Availability of Safe Drinking Water

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Trichloroethylene (TCE)

- TCE is a volatile organic carbon (VOC) considered to be a main environmental pollutant.
- commonly used in industry as a cleaner, metal finishing, electrical component, paint and ink formulation
- MCL= 5µg/l

Activated carbon (AC)

- Made of organic materials such as wood, nuts shells, and lignite.
- Carbonization (changes raw material to char), followed by activation (creation of pores by oxidation)
- AC regarded by USEPA as the best available technology for removing VOCs

Adsorption

- The ability of solid substances to attract molecules of solutions and separate them form the bulk solution
- Physical adsorption (physisorption) motorized by Van der Waals forces
- Chemical adsorption (chemisorption) where chemical bonds are formed

Treatment

- Can not be removed by conventional treatment processes
- Adsorption by GAC
- Background materials in natural water can highly impact this process.
- Presence of NOM in all water sources
- GAC capacity reduces due to NOM

Nanoparticles

- Nanoparticles (NP) material with two dimensions less than 100nm
- The high production and use of the NP is manifested by high release of NP into the environment and natural water
- Zero valent iron is one of the most common NP in water system because of their use in water and soil treatment.

Presence of NP

- NPs aggregate in water and form larger particles
- According to their electrical charge and the water pH and ionic strength

  - Attached to the GAC, block the adsorption pores

  - Behave as adsorption sites, carried by water, along with TCE to the consumer.

How Activated Carbon Works

Source: http://www.airpurifiers.com

Why AC adsorption

- Relatively low cost
- Simple
- Tap filters

Source: http://www.freedrinkingwater.com

Materials & Methods

- ***Adsorbates*** – TCE, Fe_2O_3 & Humic acid
- ***Adsorbents*** – GAC F-400
- ***Organic-free water*** – autoclaved DI water, buffered with 0.01M KH_2PO_4, pH adjusted to 7 with 10M solution of NaOH

Materials & Methods

- Calibration curve15,30, 50,100 & 150 µg/L
  - R-squared > 0.95
  - Response Factor (RF)

$$RF = \frac{Theoretical\ \ Concentration}{Peak\ \ Area}$$

  - Coefficient of Variance (CV)
  - CV<10%

$$CV = \frac{\left| Average\ RF\ -\ RF \right|}{Average\ RF} x\mathbf{100}$$

Materials & Methods

- Adsorption isotherms $$q_e = \frac{(C_o - C_e).V}{m}$$

Where $\mathbf{q_e}$ = the amount adsorbed µg/g of adsorbent
$\mathbf{C_o}$ = initial concentration of the adsorbate (geosmin or MIB), µg/L
$\mathbf{C_e}$ = equilibrium concentration of adsorbate (geosmin or MIB), µg/L
V = volume of solution in the isotherm bottle, 125 mL
m = mass of ACFs in the isotherm bottle, g

- **Freündlich adsorption isotherm**

$$x/m = Kc^{1/n}$$

x = mass of adsorbate

m = mass of adsorbant

c = Equilibrium concentrationof adsorbate in solution.

K and 1/n are constants for a given adsorbate and adsorbent at a particular temperature.

Analytical Procedure

P&T+GC - FID

UV - Vis

Project Time line

Date	Expected Outcome
First & Second week	Prepare isotherm bottles for TCE with and without humic acid on PAC; and also prepare calibration curve for TCE and humic acid
Third Week	Prepare isotherm bottles for TCE with 0.5 and 1.0 mg/L Fe_2O_3 Without humic acid on PAC.
Fourth Week	Analyze samples prepared in June 19 through July 13. Prepare regression analyses for all experimental samples collected.
Fifth Week	Prepare isotherm bottles for TCE with 0.5 and 1.0 mg/L Fe_2O_3 and 0.5 mg/L humic acid on PAC.
Sixth Week	Analyze samples prepared in July 16 – July 20. Prepare regression analyses for all experimental samples collected.

Water Treatment Plant Layout