Report for 2005MT69B: STUDENT FELLOWSHIP: Towards sustainable materials for drinking water infrastructure

Publications

- There are no reported publications resulting from this project.

Report Follows

The Lead and Copper Rule (LCR) sets the action level for copper in the distribution system as 1.3 mg/L. Copper corrosion can cause not only health effects but also damages the water supply infrastructure. It is known that water quality factors having the greatest affect on lead and copper corrosion are pH, alkalinity or dissolved inorganic carbonate (DIC), orthophosphate concentration, and buffer intensity. Also, as the microbial community in the distribution system is influenced by nutrients, the nutrient concentration in water may play a significant role in microbial copper corrosion. Because of the DBP Rule, many water utilities have switched to monochloramine. When monochloramine decays it forms ammonia, which may influence copper corrosion and cause nitrification in the distribution system and plumbing systems. The objective of my research is to investigate the effect of total organic carbon and ammonia on copper corrosion under stagnant flow conditions and to discover the diversity of the biofilm in a simulated plumbing system.

A modified version of the commonly used CDC reactors was used in this project. In the first set of experiments two types of copper coupons (new and old, i.e. pre-exposed to 0.1N NaOH solution) were used. These reactors were fed with water with different carbon (2~4ppm) and ammonia (0.36~0.71ppm) concentrations. Biologically treated tap water was used to supply the homogenous bacterial population. Water in the reactor was stagnant for eight hours and then flowed for five minutes. At the low carbon concentration for both old and new copper, total copper concentration is lower than that for high carbon reactors. A similar trend was also found in the case of the dissolved copper. Heterotrophic plate counts also showed higher numbers for high carbon reactors. After three months of operation the biofilm was sampled from the reactors and DNA was collected. Molecular techniques such as PCR DGGE were used to analyze the microbial community profile of these samples. In the second set of experiments, pre aged copper and PVC coupons were used with high carbon (4 ppm) and ammonia feed. For each condition we used two duplicate reactors.

After three months of operation, the PVC reactors showed evidence of nitrification, while the copper reactors also expressed nitrification within five months. The nitrification in copper reactors may be delayed by copper toxicity. We are now investigating the population and processes of nitrification in these reactors. The microbial population in those reactors is being analyzed using PCR and DGGE. But preliminary results from duplicate reactor show the reproducibility of this experiment. So these modified CDC reactor can be used to investigate domestic plumbing system biofilm. Recently we raised the low ammonia feed (0.36ppm) reactor to high level (0.71ppm).The PVC reactors adjust to the change very quickly and nitrify the excess ammonia. But the copper reactors reacted slowly. So the biofilm in PVC reactors has more potential for nitrification. The corrosion in copper also increases as the nitrification starts. Also, a batch test is on going to estimate heterotrophic and autotrophic nitrification.