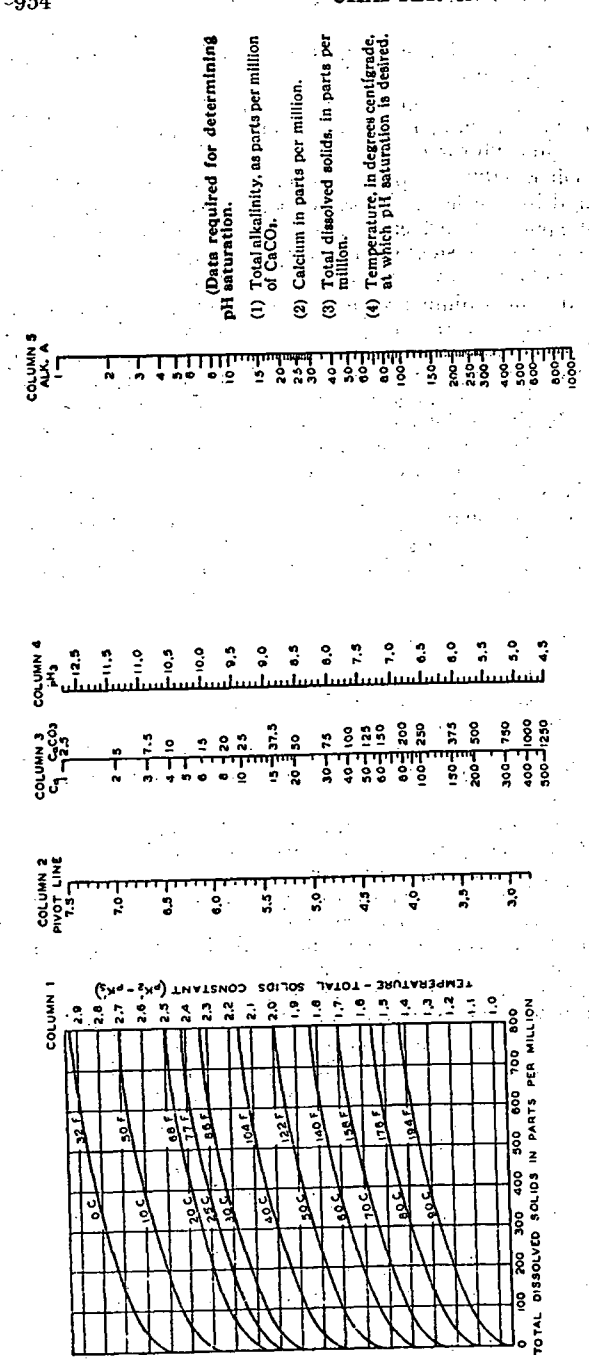

(Data required for determining pH saturation.

(1) Total alkalinity, as parts per million of $CaCO_3$.

(2) Calcium in parts per million.

(3) Total dissolved solids, in parts per million.

(4) Temperature, in degrees centigrade, at which pH saturation is desired.

FIG. 4. GRAPH AND NOMOGRAM FOR DETERMINATION OF pH SATURATION BY LANGELIER'S FORMULA

(Applicable within pH Range 7.0—9.5)

Based on article in Oct. 1936 issue of American Water Works Association Journal and later corrections for Tables 2 and 4 of article. Prepared for Charles P. Hoover of the Columbus, Ohio, Water Softening and Purification Plant by M. L. Riehl.

Instructions for Using Chart:

1. Knowing temperature and total dissolved solids, find temperature and total solids constant on Col. 1.
2. Align this constant with given value of calcium on Col. 3 of Chart, then locate point on Col. 2 of Chart (Pivot Line).
3. Align this point on Pivot Line with given alkalinity on Col. 5; read pH saturation on Col. 4.

Saturation index is pH actual minus pH saturation.

e.g.—pH actual,	pH saturation.	Saturation index.
7.6	8.1	−0.5 (corrosive)
8.4	7.8	+0.6 (scale forming)

While chlorine is the most generally used chemical, the use of others may occasionally prove to be more practicable. Choice of the chemical is conditioned largely by the design and operation of the system.

Open Recirculating Systems

In spray ponds and cooling towers of the open type, light-loving algae growths are likely to cause blocking of the distribution piping and troughs. These organisms are most troublesome in areas accessible to sunlight. Algae slimes are usually stringy in character.

In open recirculating systems, continuous use of small quantities of chlorine is generally most satisfactory. In once-through systems, where large quantities of water are used, intermittent treatment a few times each day will usually result in satisfactory slime removal and chemical economies.

Neither the phenols nor copper sulphate may be used for the removal of slime already formed. For this purpose, chlorine gas is used. After being cleaned, the other chemicals may be used to prevent the reestablishment of slime in the system. The removal of green algae from a cooling tower should never be used as an indication that the true slime-forming organisms on heat exchanger surfaces have been removed. The more resistant slime formers, which so materially reduce heat transfer efficiency, will often be unaffected by treatment which completely eliminates algae.

TABLE 6. COMMON CHEMICALS USED FOR SLIME CONTROL

CHEMICAL	TRADE NAME	PHYSICAL STATE[a]
Chlorine	Chlorine	Gas
Hypochlorites	Calcium Hypochlorites Sodium Hypochlorites	Crystalline
Chlorinated Phenols Sodium—	Chlorophenylphenate Tetrachlorophenate Pentachlorophenate	Briquettes Briquettes Briquettes
Potassium Permanganate	Permanganate of Potash	Crystalline
Copper Sulphate	Blue Vitriol	Crystalline

[a] As Shipped.

Closed Once-Through Systems

In equipment where light is excluded, slime formations are due to fungi. Usually, they predominate on the heat exchange surfaces. Bacteria form thick, soft slime. Yeast and molds form tough rubbery slimes. Chlorine and hypochlorite solutions, fed intermittently, are used to prevent such slimes.

UNDER-WATER CORROSION

When deleterious substances are present in water, the corrosivity of the solution is increased in proportion to the amount of deleterious substances present, the temperature, and usually the rate of flow of the solution over the metal surfaces. There are other relevant factors, but their influence in general is subordinate to those mentioned. Dissolved oxygen, acid