

Evaluation of a Silver Ion System for RW purification

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- Quality drinking water difficult to access, particularly in developing countries
- Rainwater potentially good resource, but with quality issues
- Conventional methods...
 - Leave harmful by-products (chlorine)
 - Don't have 'residual' (UV, Ozone) allowing for re-contamination
- RW needs to be stored for long periods of time!



San Miguel de Allende, Mexico

- 14 Pilot RWH systems developed – 2007
- Silver Ion Prototypes inserted – 2009
- Sampling and water quality testing – 2010/2012



Rural Clinic with rainwater collection and underground cistern

Schools in rural communities

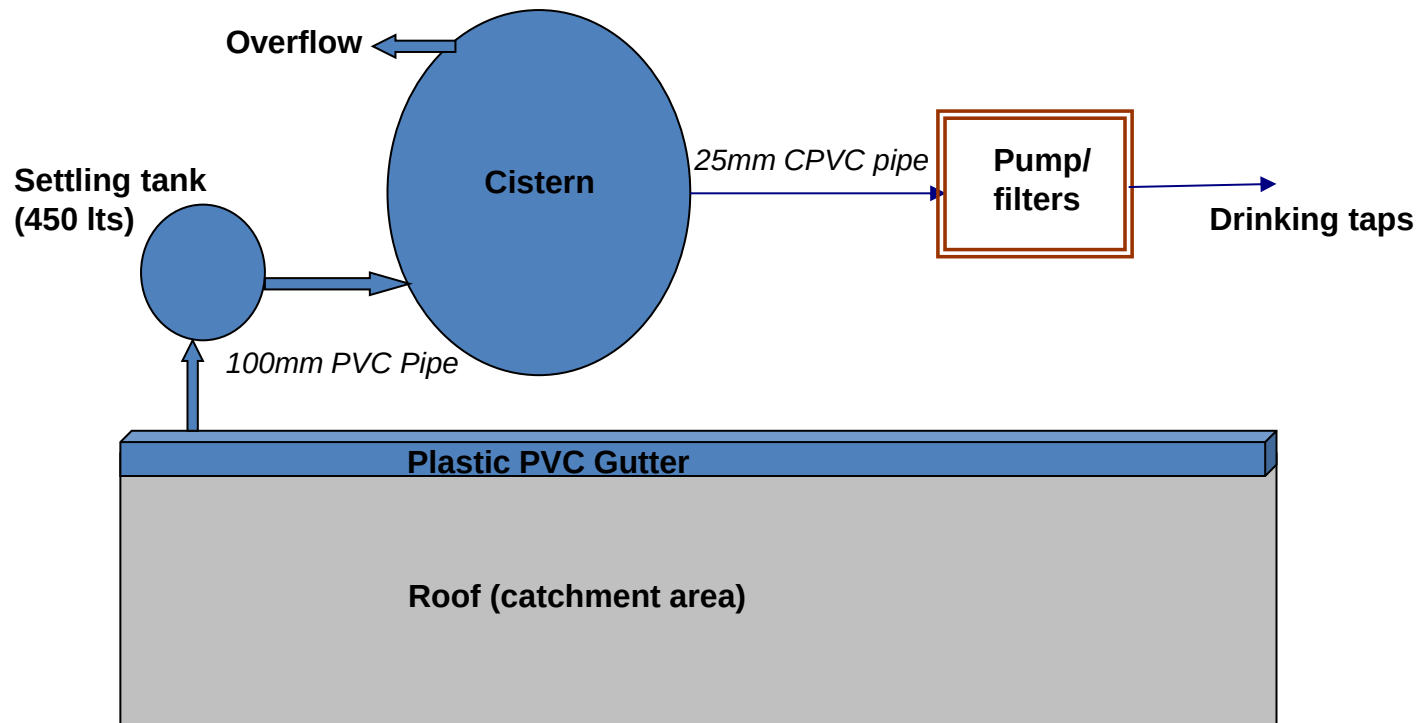






*To test a model of **Silver Ion Technology and Filtration** for purifying rain, as a safe and affordable alternative to remove bacteria and other contaminants.*





Guttering



Cisterns - Underground



Cisterns - Overground





Pump and basic filtration system.
Solar-powered Silver Ionizer to the right

Drinking Fountains







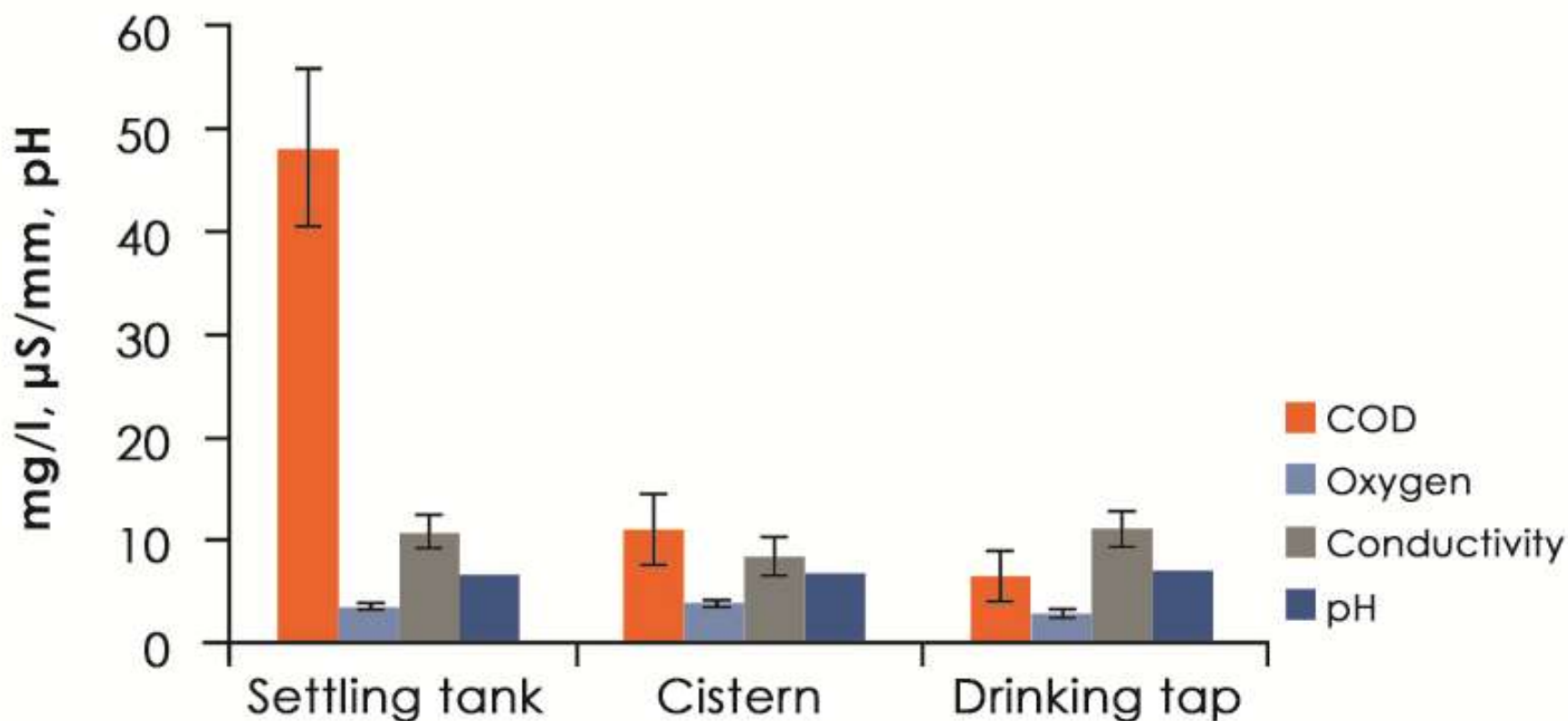
Table 1. Rainwater harvesting systems analysed.

ID Community/sampling site	Roof area	Consumption	Cistern	Cist. size
	(m2)	(m3/year)	Type	(m3)
1. Rancho Nuevo Villa Guadalupe	80	10.0	TK	5
2. San Antonio de la Joya	82	11.6	OG	17
3. Don Juan	49	8.0	OG	7.5
4. La Aurora	60	8.8	TK	10
5. San Miguel Viejo – Classroom	98	32.0	OG	45
6. San Miguel Viejo – Kitchen	60	16.0	UG	17
7. Augustin Gonzalez – Clinic	140	NA	UG	45
8. Augustin Gonzalez - School	350	48.0	UG	80
9. El Salitre	200	30.0	OG	17

Notes: Systems are all installed in schools, except for a rural clinic (#7).

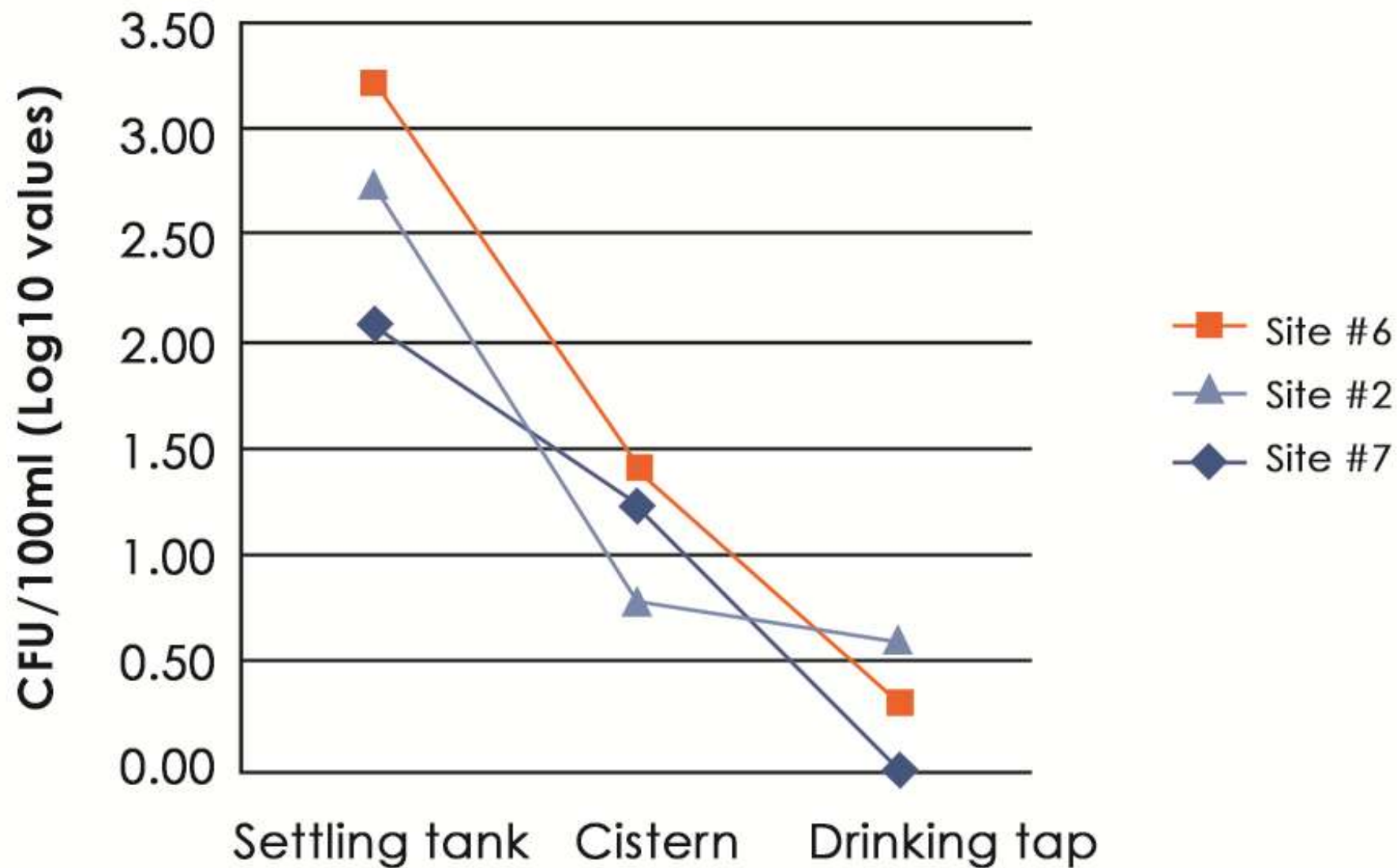
OG – Overground geomembrane; UG – buried/underground cistern with geomembrane liner;

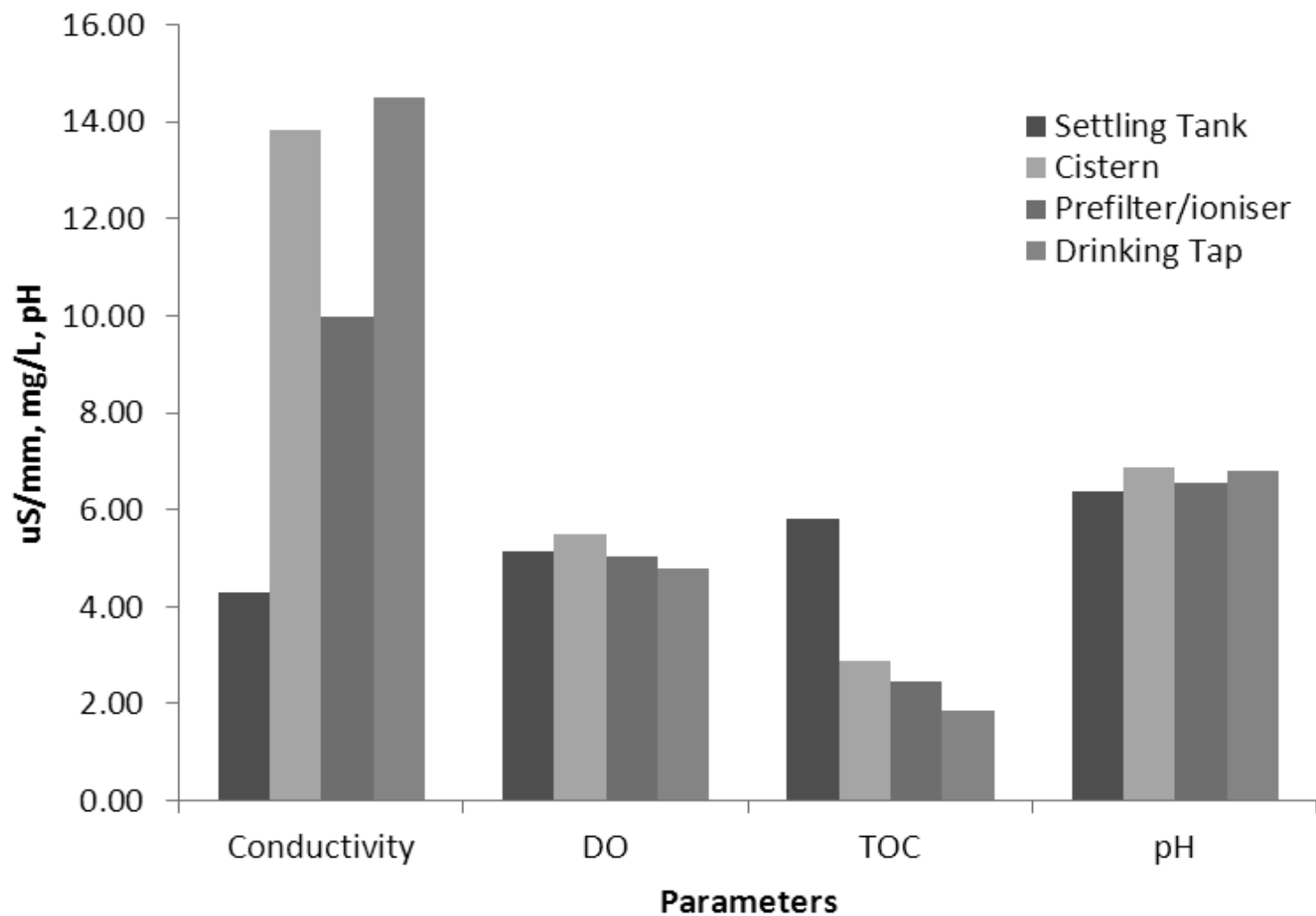
TK –pre-fabricated plastic tanks (5,000 l) with lids.



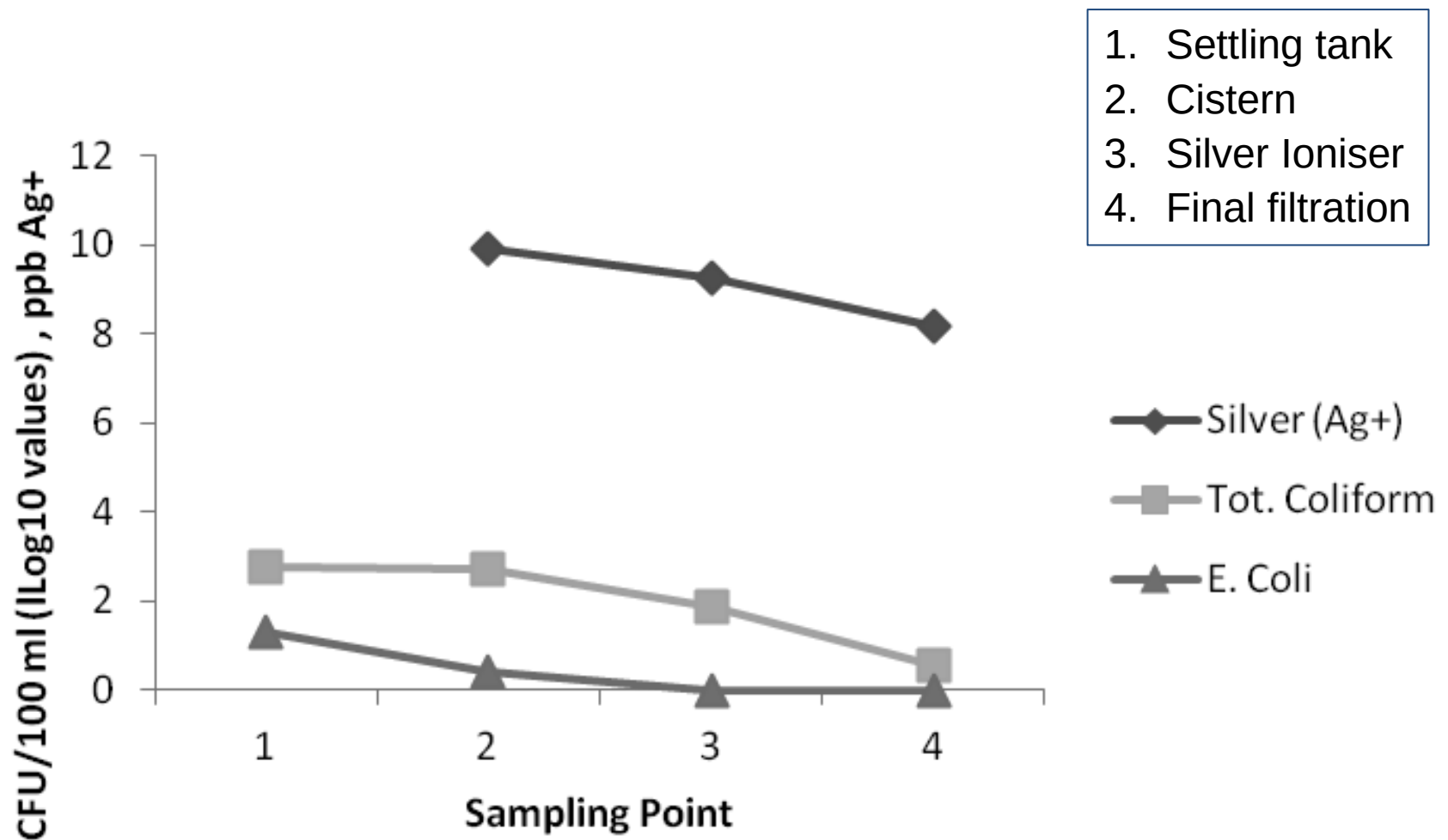
Comparison of selected field parameter means.

Standard error of the mean (SEM) values shown in black line.





Comparison of selected field parameter means

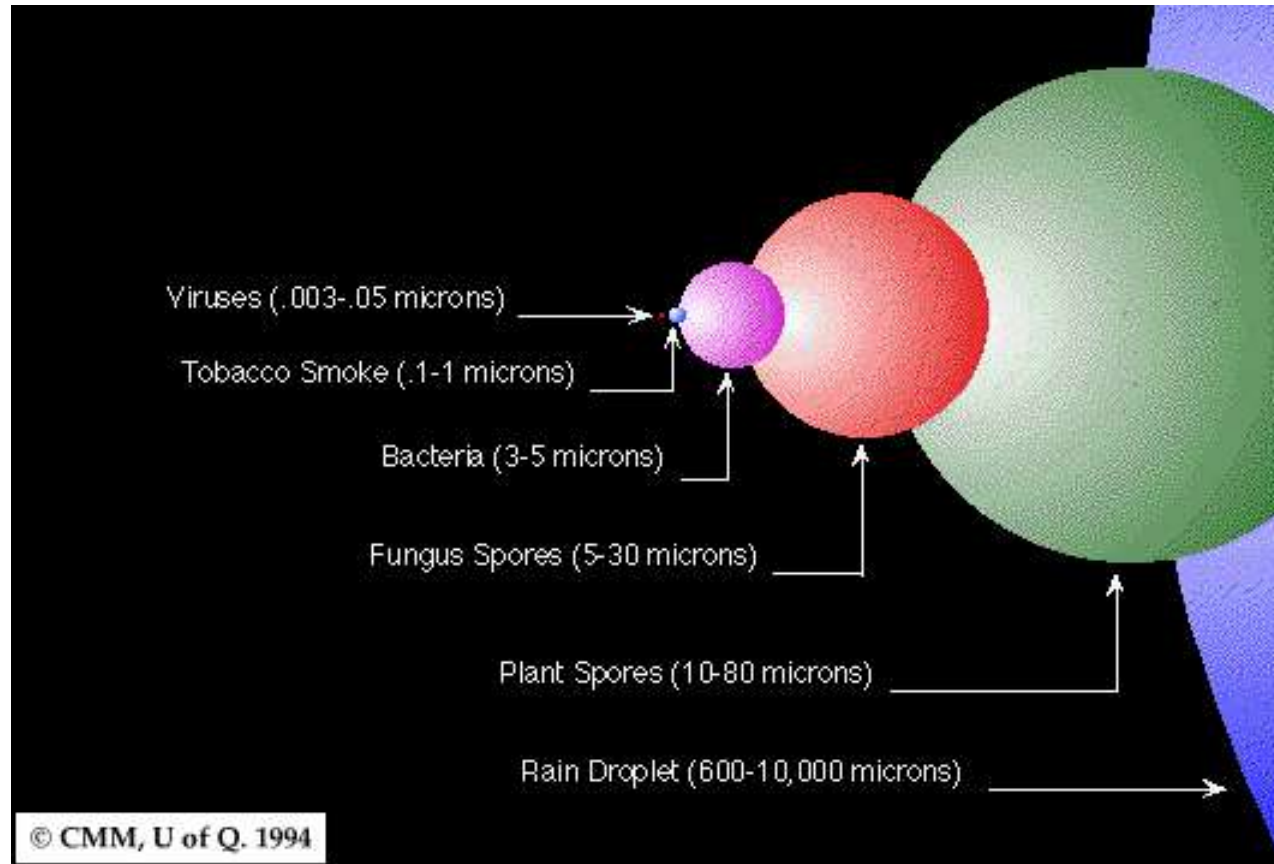


Average values for silver concentrations and coliform counts

Lab model



Viruses as indicators of water quality



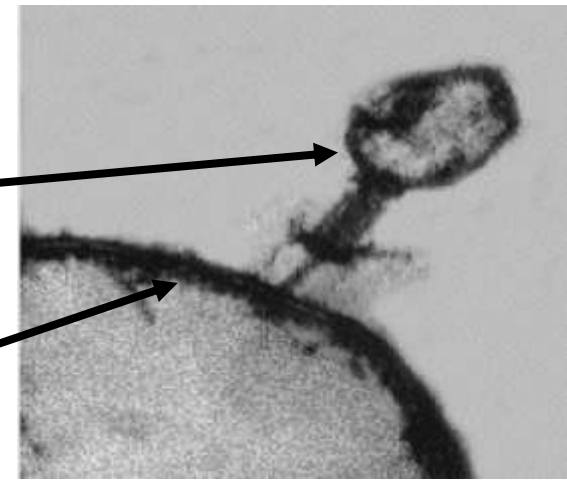
Why use viral indicator?

- Unable to replicate in environment
- Survive sewage treatment
- Persist for longer time in water
- Better indication of presence of human enteric virus (e.g. Adenovirus)
- Better indication of potential risk to health
- Lower-cost than membrane filtration

Bacteriophage

Bacteriophage

Bacteria



- Bacteriophage comes from Greek “Bacteria-eater”
- Virus capable of infecting bacteria
- Have very narrow host ranges
- More persistent in the environment than bacteria they infect

Enumeration of somatic coliphages

Methodology:

Step 1



Grow bacterial host
(*E. coli* WG-5)

Step 2



Mix host with sample in
semi-solid agar and pour
onto agar plate

Step 3



Incubate at 37 °C, count
zones of lysis (plaques)

Results expressed as plaque forming units (PFU) per 100 ml

Plaques appear after just 4 hours incubation!

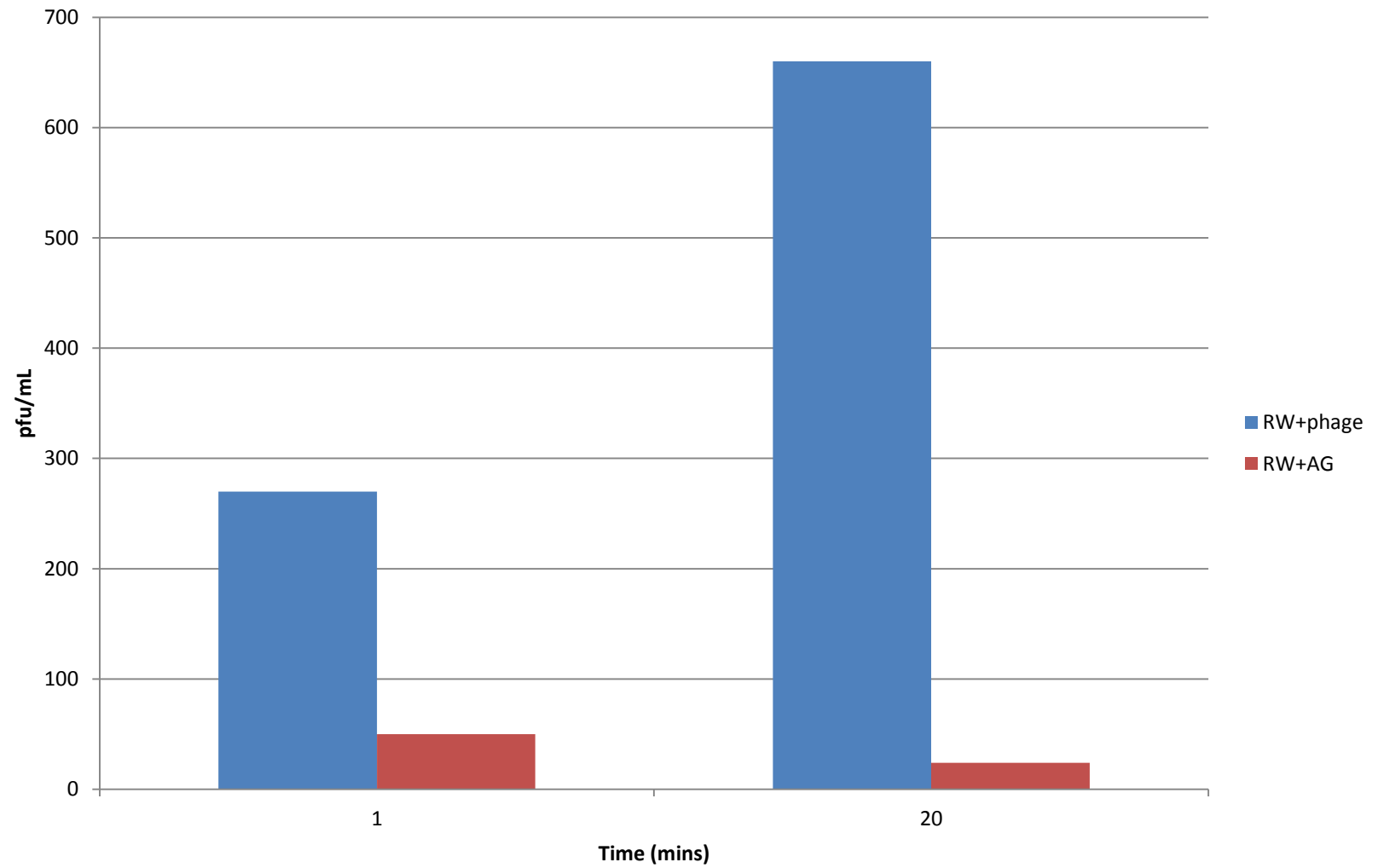
Results

Silver (Ag_ppb)	Control	Sample	Reduction
150	660	24	96.4%
200	250	0	100%
800	250	0	100%

- Values represent average colony counts (pfu/ml)
- Contact time for all experiments aprox. 30 mins
- Rainwater used for all tests from UCL lab rooftop
- Similar Ag concentrations: 100% E. Coli elimination*

**Tested on TSA and MSA agar, control $\approx 10^5$ CFU/ml*

Ag = 150ppb



- ✓ Thorough reduction of Coliforms/COD/TOC in field tests
- ✓ No known toxic or harmful health effects: low residual as eventually silver precipitates out of solution
- ✓ pH, conductivity and DO not affected significantly
- ✓ Somatic coliphages inactivated at around 150 ppb
- ✓ Coliphages shown to be good indicator (more resistant).
Silver neutralization in experiments must be investigated
- ✓ Maintenance issues affect overall quality of systems:
 - Cleaning of roofs, tank
 - Replacement of silver cells/cartridges
 - Capacity building

Thank you!

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www.irrimexico.org

www.rainwaterguru.co.uk