

PROVIDING A SAFE SUPPLY OF WATER IN THE UK AND WORLDWIDE

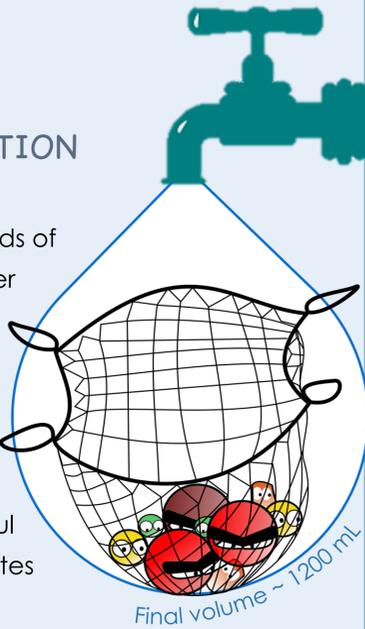
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STANDARD PROCEDURE FOR PATHOGEN DETECTION IN DRINKING WATER (USEPA 1623.1)

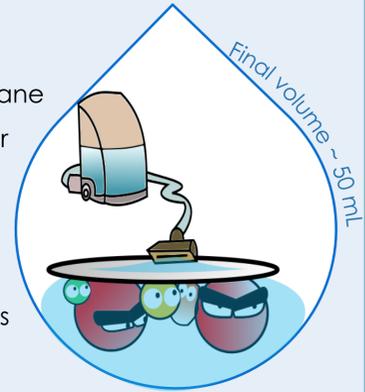
1 FILTRATION

Thousands of litres of water are filtered to capture particles including potential harmful parasites



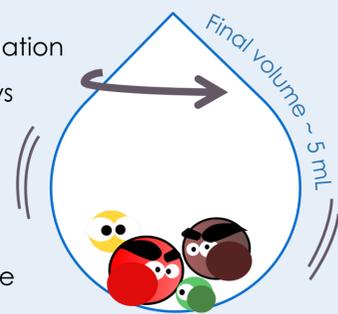
2 CONCENTRATION

A membrane is used after filtration to concentrate retained particles



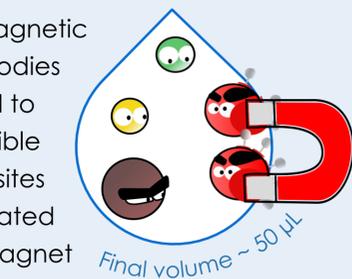
3 CENTRIFUGATION

A centrifugation step allows to further decrease the sample volume



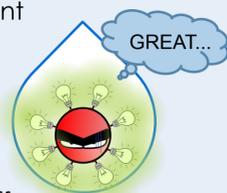
4 IMMUNO-MAGNETIC SEPARATION

Magnetic antibodies attached to compatible parasites are isolated using a magnet



5 DETECTION

Using fluorescent antibodies parasites can be counted by experienced microscopy staff



WHAT IS CRYPTOSPORIDIUM?

Cryptosporidium is a microscopic parasite causing diarrheal diseases that can infect humans via water. Only a few of this highly resistant parasite are enough to create significant outbreaks as recently experienced by more than 300,000 households in Lancashire (summer 2015). Importantly however, the standard procedure for its detection (cf. blue box on the left hand-side) is time- and manpower-intensive and presents a limited success rate (<30%). An efficient capture of *Cryptosporidium* is one of the main bottlenecks in this procedure.

~5 µm
(*Cryptosporidium parvum*)



Source: cdc.gov

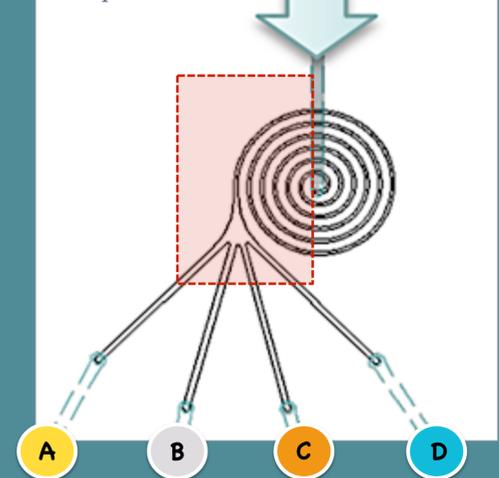
SMALL PLUMBING FOR COLLECTING PARASITES

To improve this capture efficiency, a system with a spiral at the sub millimetre scale has been designed, manufactured and optimized to simply and quickly isolate target particles such as *Cryptosporidium* (schematic representation in Fig1)

SOME KEY INFORMATION

- ❖ The spiral is 170 µm in width and 30 µm in height (the diameter of a human hair is ≈ 80 µm)
- ❖ A complex set of forces is created capable of controlling the behaviour of particles including parasites (cf. Fig2)
- ❖ The spiral is designed so that, when a water sample is injected, parasites are collected in a single and known outlet (A, B, C or D)
- ❖ The velocity of water inside the system can exceed 3 m/s
- ❖ 10 spirals can process the volume contained in a can (330 mL) in less than 30 minutes

Fig1. Design of the spiral



OPERATING PROCEDURE: PLUG AND COLLECT

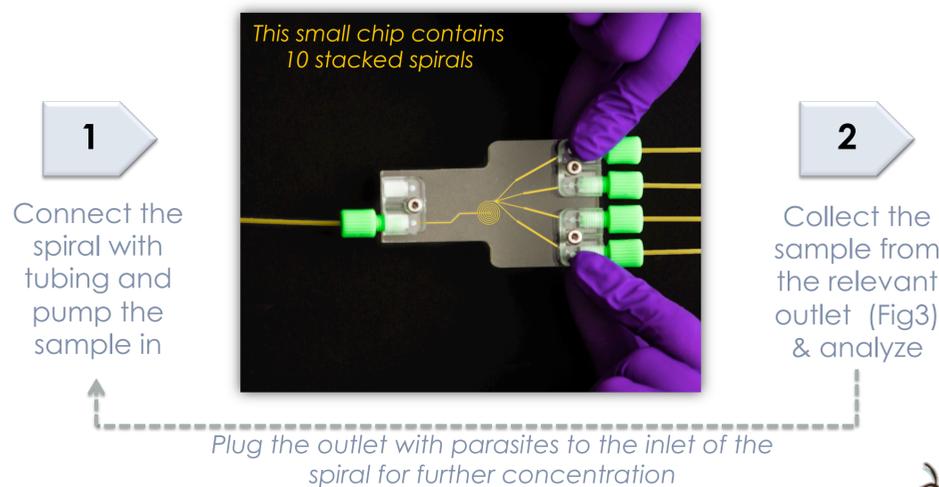


Fig2. Fluorescent particles isolated in outlet C

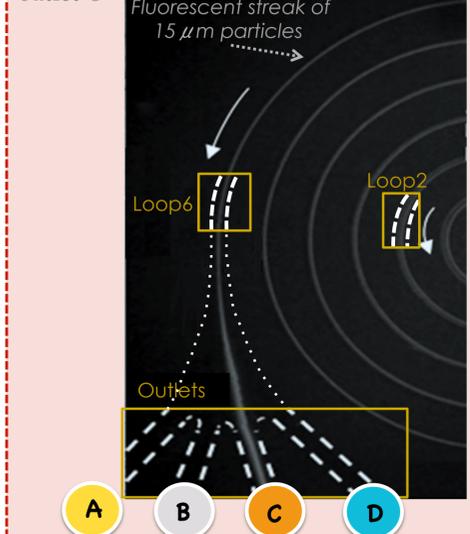
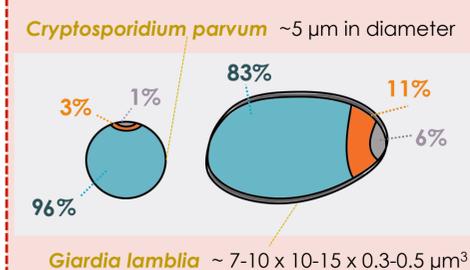


Fig3. % of parasites collected in each outlet



CONCLUSION

- ❖ Innovative microsystems can isolate easily and quickly harmful parasites
- ❖ System successfully used at Scottish Water with tap water and separation efficiencies > 95% for *Cryptosporidium*
- ❖ System successfully scaled up/down and stacked to propose a new, fast filtration unit with many other applications (e.g. biomedical)