An Assessment of an In-line Alum Injection Facility Used to Treat Stormwater Runoff in Pinellas County, Florida

Author(s):	Year Completed:	Project Costs:
David W. Carr	1998	District - $60,000 (monitoring) / SWIM - $249,115 (construction and monitoring)

Project Rationale:

This study was conducted to determine the feasibility of using an in-line alum injection facility for a stormwater treatment retrofit. Alum treatment is primarily used to remove phosphorus (usually the limiting nutrient in fresh water). Other alum treatment facilities constructed in Florida inject alum into the stormwater flow in storm sewers located upstream of receiving water bodies (e.g., a lake) with the alum floc allowed to settle in the water body. The purpose of this study is to determine the effectiveness of alum technology for an in-line system with limited storage volume for alum floc containment, and to conduct an environmental impact assessment. This study also afforded the District an opportunity to characterize the water quality of an older urban ditched system.

Project Description:

Data collection included flow-weighted storm event samples, monthly water quality samples, and hydrologic data collection. Event based load reductions were calculated, comparisons were made of pre- and post-treatment data, and event and monthly water quality were compared to State surface water quality Class III standards. Additionally, a comparison to event mean concentration (EMC) pollutant reduction was performed between predicted reductions estimated in the permit application and load reductions measured during this study. The water quality constituents analyzed included various forms of phosphorus and nitrogen, and several metals. To some degree, portions of these data were likely biased due to a backflow of alum in the inflow station samples. A detailed analysis of the potential for aluminum toxicity to various fish and benthic species was also conducted.

Project Results:

- Event load reduction calculations were performed on inflow and outflow data collected during seven storm events that were successfully treated with alum. Mean total phosphorus and ortho phosphorus load reductions were 37 and 42 percent respectively. Mean percent load reductions of ammonia and nitrate+nitrite were 24.5 and 52.2 percent respectively while, event total Kjeldahl nitrogen loads increased on average by 5 percent. Zinc loads were reduced in most events (despite the alum solution being contaminated with zinc) and when a single outlier was excluded, mean zinc removal was 41 percent. Iron and lead load reductions were variable with the mean load increasing (export). Dissolved monomeric aluminum event loads were mostly reduced with a mean 56 percent reduction. However, total aluminum mean loads revealed an increase of 258 percent. This large increase in total aluminum was attributed to inadequate storage volume for the alum floc. Generally, the load reductions outlined above are good considering the settling pond's small size.

- Lead and iron EMCs were in noncompliance less at the outflow than inflow. Copper and zinc EMCs, on the other hand exhibited higher percent noncompliance at the outflow than inflow. The increase in copper and zinc standard noncompliance at the outflow were attributed to these metals being a contaminant in the alum solution.

- Lower pH values were mirrored by increases in aluminum concentrations. This relationship exemplifies the environmental chemistry of aluminum where pH is the driving force in aluminum solubility. Zinc was the sole metal to consistently show concentrations within detectable levels and seemed unaffected by facility operations. Generally, phosphorus concentrations measured downstream of the alum facility were lower and less variable after facility installation. The data suggest that alum residual in the sediment pond tempered phosphorus concentration increases during periods when the injection facility was inoperable. TSS concentration peaks at the outflow were lower after installation. TKN concentrations at all stations showed little change throughout the study due to alum facility installation and operation.

- Inflow and outflow event mean concentration (EMC) data were compared to predicted EMC reductions calculated in the MSSW permit application. Predictions for ammonia and nitrate+nitrite agreed with measured data. Measured changes in pollutant EMCs were a 32 percent *increase* in total nitrogen, a seven percent *decrease* in total phosphorus and a 184 percent *increase* in total suspended solids. EMC predicted percent reduction should not be confused with actual percent load reduction also presented in the report.

Project Conclusions:

- The importance of operation and maintenance cannot be over emphasized. The regulatory agencies should require the permittee of an alum injection system to: a) assure sufficient funds are available for repair/replacement of inoperable equipment, b) submit semi-annual operation and inspection reports, and c) require operators to have some level of expertise appropriate for facility operations.

- It is important to maximize alum floc containment volume to minimize potential adverse environmental impacts downstream. The containment volume at this study site was inadequate.

- Despite the operation and maintenance problems experienced, event mean concentration and loads of phosphorus were reduced during alum facility operations. The data indicate the alum facility could be effective in reducing phosphorus if properly maintained.

- Monthly samples showed that phosphorus concentrations measured downstream from the alum injection facility were generally lower and less variable after facility installation.

- Potentially toxic concentrations of aluminum to aquatic wildlife were measured at stations immediately upstream and downstream of the alum facility. Aluminum concentrations at

stations further downstream were below these potentially harmful levels.

District Report Reference:

Carr, David W. 1998. An Assessment of an In-line Alum Injection Facility Used to Treat Stormwater Runoff in Pinellas County, Florida. Southwest Florida Water Management District. 36 pages.