necessitates larger and more regular deliveries. Being a liquid, product must be stored at the WTP in a dedicated tank, so is less convenient than storage of bagged products on a pallet.

While designated an acid, and being corrosive to human skin, the product is not as dangerous in this regard as stronger corrosives such as caustic soda or sulphuric acid.

Due to increasing resistance to manual handling over the past decade, the current trend seems to be towards the liquid product from a safety and convenience perspective.

Capital costs of fluoride installations can also vary significantly from one product to the next, and this also has an influencing factor on the choice of fluoridation reagent.

A brief summary of comparison between the products is shown below. These are indicative only, with actual circumstances varying with each individual water treatment plant.

Table 1: Reagent Comparison

	Sodium Fluoride	**Sodium SilicoFluoride**	**Fluosilicic Acid**
Form	Powder	Powder	Liquid
Concentration	Medium	High	Lower
Capital Cost	Medium	High	Medium
Product Cost	High	Low	Medium
Operator Convenience	Medium	Low	High

FLUORIDATION SAFETY

Fluoride content in drinking water at the one ppm rate provides significant health benefits for the consuming population in general, however, like most pharmaceuticals, drugs or other substances accidental or intentional high doses can be harmful.

General Public

Water consumers must be protected from accidental high doses of Fluoride, (as with other water treatment chemicals). Fluoridation installations have multiple fail safe devices including day tanks, dual flow sensing switches, on line monitoring, automatic shut downs, and a other such protections in place.

Water Treatment Plant Operators

Most water treatment chemicals, and some equipment can be both very safe if used properly, and dangerous if not. Fluoride products are no exception to this rule.

Key questions to answered in any risk assessment include:

- Can contact with the product be avoided altogether ?
- If not, can contact be minimised ?
- What is the risk of accidental exposure ?
- What PPE and other equipment will eliminate risk ?

From a risk perspective the two solid products can be analysed in a similar manner. Both are finely ground powders, delivered in bags, that must be opened and emptied in some manner. Being toxic, there is a risk of exposure by ingestion, contact with the eyes, or inhaling the dust.

One supplier has Sodium Fluoride available in soluble plastic bags ,which allows most of the contact issues to be avoided, by loading the packages directly into a mixing tank, eliminating most of the dust generated in opening and disposing of standard packaging.

Other equipment manufacturers produce automated bag dispensing systems, which cut and empty bags that have been loaded by an operator.

The liquid product, Fluosilicic Acid, has a very different , and lower set of risks, being a corrosive liquid, but almost always delivered and used in bulk, to eliminate any handling risks. The majority of the handling risk occurs at the point of transfer from tanker to WTP storage tank, a process which is managed by the suppler, and not plant operators.

In most other aspects, operator risks and safety systems are similar to other bulk liquid products such as Alum, Hypochlorite, and Caustic, etc.

OPERATING A WTP WITH FLUORIDATION

The addition of fluoridation at a water treatment plant is physically a simple process, with the primary requirements being a constant concentration in the treated water, usually one ppm. The dosing level doesn’t change with other aspects of water quality, and fluoride dosing is usually the last process before water enters storage or the network.

Whether retro fitted or installed in a new plant, fluoridation readily becomes part of the process once commissioned. The fluoride compound is generally introduced into the water as the last process step, given that it has no effect on the taste, colour, odour or turbidity, or other physical characteristics of the water. Use of Fluosilicic Acid may cause a few points reduction in pH, depending on the natural buffering capacity of the raw water.

Health Departments run by state governments monitor fluoridation very closely, and usually require daily calculations of fluoride balance to be provided, to ensure against over fluoridation. The primary responsibility of the operator is to record, and check data , and ensure that correct concentration and tolerances are maintained in the finished water.

Maintenance required on fluoridation systems can vary, with powder systems being more mechanical based, with the associated maintenance, and liquid systems maintenance relating more to corrosion prevention, and periodic flushing of equipment with water to prevent build up.

QUOTATION

Dr Don Anning, President of the Australian Dental Association (Qld)
Queensland spends twice the national average per person on dental treatment in public dental services yet our waiting lists continue to grow even longer and Queenslanders still have the worst teeth in Australia. This is not a coincidence. The fact that less than 5% of Queenslanders enjoy the benefits of water fluoridation is the greatest triumph of quackery over science that I am aware of. In the face of the "big lie" perpetrated by anti-fluoridationists, it is time for the Queensland public to be aware of the facts and demand the long overdue introduction of one of the great preventative public health measures of modern times.

CONCLUSIONS

- Artificial water fluoridation has been hailed is one of the 10 greatest public health achievements of the twentieth century, by the World Health Organisation (WHO)
- Fluoridation has been used in Australia for over 50 years.
- It is handled successfully by the biggest and smallest water treatment plants in Australia.
- Fluoridation is a great way in which water treatment operators can have personal involvement in improving the health and well being of their local community.

ACKNOWLEDGEMENTS

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DEUS – NSW Government
Department of Human Services – Victorian Government

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