

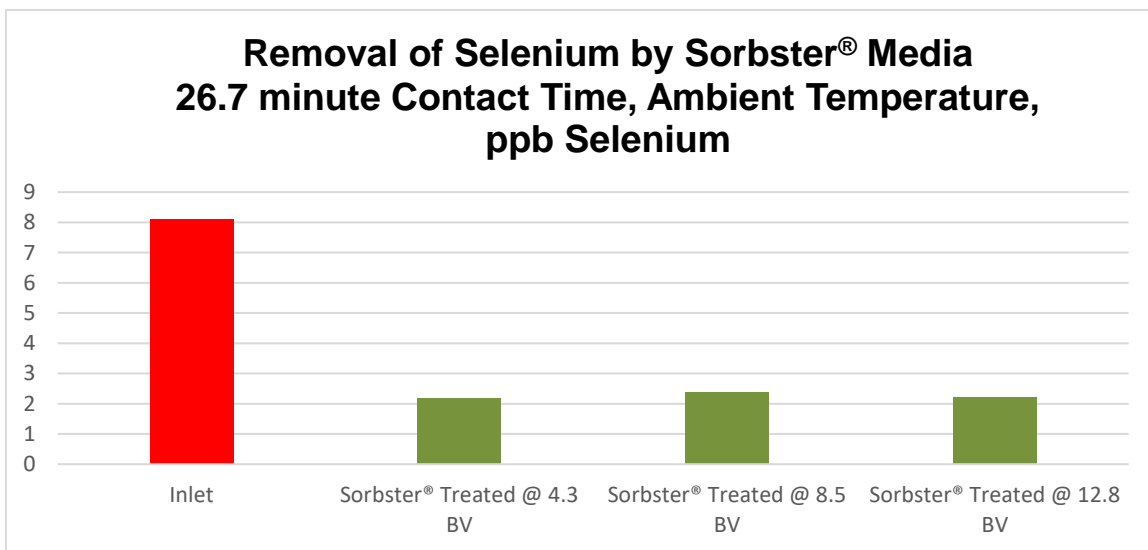
Sorbster® Media Column Studies for Removal of Selenium and Other Contaminants from Northwestern US Refinery Pond Water

A pond water containing 8.0 ppb dissolved selenium @ pH 7.00 was sampled to Sorbster for investigation of chemisorption removal by Sorbster® media. Selenium in this water was removed by Sorbster® media to an average of 2.25 ppb in a single column pass at a 26.7 minute water-to-media contact time to achieve the refinery target of <5 ppb selenium. In addition, the media provided strong removal of mercury, fluoride, barium and zinc, and the complete removal of arsenic, vanadium, orthophosphate and nitrate to below standard detection limits.

Sorbster® media reduced the selenium in the refinery pond water by 73%. Average selenium levels of 2.25 ppb were obtained and maintained in the water, Table 1.

Table 1: Selenium Removal by Sorbster® Media

	Dissolved Selenium, ppb	% Removal	Water-to-Media Contact Time	Total Bed Volumes Treated (BV)
Inlet to Column	8.1	-	-	-
Treated Outlet @ Liter 2	2.18	73%	26.7 minutes	4.3
Treated Outlet @ Liter 4	2.38	71%	26.7 minutes	8.5
Treated Outlet @ Liter 6	2.20	73%	26.7 minutes	12.8



Sorbster® Media Removal of Other Contaminants

Several other dissolved metals and contaminants were followed during the selenium column test. The chemistry on the media allows for the simultaneous removal of both cationic and anionic contaminants as a function of the amount of oxyanion selenium in the water and the overall water quality. For this pond water, both the selenium and all the other contaminants followed were significantly removed, as shown in Table 2.

Table 2: Additional Contaminant Removal by Sorbster® Media			
Contaminant	Inlet Concentration	After 13 BV of Sorbster® Media Treatment	% Removed
Arsenic	9 ppb	Not detected	>95%
Barium	188 ppb	57 ppb	70%
Fluoride	3.0 ppm	0.36 ppm	88%
Mercury	66 ppt	20 ppt	66%
Nitrate	0.52 ppm	Not detected	>95%
Orthophosphate	0.74 ppm	Not detected	>95%
Vanadium	3.0 ppb	Not detected	>95%
Zinc	326 ppb	82.8 ppb	75%

Test Method

6000 milliliters (13 bed volumes) of refinery pond water was pumped as received upflow @ 17.5 ml/minute through a 1"x36" high packed bed containing 375 grams of commercial Sorbster® media pellets (lot SP-A042412-1-P.) This flow provided a water-to-media contact time of 26.7 minutes. The inlet water and Sorbster® media treated water samples after 2, 4 and 6 liters of column flow were analyzed for selenium by Precision Analytical, Inc., Cleveland, OH using EPA method 200.8 CRC (ICP-MS with CRC, reporting limit of 0.25 ppb.) Precision Analytical also analyzed the samples for metals (method E200.7), mercury (method E245.1) and anions (method E300.0.)