

# Metal Addition to Enhanced Biological Filtration Performance

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# Objectives

- Explore ways to enhance the properties of metal-oxide coatings to improve filter treatment performance  
=> An alternative: substitute iron-oxide sand for GAC

# Background

- What is NOM?
  - Predominantly humic substances + other materials
  
- Problems caused by NOM
  - Colored water
  - Sometimes water smell and have bad taste

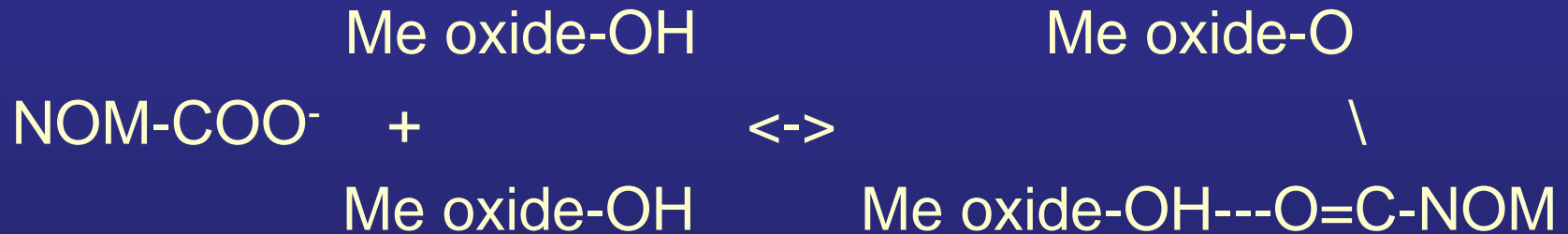
- Can react with chlorine to produce chloroform and other carcinogens
- Chlorine demand
- Complex with Metals

- What is E. coli?
  - Intestinal bacterium of the mammals very common in the human being
  
- Problems Caused by E.coli
  - diarrhoea and abdominal cramps
  - Disease call: haemolytic uremic syndrome

- Problems Caused by Arsenic
  - damage the human nervous system
  - is a known carcinogen
  - is also a teratogen, meaning it can enter the metabolic system of unborn children
  - and many other diseases

- How iron oxide sand can remove NOM and microorganism?

-NOM adsorption involved ligand exchange mechanism (Gu et al, 1994)



These reaction indicate that decreasing pH (more protonated sites) will be favorable to NOM adsorption.

# Experimental Methodolgy

Sand collection



Sand Cleaning and Preparation



NOM Challenge



Arsenic or E.Coli Challenge

# Filter Sand Utilized

- Winthrop (ME) Slow Sand Filtration water treatment plant
- Philadelphia (PA) Rapid Sand Filtration water treatment plant



Sands were sieved using sieves of 0,6 mm and 0,85 mm opening

# •NOM Challenge Solution:

- Solution realized with a concentrated humic acid stock solution
- Buffered Water prepared with 168 mg/l of  $\text{NaHCO}_3$  (alkalinity =100 mg/l as  $\text{CaCO}_3$  ) and 40 mg/l of NaCl
- Initial TOC Solution around 7 mg/l

- **E.Coli solution:**

- Stock solution of  $5,45 \cdot 10^8$  Colony Forming Units (CFU) / 100ml

- Dilute with buffered water until realize a  $5,45 \cdot 10^6$  CFU/100mL

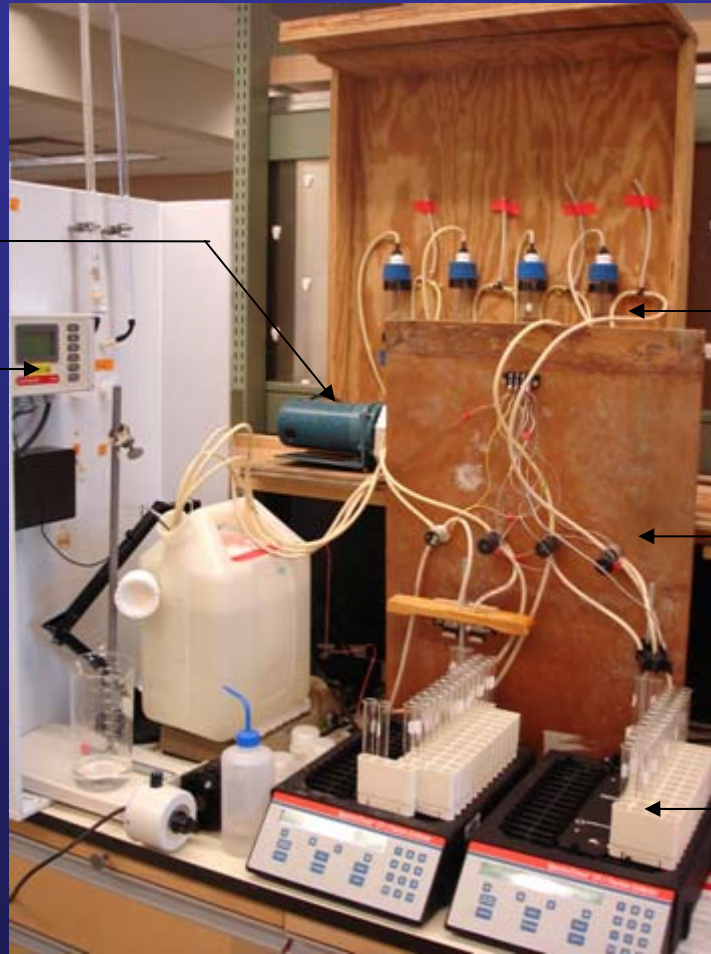
- **Arsenic Challenge Solution:**

- Stock solution of 1 g/l Arsenic

- Dilute with buffered water until realize a 2mg/l arsenic V solution

# Setup

Pump  
pH controller  
CONSORT  
R305

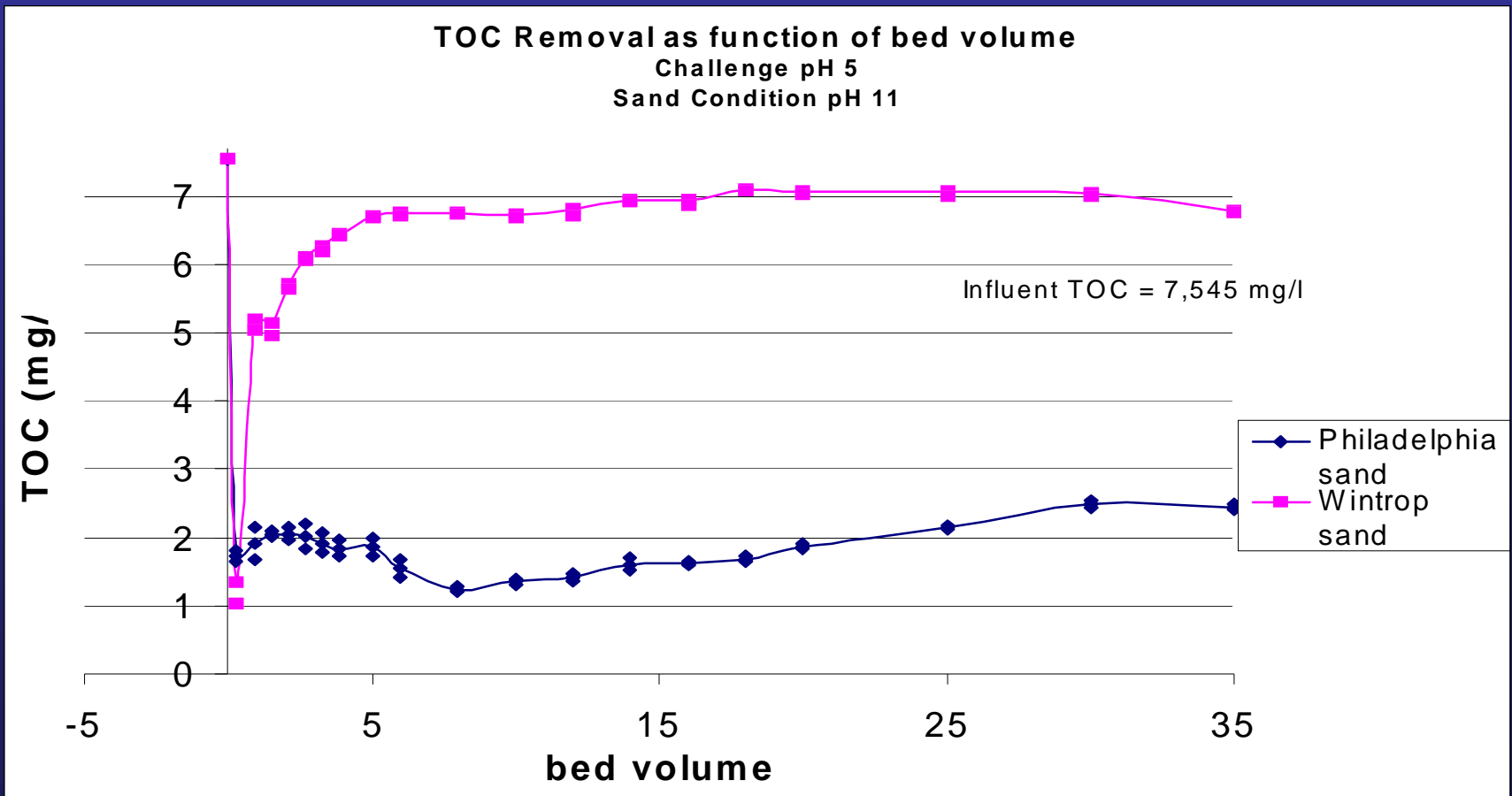


Column

Valve

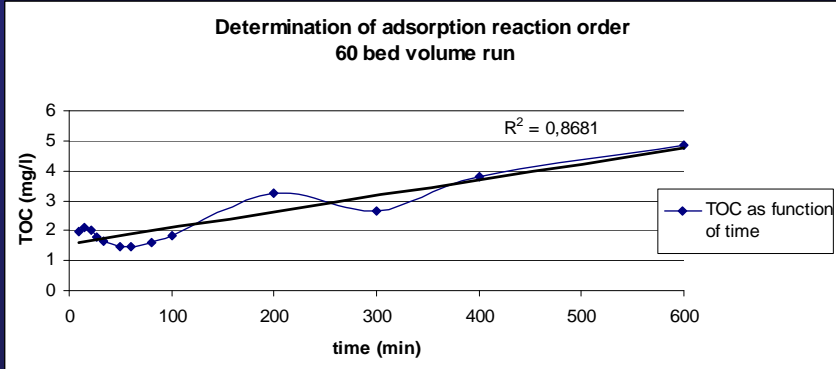
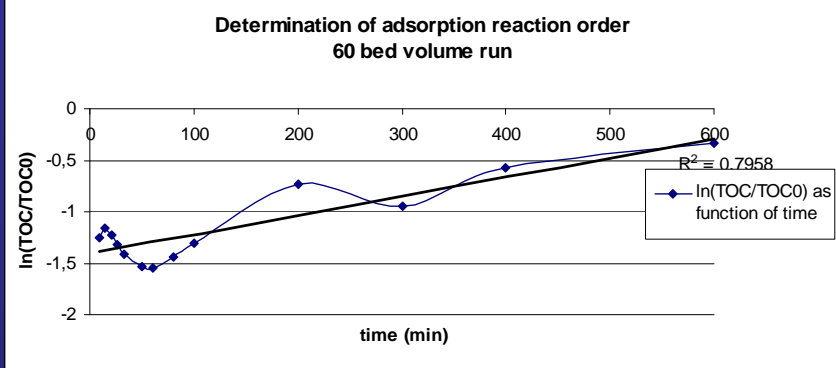
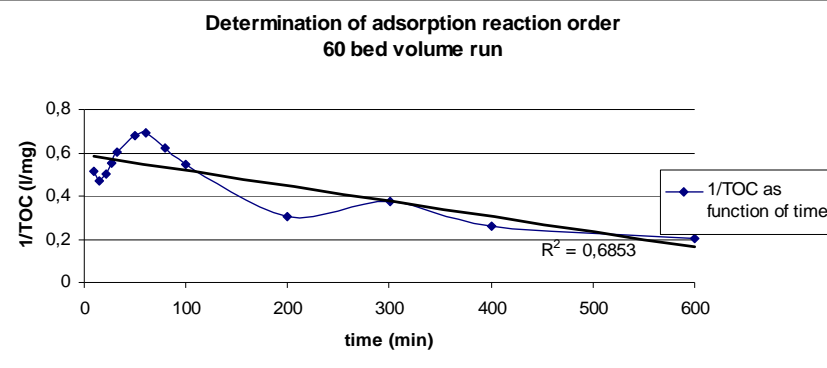
Autosampler

# RESULTS

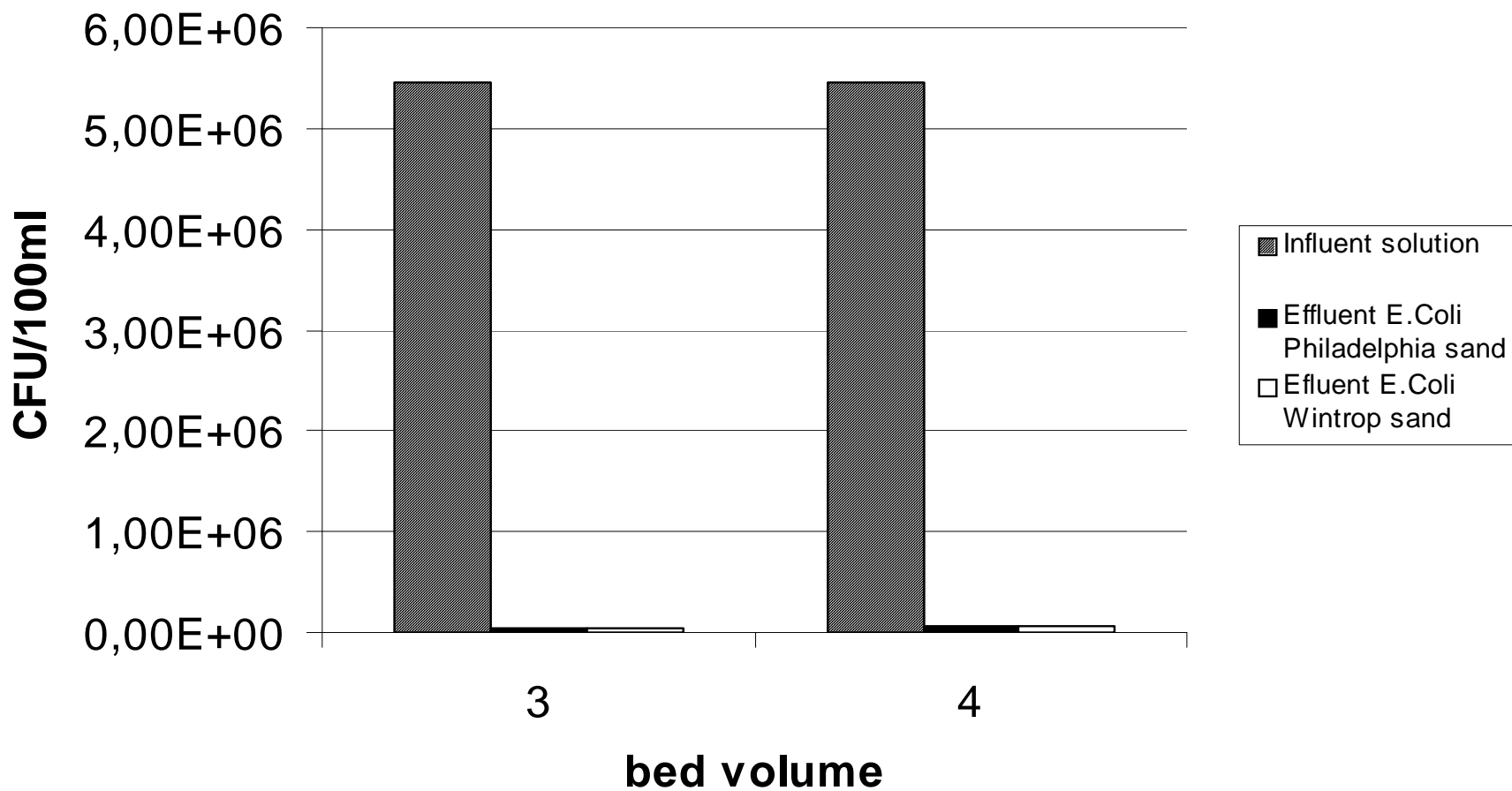


=> Only the Philadelphia sand are Iron Coated Sand

# Determination of the adsorption reaction order

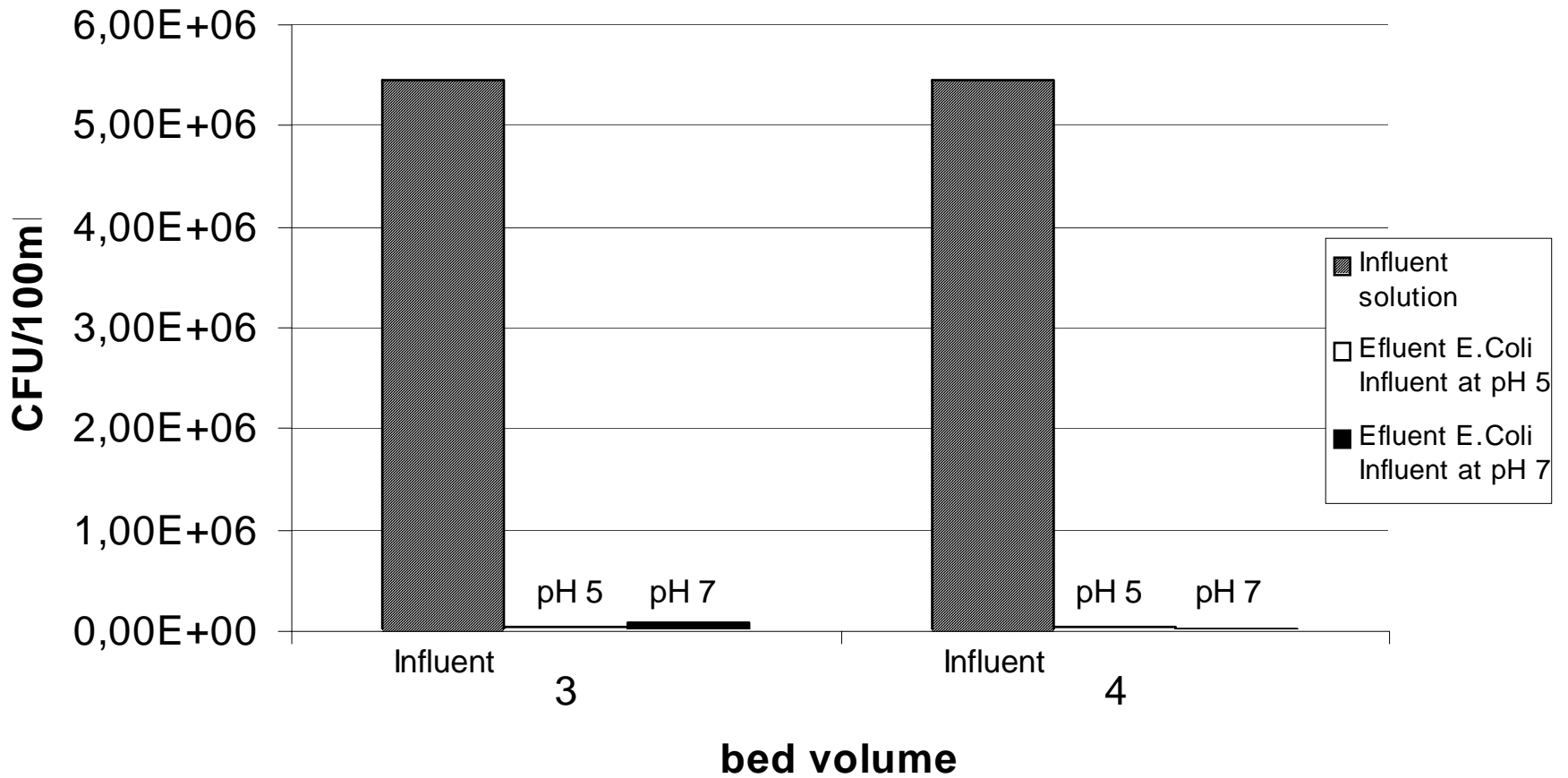


## E.Coli Removal



E.Coli Removal is quite the same for Iron-Oxide Sand and sand which are not.

## E.Coli Removal from Metal Coated Sand Philadelphia Sand



The pH of the E.Coli Solution does not have effect on the E.Coli Removal

# CONCLUSION

- Iron-Oxide Sand Enhanced NOM Removals
- Contrary to what was envisaged Iron-Oxide Sand does not exert a significant influence on E.Coli Removals after preloading the sand with NOM

# Recommendation

- Challenge with a mixed solution of Arsenic and NOM
- Determine the influence of the age of the media on the NOM, E.Coli and Arsenic Removal