EGU21-16567
https://doi.org/10.5194/egusphere-egu21-16567
EGU General Assembly 2021

Microbial removal rate efficiencies measured for coral sand

Lee F. Burbery, Bronwyn Humphries, Louise Weaver, and Jan Gregor
Institute of Environmental Science and Research Ltd., Christchurch, New Zealand

Coral sand forms the surficial geology on many coral cay and low-lying atolls, such as are located throughout the Pacific region. Shallow groundwater hosted within such sand is the main source of freshwater for many island communities. It is critically at risk from the impacts of climate-change and anthropogenic stresses. A United Nations' Sustainable Development Goal is to improve water access and sanitation issues in such environs. Working towards that goal, we have conducted a set of laboratory column experiments to obtain some initial measures of microbial removal efficiencies for coral sand substrate from the Pacific atoll of South Tarawa, Kiribati.

In one experiment we attempted to mimic physio-chemical conditions at the Bonriki Freshwater Reserve that supplies most of the water on South Tarawa. Three small plastic columns were packed with very poorly sorted gravelly coral sand sampled from the reserve. The effective transport of Escherichia coli J6-2 and MS2 bacteriophage through the packed columns was evaluated under saturated flow conditions.

In a second experiment we conducted infiltration tests on naturally well-sorted coral sand, sourced from Bikenibeu beach, South Tarawa. We perceive such sand has potential to be used in the construction of effluent drainage fields from septic tank systems in use on South Tarawa, where currently there are no established design criteria. The sand was packed to a depth of 400 mm in triplicate glass column apparatus. It was conditioned by dosing with septic tank effluent twice per day for 27 days (8 mm head each event). Effluent spiked with bacterial and viral indicator organisms: Escherichia coli J6-2, Enterococci faecalis and MS2 bacteriophage, as well as the viral pathogens: adenovirus, echovirus, norovirus and rotavirus was then dripped on to the columns, as a 35 mm application. Any resulting drainage from the base of the columns was collected and analysed, and the depth profile of the tracer organisms was examined in the sand columns by destructive sampling.

The very poorly sorted coral substrate from Bonriki Reserve proved very effective at attenuating Escherichia coli J6-2 under saturated flow conditions. We estimated a spatial removal rate of 0.05 ± 0.02 $\log_{10}$ cm^{-1} for this bacterial tracer. No removal rate could be quantified for the viral indicator. Although overall, our observations suggest the coral sand was significantly less effective at attenuating MS2 bacteriophage than it was at attenuating Escherichia coli J6-2.

In the unsaturated column experiments made on beach sand conditioned with effluent, all the microorganisms examined demonstrated >4-log removal values. Contrary to our finding from the

saturated sand column experiment made with material from Bonriki Reserve, the conditioned coral beach sand filters demonstrated higher affinity for MS2 bacteriophage (also viruses) than they did Escherichia coli J6-2, or Enterococci faecalis.