**Project name:** **Silver ions in zeolite in water filters**

# Beamtime Report
**26.05.2014**

## General information

| **Name of the rapporteur** | **Name of the rapporteur's organisation** |
|---|---|
| Mehrdad Mahdjoubi | Orbital Systems AB |
| **Type of research (nanotechnology/health care/chemistry etc.)** | **Name of the research facility** |
| | MAX IV Laboratory<br>DESY |
| **Date of the measurement, duration** | **Location of the event** |
| 08-10-2013<br>14-01-2014 | MAX IV Laboratory<br>DESY |
| **Facility personnel participating in the measurement** | |
| *MAX IV: Stefan Carlson, Kajsa Sigfridsson*<br>*DESY: Gerald Falkenberg, Ulrike Boesenberg* | |

## Description of the project

**Research description (short summary as written in the application)**

**Application:**
Our technology is based on recycling drain water at a very high speed, thus making it possible to go back in the water pipeline with desired properties. An example of this could be real-time recycling (i.e. looping) the water that is used in showers. The active component in the filter consists of electropositive 2 nm diameter aluminium fibrilles, end-bonded to microglass fibers.
After discussions with representatives from MAX LAB in Lund, we see possibilities to further investigate and learn how specific pollutants in the water is affecting our filtering system. An example of this would be Cupper particles that is exfoliated from the water pipes and is absorbed in our filters. This is of course a contributing factor that is shortening the life-time of our filters.
Getting better insight of this with help of for example X-ray Absorption Spectroscopy could be of great value both for our business model and further development of our technology.

**Project description:**
After further discussions, the project was changed from analyzing filter contaminants to analyzing silver content in the filter mass. Silver is added to counteract microbes in the water and microbial growth in the filter. However, it is important to know the amount silver that is released from the filter and to the sewer system. Thus, the project was redesigned toward quantification of silver content before and after filter use.


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**Summary of activities (experiments performed, beamtime used, preliminary overview of results, next steps and other relevant information)**

As an industrial user who was not directly participating in the experiments, it is difficult to give detailed information about how they were performed. But here are the general results.

**MAX IV Labs, XANES & XRF:**
Silver in fresh and exposed water-filters from Orbital systems were studied to observe any possible changes in molecular coordination and Ag concentration. XANES data show that the Ag ligand bonding becomes less ionic and more covalent in character when the filter has been used. An example of such changes in bonding can be seen when comparing AgNO3 (ionic bonding character) and Ag2O (covalent bonding). However, this investigation cannot clearly determine the exact nature of the ligands that coordinate Ag. An extended study, including reference compounds (such as Ag2O), is necessary to be able determine the coordination changes. XRF data show that the concentration of Ag does not change considerably between the filters. The uptake of Cu and Cl in the exposed filter (position 12) is shown by the appearance of new emission lines.

**DESY, XRF:**
There is a suggested loss in silver concentration in the used filter, when compared to the unused filter (from samples 3 and 4 - analysis on filter fibres) - maybe a factor of three lower but it is hard to be quantitative

For the fabric support layer (analysed in samples 1 and 2) the sample from the used filter showed contamination with many other elements, including Y, Ru, Rb, Br, Sr as well as Zn, Cu, Mn, V (but the last 4 could have come from our experimental setup) - it is very interesting to know where these contaminants came from during filtering of shower water. Also, in these samples, there was actually MORE Ag in the used filter fabric than in the unused one, in contrast to what we saw in samples 3 and 4.

**Next steps:**
Quantitative results about differences in Ag amount were not achieved, but there are indications that significant Ag is released when the filters are used. (Increased Ag in the filter mass could indicate that Ag has been moved around.) This is interesting and calls for further investigations.

It would be interesting to know more about the contamination from other elements (Y, Ru, Rb…) in the DESY results.

Further investigations are needed, but we are not convinced that synchrotrons are the best option. Also, it may be more fruitful to look for silver traces in filtered water than to analyze Ag amount before and after in the filter.



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| How would you describe cooperation and assistance from industrial liaison officers and national contact points while preparing and carrying out the research at large scale facilities? |
| --- |
| Very good collaboration with both sites. Experiments were made at MAX IV Labs first, but it turned out that higher energies were needed. New experiments were then performed at DESY without any extra costs or trouble, which we are grateful for. The DESY experiments were performed while our main contact (G. Appleby) was absent, resulting in slight miscommunication about the aim. |
| **Other personal remarks** |
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## Annexes

| **Annexes**<br>(list of annexes; meeting minutes, graphical illustrations, tables and other supplementary data) |
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