# Sorbster®

Ecologically Effective Contaminants Adsorption

**Case Study 3**

## Removal of Copper from Potable Water Using Sorbster® Cu-1

### Problem

A Midwestern USA municipal water plant experienced copper as a regularly occurring contaminant in its potable water system.  Municipal water can be contaminated with copper due to infrastructure conditions and the use of disinfection chlorine, which is corrosive to copper piping.   The US EPA and regulatory agencies have limited copper levels in both drinking and industrial waters.  The US EPA has set the maximum contaminant level goal for copper at 1.3 mg/L (1.3 ppm) for drinking water.  Individual US states often have more stringent regulations.  Industrial and municipal discharge limits on copper are also set to protect aquatic wildlife and fish.  The copper levels in this municipal water at 0.3 mg/L were below EPA guidelines but the municipality desired to reduce copper further to <0.05 mg/l to ensure that all water met guidelines at the point of use.  Adsorbent medias were ideal for this application because they do not involve chemical addition.  Sorbster® Cu-1 media, a promoted activated alumina especially formulated for copper removal, was selected to treat this water because of its low cost, green chemistry and ease of use.

### Evaluation

Two demonstrations of Sorbster® Cu-1 were run with this potable water. The first was a fill-hold-drain static jar test that measured copper removal using a 30-minute contact time. Into a 250 ml capped polypropylene bottle, 175 ml of potable water was added to 155 grams of Sorbster® Cu-1.   After addition of this feed stream water and the Sorbster® Cu-1, the bottle was capped and mixed slowly to ensure that the media was wetted.  At an ambient temperature of 72°F, the feed stream water and Sorbster® Cu-1 were left in contact without stirring for 30 minutes.  After 30 minutes, the water was withdrawn from the Sorbster® Cu-1 and filtered immediately through a 0.45µ syringe filter into nitric acid preserved bottles for copper analysis. The filtration step separated any fine particles of Sorbster® Cu-1 from the water to ensure that no further removal continued beyond the 30 minute contact time.  Copper for the feed stream and the 30 minute sorption media treated water was measured by ICP using EPA method 200.7.

In the second evaluation, a packed bed, flow-through column of Sorbster® Cu-1, was prepared in a 1" diameter x 36" long glass column.  A feed stream of Midwestern USA potable water containing varying levels of copper was pumped up-flow through the column at a water flow rate of 19.0 mL/minute.  This flow rate provided an empty bed contact time of 25.1 minutes.  The empty bed volume of the column was 460.9 cm3.  42 liters (equivalent to 91.1 bed volumes) of water were treated.

The use of two removal tests to evaluate performance provided the municipal plant with two deployment treatment options: continuous flow or batch treatment.

The potable water quality used in both treatment options is shown in Table 1.

### Table 1

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| Potable Water Quality | | | |
|---|---|---|---|
| **Water Constituent** | *Typical Concentration* | **Water Constituent** | *Typical Concentration* |
| Copper | *255 to 302 ppb* | Boron | *186 ppb* |
| Calcium | *34 ppm* | Iron | *41.2 ppb* |
| Magnesium | *9.2 ppm* | Manganese | *14.4 ppb* |
| Sulfate | *147 ppm* | Silica | *0.68 ppm* |
| Chloride | *19.2 ppm* | Strontium | *148 ppb* |
| Nitrate | *0.69 ppm* | Orthophosphate | *1.46 ppm* |
| Fluoride | *1.6 ppm* | pH | *7.03* |
| Barium | *17.3 ppb* | Alkalinity, $CaCO_3$ | *452 ppm* |

## Sorbster® Cu-1 Results:  Fill-Hold-Drain Jar Test

The potable water contained 255 ppb to 302 ppb of dissolved copper.

Sorbster® Cu-1 removed >96% of the copper in all samples tested.  Nine repeat runs of the test all showed the same 96 to 99% removal rate to copper levels of 0.01 mg/L or less. Many results were 0.002 mg/L of copper. As can be seen from the data in Table 2, the use of Sorbster® Cu-1 in contact with water in a 30-minute fill-hold-drain batch treatment application was highly effective for copper removal.

## Table 2

| Sorbster® Cu-1 Treated Water for Removal of Copper Fill – Hold – Drain Test | | | |
|---|---|---|---|
| **Test Number** | **Copper Content of Feed Stream Water, Mg/L** | **Copper Content of Treated Water after 30 Minutes, Mg/L** | **% Copper Removed** |
| 1 | 0.255 | 0.0026 | 98.9 |
| 2 | 0.302 | 0.004 | 98.7 |
| 3 | 0.302 | 0.002 | 99.2 |
| 4 | 0.302 | 0.010 | 96.7 |
| 5 | 0.302 | 0.003 | 98.9 |
| 6 | 0.255 | 0.002 | 99.2 |
| 7 | 0.302 | 0.006 | 97.7 |
| 8 | 0.302 | 0.003 | 99.0 |
| 9 | 0.302 | 0.002 | 99.2 |

## Sorbster® Cu-1 Results: Flow-Through Column Test

Results of the flow-through column test are shown in Table 3.

### Table 3

| Sorbster® Cu-1 Copper Removal During Flow-Through Treatment | | | |
|---|---|---|---|
| Bed Volumes of Feed Stream Water Flow | Copper Content of Untreated Inlet Feed Stream, Mg/L | Copper Content of Water Exiting Column After Flow Through Sorbster® Cu-1, Mg/L | % Copper Removed |
| 4.3 | 0.441 | 0.0185 | 95.8% |
| 8.7 | 0.441 | 0.0173 | 96.1% |
| 13.0 | 0.441 | 0.0125 | 97.2% |
| 17.4 | 0.441 | 0.0112 | 97.5% |
| 34.7 | 0.339 | 0.0132 | 96.1% |
| 52.1 | 0.126 | 0.0085 | 93.3% |
| 69.4 | 0.339 | 0.0139 | 95.9% |
| 86.8 | 0.474 | 0.0148 | 96.9% |
| 91.1 | 0.317 | 0.0139 | 95.6% |

Copper was removed by Sorbster® Cu-1 to low µg/L copper levels with removal rates as high as 97%. In addition, the removal rate was sustained over a high number of bed volumes treated, an indication that media life will be long at a minimum of one year. The results for flow-through treatment were equivalent to the fill-hold-drain treatment making both options a viable approach for copper reduction. Since Sorbster® Cu-1 media is a lower cost media, treatment costs were attractive for the municipality and implementation could be easily done in tanks already on site.