Viewpoint:

The fluoridation of water in South Africa

THE ROLE OF THE DEPARTMENT OF WATER AFFAIRS & FORESTRY IN THE FLUORIDATION OF WATER

Mandatory regulations to fluoridate water supplies in South Africa were published (under the Health Act) in the government gazette of 8 September 2000. Water providers were required to register their water works sites with the Department of Health within 12 months of the date of these regulations – i.e. by September 2001, and implement water fluoridation at sites within two years of registration by the Department of Health. The Water Wheel asked a few role players for their viewpoint about this important, and often, controversial development in the water field.

Fluoridation of water is primarily a health issue and therefore the Department of Health is the leading national department. The Department of Water Affairs and Forestry (DWAF) will support the Department of Health in implementing national policy in the same way as DWAF will support other national and provincial departments as well as local government to implement government policy.

DWAF has a duty in terms of the National Water Act to protect the aquatic resources for future generations DWAF has also a regulatory role in terms of the Water Services Act, in other words, to ensure that the objectives of this Act are achieved by all water service institutions. This implies that the implementation of any decision to fluoridate a water supply must be done in an integrated, phased and progressive fashion and take the requirements of both water acts into account.

DWAF'S OVERARCHING RESPONSIBILITIES

- Protect the aquatic resources for future generations.
- Ensure sustainable water services to all South Africans.
- Support other spheres in the spirit of co-operative government

DWAF'S RESPONSIBILITY IN TERMS OF THE FLUORIDATION REGULATIONS

- The Department must evaluate all applications to determine the impact on the water resources.
- The Department must assess the respective institution to ensure that the objectives of Water Services Act will be met.

DWAF'S APPROACH

DWAF will evaluate all applications to fluoridate water supplies, using the following protocol:

- The impact on the environment will be assessed.
- If no negative impact is evident, the application will be considered in terms of the principles of the Water Services Act.
- DWAF's decision and recommendations will be forwarded to the Department of Health.

IMPACT ON THE ENVIRONMENT

Effluents from communities

served by fluoridated water supplies eventually return to the water resources. DWAF therefore insisted that the Water Fluoridation Regulations contain a clause allowing for an impact assessment in cases where one was deemed necessary. Three Scenarios are envisaged:

- The waste water after domestic use is discharged directly to the sea - there is no impact on the water resources
  - The department would favourably consider such applications.

- The waste water is discharged into catchments where studies have shown that downstream fluoride levels are already above acceptable levels or - Fluoridation would raise the fluoride level above that acceptable for human consumption.
- Inland resources where the fluoride level must be established - Impact assessments must be done.

THE PRINCIPLES OF THE WATER SERVICES ACT

The Water Services Act compels all water services authorities to develop water services development plans as part of an integrated development plan. Plans to fluoridate must be part of the development plans and as such must also be communicated to the consumers within that municipality. DWAF will consider the following:

- Whether all citizens supplied by the Water Service Provider have access to at least basic services - If a portion of the community does not have access to a basic water supply, and the cost of fluoridating the water will significantly delay the extension of such services, the Department will advise that the water not be fluoridated at this stage.

- Whether the requirement to fluoridate the water will adversely affect the Water Service Authority's ability to supply free basic water to its consumers. Should a significant adverse effect be indicated, the Department will advise that the water not be fluoridated until free basic water becomes a reality.

- Whether the water service provider has the capacity to operate the service satisfactorily. Smaller operators often do not have sufficient qualified staff to e.g. guarantee the safe operation of fluoride dosing equipment and therefore initially only plants serving more than 100 000 persons will be recommended to practise fluoridation.

CONCLUSION

DWAF believes that if all cases to fluoridate or not to fluoridate water be evaluated in such an integrated, logic and holistic way (without the emotions) then the right decision will be taken to the ultimate benefit of the consumer.

UMGENI WATER

UMGENI WATER · AMANZI

UMGENI'S COST OF WATER FLUORIDATION

Costs for fluoridation implementation varied from site to site, with seven out of thirteen water works calculated to be too expensive to implement fluoridation.At the remaining six sites, costs were estimated at 3 cents/kℓ, at 2001 costs.

UMGENI WATER'S ACTIONS

Over the two-year period since promulgation of the mandatory regulations to fluoridate water supplies (Sep 2000–Aug 2002), Umgeni Water had undertaken various actions, which included: -

- Communication to its customers, namely, water services authorities, water services providers and the general public regarding the content of the regulations;

- Monitoring and assessment of the raw and treated water quality, to assess the baseline fluoride concentrations in its water resources;

- Evaluation and pilot assessment of water fluoridation technology, and assessment of plant personnel requirements;

- Assessment of the costs of implementing fluoridation at each of its water works sites and the resulting tariff implications thereof;

- Submission of registration and/or exemption forms to the Department of Health for thirteen water works sites.

RESULTS OF FLUORIDE MONITORING

Of the entire source water supplies monitored, all but one had low levels of natural fluoride, with average values ranging from 0.100 mg/ℓ to 0.150 mg/ℓ.

One site had an average concentration of 0.450 mg/ℓ and is close enough to the Department of Health's requirement for beneficial effects, not to be considered for water fluoridation.

CUSTOMER'S RESPONSE

Apart from one, all bulk water supply customers requested that their water supplies not be fluoridated. No discussions have therefore proceeded to a level where fluoridation agreements could be considered. Umgeni Water has thus at this stage not proceeded to implement water fluoridation at any of its sites.

NATIONAL DEBATE AND INITIATIVES

At a recent Department of Water Affairs and Forestry Portfolio Committee Meeting (June 2002), where various presentations by professionals on the subject of water fluoridation were made, (including by the Department of Health, Department of Water Affairs and Forestry, African Health and Development Organisation and Rand Water), it was concluded, after hearing the various perspectives, that the current level of national information and knowledge was insufficient to show the benefits or lack thereof of water fluoridation and more research needed to be done in the South African context before proceeding with this intervention.

The Water Research Commission is currently considering a project to collect the necessary information with regards to several key areas relating to water fluoridation (namely, social, environmental, health, technical and economic) that would inform and advise this debate.

Umgeni Water's current position is therefore to await the outcome of the national research work and anticipates a further directive once this information has been made available.

FLUORIDATION OF WATER SUPPLY IN CAPE TOWN

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

The fluoridation of the water supply to the City of Cape Town is posing a considerable challenge to the Bulk Water Department of the City. A number of technical and logistic problems will have to be overcome in order to implement fluoridation in terms of the promulgated regulations under the Health Act.

The City owns and operates eleven different treatment facilities ranging from 3 Megalitres per day to 500 Megalitres per day and treatment varies from an unattended groundwater treatment facility to a state of the art full water treatment plant. The City believes that the requirements in the regulations with respect to the class of operator required at any time is in practice not achievable for most water service providers. This also does not make sense in, for example, instances of intermittently attended groundwater treatment facilities where the water normally requires minimal treatment.

Of the technical aspects identified as potential problem areas is the point of introduction of the fluoride into the water stream during the treatment process. It has been identified from literature research that the addition of a very commonly used coagulant, namely aluminium sulphate, will form complexes with the fluoride, which are potentially problematic from a health point of view. The addition of lime also interferes with the effectiveness of the fluoride potentially leading to fluctuations in fluoride levels to totally wasted expenditure due to precipitation of the calcium fluoride. The latter is a particular problem with the treatment of the typical acidic brown coastal waters that require lime dosing and the addition of carbon dioxide to stabilize the water as a late stage water treatment process. This needs to be investigated before full-scale implementation.

The City's water supply is a totally integrated system with the result that not a single area of the City is supplied continuously by a single treatment plant. This is a particular problem in selecting any pilot implementation scheme and monitoring the results of fluoridation on the affected community.

The cost of implementing fluoridation of Cape

National Short Course on Aquatic Biomonitoring in Water Resources Management

Course for 2003

Monday 10 to Friday 14 February

Continuing Education Centre
Rhodes University, Grahamstown
Initiated by CSIR's Division of Water, Environment and Forestry Technology (Environmentek) and
The Institute for Water Quality Studies (IWQS) of the Department of Water Affairs and Forestry

Currently coordinated by
The Institute for Water Research
and Coastal & Environmental Services, Grahamstown

Aim of the course

Aquatic biomonitoring, or response monitoring, is increasingly used as a monitoring and assessment tool in water resource management. This course will provide a basic understanding of the concepts, advantages, limitations and results associated with different biomonitoring techniques, including field bioassessments. The course is designed to address the relevant concepts and the interplay between biomonitoring and resource management, rather than the technical details of how to conduct the monitoring.

Who should attend?

Mid-level managers, planners and other officials from government or private institutions who need and want to improve their knowledge and use of biomonitoring in general.

Cost of the course:

Course - R5 000
Accommodation - R1 000
Total cost of course - R6 000 (incl VAT)

For more information, please contact:
Dr Patsy Scherman - Coastal & Environmental Services
Tel: 046-622 2364 • Fax: 046-622 6564 • E-mail: p.scherman@cesnet.co.za
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Town's water supply has been estimated to be a capital cost of more than R15 million and an ongoing operating cost of about R6,5 million per annum.

A "Front Runner" concept was proposed at a work session between the South African Association of Water Utilities, the Department of Health, the Department of Water Affairs and Forestry and the South African Local Government Association. A possible pilot implementation plant will have to be assessed based on the criteria already selected for identification at this workshop.

Arne SingelsHead:Bulk Water Department - City of CapeTown
2002 – 11 – 21

RAND WATER – FLUORIDATION OF RAND WATER DRINKING WATER

In September 2000 the Department of Health legislated regulations in respect of fluoridation of potable water in South Africa. Fluoridating potable water is considered by some as being unconstitutional in that the use of fluoridated water is forced on consumers who have no choice in the matter. During the past five years water boards, and Rand Water in particular, made several submissions to the appropriate ministries. A key aspect of these submissions is that Rand Water sought indemnity from the Department of Health against any claims arising from the fluoridation of water that may give rise to possible health implications or impact on the environment or industrial water users. The Department of Health responded that any claims regarding possible health implications or impact on the environment on industrial water users must be made against the Minister of Health.Fluoride, in the correct concentration,is effective in protecting teeth and is especially necessary in children within the one to ten year age group. The rationale for supplementing potable water with fluoride is that South Africans, particularly those in rural areas who do not use fluoridated toothpaste, would benefit. Given that most people in rural areas do not receive piped water the benefit will not reach the target population.Furthermore only 0,65 per cent of the water produced by Rand Water is used for drinking purposes. This equates to 19 000 m^3 of the 3 000 000 m^3 sold daily, which means that 99,35 per cent or R25 000 of the direct costs (chemical costs per day) is not effectively utilised for the intended purpose.The question thus arises, how cost effective is this method of augmenting dietary fluoride intake? Rand Water will introduce 1 500 kg of fluoride daily into potable water. Approximately 1 000 kg of fluoride per day will find its way into water streams. This may have long-term negative consequences on the water environment. The cost of de-fluoridation can amount to as much as R5.50/m^3 if reverse osmosis is used and the cost of using alternative methods of removing fluoride from water such as the use of activated aluminia is estimated at R1.80 m^3. Who will be expected to pay this cost? Rand Water does not consider fluoridation of water as the highest priority for South Africa. In fact, the total estimated national cost of R30 million per annum should rather be used to extend the provision of free water to South Africans.Based on Rand Water's experience the R30 million could extend water provision to some 300 000 unserved consumers. Considering the above costs and the large sector of the targeted population, that will not be reached through water fluoridation,the question raised is whether alternative methods of fluoride augmentation such as supplementing milk, sugar, salt, maize meal have been thoroughly investigated. These may have a much better chance of reaching the target population, especially if fluoridated foods are subsidised such that it is cheaper than non-fluoridated foods. Rand Water does not wish to challenge the rationale for augmenting diets with fluoride. Rand Water does however express major concerns with the decision to fluoridate potable water. It is apparent, from the above, that the social and financial viability of fluoridating potable water supplies requires further consideration. It is therefore proposed that government reconsider the matter of fluoridating potable water supplies and that other options are investigated. In the meanwhile, Rand Water will abide by the regulations regarding fluoridation.

ESTIMATED COSTS OF WATER FLUORIDATION TO RAND WATER

Capital cost estimates are based on a study conducted during 1996 for five different water fluoridation plants for The Metropolitan Water District of Southern California.The treatment capacity of these plants varies from 123 500 to 2 850 000 m^3 of water per day and the required fluoride dosage was estimated at 0,6 mg/ℓ. For all practical purposes the size and dosages required are comparable to what would be envisaged for Rand Water.

The capital cost required to treat 1 000 m^3 per day would be R3 695.The estimated capital cost for a fully automated state of the art fluoridation dosing plant for Rand Water would then be:

Capital costs

Vereeniging Water Treatment Plant : R4 850 000
Zuikerbosch Water Treatment Plant: R14 000 000
Total: R18 850 000

The capital amount takes into account the following components: 20 per cent for Planning and Design, 10 per cent for Contract Administration and 15 per cent for Contingencies.

Capital redemption at 13,47 per cent per annum for 20 years is calculated at R3 298 700 per year, which equates to 0,30 cent per m^3 of water treated.

Operating costs

Irrespective of the type of fluoride compound that will be used,a team of highly trained operators will have to be employed to operate several dosing sites and to oversee the offloading,storage and distribution of the concentrated product (as well as operating the dosing plant). Additional staff will have to be trained to deal with emergencies that could arise after spillage or contamination. All concentrated fluoride compounds are toxic and extreme care must be exercised during handling such compounds. This fact cannot be over emphasised and the design of storage and handling facilities must incorporate all the required safety aspects.

The minimum number of personnel required per site would be:

Four dedicated shift operators to monitor the performance of the dosing plants

- Three operators to receive and distribute the product to the various dosing plant
- One senior operator to supervise the fluoridation of water

The total annual remuneration for these personnel is estimated at R 1 322 000 which equates to 0,12 cent per m^3 of water treated.

Maintenance costs

Maintenance costs on the fluoridation plant are expected to be high due to the highly dangerous and corrosive nature of the product. Annual maintenance cost is estimated at five per cent of the capital cost, this is estimated at R950 000 which equates to 0,1 cent per m^3 of water treated.

Based on the above assumptions the annual cost of fluoridation to Rand Water would be:

Item	Value	Cost in cents per m^3
Capital redemption	R3 298 700	0,30
Chemical treatment cost	R9 351 000	85
Personnel	R322 000	12
Plant maintenance	R950 000	0,10
Total	R14 921 750	1,37

The present fluoride concentration in both the raw water used for purification and the water put into supply varies within the range of 0,18 to 0,2 mg F^-/ℓ. To meet the 0,7 mg F^-/ℓ required by the new legislation it would require Rand Water to increase the concentration level of fluorides in its potable water supply by an average of 0,5 - 0,6 mg F^-/ℓ.

Based on the above information the estimated cost in respect of fluoridation is 1.37c/m^3.

Based on the latter, the following calculations were done for a 3000 000 m^3/day plant (rounded off):

Total costs per day = R41 000
Total costs per annum = R15 million

Studying the above information it is noted that an increase of 0,85c/kℓ over our present chemical costs of 6,97c/kℓ would imply an increase of 12,2%. Expressed as a percentage increase in the water treatment costs (chemical and operational costs) this equates to an increase of 0,97c/kℓ over the current purification costs of 13,2c/kℓ, an effective increase of 7,3%. (Figures relate to November 2001).

When meeting basic water needs of 25 ℓ per person/day this will result in an increase in costs to the consumer of 13c per person/annum and for the average household usage of 30 m^3/month,which will result in an increase of R4.93 per household/annum.

ESTIMATED COSTS OF WATER FLUORIDATION TO SOUTH AFRICA

It is estimated that the total volume of water treated by water boards, metropolitan councils and the larger local authorities is 6 000 000 m^3/day. Based on the assumptions made above, the estimated cost of fluoridation to the country is estimated at:

Total cost per day R82 000
Total costs per annum R30 million

IMPACT OF WATER FLUORIDATION ON THE ENVIRONMENT

Generally the environment is tolerant to fluorides and little impact has been seen at fluoride concentration levels below 2 mg/ℓ.

High fluoride concentrations may be harmful in certain industries, particularly those involved in the production of food,beverages,pharmaceuticals and medical items. Fluorides in boiler feed water also present problems in steam generation plants and need to be removed prior to use. The disposal of mineralised wastewater from steam generation plants with high fluoride concentrations may become a problem in future. The present fluoride effluent standard is set at 1 mg F^-/ℓ and this value has also been used as in-stream water quality standards in newly established river forums.

As water is a scarce commodity in South Africa it is recycled and this should be considered in the overall water use strategy. Fluoridation of Rand Water's supply at a rate of 0,5 mg F^-/ℓ will introduce 365 tons of fluoride per annum into the environment. If 0,5 mg F^-/ℓ is added to our water supply this would theoretically imply (during periods of drought or the dry season) that the effluent concentrations will also increase by 0,5 mg F^-/ℓ as fluorides are not appreciably removed through the wastewater treatment process. This for example could increase the average fluoride concentration in the effluent emanating from a works near Alberton to approximately 0,9 mg F^-/ℓ which is only 0,1 mg F^-/ℓ less than receiving water quality criteria.This may start presenting a problem to both the receiving streams and the downstream users if not managed with care. The fluoride levels in other works investigated were much lower and would therefore not present a problem.

A study of the present in-stream fluoride concentrations of the major streams and water bodies that will receive water emanating from wastewater treatment works treating water supplied by Rand Water was conducted.The fluoride concentration in most of these streams varies between 0.3 and 0,4 mg F^-/ℓ and would therefore have to be monitored carefully once fluoridation is implemented. Of concern is the high average fluoride values recorded for the Rietspruit (Loch Vaal) and the Vaal River downstream of the Barrage at Lindeques Drift.Fluoride concentrations in these streams at times will exceed the 1 mg F^-/ℓ level if the water supplied by Rand Water is augmented by 0,5 mg F^-/ℓ, especially during the dry seasons or periods of drought.The question is raised, to what extent Rand Water will be held liable if down-steam users are required to de-fluoridate in order to comply with set standards.If it is the intention to manage fluoride concentrations in potable water to levels below 0,7, mg F^-/ℓ it will be necessary to protect the raw water supplies of down-stream users.It will therefore be necessary to consider existing in-stream fluoride concentrations when establishing Rand Water's dosage rates.

THE DEPARTMENT OF HEALTH

Tooth decay is the most common chronic disease known to human kind. In South Africa 70 per cent of six year old children have dental decay and by the time they reach adulthood it rises to more than 90 per cent. Over R2 billion is annually being spend on dental treatment in our country. In spite of this high figure the majority of the population could still not receive comprehensive dental treatment.

More than 50 years of research worldwide, published in reputable scientific journals, proved the safety and cost-effectiveness of water fluoridation. This academic information are taught to dental students at under- and post-graduate levels at universities.

Water fluoridation is endorsed by a number of national and international organisations.

At an optimum concentration it reduces tooth decay by up to 60 per cent.The cost for water users is about R2,00 per person,per year, at the major water providers.It is 18 times cheaper than toothpaste, and 61 times cheaper than filling one tooth.

In practice fluoridation means:

- Less toothache;
- Fewer and smaller dental bills;
- Better looking teeth;
- Reduced need for dentures, crowns and bridges which are expensive dental treatment services;
- Fewer school and working days lost due to dental disorders or visits to the dentist;
- Less fear and anxiety about visits to the dentist as

treatment would be less complicated, with less anaesthesia and drilling.

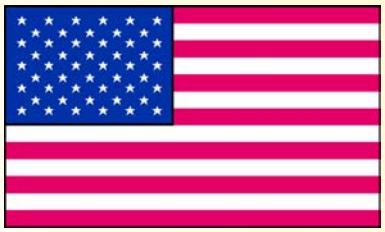
Tooth decay is strongly associated with social deprivation. Water fluoridation is one of the most successful health disease preventive programmes ever initiated.It has the potential to benefit all age groups and all socio-economic strata, especially the lower deprived group, who has the highest unmet dental treatment needs and the least accessibility to oral health services, due to inafordability and shortage of services.

The higher socio-economic group will also benefit because they will save on expensive advanced treatment services and do not have to buy fluoride supplements for their children.

The Department of Health has therefore accepted a policy to fluoridate the water supplies of South Africa.

Dr Johan Smit
Head of Oral Health

THE UNITED STATES OF AMERICA COMMENTS FROM THE SURGEON GENERAL



Since the 1950s, each U.S. Public Health Service Surgeon General has committed his or her support for community water fluoridation. Below is the most recent endorsement supporting community water fluoridation from Surgeon General, David Satcher, MD, PhD.

For more than half a century, community water fluoridation has been the cornerstone of caries prevention in the United States.As noted in my May 2000 report, **Oral Health in America: A Report of the Surgeon General** , community water fluoridation continues to be the most cost-effective, practical and safe means for reducing and controlling the occurrence of tooth decay in a community. In thousands of communities in the United States where naturally-occurring fluoride levels are deficient, small amounts of fluoride have been added to drinking water supplies with dramatic results. More than 50 years of scientific research has found that people living in communities with fluoridated water have healthier teeth and fewer cavities than those living where the water is not fluoridated.

Almost two-thirds of the United States population served by public water supplies consume water with optimal fluoride levels. Of the 50 largest cities in the country, 43 are fluoridated.A significant advantage of water fluoridation is that anyone, regardless of socioeconomic level, can enjoy these health benefits during their daily lives – at home, work, or at school or play – simply by drinking fluoridated water or beverages prepared with fluoridated water. Water fluoridation is a powerful strategy in our efforts to eliminate health disparities among populations. Unfortunately, over one-third of the United States population (100 million people) is without this critical public health measure.

The U.S. Centers for Disease Control and Prevention has recognized the fluoridation of drinking water as one of ten great public health achievements of the twentieth century. Water fluoridation has helped improve the quality of life in the United States through reduced pain and suffering related to tooth decay, reduced time lost from school and work, and less money spent to restore, remove, or replace decayed teeth.Fluoridation is the single most effective public health measure to prevent tooth decay and improve oral health over a lifetime, for both children and adults.

Water fluoridation continues to be a highly cost-effective strategy, even in areas where the overall caries level has declined and the cost of implementing water fluoridation has increased. Compared to the cost of restorative treatment, water fluoridation actually provides cost savings, a rare characteristic for community-based disease prevention strategies.

While we can be pleased with what has already been accomplished,it is clear that there is much yet to be done. I join previous Surgeons General in acknowledging the continuing public health role for community water fluoridation in enhancing the oral health of all Americans.

David Satcher, MD, PhD
Surgeon General
December 3,2001