Selenium and sulfur interaction during bio-cycling

BINGNAN SONG[1*], RENATA D. VAN DER WEIJDEN[1], JAN WEIJMA[1], CEES J.N. BUISMAN[1]

[1]Wageningen University, Environmental Technology, Bornse Weilanden 9, 6708WG, Wageningen, The Netherlands (*correspondence: bingnan.song@wur.nl, renata.vanderweijden@wur.nl, jan.weijma@wur.nl, cees.buisman@wur.nl)

Potential role of sulfur

The biological cycling of sulfur and selenium when both are present is intertwined. It has been shown that when selenate is reduced to selenite, sulfide addition can yield a SeS_2 solid which can be bio-reduced to Se and H_2S [1]. We investigated the effect on the removal of selenium oxyanions by adding elemental bio-sulfur. The in-situ generation of sulfide could aid in removal of selenite, which at high levels is potentially toxic for selenate reducing microbes.

Batch tests

Anaerobic batch experiments were carried out at 30^{o}C with Eerbeek or Emmtec sulfate/sulfur reducing sludge. Selenate or selenite were 2mmol/L and lactate was 1.25 mmol/L. Aqueous selenium species were quantified using IC.

Results

Sulfur increased selenite removal (table 1). For Emmtec with biomass (1.3gVSS/L), removal increased from 74.1% to 99.99%. However, for equal Eerbeek and Emmtec biomass (2.8gVSS/L) the removal without sulfur was already 99+ %. For equal VSS, sulfur decreased selenate removal for Eerbeek but it increased for Emmtec. Sulfur had a pronounced effect on the attachment of selenium to Emmtec biomass affecting selenium mobility and liquid/solid separation. The effect of sulfur on Se removal can be positive or negative depending on relative amounts of Se, S, biomass and electrondonor.

Sulfur mg/L	Eerbeek selenate	Emmtec selenate	Eerbeek selenite	Emmtec selenite
0	14%	11%	99.9%	74.1%
32	5%	10%	99.9%	~100%
64	6%	8%	99.9%	~100%
128	4%	13%	~100%	96.2%

Table 1: Removal percentages when adding bio-sulfur using 20g/L (different VSS/L) for Eerbeek and Emmtec.

[1] Hageman et al. (2017), J Hazard Mater **329**, 110-119.