Copper Source Tracking in Stormwater Using X-Ray Fluorescence and Design of Custom Stormwater BMPs

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Background. An investigation into the potential source(s) of dissolved copper in stormwater was conducted on the *Mt. Washington*, a vessel moored at the Suisun Bay Reserve Fleet in Benicia, California. Stormwater monitoring data indicated that over the past four sampling events elevated concentrations of copper were present in the stormwater with no known source. Total copper concentrations were between 1,000 and 3,000 mg/L, with approximately 90% of the copper in the dissolved form. The objectives of the investigation were to identify the potential source(s) of copper in stormwater; confirm the leachability of the copper using a simple test; and develop source and/or treatment controls to reduce the copper concentrations in stormwater.

Activities. An x-ray fluorescence (XRF) field meter, typically used for screening metals contaminated soils or toys with lead paint, was used to screen deck-mounted equipment and surfaces at 19 locations on the vessel. A simple field-based test was used to confirm the source by applying two gallons of distilled water to the surface area of the potential source area and capturing and analyzing the dissolved copper concentration in the leachate. The leachate was also used to conduct a column test (representing the diameter of the vessel's drain) with the filtration media to estimate the potential removal efficiency of dissolved copper.

Results. Copper concentrations detected with the XRF ranged from non-detect to a maximum of 864,000 milligrams per kilogram. The highest copper concentrations were detected on the surfaces of the single anchor-leg mooring (SALM) structure located on the central portion of the vessel's main deck. Copper concentrations measured on surfaces of the SALM were between one and three orders of magnitude greater than the other measured copper concentrations. Based on the XRF screening results, the most likely source of high concentrations of dissolved copper in stormwater was determined to be the paint on the SALM, which contains copper (ablative paint) to inhibit the growth of aquatic organisms when it was deployed underwater. The storage of the SALM on the deck of the vessel and it's large size (approximately 55 feet by 140 feet) allowed for significant contact time and area for rainfall to leach copper from ablative paint. The leachate from the field confirmation test had a dissolved copper concentration greater than 800 μg/L.

Source control is often the preferred method of reducing or eliminating pollutants in stormwater. However, source control was determined to be impractical and not cost-effective for stormwater pollution prevention on this vessel. Instead, custom structural best management practices (BMPs) using zeolites, a specialized filtration media, were designed and constructed. A column test of the filtration media exhibited greater than 80% removal efficiency in dissolved copper while maintaining sufficient hydraulic capacity. The BMPs were installed on the vessel and are being monitored during the wet-season for treatment effectiveness and sufficient hydraulic capacity. The innovative use of an XRF field meter in the stormwater field allowed for quick, cost effective source identification and can be applied across the environmental industry for metals source tracking beyond the conventional area of soil screening.