

CITY OF BURNABY

ENVIRONMENT AND WASTE MANAGEMENT COMMITTEE

HIS WORSHIP, THE MAYOR  
AND COUNCILLORS

RE: ALUMINUM IN DRINKING WATER

RECOMMENDATION:

1. THAT on the basis of prudence avoidance, the following position be recommended to the GVWD:
  - a) The best, most practical chemical be chosen for the flocculation process.
  - b) If Alum is chosen, the following must apply:
    - i) finished water shall not contain aluminum in excess of 100 micrograms per litre;  
and
    - ii) finished water shall have a PH of 7.5 to 8.0.

R E P O R T

The Environment and Waste Management Committee, at its meeting held on 1995 May 09, adopted the attached staff report outlining the use of aluminum sulphate in the GVWD pilot filtration program and alternate compounds that may be used.

Arising from the discussion, the Committee requested that staff evaluate the possible effects of introducing iron into local waterways.

Respectfully submitted,

Councillor D. Drummond  
Chair

Councillor D. Johnston  
Member

Councillor D. Lawson  
Member

:- COPY	- CITY MANAGER
	- DIRECTOR ENGINEERING
	- MEDICAL HEALTH OFFICER
	- CHF. ENV. HEALTH OFFICER

C I T Y O F B U R N A B Y

INTER-OFFICE COMMUNICATION

TO: CHAIRPERSON AND MEMBERS 1995 MAY 02  
ENVIRONMENT AND WASTE  
MANAGEMENT COMMITTEE

FROM: MEDICAL HEALTH OFFICER

SUBJECT: ALUMINUM IN DRINKING WATER

PURPOSE: TO INFORM THE COMMITTEE ON THE USE OF ALUMINUM SULPHATE  
(ALUM) IN THE GVWD PILOT FILTRATION PROGRAM AND  
ALTERNATE CHEMICAL COMPOUNDS THAT MAY BE USED.

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**RECOMMENDATION:**

1. THAT on the basis of prudence avoidance, the following position be recommended to the GVWD:
  - a) The best, most practical chemical be chosen for the flocculation process.
  - b) If Alum is chosen, the following must apply:
    - i) finished water shall not contain aluminum in excess of 100 micrograms per litre; and
    - ii) finished water shall have a pH of 7.5 to 8.0.

REPORT

**1.0 INTRODUCTION**

At the Environment and Waste Management Committee meeting of 1995 April 11, the Committee received information on the use of aluminum (Alum) in drinking water treatment and its possible long term impact on human health (Globe & Mail 1995 March 30).

The Committee asked the Medical Health Officer to obtain further information on the use of Alum in the GVWD filtration program and alternative chemical compounds that may be used.

## 2.0 GVWD PILOT FILTRATION STUDIES

These were conducted at the Capilano and Seymour reservoirs in 1991/1992 in order to develop design standards for the proposed filtration plants.

Alum is a soluble form of aluminum which is used extensively by water treatment plants as a flocculant to help filter out organic material. In this way, bacteria and protozoa (ameoba, giardia, cryptosporidium, etc.) are also reduced and the amount of disinfection subsequently required for purification is markedly diminished.

Of equal efficacy is ferric chloride, but research data from Toronto points to a reaction of the iron coagulant with iron pipe forming deposits on the interior wall of the pipe, thus reducing the carrying capacity of the pipe. Flocculation is an important process in protecting the public health because of more effective control of bacteria and protozoa.

Additional flocculants included other aluminum compounds (polyaluminum chloride and aluminum chlorohydrate) and cationic polymer LT31, but Alum was as efficient or more efficient than the alternatives. It is understood that polymer flocculants are very expensive.

Alum may, therefore, be the most practical choice. Further studies by the GVWD show that in spite of using Alum in the treatment process, finished water can be produced with less than 100 micrograms aluminum per litre, the standard used in Ontario; the one most likely to be considered by Health Canada and the one most often considered by regulatory bodies.

## 3.0 STANDARDS FOR FINISHED WATER

I attended the Conference in Burlington, Ontario referred to in the Globe & Mail article. Twenty scientists from Canada, the U.S. and Norway attended. Six papers were presented (including mine) and discussions were held for one-and-a-half days. The conclusion included:

"On the grounds of prudence, and since no physiological benefit is derived from aluminum, the ingestion of aluminum from any source be reduced. In particular, water treatment plants should be encouraged to keep the aluminum content of water below the recommended upper limit, which in most North American jurisdictions is currently 100 micrograms/litre."

There were, however, two references to a standard of 50 micrograms/litre, one from a University of Toronto researcher (McLachlan) and one from Guidelines for the European Community, but most in attendance concurred with the 100 micrograms/litre standard.

#### 4.0 THE BASIS FOR HEALTH CONCERNS

Animal experiments like those in Australia referred to in the Globe and Mail and other animal studies reveal brain damage to animals from aluminum, but research about the Aluminum/Alzheimer connection is hampered because only humans, not animals, get clinical Alzheimer's disease.

Patients receiving kidney dialysis with water containing aluminum did, in fact, rapidly develop Alzheimer's disease. Clearly when the human gastro-intestinal barrier is bypassed by dialysis, large amounts of aluminum are present in the blood stream and then cause the damage.

Dr. Crapper McLachlan's studies showed small but higher amounts of aluminum in the brain cells of patients who had died of Alzheimer's disease compared with those who died of other disorders.

Attempts to show differences in the rate of Alzheimer's in populations exposed to different levels of aluminum have produced results which have not always been consistent and, therefore, not accepted by all scientists, although more recent work by Dr. W.F. Forbes (Statistics Canada), is more convincing. Dr. Forbes took into account the pH of water (high pH is protective), fluoride levels (fluoride is protective), and silica. Of these three, the pH of the water appears to be the most important in reducing the bioavailability of aluminum.

When evidence is sufficient for concern but is still imperfect certain research options which involve exposure to control groups become unethical. Studies to consolidate a full consensus on the Aluminum/Alzheimer's connection may take several further decades. In the meantime, Alzheimer's is a serious condition with a high prevalence. Compounding the research efforts is the knowledge that aluminum is found naturally in water, in many foods, medications and anti-perspirants, but may turn out that all of these sources may be irrelevant since aluminum in soluble form (Alum) may be the only significant source. This is why aluminum in water purification is receiving most of the attention.

5.0 PHYSIOLOGY

Aluminum in solution takes many different chemical forms but only soluble forms that can be absorbed by the human intestinal tract (thereby becoming bioavailable) are likely to be important. Research evidence points to aluminum in acid solutions being more bioavailable (and thereby potentially more harmful). Most surface waters (including GVRWD sources) are acidic. The objective, therefore, should be a water treatment program that ultimately neutralizes acidity and produces finished water with a pH of 7.5 to 8.0.

Studies have been done by GVRWD consultants which have shown pH adjustment to be cost-effective as the costs of this are far less than the costs from corrosion of copper pipes due to acid water.

An additional public health benefit from water in the pH 7.5 to 8.0 range is the reduction in lead exposure. Acid water leaches out lead from soldered joints in the piping system. Small children are very vulnerable to damage from small amounts of lead. (Public health officials have always recommended the flushing of water pipes in the morning before children drink water). Adjustment of drinking water to pH 7.5 to 8.0 will reduce copper pipe corrosion and will reduce the exposure of children to lead.

6.0 CONCLUSION

GVWD pilot filtration studies have shown that Alum was as efficient or more efficient than alternative flocculants and that finished water can be produced with less than 100 micrograms aluminum/litre using Alum as the flocculant. Research evidence also points to aluminum in acid solutions being more bioavailable and thus potentially more harmful. Therefore, the design criteria for the proposed water filtration plants should ensure that the best and most practical flocculant be selected and if Alum is chosen, finished water shall not contain aluminum in excess of 100 micrograms/litre and shall have a pH of 7.5 to 8.0.



Gerald Bonham, MD FRCP(C)  
MEDICAL HEALTH OFFICER

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- cc: ( ) City Manager  
( ) Director Engineering  
( ) Chief Environmental Health Officer

