

# Availability of Safe Drinking Water

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# Trichloroethylene (TCE)

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- 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
- TCE Maximum Contaminant Level is 5µg/l

## Activated carbon (AC)

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- 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

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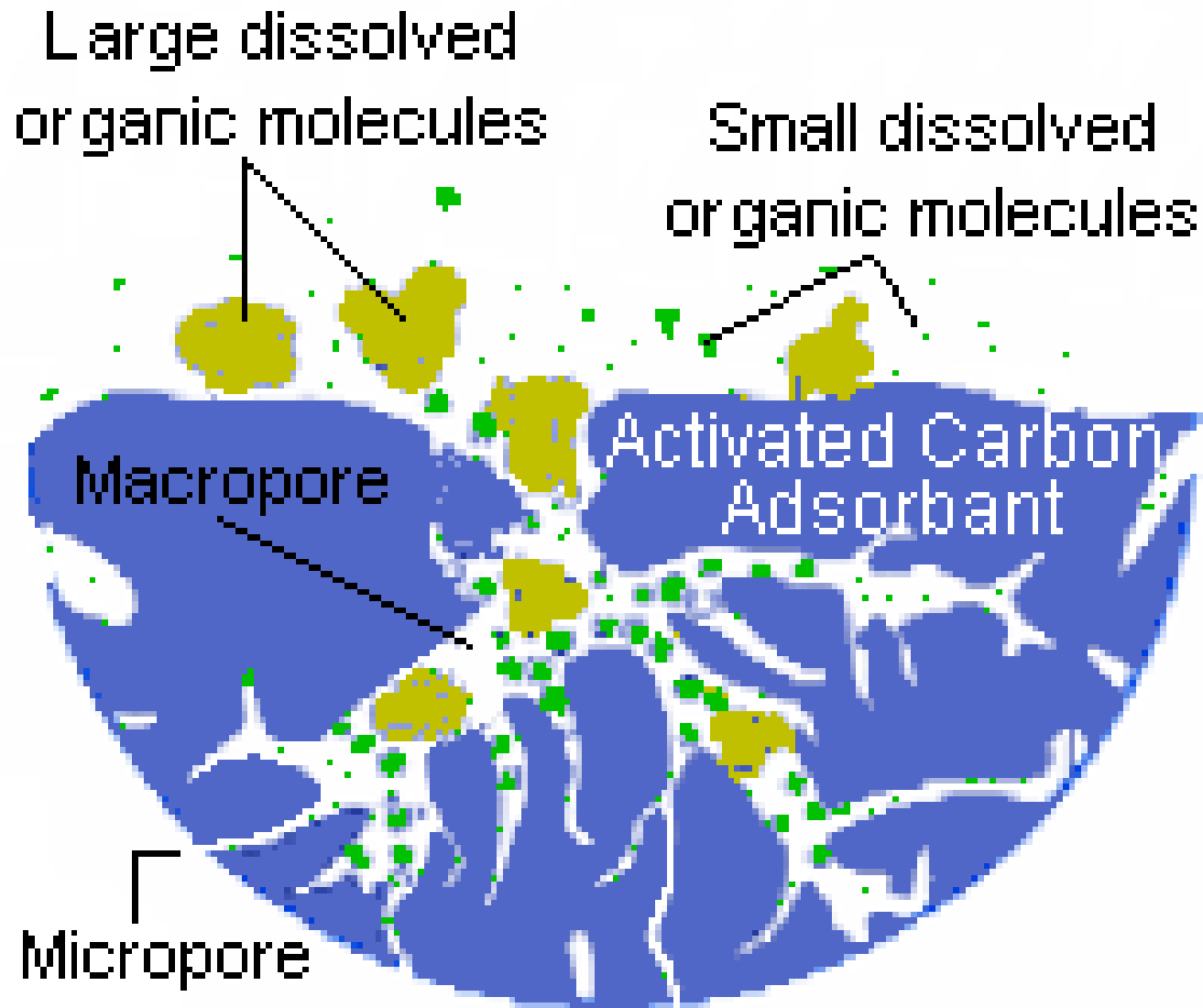
- The ability of solid substances to attract molecules of solutions and separate them from the bulk solution
- Physical adsorption (physisorption) motorized by Van der Waals forces
- Chemical adsorption (chemisorption) where chemical bonds are formed

# TCE Removal

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- 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

# How Activated Carbon Works



Source: <http://www.airpurifiers.com>

# Nanoparticles

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- 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
- Silicon dioxide ( $\text{SiO}_2$ ) is one of the most common NP in water system

## Presence of NP

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- NPs aggregate in water and form larger particles
- According to their electrical charge, 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.



# Materials & Methods

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- ***Adsorbates*** – TCE, SiO<sub>2</sub> & Humic acid
- ***Adsorbents*** – GAC F-400
- ***Organic-free water*** – autoclaved DI water, buffered with 0.01M KH<sub>2</sub>PO<sub>4</sub>, pH adjusted to 7 with 10M solution of NaOH

# Materials & Methods

- Calibration curve 15, 30, 50, 100 & 150 µg/L
  - R-squared > 0.95
  - Response Factor (RF)

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

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

$$CV = \frac{|\text{Average RF} - \text{RF}|}{\text{Average RF}} \times 100$$

# Materials & Methods

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

Where  $q_e$  = the amount adsorbed  $\mu\text{g/g}$  of adsorbent

$C_o$  = initial concentration of the adsorbate (geosmin or MIB),  $\mu\text{g/L}$

$C_e$  = equilibrium concentration of adsorbate (geosmin or MIB),  $\mu\text{g/L}$

$V$  = 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 concentration of 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 SiO <sub>2</sub> Without humic acid on PAC.
Fourth Week	Analyze samples prepared in June 23 through July 24. Prepare regression analyses for all experimental samples collected.
Fifth Week	Prepare isotherm bottles for TCE with 0.5 and 1.0 mg/L SiO <sub>2</sub> and 0.5 mg/L humic acid on PAC.
Sixth Week	Analyze samples prepared in July 14 – July 15. Prepare regression analyses for all experimental samples collected.

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**Thank you**

*Questions???*