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Effects of Combined Calcium Hypochlorite and Chlorine Dioxide on Drinking Water Quality in Qatar and Disinfection by Products Formation

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Abstract

Chlorite, chlorate, bromate and trihalomethane's (THMs) are included in WHO guidelines for drinking water quality. This study examined dosing different chlorine concentrations as calcium hypochlorite ($Ca(ClO)_2$) to water containing chlorine dioxide to evaluate the control of water quality in storage and the distribution system in Qatar with emphasis on chlorite, chlorate, bromate, pH and other parameters. Seven water samples were collected from the Ras Laffan-Q Power desalination plant outlet in amber bottles having a chlorine dioxide concentration of 0.3 mg/l in 1 liter. The bottles were spiked with $Ca(ClO)_2$ in sequence to give concentration of 0.2, 0.4, 0.6, 0.8, 1.0, and 1.2 mg/l as free chlorine. The mixtures were stored for 7 days at 25°C in the dark then heated to 45°C for two days more, and analyzed daily for physical and chemical parameters. A total of 312 sub-samples were analyzed for chlorite, chlorate, bromate, bromide, chloride, nitrate, nitrite, sulfate, THMs, temperature, pH, electrical conductivity, and chlorine and chlorine dioxide residuals. Chlorite concentration reductions were observed from the first day forward as 59, 65, 68, 94, 100, and 100%, and 17.4, 22.1, 39.2, 63.9, 66.0, 68.9% (from 0.157 to 0.049 mg/l) respectively based on observed means for seven days the commensurate respective chlorate concentrations increases were 196, 344, 516, 602, 703, 787% (from 0.035 to 0.313 mg/l) based on observed mean values for seven days. These data were statistically analyzed by multivariate regression. There were no significant changes in THMs concentrations and the reductions in chlorite and increases in chlorate concentration are chlorine dosage dependent. No bromate formation was observed. Chlorine dioxide levels decrease as the free chlorine residual levels increased. This study demonstrates

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that hypochlorite/chlorine can be used as an operational tool to control the chlorite levels, and slow the disappearance of the chlorine dioxide over time during distribution, that is usually faster than chlorine disappearance. The original chlorine dioxide dosage will determine the ultimate chlorate concentration, which must also be managed.

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