The FILTRON:

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A Pressing Issue

- Diseases related to inadequate water and sanitation cause an estimated 80% of all sickness in the developing world
- Many factors contribute to this scarcity of clean water including the existence of dry-climate regions, the impacts of natural disasters, and the lack of proper education

Point-of-Use Devices

- Low-cost, efficient solution to the challenge of providing potable drinking water in low-income situations
- Refer to water treatment methods which treat water at the point of consumption rather than at the source

FILTRON: The Basics

- Combine local clay with a combustible element such as sawdust or milled rice husks, pressed into a bucket shape and fired in a kiln.
- Surface coated with or submerged in colloidal silver.
- Gravity-driven flow of water during treatment
- Inner volume of about 8.5 liters
- Placed in a five-gallon plastic or ceramic receptacle with lid and faucet

FILTRON: How does it work?

- Ability to convert raw water into clean drinking water is two-fold
- Pores are small enough to capture a significant portion of disease-producing micro-organisms
  - Most protozoans, some bacteria, little-to-no viruses (smaller than pore sizes)
- Silver serves as a means for bacterial inactivation
  - Currently unknown if effective on viruses

Past Research

- Pore size typically 0.6-3.0 microns
  - *Latange, Danielle (Altheia Environmental)*

- Pathogen removal in excess of 99%
  - http://www.pottersforpeace.org

Research Objectives

- Evaluation of pore size by measuring removal efficiency of virus-sized microspheres
- Evaluation of the silver's role in pathogen inactivation
  - Likely to be a function of both silver concentration and contact time

Fluorescent Microspheres

- Carboxylate-modified polystyrene from Molecular Probes
- Serve as surrogates for viruses and bacteria
- Range in size from 0.02 - 2.0 microns
- What kind of organisms are we talking about?
  - Rhinovirus, Influenza virus, Ebola virus, E.coli
  - *Cryptosporidium parvum* and *Giardia lamblia*


Ebola virus


Cryptosporidium


E.coli

Spheres Used in Experimentation

Size (um)	Color	Surrogate For:
0.02	Nile Red	Rhinovirus
0.1	Orange	Influenza virus
0.5	Yellow-Green	Aeromonas hydrophilia
1.0	Yellow-Green	E.coli
2.0	Yellow-Green	Encephalitozoon spores

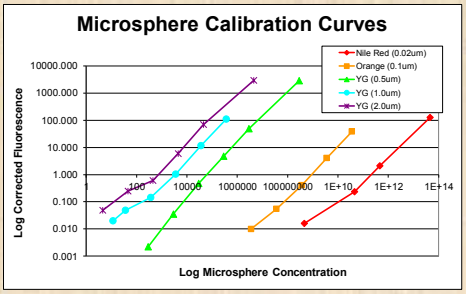
The Filters

- 2 New filters without silver (1NS, 2NS)
- 2 New filters with silver (1New, 2New)
- 2 Used filters - 3 years in Nicaragua (1Used, 2Used)

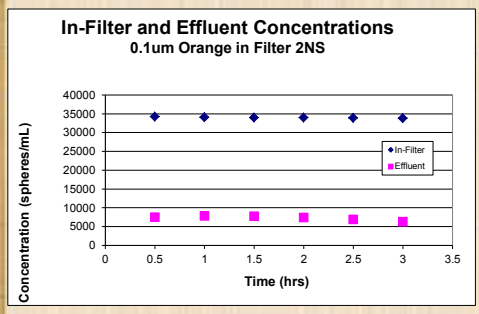
Microspheres: The Procedure

- Dechlorinate tap water, add microspheres, and pour batch of water into each of 6 filters
- Collect water samples from inside filter and from effluent tap at multiple time points
- Measure depth of water in filter at each time point (use to calculate flow rate via geometry)
- Measure samples for: fluorescence (microsphere conc), turbidity, pH, water temperature
- Refill filter and repeat each test in triplicate

Microspheres - The Results



Microspheres: The Results



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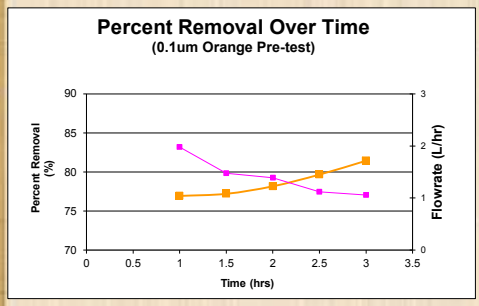
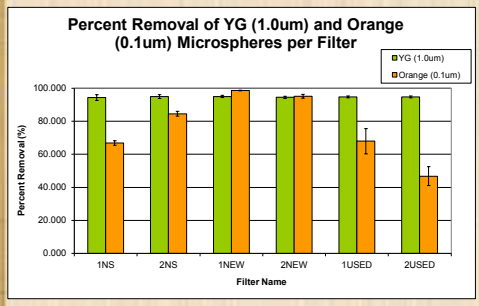
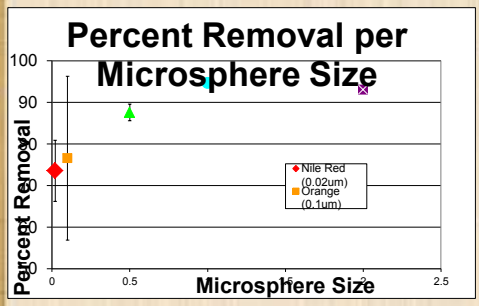


Microspheres: The Results



Microspheres: The Results



E.coli: The Procedure

- Grow E. coli sample in TSB broth for 2 days
- Measure turbidity of prepared stock solution and use linear equation to obtain concentration
- Determine amount of stock solution to be spiked
- Pour batch of water into test filter (2New); also fill one filter (1New) with unspiked water
- Collect samples from inside and effluent of filter at 2 and 4 hours
- Plate 3 replicates of multiple dilutions (3 or more) on agar using spiral plater and count 24 hrs later

Summary of Results

Future Research: Pathogen Removal

- Additional tests on pathogen removal
- Re-coating "New" filters with silver
  - Also may re-coat "Used" filters

Questions?

Salamat! Asante! Dhanyavad! Gracias!

- Thanks to Professor Angela R. Bielefeldt, Professor Scott Summers, Kate Kowalski, and Ben Bishop!