TAKING MICROSCOPY TO A WHOLE NEW LEVEL

Image Sydvatten´s experiments at MAX IV Laboratory aimed at finding methods for recycling the ferric cloride used to purify lake water.

Waterworks sludge contains organic substances bound to the iron used in the purification process. By studying the structure of the sludge at the atomic level, it can be possible to recycle the iron while making the sludge residue more usable for soil improvement, for example.

Sydvatten delivers drinking water to 900 000 people in southern Sweden. The water is taken mainly from the Bolmen lake and runs through a tunnel, 80 kilometers long, to the Ringsjöverket waterworks, where the raw water is converted into drinking water. Ferric chloride is used in the purification process to cause a chemical precipitation that removes microorganisms, solid particles and unwanted substances from the raw water. In the residual sludge, organic substances are bound to iron compounds. The sludge is harmless and could for example be used to bind phosphorus in agricultural land. But currently there are no competitive methods to recycle to ferric chloride, something that could entail financial gain and be good for the environment.

"Large volumes are involved", says Kenneth M Persson, head of research at Sydvatten and Professor of Water Resources Engineering at Lund University's Faculty of Engineering, LTH.

"Sydvatten's waterworks produce approximately 70 million cubic meters of drinking water per year and that gives rise to several thousand tons of ferric

chloride. We would like to retrieve and reuse the ferric chloride, but the bond between the organic substances in the sludge and the iron compounds that take form are very complex and difficult to study. We therefore turned to the MAX IV Laboratory, through the Science Link project, in the hope of obtaining a clearer picture of the structure of the sludge."

FIRST EVER IN 3D

With the help of the staff at the MAX IV Laboratory, EXAFS was identified as a suitable technique to analyze Sydvatten's sludge samples. The conducted experiments provided the first ever three-dimensional image of the structure of the sludge and its composition at the atomic level.

"You could say that the MAX IV Laboratory gave us access to microscopy at a level of detail that we have previously never approached. The experiments and the help we got in interpreting the results gave us a fantastically detailed analysis, which now forms the basis for the work on finding effective methods of separating the iron from the organic substances. It is very likely that we will continue to use the MAX IV Laboratory's resources to move forward in the process. The vision is to be able to recycle and reuse the ferric chloride in the waterworks while producing a completely harmless organic sludge that could be useful in things like soil improvement."

Image Sydvatten delivers drinking water to 900 000 people in Southern Sweden.

Image Professor Kenneth M Persson, head of research at Sydvatten.

"The MAX IV Laboratory did not only give us access to an extremely advanced instrument of analysis – we also got help in interpreting and understanding the results of our measurements. This has allowed us to move forward in our development process."

Kenneth M Persson, Head of Research at Sydvatten and Professor of Water Resources Engineering at Lund University's Faculty of Engineering.

Fact box:

Finding out how substances are structured at the nanometer level requires extremely sensitive methods. One such method is EXAFS, or Extended X-ray absorption fine structure, which is used to investigate the structure of materials at the atomic level. The method relies on scanning the photon energy of an x-ray over a so-called absorption edge, i.e. the energy at which the inner electrons in a specific element start to absorb photons and are ejected from the atom. The appearance of the absorption provides information on what other kinds of atoms are present and the distance to them.

For further information visit science-link.eu

Science Link is a network between leading research facilities of photon and neutron sources and its users. The project aims to support and encourage innovation and entrepreneurship in the Baltic Sea Region. Apart from the research facilities, the network also includes scientific institutes, universities and regional organisations that serve as service and promoting units. Science Link is part-financed by the European Union (Baltic Sea Region Programme) and involves 17 partners from 8 countries during the project period 2012 to 2014.

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Research facilities

DESY
HZB Helmholtz Zentrum Berlin
Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research
MAX IV LABORATORY