Chloride

For water and wastewater

Mercuric Nitrate, Mohr Argentometric and Mercuric Thiocyanate Methods

Introduction

Chlorides are present in all potable water supplies and in sewage, usually as a metallic salt. When sodium is present in drinking water, chloride concentrations in excess of 250 mg/L give a salty taste. If the chloride is present as a calcium or magnesium salt, the taste detection level may be as high as 1000 mg/L chloride.

Chloride is essential in the human diet and passes through the digestive system unchanged, thereby becoming one of the major components of raw sewage. The wide use of zeolite spheres in water softeners also contributes a large amount of chloride to sewage and wastewaters.

High chloride concentrations in water are not known to have toxic effects on humans, although large amounts may act corrosively on metal pipes and be harmful to plant life. The maximum allowable chloride concentration of 250 mg/L in drinking water has been established for reasons of taste rather than as a safeguard against physical hazard.

Chemical reactions

Mercuric nitrate method
Mercuric nitrate reacts selectively with all the chloride present in a sample to produce mercuric chloride and nitrate ions. When all the chloride present in the sample has been complexed, excess mercuric ions combine with diphenylcarbazone to form a purple-colored complex indicating the end point. Hach procedures use Diphenylcarbazone Reagent Powder containing the indicator and a buffer for maximum convenience and reagent stability.

$$Hg(NO_3)_2 + 2Cl^- \rightarrow HgCl_2 + 2NO_3^-$$

Silver nitrate method (Mohr Argentometric method)
In the chloride test, using silver nitrate as the titrant and potassium chromate as the indicator, silver nitrate first reacts selectively with the chloride present in the sample to produce insoluble white silver chloride. After all the chloride has been precipitated, the silver nitrate then reacts with the potassium chromate to form an orange-colored silver chromate precipitate, thereby marking the end point of the titration. Potassium chromate indicator is combined with a buffer in Chloride 2 Indicator Powder.

$$AgNO_3 + K_2CrO_4 + Cl^- \rightarrow AgCl + NO_3^- + K_2CrO_4$$

$$2AgNO_3 + K_2CrO_4 \rightarrow \underset{\text{(Orange)}}{Ag_2CrO_4} + 2KNO_3$$

Mercuric Thiocyanate method

Colorimetric determination of chloride by the Mercuric Thiocyanate Method involves reaction of chloride in the sample with mercuric thiocyanate to produce mercuric chloride and free thiocyanate ions. In the presence of Fe^{3+} (ferric ion), the free thiocyanate ion forms highly colored ferric thiocyanate in proportion to the chloride concentration. Two liquid reagents have been formulated for this test: Mercuric Thiocyanate Solution and Ferric Ion Solution.

1. $\underset{\text{(Mercuric Thiocyanate)}}{Hg(SCN)_2} + 2Cl^- \rightarrow HgCl_2 + 2SCN^-$

2. $Fe^{3+} + 3SCN^- \rightarrow \underset{\text{(Red-orange)}}{Fe(SCN)_3}$