

## CHEMICALS USED IN WATER FLUORIDATION

In North America, approximately 90% of the chemicals used to fluoridate the cities water supplies are of industrial origin. They are hydrofluorosilicic acid ( $H_2SiF_6$ ) and sodium fluorosilicate ( $NaSiF_6$ ). These chemicals originate from chemical fertilizer plants and are used directly for water fluoridation without treatment to eliminate the toxic substances from these industrial water products. Please see tables 1 and 2 for the corresponding product data sheets.

**TABLE 1**

Fluorosilicic Acid $H_2SiF_6$ Hydrofluorosilicic Acid Product Data Sheet	
Chemical Analysis	Typical
Assay ( $H_2SiF_6$ ) Fluorine (F) Heavy Metals, as Lead (Pb) Hydrofluoric Acid (HF)	23.00 % Minimum 18.22 % Minimum 00.02 % Maximum Less than 1.00 %
Physical Properties	
Description	Water white to straw yellow solution, meeting both the AWWA Standard B703-00 and the ANSI/NSF Standard 60 for Fluorosilicic Acid.
Color	Straw yellow shall be determined as material with a maximum of 100 units (APHA) in accordance with method 2120B, visual comparison method.
Specific Gravity	1.234 ( $H_2O$ for 25%) @ 60° F
Boiling Point for 25%	222.5° F
Freezing Point for 25%	4° F (-15.5° C)
Molecular Weight	144.08
Weight per Gallon for 25%	10.29 lbs / gal
Viscosity for 23%	6.5 cps
Containers	
Bulk Rail Cars	100 tons net weight (approximate)
Bulk Tank Trucks	20 - 25 tons net weight (approximate)
Freight Description	
DOT Shipping Classification	Class 8 (Corrosive)
DOT Shipping Name	Fluorosilicic Acid

Packing Group II	Placard: Corrosive
<b>CAS NUMBER: 16961-83-4</b>	
<b>Properties</b> Fluorosilicic Acid is a 20 to 35 percent aqueous solution. It is a colorless to straw yellow, transparent, fuming, corrosive liquid. It has a pungent odor and irritating action on the skin.	
<b>Manufacture</b> Fluorosilicic acid (Hydrofluorosilicic Acid) is manufactured by two different processes, resulting in products with different characteristics. The product can be manufactured from the reaction of Apatite and/or Fluorite (fluorspar) with Sulfuric Acid.	
<b>Uses</b> > Sterilization of equipment > Electroplating > Tanning of animal hides > Ceramics and glass: Glass etching > Commercial Laundry: As a neutralizer for alkalis > Hardening of cement > Oil well acidizing > Rust and stain removal for textiles > Wood preservative > Water fluoridation	
The information presented herein is based on data considered to be accurate and that reflects the requirements of the OSHA Hazard Communication Standards in effect as of the date of preparation of the Product Specification Sheet. However, no warranty or representation, express or implied, is made as to the accuracy or completeness of the foregoing data and safety information. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices or from any hazards inherent in the nature of the product.	
Lucier Chemical Industries    415 Pablo Avenue North    Jacksonville Beach, Florida 32250 Telephone 904.241.1200    Fax 904.241.1220	

**TABLE 2**

Sodium Fluorosilicate Na <sub>2</sub> SiF <sub>6</sub> Sodium Silicofluoride Product Data Sheet	
<b>Chemical Analysis</b>	<b>Typical</b>
Assay (Na <sub>2</sub> SiF <sub>6</sub> )	98.00 % Minimum
Fluorine (F)	59.43 %
Moisture as H <sub>2</sub> O	00.50 % Maximum
Water Insoluble Matter	00.50 % Maximum
Heavy Metals, as Lead (Pb)	00.05 % Maximum

Annex ~~1~~ B

# AUSTRALIE COM. LEQ. ASD

The Victorian Inquiry Committee failed to handle these vital issues by either incorrectly reporting the facts, or ignoring the questions. For example, on the question of the fluoride build up in soft tissue, they state (para 7.22, p 42-43):

*"Soft tissues do not accumulate fluoride regardless of the level of absorbed fluoride or the duration of exposure."*

But this statement may in fact not align with some of the available evidence.

*"... Recorded data of the occurrence of fluoride in soft tissue goes back to 1869, when Horsford reported the presence of fluoride in brain tissue. In 1913 Gautier and Claussman found fluoride in the skin of a new-born girl ranging from 1-13 ppm, but in a 70 year old man the range was 146-164 ppm.*

*In 1938, Evans and Phillips examined for fluoride, portions of thyroids from 40 hypothyroidism patients. They found widely varying amounts of fluoride ranging from 1.5 to 95 ppm in the extirpated [end parts] portions of the glands.*

*A summary of the range of fluoride [F] concentrations found in the various tissues of the body, based on a number of more recent findings is given in the following table:*

Tissue	F Concentration ppm	Tissue	F Concentration ppm
Aorta	0.3 to 125	Lung	0.2 to 23
Brain	0.2 to 43	Muscle	2 to 4
Fat	3 to 4	Nails	52
Gall Bladder	3.9	Nerve (sciatic)	16
Hair	14 to 30	Pancreas	0.2 to 38
Heart	0.4 to 24	Skin	5 to 164
Intestines	2 to 8	Placenta	0.1 to 8
Kidney	0.4 to 38	Spleen	0.2 to 18
Liver	0.1 to 23	Stomach	2.9 to 7
Thyroid	0.5 to 95		

*Poison on Tap., p 258.*

## Fluoride Builds Up in The Body

Dr Jonathan Forman, M.D., world-renowned specialist in allergy, Professor Emeritus of Ohio State University, former editor of the Ohio State Medical Journal, editor of Clinical Physiology, in a statement on behalf of the Medical Dental Committee on Evaluation of Fluoridation, stated;

*"It is now known that such vital organs as the kidneys, thyroid, aorta (main heart artery), liver, lungs and others can be the sites of an*

*unusually h fluoride in t water suppl: increased a There is no individuals unpredictable fluoride in over fluorid. poison and enzyme syste*

### When Doctors

*If correct, then cannot accumul*

### Fluoride Has Ne

*When fluoridat: requirements fo ACT, it is surpr to the sort of th drug is permitte*

### Guidelines on D

*The World Heal working parties and therapeutic*

*"It is not alw use a drug th solely one of human exper*

*The urgent n to the attentio*

*Besides the p established o*

*[The W.H.O.] drugs should*

*Compounds t to known or s in an organis*

*Drugs that ar and young ad*

# Fluoride Interactions: From Molecules to Disease

ANNEXE IC

REVUE DE SUJET  
331 RÉFÉRENCES.

Anna Strunecka<sup>1\*</sup>, Jiri Patocka<sup>2</sup>, Russell L. Blaylock<sup>3</sup> and Niloufer J. Chinoy<sup>4†</sup>

<sup>1</sup>Department of Physiology and Developmental Physiology, Faculty of Science, Charles University in Prague, Czech Republic, <sup>2</sup>Department of Radiology and Toxicology, Faculty of Health and Social Studies, University of South Bohemia, Ceske Budejovice, Czech Republic, <sup>3</sup>Department of Biology, Belhaven College, Jackson, Mississippi, USA, <sup>4</sup>Department of Zoology, University School of Sciences, Gujarat University, Ahmedabad, India

**Abstract:** Fluoride has long been known to influence the activity of various enzymes *in vitro*. Later it has been demonstrated that many effects primarily attributed to fluoride are caused by synergistic action of fluoride plus aluminum. Aluminofluoride complexes have been widely used as analogues of phosphate groups to study phosphoryl transfer reactions and heterotrimeric G proteins involvement. A number of reports on their use have appeared, with far-reaching consequences for our understanding of fundamental biological processes. Fluoride plus aluminum send false messages, which are amplified by processes of signal transduction. Many investigations of the long-term administration of fluoride to laboratory animals have demonstrated that fluoride and aluminofluoride complexes can elicit impairment of homeostasis, growth, development, cognition, and behavior. Ameliorative effects of calcium, vitamins C, D, and E have been reported. Numerous epidemiological, ecological, and clinical studies have shown the effects of fluoride on humans. Millions of people live in endemic fluorosis areas. A review of fluoride interactions from molecules to disease is necessary for a sound scientific assessment of health risks, which may be linked to the chronic intake of small doses of fluoride and aluminum from environmental and artificial sources.

**Key Words:** Fluoride, aluminofluoride complexes, G proteins, animal modeling, human exposure, neurotoxicity.

## INTRODUCTION

The use of fluoride in laboratory investigations helped in the discovery of glycolytic and Krebs-cycle pathways. The finding by Rall and Sutherland in 1958 that adenylyl cyclase (AC) is activated by fluoride started the era of new discoveries on signal transduction processes [1-4]. During the last two decades, there are numerous references of laboratory studies involving fluoride alone or in combination with aluminum ions ( $Al^{3+}$ ), mostly investigating its role as a general pharmacological activator of G protein-coupled systems. The effects of fluoride have been studied in many cells/tissues *in vitro* and whole organisms *in vivo*. The expanding research provides evidence that fluoride affects life processes from fertilization to ageing, from gene transcription to cognition with powerful efficacy [5, 6]. In addition to the interpretation of laboratory investigations using isolated cells/tissues or animal models, many epidemiological, ecological, and clinical studies have shown the effects of fluoride on domestic animals and humans.

Dean's reports formed the foundation of the concept that the ingestion of fluoride will harden the surface of teeth and make them less susceptible to dental caries [7, 8]. The artificial fluoridation of drinking water as a way of preventing dental caries has been in practice for over 50 years in several countries. The past 50 years have seen a dramatic increase in the volume of man-made industrial fluoride compounds released into the environment. Fluoridation of drinking water as well as the use of aluminum sulfate as a flocculating agent in water treatment plants, in addition to the wide use of fluoride and  $Al^{3+}$  in medicine, industry, and agriculture, started the era of supplementation of living environment with these ions as never before in the history of human race [9, 10]. Dental fluorosis as the sign of fluoride overload is endemic in at least 25 countries across the globe. Millions of people live in endemic fluorosis area. WHO recently estimated that 2.7 million people have skeletal fluorosis in China, over 6 millions suffer this crippling bone disease in India. Carlsson concerns about what increased fluoride levels would do to the developing brain of newborn infants [11] have gained renewed significance in light of recent findings concerning fluoride and  $Al^{3+}$  potential neurotoxicity.

The objective of our article is to provide a comprehensive view of fluoride and aluminofluoride complexes interactions with some components and processes of signal transduction. Such

knowledge could help to increase scientific understanding of health risks linked to the chronic but cumulative intake of small doses of fluoride plus  $Al^{3+}$  from environmental and artificial sources.

## MECHANISMS OF FLUORIDE ACTION

The highly electronegative fluoride ion with the same size and the same valence orbital as oxygen became the useful laboratory tool in our understanding of the biochemical and biophysical mechanisms of enzyme catalysis underlying biological processes as metabolism and signal transduction. Of particular interest is the ability of fluoride to induce free radical generation and lipid peroxidation in the brain.

### 1. The Effects of Fluoride on Metabolic Enzymes and Energy Metabolism

The most important enzyme of carbohydrate metabolism inhibited by fluoride is enolase, which changes 2-phosphoglycerate to phosphoenolpyruvate and is intimately related to anaerobic production of energy in glycolysis [12]. The inhibitory effect of fluoride on enolase activity was later identified to be through competition with magnesium ( $Mg^{2+}$ ) [13]. The competition with  $Mg^{2+}$  seems to be also a mechanism of fluoride inhibition of the group of inorganic pyrophosphatases, which catalyze one of the oldest and most common reactions in cells [14, 15]. Fluoride interacts first with the  $Mg^{2+}$  on the enzyme in a readily reversible reaction causing a 90% decrease of the catalytic activity. Thereafter, a slow isomerization of the enzyme substrate complex takes place, resulting in a complete loss of activity [16].

Lunardi *et al.* [17] reported that the inhibition of mitochondrial F-ATPase by fluoride requires the presence of  $Al^{3+}$ . Prior incubation with the  $Al^{3+}$  chelator deferoxamine markedly slowed inactivation, whereas adding 1  $\mu M$   $AlCl_3$  speeded it. Missianen *et al.* [18] studied the fluoride effect on the  $Ca^{2+}$ - $Mg^{2+}$ -ATPase of the endoplasmic reticulum and provided evidence that the time course of inhibition and the concentrations of fluoride and  $Al^{3+}$  required for this inhibition differ for enzymes from different tissues. The mechanism of fluoride inhibition of P-type cation-transport ATPases has been suggested by the action of aluminofluoride complexes ( $AlFx$ ), which act as phosphate analogues [17-19].

The experimental evidence indicates that the effects of fluoride on some metabolic enzymes might be attributed to the action of fluoride alone. For example, fluoride has been often used as the inhibitor of various tyrosine and serine/threonine protein phosphatases. Nevertheless, in many cases the biological activity of fluoride is realized by synergistic action of fluoride plus  $Al^{3+}$  [20-22]. Ta-

\*Address correspondence to this author at the Department of Physiology and Developmental Physiology, Faculty of Science, Charles University in Prague, Vinicna 7, 128 00 Prague 2, Czech Republic; Tel: +420 221951769; Fax: +420 221951761; E-mail: strun@natur.cuni.cz

FINAL