

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

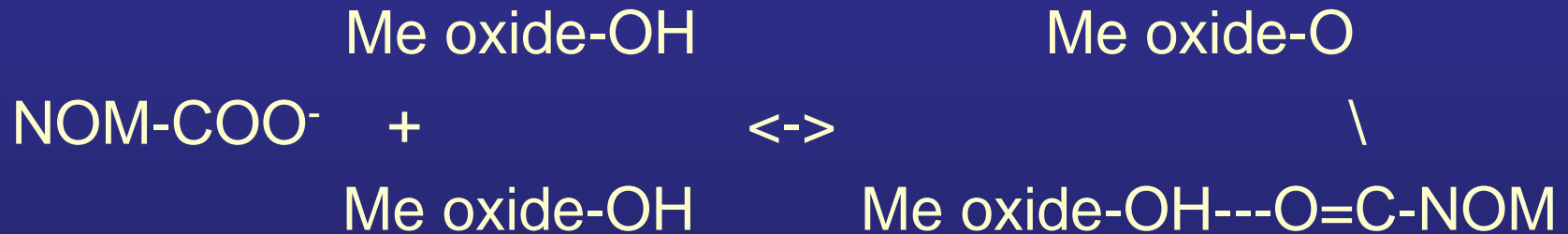
- What is E. coli?
 - Intestinal bacterium of the mammals very common in the human being

- 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 NaHCO_3 (alkalinity = 100 mg/l as 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

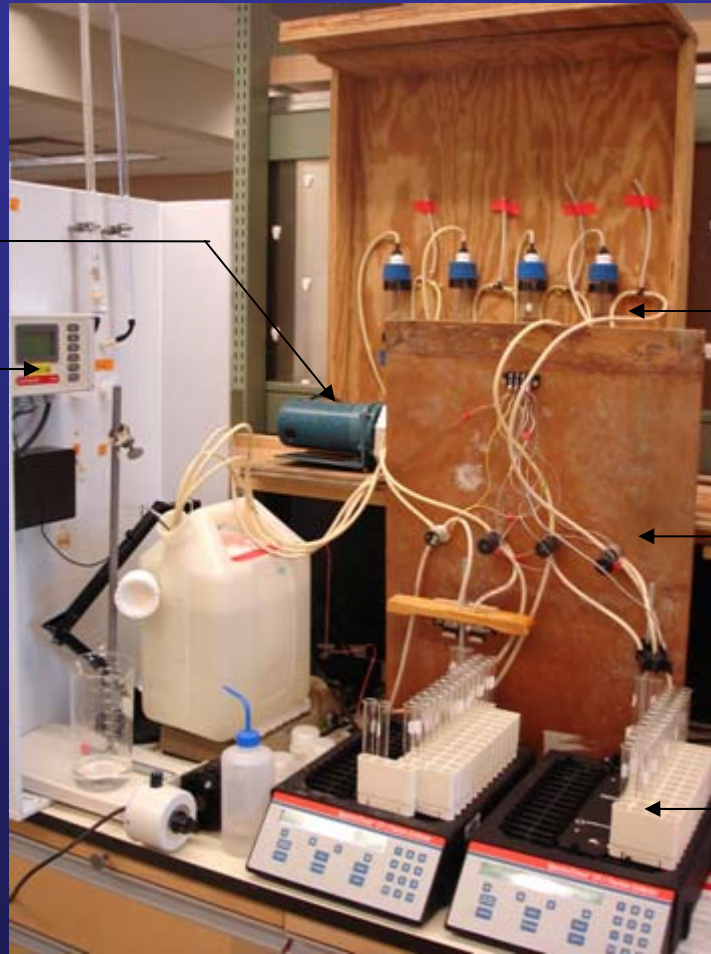
- **Arsenic Challenge Solution:**

- 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

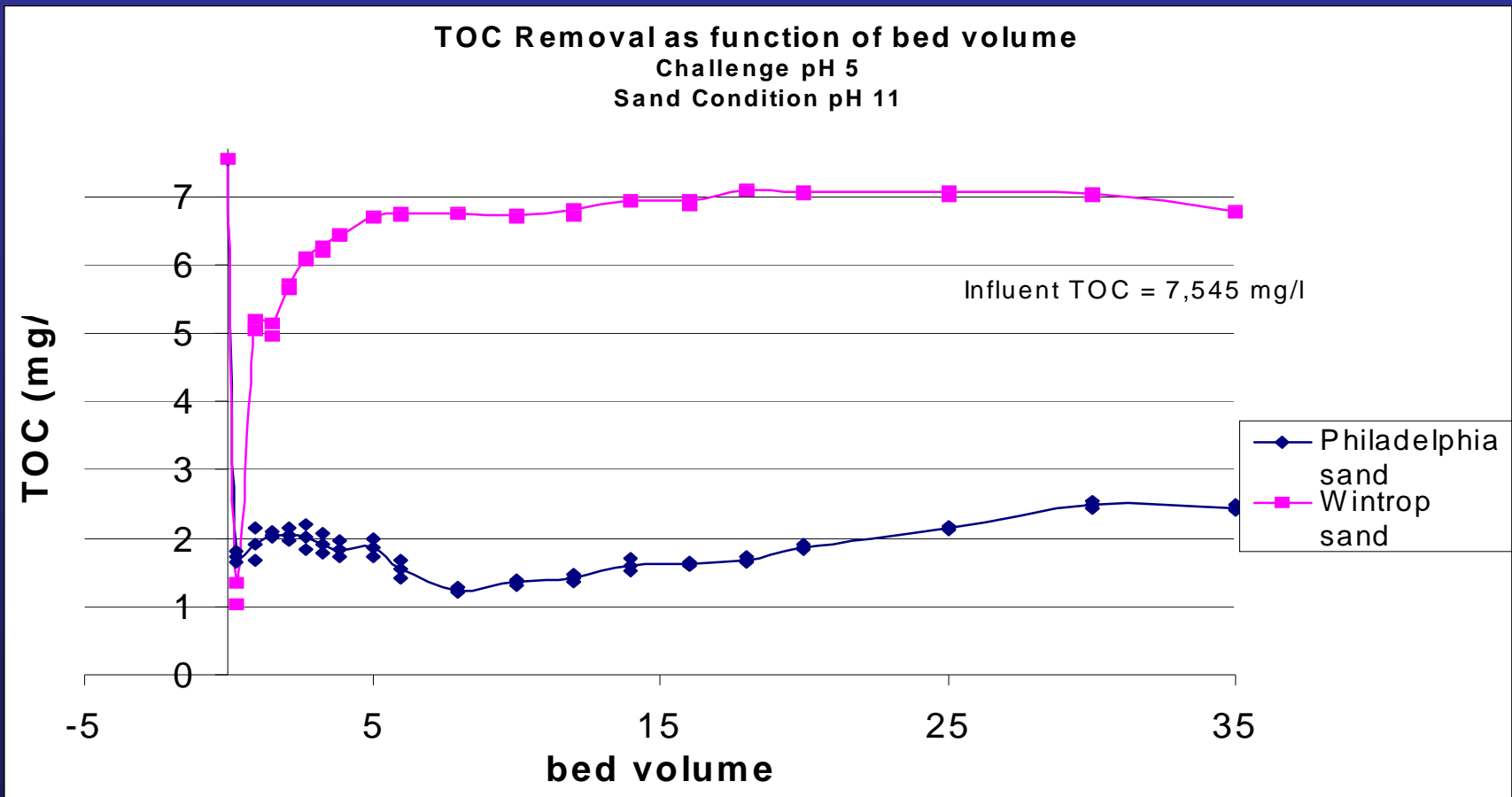


Column

Valve

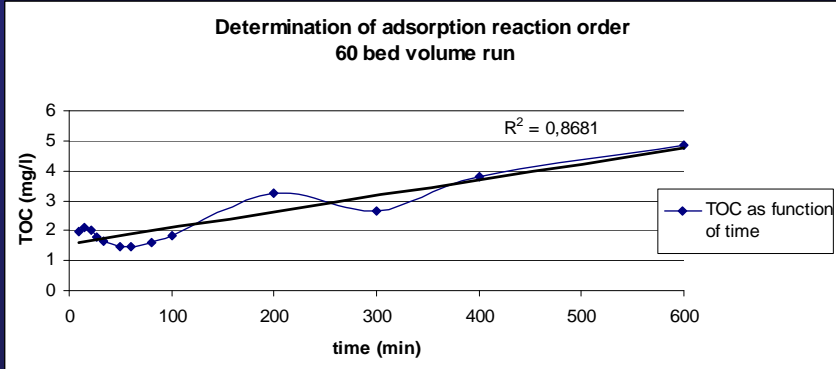
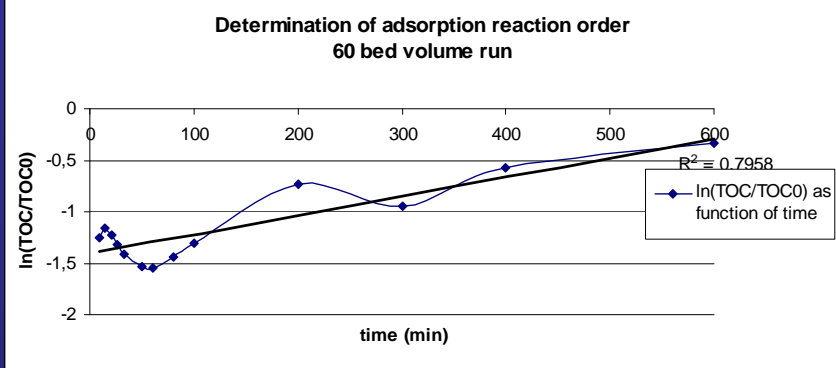
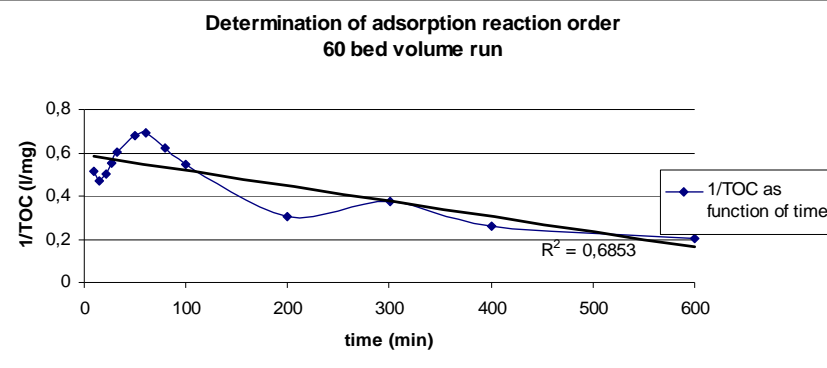
Autosampler

RESULTS

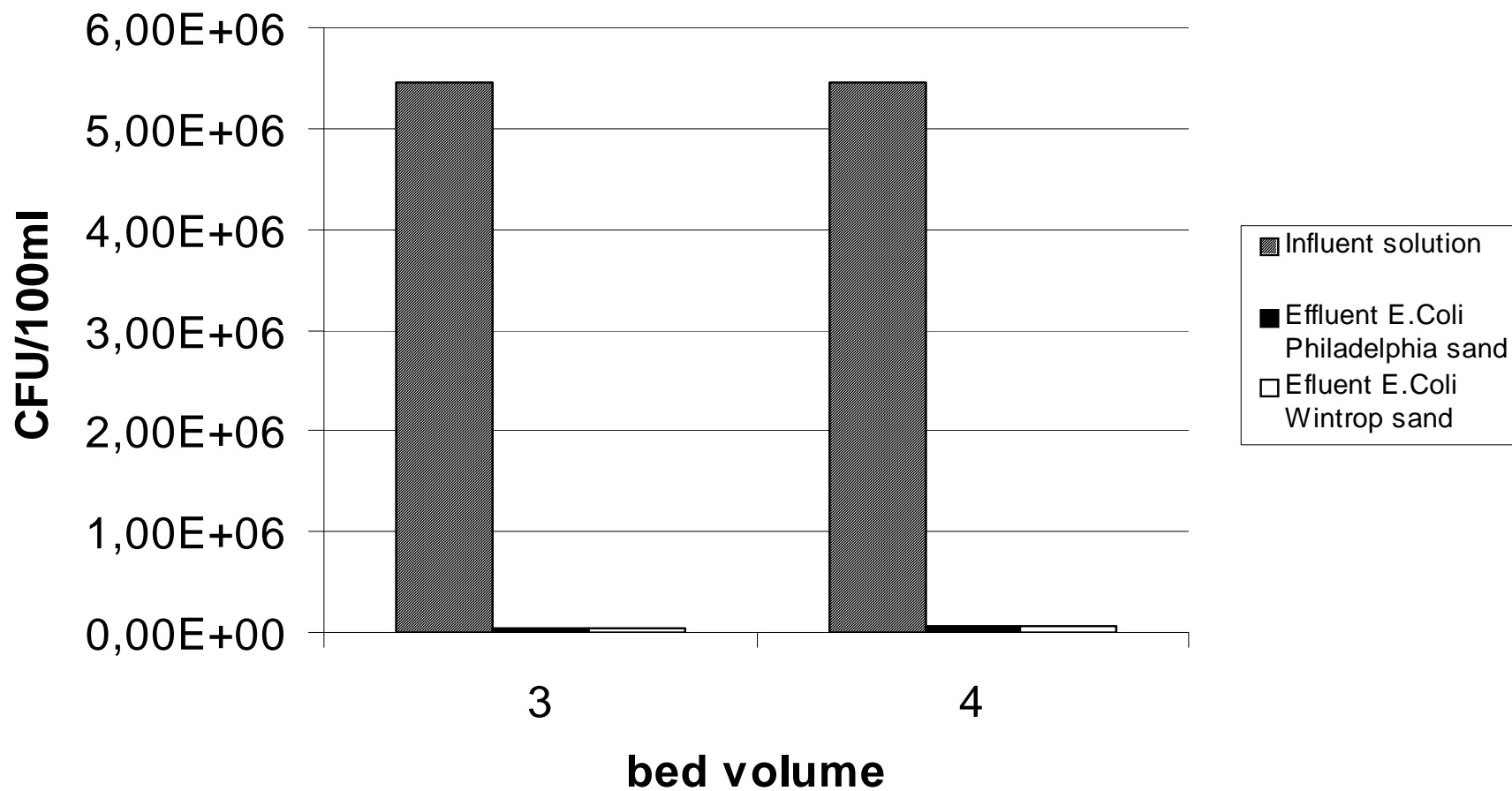


=> Only the Philadelphia sand are Iron Coated Sand

Determination of the adsorption reaction order

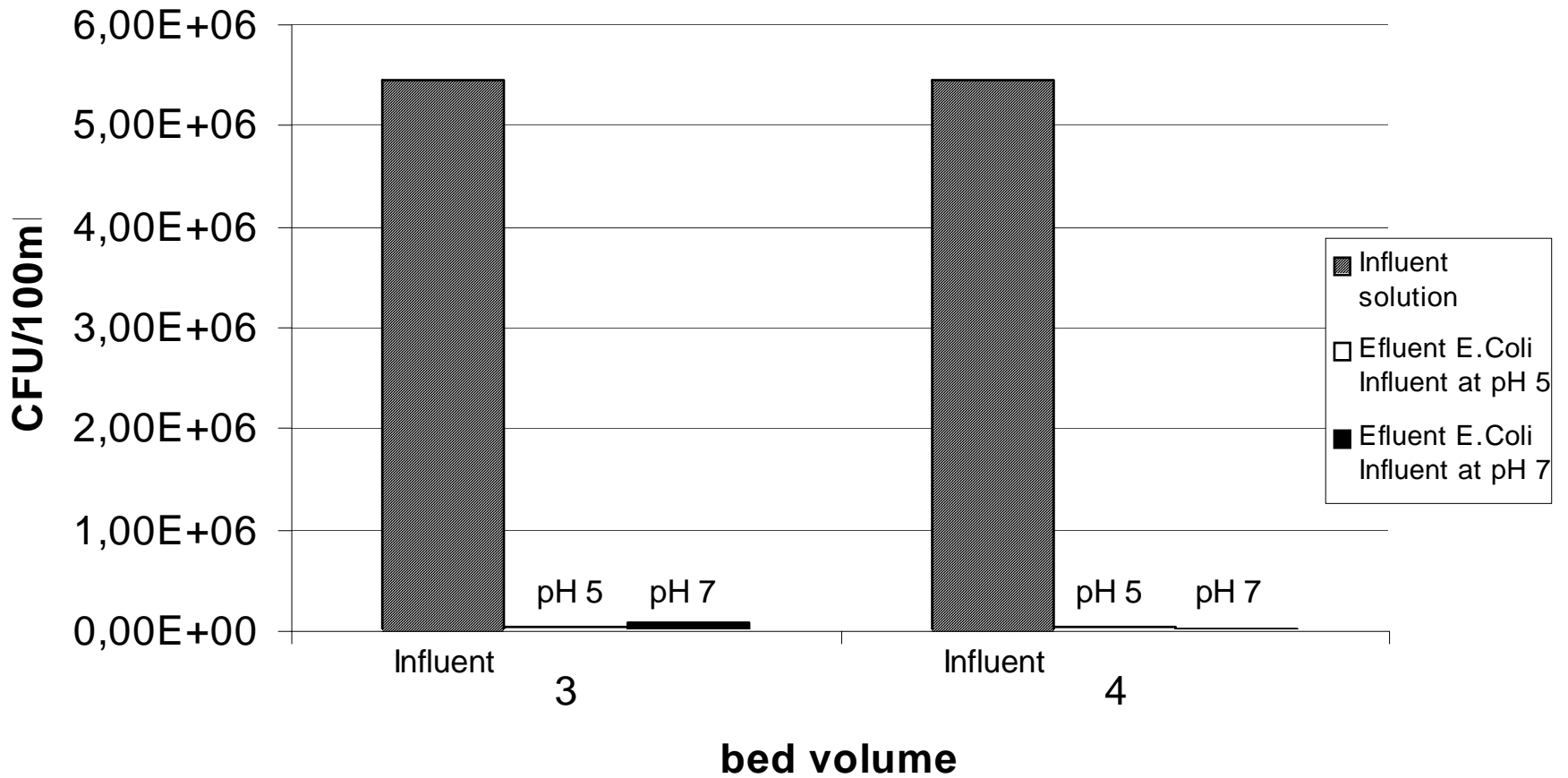


E.Coli Removal



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