NORTHERN ARIZONA UNIVERSITY

Memorandum

To: Dr. Odem

From: Robert Hoppe

Date: 12/1/16

Re: Innovative Water Treatment Lit Review

Objective: Arsenic Removal
Summary: ElectroChemical Arsenic Remediation (ECAR)

ECAR uses a low electrical current to create rust from iron plates in contaminated water. The rust binds to arsenic, which can then be removed from the water through settling and/or filtration. It is targeted for communities or countries that do not have the resources for standard coagulation/filtration plants. The technology was developed at Lawrence Berkeley National Labs and is currently being pilot-tested by a company called SimpleWater. The ECAR process is reportedly much less expensive than conventional technologies [1].

The surface-modified iron nanoparticles (S-INP) were synthesized, characterized and tested for the remediation of arsenite (As(III)). The S-INP material was fully dispersed in the aqueous phase with a particle size distribution of 2–10 nm estimated from high-resolution transmission electron microscopy (HR-TEM). X-ray photoelectron spectroscopy (XPS) revealed that an Fe(III) oxide surface film was present on S-INP in addition to the bulk zero-valent Fe0 oxidation state. Results using S-INP pretreated 10 cm sand-packed columns containing ~2 g of S-INP showed that 100 % of As(III) was removed from influent solutions (flow rate 1.8 mL min−1) containing 0.2, 0.5 and 1.0 mg L−1 As(III) for 9, 7 and 4 days providing 23.3, 20.7 and 10.4 L of arsenic free water, respectively. In addition, it was found that 100% of As(III) in 0.5 mg/L solution (flow rate 1.8 mL min−1) was removed by S-INP pretreated 50 cm sand packed column containing 12 g of S-INP for more than 2.5 months providing 194.4 L of arsenic free water. Field emission scanning electron microscopy (FE-SEM) showed S-INP had transformed to elongated, rod-like shaped corrosion product particles after reaction with As(III) in the presence of sand. These results suggest that S-INP has great potential to be used as a mobile, injectable reactive material for in-situ sandy groundwater aquifer treatment of As(III) [2].

This patent explains the method and apparatus needed for Electrochemical insolubilization of anionic arsenic [3].

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Objective: Nitrate Removal
Summary: Ion Exchange (IE)

IE is a commonly used nitrate treatment technology. Although nitrate-selective IE resins have been developed, most are more selective toward sulfate than nitrate, therefore the impact of sulfate on nitrate exchange capacity must be considered. IE technologies are simple to design, operate and monitor. They are cost-effective for smaller applications such as direct treatment of groundwater at well sites, and usually feature fully automated regeneration sensors and equipment. These systems are regenerated using sodium chloride. IE is best for waters with total dissolved solids (TDS) concentrations of less than 500 mg/l. Salts and organics in water eventually spoil IE resins, but many systems operate for 5 to 10 years without requiring resin replacement [4].

Testing is being done of a titanium dioxide-based hybrid IE media that performs simultaneous removal of arsenic and nitrate. The estimated maximum adsorption capacity for arsenic per mass of titanium ranged between 16.6 mg As g^{-1} Ti, 24.9 mg As g^{-1}Ti, and 27.3 mg As g^{-1} Ti for different types of tested titanium dioxide-based hybrid IE media [5].

References

[1] http://www.wateronline.com/doc/arsenic-removal-technologies-a-review-0001

[2] http://link.springer.com/article/10.1007/s11051-007-9225-7

[3] https://www.google.com/patents/US5858249

[4] http://www.swhydro.arizona.edu/archive/V8_N4/feature6.pdf

[5] http://pubs.acs.org/doi/abs/10.1021/bk-2013-1123.ch013