

Biofilms in Drinking Water Treatment

Drinking water preparation in Sweden uses biological filters, either as slow sand filters or artificial infiltration ponds, together with other types of treatment such as flocculation or UV light. Within the sediments of these structures, bacteria grow as biofilms, and transform the surface water obtained from Swedish lakes to the drinking water in our taps. Surprisingly, very little is known about how this microbial ecosystem service carries out its vital task. Who is removing the organic carbon from the water? Where do the different organisms come from? Are they contributing to the rusting of the pipe infrastructure? Could disease causing organisms hide in the biofilms? Or are the microbes actually able to protect the drinking water until it flows out of our taps? If we can answer these, and other, questions we can ensure that drinking water production continues to deliver safe, high quality water and at the same time we can begin to study how factors such as contamination or climate change could affect this ecosystem service provided by the microbes.

An ongoing cooperation between Applied Microbiology (Department of Chemistry, Lund University), Water Resources Engineering (Department of Building and Environmental Technology, Lund University) and Sydvatten AB (Lund) has been examining the drinking water biofilms formed in southern Skåne. Current research is financially supported by Svenskt Vatten Utveckling, NSVA (Nordvästra Skånes Vatten och Avlopp AB), VA SYD och Sydvatten AB. In November 2013, the Swedish Research Council (Vetenskåprådet) awarded 2.2 million SEK to expand the research to include looking at biofilms in sand filters and infiltration ponds within the drinking water treatment plants, or water works.

The research team of Dr. Catherine Paul, Professor Peter Rådström, Professor Kenneth Persson, are supervising projects using next generation DNA sequencing, flow cytometry, bioinformatics, multivariate analysis and quantitative polymerase chain reaction (qPCR) to describe the biofilm bacteria present in real samples obtained from real drinking water distribution and production systems in Skåne. The project of doctoral student Katharina Lührig seeks to determine if different bacterial communities are associated with different water qualities, as perceived by the consumer (see above). In May 2014, doctoral student Sandy Chan began to examine if there are differences in the bacterial communities of infiltration ponds and slow sand filters which produce drinking water. Physical factors such as pond size, length of exposure to source water, season or sun exposure will be correlated together with the genetic profile of the biofilm community to see if changing the physical factors can influence or optimize the quality of the drinking water produced. Future research will include building model drinking water purification ecosystems at both the lab and pilot scale to see how bacterial biofilm communities respond to changes in temperature, and specific pathogen or toxin challenges.

By understanding the biological and physical components that form the ecosystem we can ensure the continued safe production and delivery of drinking water; and ultimately optimize, monitor and engineer the biofilms and the ecosystem service they provide.

Photos, by Catherine Paul:

Picture 1: PhD candidate Sandy Chan sampling infiltration ponds at Vombverket

Picture 2: Close of up a sand core from an infiltration pond at Vombverket



