UNIVERSITY OF Cincinnati

Availability of Safe Drinking Water

Faculty Sponsor : **Dr. George A Sorial**

Graduate Assistant : **Hafiz Salih**

Water Quality Group

Environmental Engineering Division

Department of Civil and Environmental Engineering

UNIVERSITY OF Cincinnati

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
- TCE Maximum Contaminant Level is 5µg/l

UNIVERSITY OF Cincinnati

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

UNIVERSITY OF Cincinnati

Adsorption

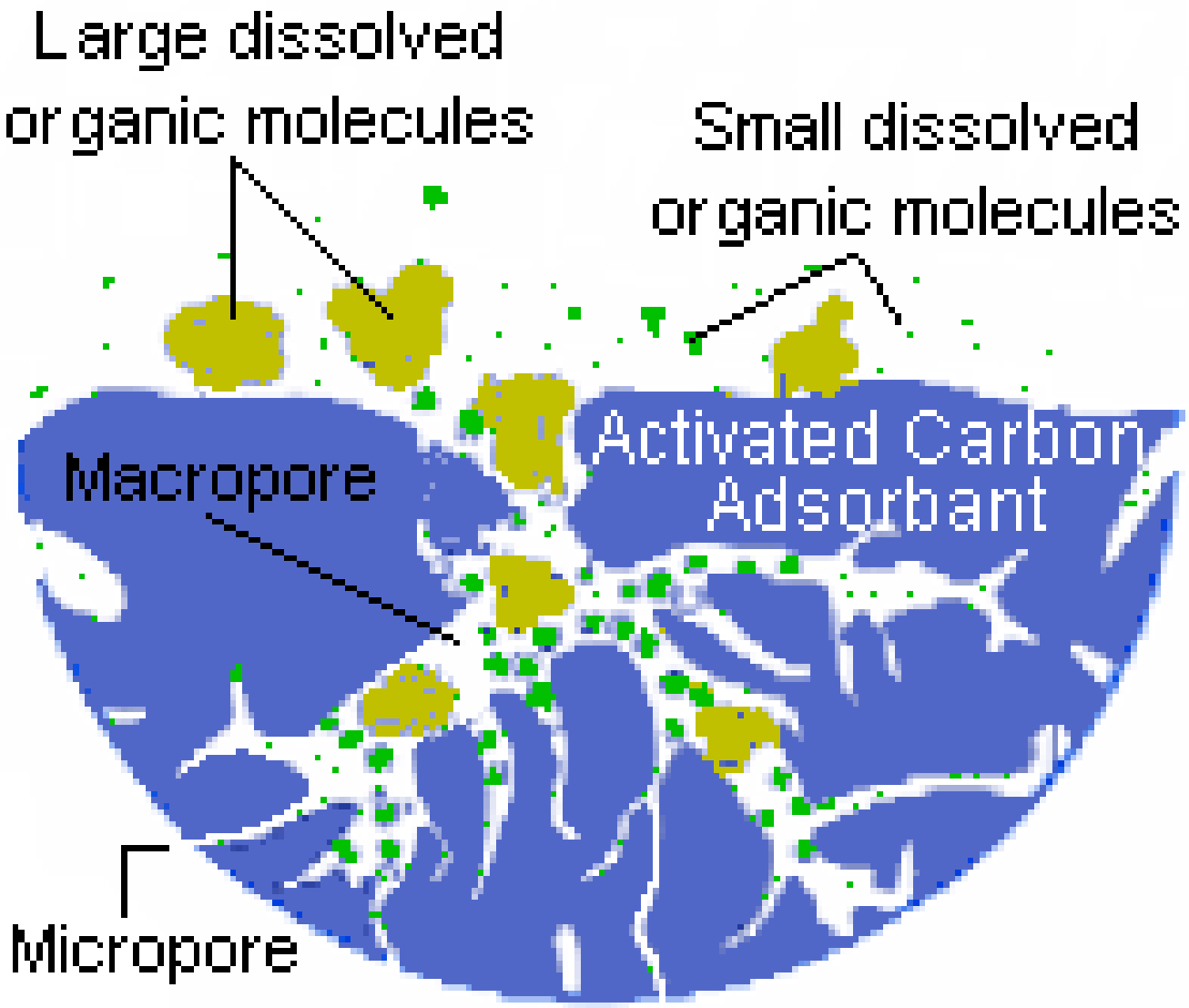
- The ability of solid substances to attract molecules of solutions and separate them form the bulk solution
- Physical adsorption (physisorption) motorized by Van der Waals forces
- Chemical adsorption (chemisorption) where chemical bonds are formed

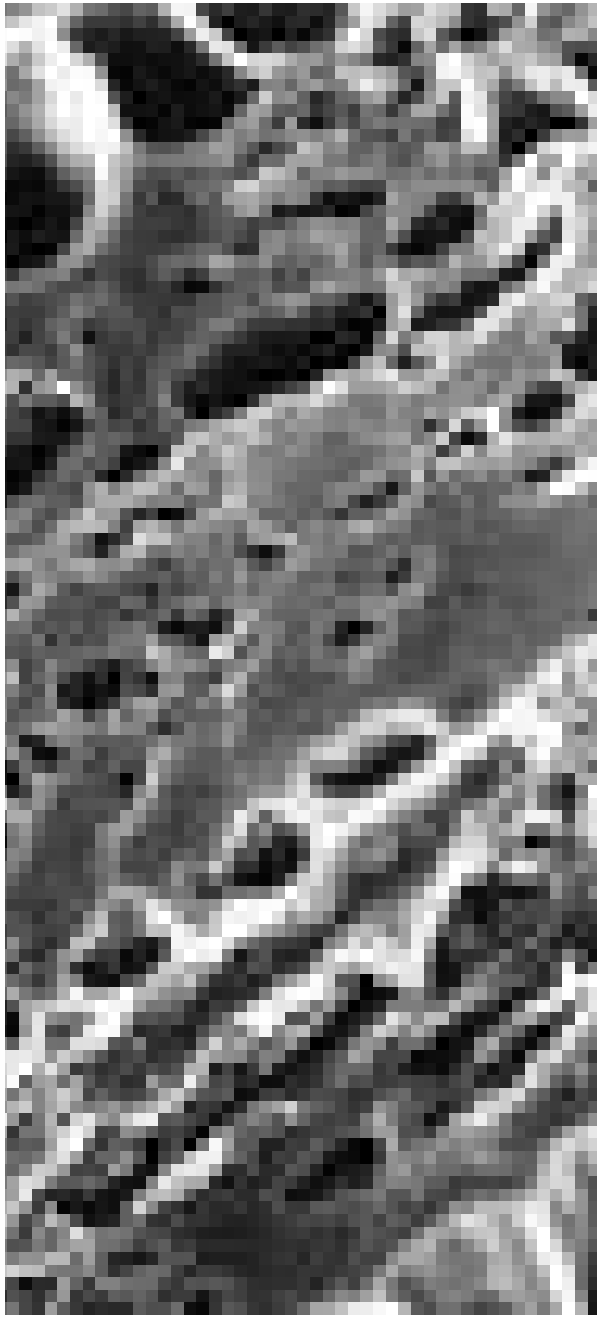
UNIVERSITY OF Cincinnati

TCE Removal

- 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

UNIVERSITY OF Cincinnati

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
- Titanium dioxide (TiO_2) is one of the most common NP in water system because of their extensive use in water treatment.

UNIVERSITY OF Cincinnati

Presence of NP

- 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.

UNIVERSITY OF Cincinnati

Materials & Methods

- ***Adsorbates*** – TCE, TiO_2 & 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

UNIVERSITY OF Cincinnati

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%

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

UNIVERSITY OF Cincinnati

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.

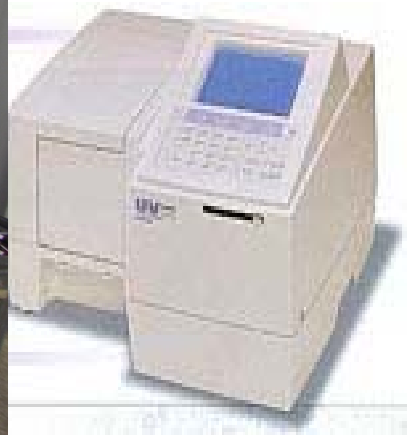
K and 1/n are constants for a given adsorbate and adsorbent at a particular temperature.

UNIVERSITY OF Cincinnati

Analytical Procedure

P&T+GC - FID

UV - Vis



UNIVERSITY OF Cincinnati

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 TiO_2 Without humic acid on PAC.
Fourth Week	Analyze samples prepared in the first two weeks. Prepare regression analyses for all experimental samples collected.
Fifth Week	Prepare isotherm bottles for TCE with 0.5 and 1.0 mg/L TiO_2 and 0.5 mg/L humic acid on PAC.
Sixth Week	Analyze samples prepared in the third and fifth week. Prepare regression analyses for all experimental samples collected.

UNIVERSITY OF Cincinnati

Thank you

Questions???