Development and comparable analysis of autonomous chlorination-by-electrolysis for drinking water treatment

Ed Hammond
Current supervisors: Rebecca Scott and Susie Goodall
Potential supervisors: Tanja Radu and Sarper Sarp

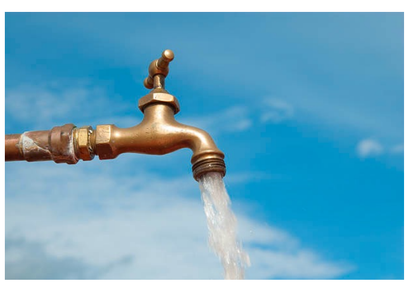
Loughborough University

WATER WISER

Problem:

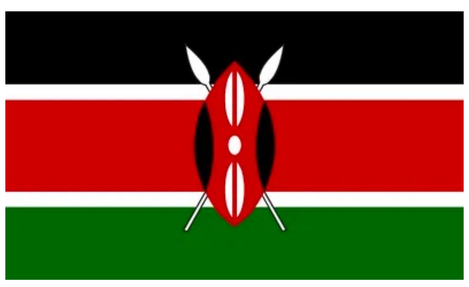
- Poor water quality status of groundwater resources across low-resource areas in Sub-Saharan Africa (SSA)[(1)].
- This is a public health concern across the region, including Kenya where groundwater use is widespread[(2)].
- Unprotected Kenyan groundwater sources are notably prone to exhibiting high levels of physio-chemical and pathogenic microbial contaminants known to cause ill-health and enteric infections[(3; 4)].
- Kenyan groundwater research calls for better groundwater protection and simple water treatment methods such as chlorination[(5)].

- Waterpoint technologies in low-resource SSA areas, including Kenya, often breakdown. Maintenance is often required but not readily available[(6)].
- Chlorination dosing requires regular maintenance and a Chlorine supply chain. Other Chlorination by Electrolysis (CBE) technologies are typically integrated with other pieces of equipment. Unlike the CBE chlorinator developed by Thermofluidics Ltd, both dosing and other CBE technologies do not autonomously adjust applied current with the incoming influent Chloride concentrations which can result in: 1) Not enough Chlorine for microbial termination, OR 2) A strong Chlorine odour that is known to prevent consumption.



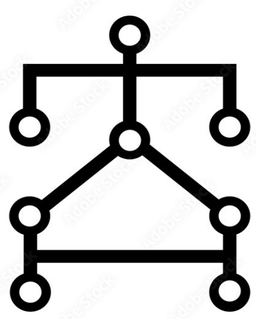
Lab and field analysis to address/gain scientific understanding on:

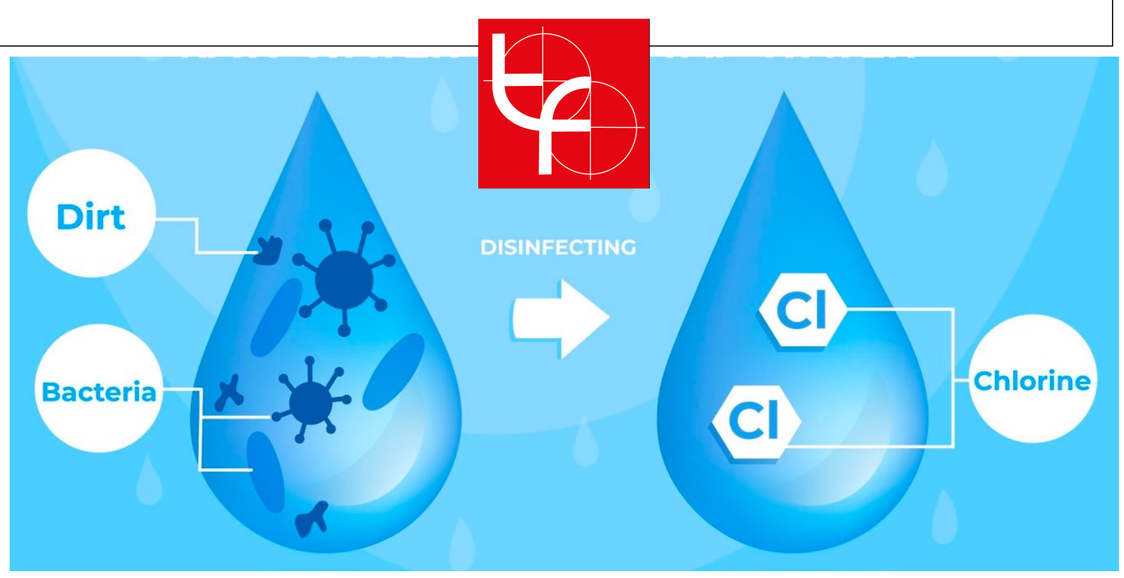
- A lack of CBE treatment performance data in the literature.
- Interplay between influent and effluent chemicals and heavy metals.
  - Possible Disinfection-By-Product (DBP) formation concerns.
  - Possibility of comparably lower technical check-ups.
- The significant discrepancies between lab and field-based water treatment studies[(7)]



Current novelty to investigate and develop:

Influent Chloride is measured and the current is adjusted in real-time to get a desired free Chlorine concentration in effluent.





Methods:

- Key microbial indicator organism, chemical, heavy metal and DBP analysis in lab and field compared with similar technologies such as Chlorine dosing.
- Influent alterations ⟷ Treatment ability.

Aims:

- To understand the extent that CBE technology is technically appropriate in certain locations and why.
- To understand its shortcomings and advantages over comparable technologies such as chlorination dosing.

Objectives:

- To undertake rigorous lab and field analyses.
- To alter the unit, by using primary findings during the research process, to gain previously outlined scientific understanding.

UKRI WEDC UNIVERSITY OF LEEDS Cranfield University

References: **1)** Lapworth, *et al.* (2015) **2)** Okotto-Okotto, *et al*. (2015) **3)** Murray, *et al.* (2020) **4)** Nowicki, *et al*. (2018) **5)** Kanoti, *et al*. (2019) **6)** Hope, *et al.* (2020) **7)** Zimmer and Dorea (2023)