# Modelling concentration - time dynamics for chlorine disinfection

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stream

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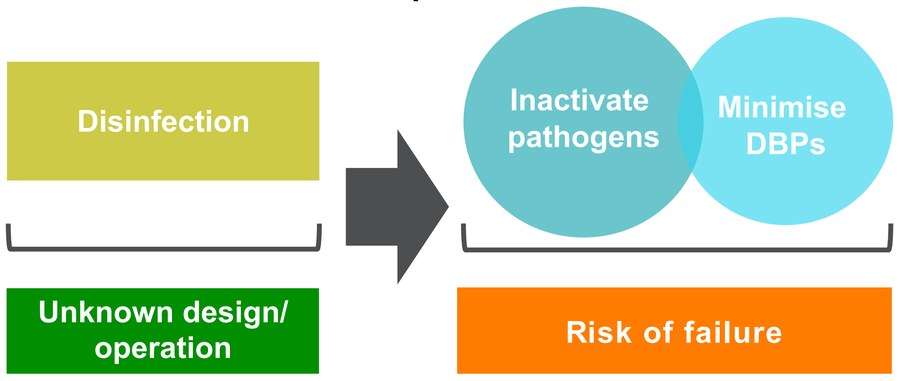
## Rationale

Chlorine disinfection remains the most common barrier for bacterial inactivation in drinking water treatment. The 'CT' method is the most adopted way of assessing the performance of chlorine contact tanks (CCT) which is the product of chlorine residual (mg/l) and contact time (mins) to give a CT value (mg.min/l). A minimum CT of 15 mg.min/l is recommended by the World Health Organisation. Disinfection is often the final barrier to pathogens in water treatment but it is also important to consider the impact of upstream processess. **In many cases, the operational CT of disinfection processes is unknown.**



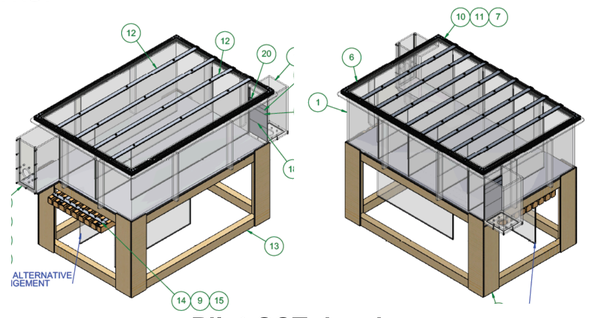

## Approaches

We have taken two approaches in this project, both of which have had a focus around the use of flow cytometry as a diagnostic tool.

1. Laboratory analysis has been undertaken to determine the suitability of flow cytometry to assess chlorine disinfection efficacy.

2. Flow cytometry has been employed to rapidly quantify log removals of bacteria across treatment trains of drinking water treatment works.

Flow cytometer



Pilot CCT drawings

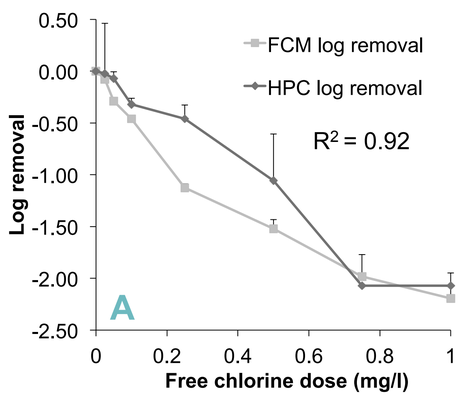
## Results

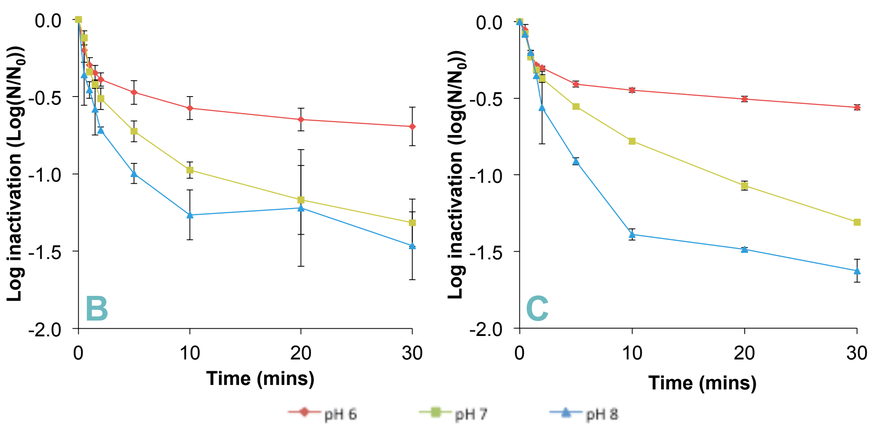
### 1. Laboratory data

**A)** Inactivation of a filtrate water from a live WTW showed a strong correlation between culture and flow cytometry methods.

**B,C,D)** Inactivation of filtrate water at pH 6, 7 and 8 from two different WTW (free chlorine dose = 0.25 mg/l), showed an inverse trend to what was expected (see inactivation rate constants in D). Chlorine is known to be more efficient at low pH where more hypochlorus acid is present.

Ongoing work - investigating the chlorine mechanism of action in more detail.

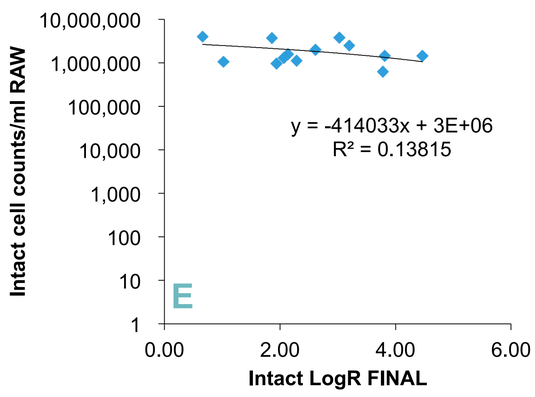


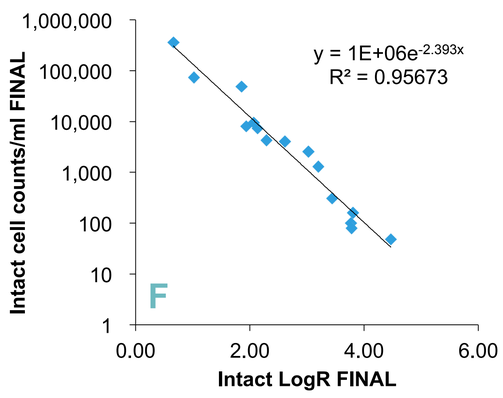




D

| Chick/ Watson *K* values | pH 6 | pH 7 | pH 8 |
|---|---|---|---|
| WTW A | -0.14 | -0.20 | -0.23 |
| WTW B | -0.10 | -0.20 | -0.27 |

### 2. Site observations

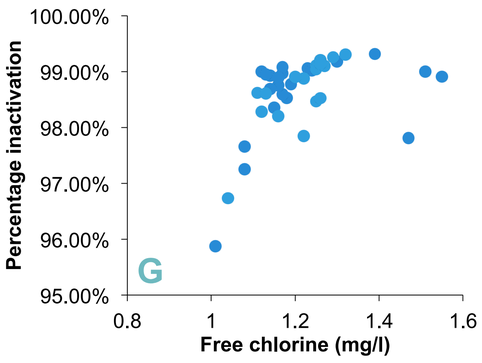



**E)** The numbers of cells entering the WTW (Raw) seems to have no impact on the log removal (LogR) across the treatment train.

**F)** Cell counts leaving the WTW (Final) show a strong correlation with the LogR.

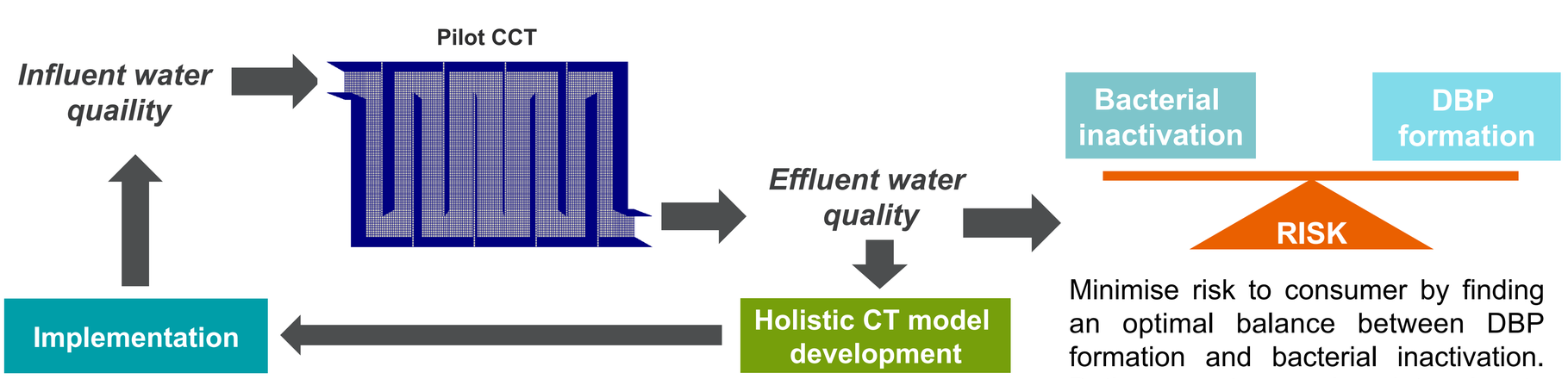
**G)** At constant flow, in a live CCT it was observed that small changes in free chlorine dose can drastically effect the inactivation efficiency of the process




## Pilot trials

A pilot scale model of a chlorine contact tank (see drawings above) has been constructed that can mimic a wide variety of lateral and longitudinal baffling ararngements. There is the option to also alter the depth and flow through the tank.

Tracer studies in combination with full scale disinfection tests will be carried out on a live WTW throughout the next year to develop a further understanding of 'CT'.




Minimise risk to consumer by finding an optimal balance between DBP formation and bacterial inactivation. Both parameters are key determinants of overall water quality.

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