Optimal Chlorine/Ammonia Chloramine Equilibrium Ratios to Prevent Lead Leaching

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Chloramines have been used to disinfect potable water because they do not product carcinogenic DBP's like traditional free chlorine. However, chloramines have been linked with lead leaching especially in cities with older plumbing infrastructure. The objective of this experiment is to determine the optimal equilibrium system of chloramines to limit lead leaching by adjusting concentrations of chlorine and ammonia. Adjusting the ratio of chlorine and ammonia changes the equilibrium concentrations of excess ammonia, monochloramines (NH2Cl), dichloramine (NHCl2), and nitrogen trichloride (NCl3) in solution. Chlorine to ammonia weight ratios of 3:1, 4:1, 5:1, 6:1, and 7:1 were used. A 5:1 weight ratio indicates equal moles of chlorine and ammonia. Solutions of chloramines were formed through concurrent addition, which allows for a short contact period of chlorine in deionized water after which ammonia is added. A standard amount of 0.1M free chlorine is added to each solution while the amount of 0.1M ammonium hydroxide added is changed according to the ratio. Pure lead fish weights are sanded and massed with an analytical balance. Fish weights are placed in solution. In 24 hour time intervals, they are removed from solution and massed again. Solutions with ratios of 3:1 and 4:1 are found to have significantly higher levels of lead leaching. This may be explained by the excess ammonia at this level. Using greater concentrations of chlorine limited the amount of unreacted ammonia, which most likely caused the lead leaching.The 5:1 chlorine to ammonia ratio are concluded to be the most optimal since lead leaching and DBP formation are limited.