New England Water Treatment Technology Assistance Center
University of New Hampshire • Durham, New Hampshire
PROJECT SUMMARY REPORT

Enhanced Corrosion Control in Small Water Systems Using Calcium Silicate Contactors

Objectives

The overall objective of this study was to learn how the dissolution of calcium silicate from wollastonite granules in packed bed contactors affects the chemistry of the treated water and how this treatment affects the uptake of corrosion by products from soldered (lead/tin solder) copper tubing. Part of this study focused on understanding and modeling the packed-bed dissolution process and predicting the effect of treatment on the pH and calcium and silicate concentrations of the treated water for the purpose of increasing the utility of packed-bed contactors by extending the range of treatable raw waters and increasing the ability of these units to control corrosion.

Methodology

The experimental approach included packed bed dissolution rate studies consisting of column experiments with continuous flow, and with periodic no-flow periods. Corrosion control studies were conducted using no-flow and recirculating loop-flow tubing experiments.

The first experiment used a continuous flow apparatus to study the dissolution kinetics of wollastonite in a packed bed contactor. The second experiment was designed to understand the effect of wollastonite treatment on the uptake of corrosion byproducts (lead and copper) from sections of soldered copper tubing under stagnant (no-flow) conditions. The last set of experiments used packed bed columns in an apparatus that recirculated treated solution through copper tubing units to compare wollastonite and calcium carbonate treatment. The last two experiments were conducted to compare the relative effectiveness of corrosion control procedures.

Results

Results from the study show that wollastonite dissolves incongruently, forming a layer of silicate on the wollastonite grains that slows the dissolution process and eventually limits the performance of the contactor. Based on this study there was no significant evidence that using wollastonite treatment with a packed bed contactor reduces the release of lead and copper from soldered copper tubing under either stagnant or flow conditions. Because of incongruent dissolution and reduced contactor performance, silicon concentrations in the contactor treated water were significantly less than the values typically used when sodium silicate is added for lead and copper corrosion control in water supply systems. This may explain the poor performance of the contactors in reducing lead and copper release.

Conclusions

Wollastonite in packed bed contactors dissolves incongruently and the silicate that is retained on the grains has a significant negative effect on the rate of dissolution and the performance of the bed. The effect of contactor treatment on the treated water pH and silicate concentration decreases with time as the silicate layer increases in thickness. Under the conditions of these experiments treated water contact with lead/tin soldered copper tubing under both stagnant and continuous (recirculating) flow conditions did not significantly reduce the release of lead and copper.

Recommendations

Packed-bed contactors filled with calcium silicate minerals should not be used for copper and lead-tin solder corrosion control until there is a better understanding of the how to counteract or mitigate the negative effects of incongruent dissolution and silicate layer formation on the kinetics of dissolution.

Presentations

American Chemical Society National Meeting, New York, September 2003, "Enhanced Corrosion Control in Small Water Systems Using Calcium Silicate Contactors", with A. Sriram and G. Singh Anand.

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Disclaimer

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