INDUSTRIAL PILOT PROJECT

# Verification of cleaning of pores and surfaces using Ultra-pure water using coherent X-ray scattering (CoSAXS) at MAX IV

## THE INDUSTRIAL CHALLENGE

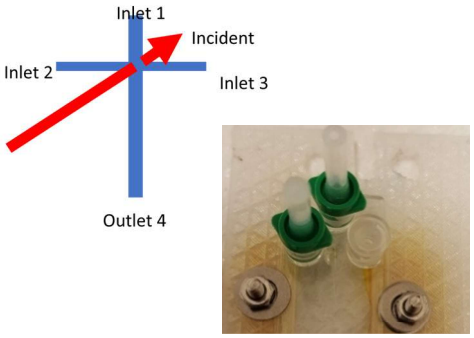
Every year billions of kg of detergents and cleaning agents are produced and used globally. Unfortunately, a large part ends up in the aquatic system and accumulate in living organisms. The Ultra-Pure DIRO-water produced by SWATAB has been showed to have the ability to clean without the need for chemicals and also at room temperature. The mechanism how different types of water can lift, and transport particles is not fully understood but crucial to optimize the process of cleaning without chemicals.

## WHY USING A LARGE SCALE FACILITY

Lab-based methods have shown that particles and oil is dispersed readily in DIRO-water but was unable to show the release of particles from pores. In order to mimic the process by which water can release dirt particles from pores or surfaces, a small angle X-ray scattering experiment was designed to track the dispersion by water of nanoparticles from a pore. The CoSAXS technique allows the quantification of the size and distribution of nanoparticles within a scattering volume.

## HOW THE WORK WAS DONE

A small angle X-ray experiment was carried out at the CoSAXS beamline of the MAX IV synchrotron by SWATAB and the University of Lund in strong collaboration with the beamline personnel at MAX IV and Malmö University. A thermoplastic (COC) micro-fluidic chip (ChipShop) with a crossed slot design was installed within a 3D printed plastic holder on the motorized sample stage at the sample position. The channel width and depth were 200 x 200 nm. The microfluidic chip was positioned such that the X-ray beam was incident in the centre of the cross (see illustration). The particles was 22 nm.




## THE RESULTS AND EXPECTED IMPACT

The experiment gave us the opportunity to actually for the first time be able to see what happens in real time when DIRO-water hits the soil, lift it and transport it away. We were also able to compare it with other type of pure water as well as a salt solution to mimic tap water. DIRO-water was able to extract the nanoparticles from the pore in a continuous manner whereas de-ionised (milli-q) water showed a variation in the extraction rate. The DIRO-water caused no degradation to the nanoparticles as the dimension of the nanoparticles did not change. The results show that DIRO-water can indeed enhance the dispersion of nanoparticles from a pore, when compared to de-ionised water (milli-q) or tap water.

This experiment has already lead to more research and these results will be presented in articles during the summer.
The investigation highlighted that different methods to produce pure water are not equivalent, supporting observations by SWATAB and others. This will reduce or eliminate the need for detergents and surfactants generating a positive impact for both nature and man.

***"This project show the importance of collaboration between state of the art synchrotron-techniques, science and the industry" / Mats Marklund, SWATAB***

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