



The relative amounts of the various chloramines that are formed are mainly a function of the hypochlorous acid present and the pH. The monochloramine form predominates at a pH greater than about 6.0, and the dichloramine at about pH 5.

Reactions also occur with reduced substances and with organic materials. Dissolved chlorine gas will react with hydrogen sulfide to produce sulfuric and hydrochloric acids. It will react with other inorganic reducing ions or substances such as  $\text{Fe}^{+2}$ ,  $\text{Mn}^{+2}$ , and  $\text{NO}_2^{-1}$ . Dissolved chlorine will also react with organic compounds, particularly unsaturated compounds. Two of the organo reactions are particularly important—those that result in chlorophenols and those that produce trihalomethanes. Chlorophenols, formed from the reaction of chlorine with phenols, impart undesirable tastes and odors to water that are detectable at phenol concentrations less than one microgram per liter. Reaction of chlorine with innocuous humic substances results in the formation of trihalomethanes including:

- $\text{CHCl}_3$  chloroform
- $\text{CHCl}_2\text{Br}$  bromodichloromethane
- $\text{CHClBr}_2$  dibromochloromethane

These compounds are limited by drinking water regulations to an in toto 0.1 milligram per liter because of tumorigenic properties.

Chloramines are effective compounds against bacteria but are not nearly so effective against viruses. The difference in effectiveness of chloramines was illustrated in a bench study (Figure 17.4) by Kruse, Hsu, Griffiths, and Stringer (1970), who utilized a synthetic waste, *Escherichia coli*, and F2 coliphage. A plot of the data of Durham and Wolf (1973) shows the same type of results on effluents from two trickling filter plants using total coliforms and any phages accepted by *E. coli* K12(f<sup>+</sup>) cells. The extrapolation of these findings on coliphages to all animal viruses is not warranted, but the results are meant to convey some inherent differences that can exist between bacteria and viruses in their susceptibility to chloramines.