

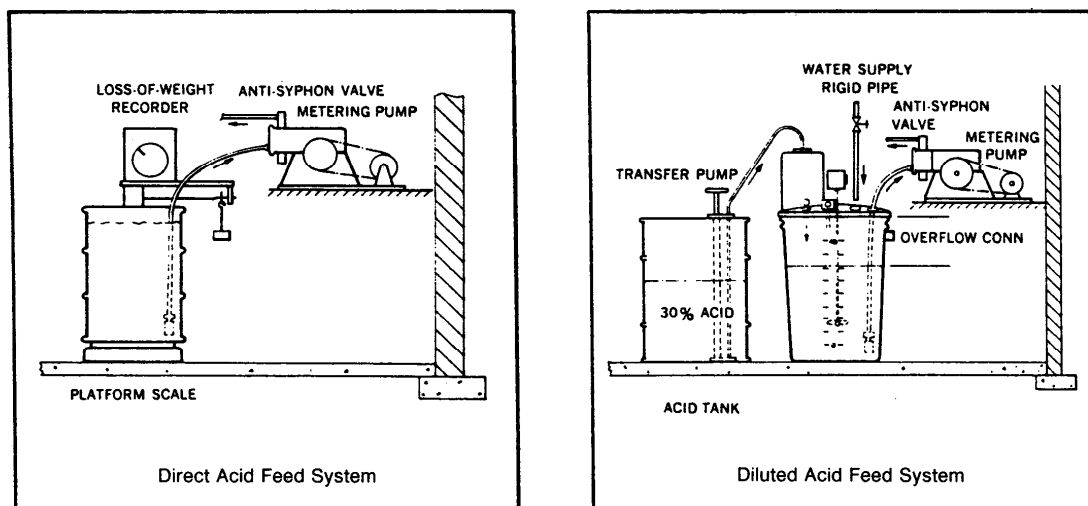
FLUORIDATION

Fluoride has been added to many water systems around the country for the past 40 years. It is used to prevent tooth decay. Fluoride makes the enamel of the teeth harder and more resistant to the bacterial enzymes and acids that can damage the enamel and result in cavities. The problem with fluoride is that it also causes the other bones of the body to become harder and more brittle. This can cause a higher than normal number of broken bones in older individuals that drink water with an excessive amount of fluoride. This is why fluoride is a Primary Inorganic contaminant and is regulated by the Safe Drinking Water Act. The MCL for fluoride is two-tiered. Notification is required at 2 mg/l and a violation occurs when the level exceeds 4 mg/l.

Fluoride can be naturally occurring in a groundwater system. If concentrations exceed the SDWA MCL, the system will have to notify the public that the standard has been exceeded every month. In systems with a high fluoride concentration, people will tend to develop gray or mottled teeth. The optimum range for fluoride concentration is considered to be between 0.8-1.2 mg/l. The range is based on average ambient air temperature. Higher annual average temperatures require lower dosages, since people drink more water when it's hot.

FLUORIDE FEED SYSTEMS

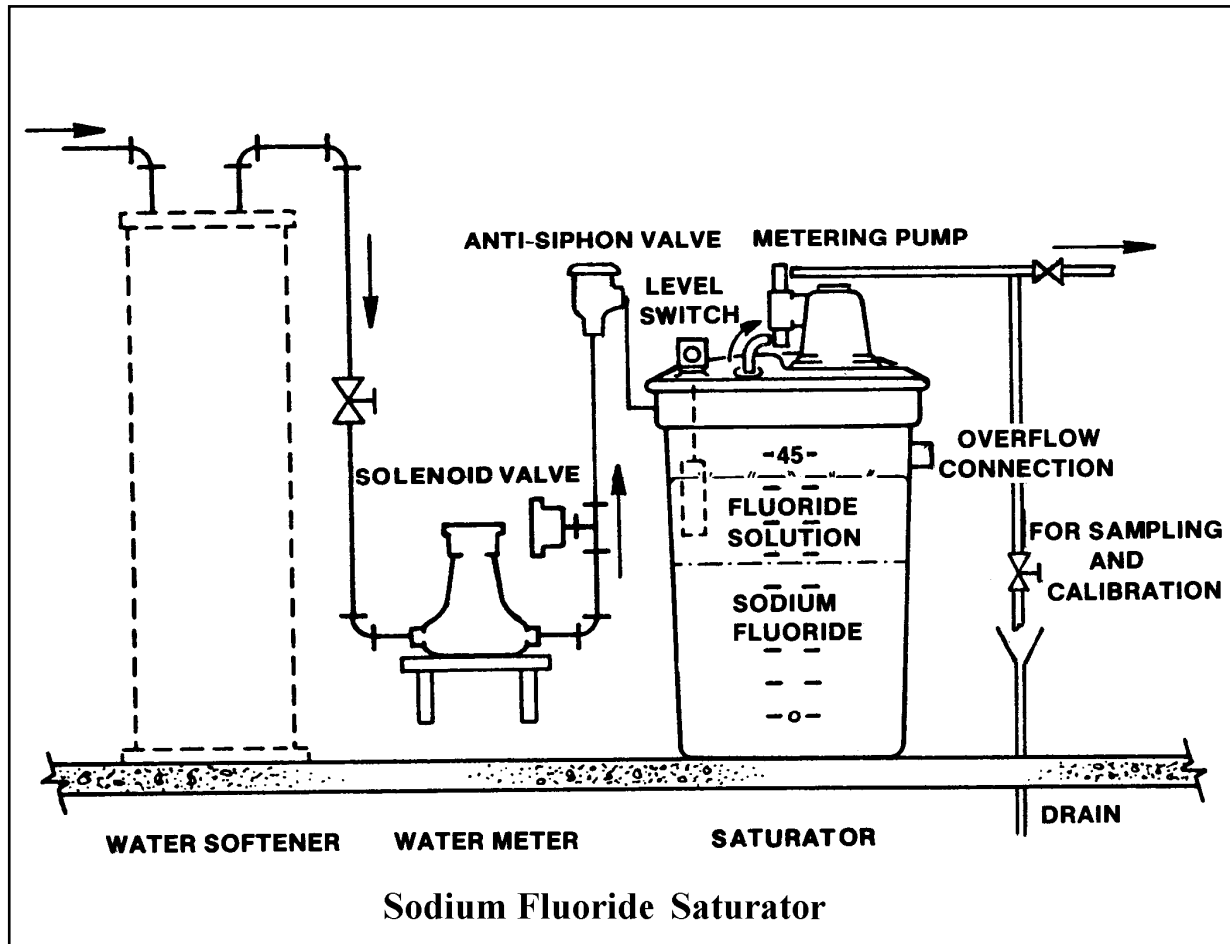
Fluoride is commercially available in several forms. It can be purchased in a dry form as sodium fluoride (NaF) or sodium silicofluoride (Na_2SiF_6). It is also available as a liquid. The liquid form of fluoride is available as hydrofluorosilicic acid (H_2SiF_6). This chemical is also sometimes called fluosilicic acid and hydrofluosilicic acid.



Fluoride is normally fed into the system as a solution, although dry chemical feeders can be used in very large systems. Hydrofluorosilicic acid is more commonly used for liquid feed systems. Positive displacement diaphragm metering pumps, like those used for hypochlorination sites, are used to feed the fluoride into the system. These pumps are subject to the same types of operational problems. These issues will be covered in the Chapter 9: Maintenance and Instrumentation. Hydrofluorosilicic acid spills will etch glass and dissolve concrete. The acid fumes are toxic. PPE include goggles, face shield, and respiratory protection. Hydrofluorosilicic acid is transported in polypropylene barrels and stored in specially lined fiberglass tanks.

SODIUM FLUORIDE SATURATORS

Small systems that use sodium fluoride will probably dissolve it and feed the solution with a metering pump. The equipment used to dissolve the dry chemical is called a saturator. At saturation the fluoride strength will remain constant. Water quality will impact the actual saturation concentration. Hard water can create scaling problems as calcium and magnesium fluorides precipitate out as scale. Water with over 10 mg/l of hardness can create scaling problems. Water softeners must be used upstream, in most cases, to prevent these scale deposits.



MONITORING FLUORIDE CONCENTRATIONS

A system that adds fluoride must take care not to overdose and exceed the SDWA MCL. Although a high concentration for a short duration will not cause any immediate health risks to customers, a violation of the SDWA will require public notification. This can lead to a public relations problem that could have been avoided with more careful monitoring. This is particularly important in systems that have naturally occurring fluoride in the raw water. Systems that add fluoride should monitor the concentration in the system on a daily basis. The SPADNS method is the colorimetric laboratory analysis for fluoride residual.

BASIC STUDY QUESTIONS

1. Why is fluoride added to drinking water?
2. Which chemicals can be used as sources of fluoride?

BASIC SAMPLE TEST QUESTIONS

1. What is the optimum concentration of fluoride in water?
 - A. 0.2-0.4 mg/l
 - B. 0.8-1.2 mg/l
 - C. 2.0-4.0 mg/l
 - D. 8.0-12.0 mg/l

2. What factor is used to determine the optimum dosage of fluoride?
 - A. Air temperature
 - B. Water temperature
 - C. Fluoride solution temperature.
 - D. pH

2. If a system adds fluoride, fluoride testing should occur:
 - A. Daily
 - B. Weekly
 - C. Yearly
 - D. Every three years

ADVANCED STUDY QUESTIONS

1. What type of equipment would be used to feed liquid fluoride?
2. Why is fluoride an Inorganic Primary Contaminant?
3. What is the name of the lab analysis for fluoride residual?

ADVANCED SAMPLE TEST QUESTIONS

1. Liquid fluoride is delivered as:
 - A. Sodium Fluoride
 - B. Hydrofluorosilicic acid
 - C. Sodium Silicofluoride

