Chloramine (Mono); Nitrogen, Free Ammonia

Indophenol method

For determining free ammonia and monochloramine simultaneously in finished chloraminated water

Introduction

Chloramination disinfection is the practice of forming inorganic chloramines in water to reduce microbial concentrations to within acceptable limits. The chloramines—monochloramine (NH_2Cl), dichloramine ($NHCl_2$), and trichloramine (NCl_3)—form when chlorine and ammonia are combined in water. In recent years, many drinking water facilities have converted from free chlorination to chloramination to disinfect potable water. Chloramines are weaker oxidants than free chlorine and therefore minimize the formation of harmful disinfection by-products.

A typical chloramination curve is presented in Figure 1. For the chloramination of drinking water, monochloramine is the preferred disinfectant (Section I of the curve). This is optimized by an approximate 5:1 ratio (by weight) of chlorine to ammonia. Adding too much chlorine leads to the decrease of monochloramine and the formation of dichloramine and trichloramine, causing taste and odor problems (Section II). Adding too little chlorine leaves excess unreacted or "free" ammonia in the water which acts as a food source and can lead to nitrification and bacterial growth in the distribution system. At the breakpoint, which is the vertical line between Sections II and III, no monochloramine remains. Any additional chlorine added will be in the form of free chlorine.

In treated wastewater, any organic nitrogen compounds present will form organic chloramines during chlorination. Organic chloramines, as a class, are much weaker disinfectants than the inorganic chloramines. Chlorine overfeeds and ineffective mixing can lead to greater production of organic chloramines, thus diminishing the total germicidal activity.

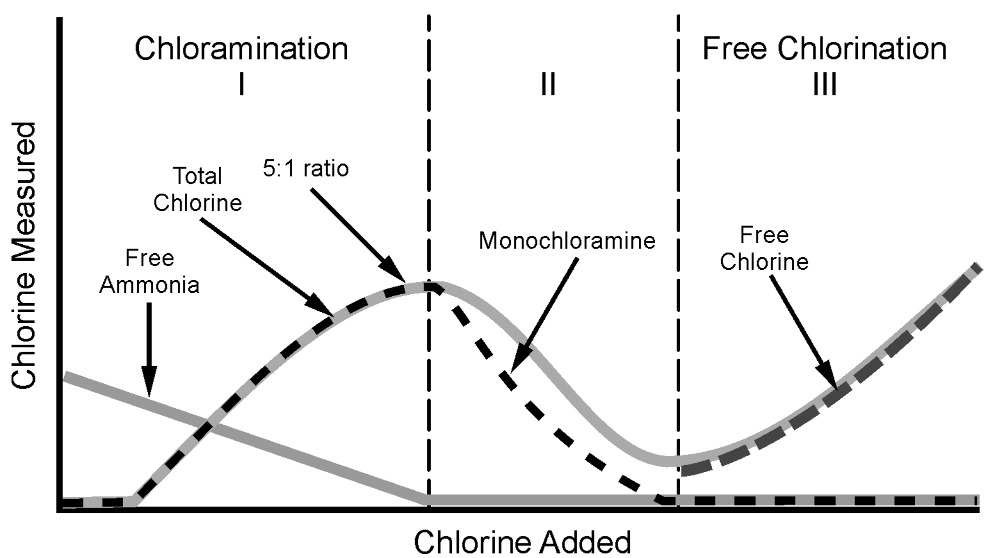

Figure 1 Breakpoint curve for chloraminated water

Chemical reactions

Refer to Figure 2 for the indophenol method mechanism.

Added hypochlorite combines with free ammonia to form more monochloramine (1). In the presence of a cyanoferrate catalyst, monochloramine in the sample reacts with a substituted phenol to form an intermediate monoimine compound (2). The intermediate couples with excess substituted phenol to form a green-colored indophenol, which is proportional to the amount of monochloramine present in the sample (3). Free ammonia is determined by comparing the color intensities, with and without added hypochlorite.

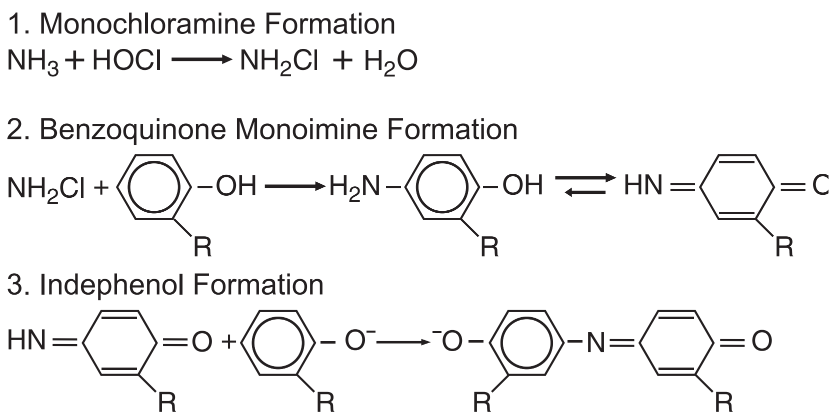

Figure 2 Chemical reactions for the indophenol method