Impact of viral aggregation during water treatment

Virus removal and inactivation present still a major challenge for drinking water treatment. Due to their small size (18-120 nm diameter) and relative resistance to common disinfectants, viruses can penetrate traditional water treatment systems\(^1\). Viruses in wastewater and natural environments are often present as aggregates. It was recently shown that the disinfection rate of bacteriophage (bacteria infecting virus) MS2 by peracetic acid reduced 2-6 fold due to aggregation, depending on both aggregation size and disinfectant concentration\(^2\). A reaction-diffusion based model was able to interpret the observed data: the disinfectant gets consumed as it diffuses into the aggregate. However, the disinfectant doses required for virus inactivation are typically determined with dispersed viruses, which therefore underestimate the doses needed if aggregates are present.

This master project will extend our study to include different viruses and more relevant disinfectants, e.g. chlorine and ozone. The main goal of this study is to solidify the reaction-diffusion model developed earlier and thereby determine the importance of viral aggregation disinfection in order to achieve safe drinking water.

A slightly modified experimental approach will be developed allowing aggregation and dispersion of new viruses. A series of disinfection experiments will then be performed under varying aggregates sizes and disinfectant types, concentrations. Finally, the data will be interpreted by means of a reaction-diffusion model to see whether the hypotheses from the previous study still hold true.

The student will be introduced to many experimental techniques like: virus enumeration, dynamic light scattering (DLS) to measure aggregation size in real time and transmission electron microscopy (TEM) to produce pictures of the aggregates.

The experimental part of the project will be supervised by LCE (Michael J. Mattle and Prof. Tamar Kohn) and the modeling part by AHEAD (Benoît Crouzy and Prof. Paolo Perona).

Pre-requisites: Interests in chemistry, laboratory work and basic modeling.
References: