Arsenic removal from groundwater via adsorption: Comparing theoretical performance with performance monitoring & pilot testing results

by Mark Burger, M.A.Sc., P.Eng.(BC)
Introduction

Arsenic and Manganese Pilot Test – Case Study

- Groundwater, deep well
- Arsenic level: 0.013 mg/L
- Manganese level: 0.1 mg/L
- pH ~ 7.9
- Community in Northern British Columbia, population ~200
- Pilot test from December 2015 to May 2016
Background

Adsorption Media for Arsenic – and Other Products

- Titanium dioxide
- Ferric oxide
- Activated alumina
- Other technologies: ion exchange resins, reverse osmosis
Methodology

Arsenic Removal Media – Titanium Dioxide
Methodology

Arsenic Removal Media – Ferric Oxide
Methodology

Pilot Test Setup - Diagram

Chlorinated Water (from distribution system)

Manganese Removal Filters F-1 and F-2 in parallel, to common header

Arsenic removal filter F-3
(activated alumina)

Arsenic removal filter F-4
(titanium dioxide)

Arsenic removal filter F-5
(titanium dioxide)

Arsenic removal filter F-6
(ferric oxide)
Methodology

Pilot Test Setup - Picture
Methodology

Flow Measurements

• Measured daily
• Laboratory sample times noted
• Sampled every 2-3 weeks for As, Mn
• Filters F-4 & F-6 at similar flow rates, F-5 slower.
• Periodic backwashes
Results

Bed Volumes

vessel diameter = 200 mm

Height of vessel = 1,067 mm
Results

Bed Volumes

- Vessel diameter = 200 mm
- Height of gravel & garnet = 150 mm
- Height of media = 600 mm
- Height of vessel = 1,067 mm
- Volume of the media + void spaces = one “bed volume” (= 0.237 m³ in this case)
Results

Pilot Test Results

GCDWQ Maximum Acceptable Concentration

Filtered Water Arsenic Concentration (mg/L)

Adsorption Filter Bed Volumes

- Filter F-4: titanium dioxide
- Filter F-5: titanium dioxide
- Filter F-6: ferric oxide

Filter F-4: titanium dioxide  △ Filter F-5: titanium dioxide  × Filter F-6: ferric oxide
Results

Comparison to Other Studies


Conclusions

**Different media, similar performance**

- Titanium dioxide and ferric oxide media performed similarly in terms of arsenic removal and bed volumes treated.
- This is consistent with other published information for media performance at higher pH (~8).
Conclusions - Questions

Mark Burger, M.A.Sc., P.Eng.

- mburger@kwl.ca

Kerr Wood Leidal Associates Ltd.
110 - 1212 1st Street SE  
Calgary, Alberta T2G 2H8  
tel. 403-262-4241

200 - 4185A Still Creek Drive  
Burnaby, British Columbia V5C 6G9  
Tel. 604-294-2088