Iron recovery and arsenic isolation from drinking water treatment sludge

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Milan Adriaenssens

milan.adriaenssens@wetsus.nl

Motivation

During the production of drinking water, carcinogenic arsenic is removed from the raw water into an iron sludge. While the iron in the sludge still has value, a high concentration of arsenic in the sludge challenges its reuse. Consequently, drinking water sludge is regularly landfilled, risking arsenic leaching into soil and groundwater and inhibiting circularity in drinking water production. With the development of an iron-sludge treatment technology, both iron recovery and stable arsenic storage are aimed for, eliminating iron landfilling.

Technological challenge

Clean drinking water can be obtained, due to the high affinity of arsenic to iron adsorbents. However, this results in a challenge to separate/mobilize arsenic from the iron compounds, an essential first step in the isolation of arsenic and recovery of iron. By altering reaction conditions, affecting both chemical and biological processes, a separation between iron and arsenic is hypothesized[1,2] (Fig 2). Secondly, the obtained arsenic should be immobilized into a stable mineral to avoid environmental contaminations when disposed of. For example as scorodite, which has a low Fe/As molar ratio[3] (Fig 1).

Finally, the recovered iron needs to be obtained in a quality/purity suitable for other applications. Potential end-users could be WWTPs for phosphate removal or bio fermenters for sulfide elimination. If reuse in drinking production is possible, lower operational costs can be obtained, making safe drinking water more available.

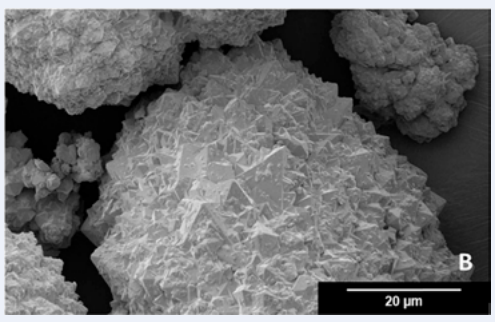

Fig 1. Left; a drinking water production plant, right; SEM picture of bioscorodite [3].

Research goals

- Understand the mobility of iron and arsenic under different reaction conditions.
- Identify reactions to form a stable As-mineral at low arsenic concentrations.
- Comprehend how different conditions affect the value of the obtained iron product.

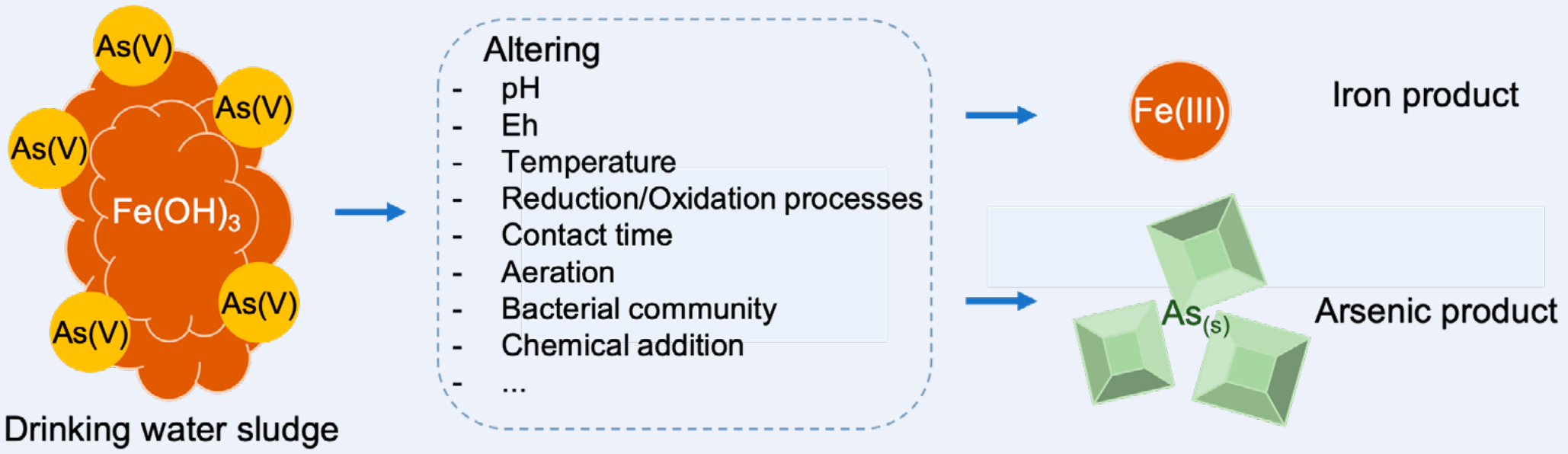

Fig 2. Proposed scheme for iron recovery and arsenic isolation.

[1] Pedersen, HD. et al., Release of arsenic associated with the reduction and transformation of iron oxides. GCA. 2006, 70(16), 4116-4129.
[2] Heijman, SGJ. et al., Ontarsening van ijzerhoudend drinkwaterslib. H2O. 1993, 26(2), 42-44.
[3] Vega-Hernandez, S. et al., An integrated green methodology for the continuous biological removal and fixation of arsenic from acid wastewater through the GAC-catalyzed As(III) oxidation. Chem. Eng. J. 2021, 421(2), Article 127758.

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M. Adriaenssens MSc, dr.ir. AR Mol, ir. L. Korving,
dr.ir. RD van der Weijden, prof.dr.ir. CJN Buisman