
Chlorine, Free and Total

For water, wastewater and seawater

DPD Method

Introduction

Chlorine is the disinfectant most frequently used for water and wastewater treatment. It was used first for industrial applications and to control odor in wastewater, in the early 1800s. The subsequent use of chlorine to disinfect water occurred by the mid-1800s. Industrial uses of chlorine include applications such as bleaching paper and controlling nuisance organisms in cooling towers.

Hydrochloric and hypochlorous acids are formed when chlorine is added to water. The disinfectant and form causing bleaching action, is hypochlorous acid.



Depending upon variables such as pH, temperature and the amount of organic or ammonia nitrogen, other forms of chlorine in water may include hypochlorite ions (OCl^-) and chloramines. Chlorine existing in water as hypochlorous acid or the hypochlorite ion is termed *free available chlorine*. Chloramines, including monochloramine (NH_2Cl), dichloramine (NHCl_2) and nitrogen trichloride (NCl_3) are referred to as Combined Available Chlorine. Total Chlorine refers to the sum of free and combined available forms.

Methods for determining free, combined and total chlorine include: amperometric titration, colorimetric DPD, titrimetric DPD and iodimetric titration. The most widely used method, colorimetric DPD, is easy to perform, requires little apparatus, is inexpensive and adapts well to field test situations. DPD (N,N-diethyl-p-phenylenediamine) is oxidized by chlorine, causing a magenta (red) color. The intensity of color is directly proportional to the chlorine concentration. DPD reacts in much the same way with other oxidants, including bromine, chlorine dioxide, hydrogen peroxide, iodine, ozone and permanganate.

Chemical reactions

Free available chlorine

Hypochlorous acid and the hypochlorite ion oxidize DPD causing a magenta color. The reaction is pH dependent. DPD and appropriate buffer are packaged together in DPD Free Chlorine Reagent Powder Pillows to handle high levels of hardness without precipitation.

Total chlorine

Potassium iodide is added to the reaction to determine combined available chlorine forms and total chlorine. Chloramines oxidize the iodide to iodine; then the liberated iodine reacts with DPD to form the magenta color. DPD Total Chlorine Reagent Powder Pillows from Hach contain DPD, potassium iodide and a buffer.

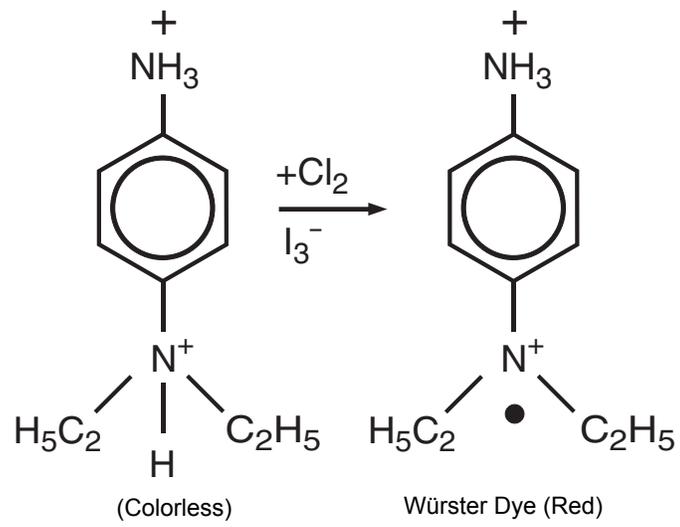


Figure 1 DPD chemical reactions