

THE MANUFACTURE OF THE FLUORIDE CHEMICALS

All of the fluoride chemicals used in the U.S. for water fluoridation, sodium fluoride, sodium fluorosilicate, and fluorosilicic acid, are useful byproducts of the phosphate fertilizer industry. The manufacturing process produces two byproducts: (1) a solid, calcium sulfate (sheetrock, CaSO_4); and (2) the gases, hydrofluoric acid (HF) and silicon tetrafluoride (SiF_4). A simplified explanation of the manufacturing process follows: Apatite rock, a calcium mineral found in central Florida, is ground up and treated with sulfuric acid, producing phosphoric acid and the two byproducts, calcium sulfate and the two gas emissions. These gases are captured by product recovery units (scrubbers) and condensed into 23% fluorosilicic acid. Sodium fluoride and sodium fluorosilicate are made from this acid.

The question of toxicity, purity, and risk to humans from the addition of fluoride chemicals to the drinking water sometimes arises. Almost all of the over 40 water treatment chemicals that may be used at the water plant are toxic to humans in their concentrated form, e.g., chlorine gas and the fluoride chemicals are no exception. Added to the drinking water in very small amounts, the fluoride chemicals dissociate virtually 100% into their various components (ions) and are very stable, safe, and non-toxic.

Opponents of water fluoridation have argued that the silicofluorides do not completely dissociate under conditions of normal water treatment and thus may cause health problems. To counter these claims, the basic chemistry of this dissociation has been carefully reviewed. Scientists at the U.S. Environmental Protection Agency (EPA) and CDC epidemiologists have examined the research that opponents of water fluoridation cite. Both groups have concluded that these charges are not credible.

The claim is sometimes made that no health studies exist on the silicofluoride chemicals used in water fluoridation. We, the scientific community, do not study health effects of concentrated chemicals as put into water, we study the health effects of the treated water, i.e., what those chemicals become: the fluoride ion, silicates and the hydrogen ion. The health effects of fluoride have been analyzed by literally thousands of studies over 50 years and have been found to be safe and effective in reducing tooth decay. The EPA has not set any Maximum Contaminant Level (MCL) for the silicates as there is no known health concerns for them at the low concentrations found in drinking water. And, of course, the measurement of the pH of the water determines the concentration of the hydrogen ion. Many earlier papers did study the health effects of water fluoridation when the silicofluoride chemicals were used, but did not identify the silicofluorides because that was not an issue at the time. These studies have consistently shown that water fluoridation, using one of the silicofluoride chemicals, was safe to our health and effective in reducing tooth decay. Finally, many, if not most, of the numerous toxicological studies on the health effects of fluoridation were on large cities, which, because of cost, were using one of the silicofluoride chemicals.

Concern has been raised about the impurities in the fluoride chemicals. The American Water Works Association (AWWA), a well-respected water supply industry association, sets standards for all chemicals used in the water treatment plant, including fluoride chemicals. The AWWA standards are ANSI/AWWA B701-99 (sodium fluoride), ANSI/AWWA B702-99 (sodium fluorosilicate) and ANSI/AWWA B703-00 (fluorosilicic acid). The National Sanitation

Foundation (NSF) also sets standards and does product certification for products used in the water industry, including fluoride chemicals. ANSI/NSF Standard 60 sets standards for purity and provides testing and certification for the fluoride chemicals. Standard 60 was developed by NSF and a consortium of associations, including the AWWA and the American National Standards Institute (ANSI). This standard provides for product quality and safety assurance to prevent the addition of harmful levels of contaminants from water treatment chemicals. More than 40 states have laws or regulations requiring product compliance with Standard 60. NSF tests the fluoride chemicals for the 11 regulated metal compounds that have an EPA MCL. In order for a product [for example, fluorosilicic acid] to be certified to meet the NSF Standard 60, the regulated metal contaminants must be present at the tap [in the home] at a concentration of less than ten percent of the EPA MCL when added to drinking water at the recommended maximum use level. This NSF Standard 60 level [10% of the EPA MCL] is called Maximum Allowable Level (MAL). The EPA has not set any MCL for the silicates as there is no known health concerns, but Standard 60 has a MAL of 16 mg/L for sodium silicates as corrosion control agents primarily for turbidity reasons. NSF tests have shown the silicates in the water samples from public water systems that are fluoridated to be well below these levels.

In tests by NSF, the majority of samples of fluorosilicic acid showed no detectable level of arsenic in the finished water. Of those that did have a detectable level, the average arsenic concentration in the finished water was 0.43 ug/L [parts per billion]. Opflow, a monthly magazine from the AWWA, has found the arsenic level in the finished water from the fluorosilicic acid to be 0.245 ug/L [Opflow, Vol 26, No. 10, October, 2000]. The NSF Standard 60 for arsenic has a Maximum Allowable Level (MAL) of 2.5 ug/L [one half of their normal MAL] and EPA has a MCL for arsenic of 50 ug/L, although it will be lowered to 10 ug/L by 2004. As can be seen, the average arsenic is less than 1/10th of even the proposed EPA MCL and less than 1/2 the proposed NSF Standard 60 MAL of 1 ug/L.

Tests by NSF and other independent testing laboratories have shown no detectable levels of radionuclides in product samples of fluoride chemicals. There is no evidence that any of the known impurities in the fluoride chemicals have failed to meet any of these standards.

Opponents of water fluoridation have sometimes charged that “industrial grade fluoride” chemicals are used at the water plant instead of pharmaceutical grade chemicals. All the standards of AWWA, ANSI, and NSF apply to these industrial grade fluoride chemicals to ensure they are safe. Pharmaceutical grade fluoride compounds are not appropriate for water fluoridation; they are used in the formulation of prescription drugs.

Finally, it is sometimes alleged that the fluoride from natural sources, like calcium fluoride, is better than fluorides added “artificially”, such as from the fluoride chemicals presently used. There is no difference. There is no reason to change the opinion of CDC that water fluoridation is safe and effective.

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