Table 7.6
Fluoridation Chemicals

$(NH_4)_2SiF_6$ (ammonium silicofluoride)
CaF_2 (calcium fluoride)
H_2SiF_6 (fluosilic acid)
NaF (sodium fluoride)
Na_2SiF_6 (sodium silicofluoride)

Fluoride content is measured by colorimetric and electrical methods.

F. CHLORIDE CONTENT

Chlorine is used as a disinfectant for water, but its strong oxidation potential allows it also to be used to remove iron and manganese ions. Chlorine gas in water forms hypochlorous and hydrochloric acids.

$$Cl_2 + H_2O \underset{pH<4}{\overset{pH\geq 4}{\rightleftharpoons}} HCl + HOCl \underset{pH<9}{\overset{pH\geq 9}{\rightleftharpoons}} H^+ + OCl^- \quad 7.24$$

Free chlorine, hypochlorous acid, and hypochlorite ions are known as *free chlorine residuals*. Hypochlorous acid reacts with ammonia (if it is present) to form mono-, di-, and trichloramines. Chloramines are known as *combined residuals*. Chloramines are more stable than free residuals, but their disinfecting ability is weaker. Their action may extend for a considerable distance into the distribution system.

The amount of chlorine to be added depends on the organic and inorganic matter present in the water. However, most waters are effectively treated within 10 minutes if a free residual of 0.2 mg/l is maintained. Larger residual concentrations may cause objectional odor and taste.

If the water contains phenol, it and the chlorine will form chlorophenol compounds which produce an objectionable taste. This may be stopped by adding ammonia to the water before chlorination.

Both free and combined residual chlorine can be detected by color comparison. However, organic matter in waste water makes it necessary to use a test based on water conductivity. The color comparison test with supply water, however, is adequate.

G. PHOSPHORUS CONTENT

Orthophosphates ($H_2PO_4^-$, HPO_4^{--}, and PO_4^{---}) and *polyphosphates* (such as $Na_3(PO_3)_6$) result from the use of *synthetic detergents* (*syndets*). Phosphate content is more of a concern in waste water than in supply water. Excessive phosphate discharge contributes to aquatic plant growth and subsequent *eutrophication*.

Phosphates are measured by a variety of means, including colorimetry and filtered precipitation analysis. Care should be taken not to confuse phosphates with phosphorus. Multiply mg/l of phosphate by 0.326 to obtain mg/l of phosphorus.

H. NITROGEN CONTENT

Nitrogen is present in water in many forms, including organic (protein), ammonia, nitrate, and gaseous ammonia. As with phosphates, nitrogen contamination is more of a problem with waste water than with supply water. Nitrogen pollution promotes algae growth. Ammonia is toxic to fish.

Drinking water is typically tested only for nitrates. The following tests are used:

Table 7.7
Tests for Nitrogen

to test for	procedure
ammonia	distillation
organic nitrogen	digestion with distillation
nitrate, nitrite	colorimetry

Gaseous nitrogen is of little concern since it is not normally metabolized by plants and it is of no danger to animal or human life.

I. COLOR

Color in domestic water is undesirable aesthetically, and it may dull the color of clothes and stain bathroom fixtures. Some industries (such as beverage production, dairy, food processing, paper manufacturing, and textile production) also have strict water color standards.

Water color is measured with a colorimeter or comparitively with tubes containing standard platinum/cobalt solutions. Color is graded on a scale of 0 (clear) to 70 color units.

J. TURBIDITY

Turbidity is a measure of the insoluble solids (soil, organics, and microorganisms) in water which impede light passage. Completely clean water measures 0 ***turbidity units*** (NTU). 5 NTU is noticeable to an average consumer, and this is a practical upper limit for drinking water. Muddy water exceeds 100 NTU. A TU is equivalent to 1 mg/l of silica in suspension.