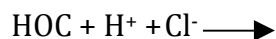


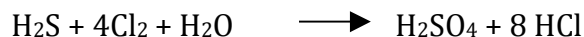
## *Chemical Oxidation with CHLORINE*

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 wastewater.

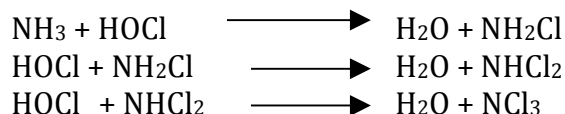
Initially when chlorine is added to water, it forms by chlorous acid  $\text{HOCl} \text{Cl}_2 + \text{H}_2\text{O}$



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, monochloroamine ( $\text{NH}_2\text{Cl}$ ) dichloramine ( $\text{NHCl}_2$ ) & Trichloramine according to the following:

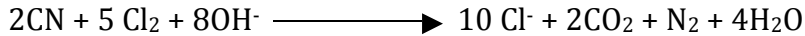


Monochloramine & Dichloramine are referred to as combined residuals & are more stable than free residual but less effective as disinfectants. Once all ammonia has reacted, further addition of chlorine converts the combined residuals into a free residual, the conversion being proportional to the dose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

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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 CaCO<sub>3</sub>.
- 2) In this calculation Normality of AgNO<sub>3</sub> 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 CaCO<sub>3</sub>.

Modified calculation method consider Eq.Wt of Chloride (Cl<sup>-</sup>) and in this method Normality is not considered as 0.02N, but we standardize AgNO<sub>3</sub> solution & take the Normality whatever it is in the modified calculation method.

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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<sub>3</sub> solution  
 Eq. wt = equivalent weight of chloride (Cl<sup>-</sup>) = 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<sub>3</sub> solution = 0.02N and observed chloride in ppm from both methods

### **PREVIOUS METHOD: -**

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

Where, B.R. = 5.0 ml

Sample taken: - 10.0 ml

### **MODIFIED METHOD:-**

$$\text{Cl- in ppm} = \frac{\text{B.R.} \times \text{N} \times 35450}{\text{Sample taken}}$$

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$$= \frac{5.0 \times 0.02 \times 35450}{10.0}$$

$$= \frac{354.5}{10}$$

$$= 35.45 \text{ ppm}$$

The chloride difference from both method is:

Difference = previous chloride method - modified chloride method  
= 500 - 354.5  
= 145.5 ppm Difference in  
% is 29.1

## **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.**

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