



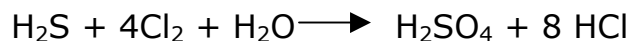
Chemical Oxidation with CHLORINE

In the field of Waste Water treatment, chemical oxidants such as chlorine, ozone & hydrogen peroxide are widely used for disinfections, removing organic materials that are resistance to biological & other treatment processes & conversion of Cyanides to innocuous products. Use of chlorine as a disinfectant destroys or inactivates bacteria present in waste water before it is discharged into receiving streams. Chlorine rapidly penetrates bacterial cells & kills the bacteria. However, the effectiveness of chlorine is influenced greatly by the physical & chemical characteristics of waste water.

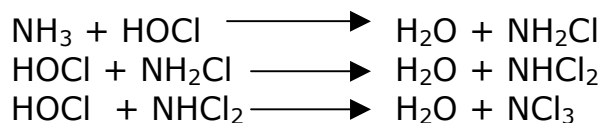
Initially when chlorine is added to water, it forms by chlorous acid HOCl



Hypochlorous acid is the disinfecting agent & is referred to as free residual or free available chlorine. If any reducing agents such as ferrous ions or hydrogen sulphide are present in waste water, chlorine reacts with them & the concentration of chlorine available to destroy pathogenic bacteria is reduced. The reduction reaction with hydrogen sulphide may be represented as :



Waste water usually contain ammonia. In the presence of ammonia, HOCl reacts to form sequentially, monochloramine (NH_2Cl) dichloramine (NHCl_2) & Trichloramine according to the following :



Monochloramine & Dichloramine are referred to as combined residuals & are more stable than free residual but less effective as disinfectants. Once all ammonia has reacted, further addition of chlorine converts the combined residuals into a free residual, the conversion being proportional to the dose at the "break point". This is the limit beyond which all the residual chlorine is available as free chlorine.



Chlorination is used to oxidize cyanide in industrial waste water to harmless carbon & nitrogen compounds. This is done in alkaline media at pH greater than 8.5 to prevent the generation of poisonous hydrogen cyanide gas.



The residual cyanide concentration after a reasonable reaction time, is very small.

Method of Testing of CHLORIDE

Method :- Argentometric Method

For Chloride as ppm :- Method of calculation of Chloride as ppm. Method given in Alfloc.

Our previous calculation for chloride method is given below :

Calculation :-

$$\text{Chloride [Cl-]} = \frac{\{ \text{ml of N/50 (0.02N) AgNO}_3 / \text{B.R. in ml} \} * 1000 \text{ Mg /L (ppm)}}{\text{sample taken for titration in ml}}$$

Or

$$\text{Cl- mg /L (in ppm)} = \frac{1000 \times \text{B.R.}}{\text{Sample taken for titration}}$$

Note :-

- 1) In this method the calculation for chloride is expressed in ppm as CaCO₃.
- 2) In this calculation Normality of AgNO₃ solution considered as Std 0.02N

Conclusion :- ppm of Chloride in this calculation consider Equivalent weight of calcium chloride [E.W.- 50]. SO ppm of Chloride is expressed in ppm as CaCO₃.



Modified calculation method consider Eq.Wt of Chloride (Cl^-) and in this method Normality is not considered as 0.02N, but we standardize AgNO_3 solution & take the Normality whatever it is in the modified calculation method.

Calculation of this method is given below :

$$\begin{aligned} \text{Cl- mg/L} &= \frac{\text{B.R.} \times \text{N} \times \text{Eq.wt (35.45)} \times 10^6}{\text{ml sample taken} \times 1000} \\ \text{In ppm} &= \frac{\text{B.R.} \times \text{N} \times \text{Eq.wt (35.45)} \times 10^3}{\text{ml sample taken} \times 1000} \\ &= \frac{\text{B.R.} \times \text{N} \times \text{Eq.wt 35.450}}{\text{ml sample taken} \times 1000} \end{aligned}$$

Where,

B.R. = titration reading in ml

N = Normality of AgNO_3 solution

Eq.wt = equivalent weight of chloride (Cl^-) = 35.450

One example for both calculation method

Ex :- Sample taken for titration is 10 ml

B.R. {Titration reading} is 5.0 ml

Normality of AgNO_3 solution = 0.02N and observed chloride in ppm from both method

PREVIOUS METHOD :-

$$\begin{aligned} \text{Cl}^- \text{ in ppm} &= \frac{1000 \times \text{B.R.}}{\text{Sample taken}} \\ &= \frac{1000 \times 5.0}{10.0} \\ &= 500 \text{ ppm} \end{aligned}$$

Where,

B.R. = 5.0 ml

Sample taken :- 10.0 ml



MODIFIED METHOD

$$\begin{aligned} \text{Cl}^- \text{ in ppm} &= \frac{\text{B.R.} \times \text{N} \times 35450}{\text{Sample taken}} \\ &= \frac{5.0 \times 0.02 \times 35450}{10.0} \\ &= \frac{354.5}{10} \\ &= 35.45 \text{ ppm} \end{aligned}$$

The chloride difference from both method is :

$$\begin{aligned} \text{Difference} &= \text{previous chloride method} - \text{modified chloride method} \\ &= 500 - 354.5 \\ &= 145.5 \text{ ppm} \\ \text{Difference in \%} &\text{ is } 29.1 \end{aligned}$$

Conclusion :-

In this calculation, consider equivalent weight of chloride [E.W. – 35.45]

Difference between both the method :-

Previous method gives 29.1% more ppm chloride because it is expressed as Calcium Carbonate. Hence we determine chloride as per modified method.

- Ref :-1. This calculation method is based on "ALFLOC" Water Treatment Service.**
2. Amended method of calculation for Chloride as ppm is given in American Std.