Online Sensor for Monitoring of Surface Deposits in Drinking Water Systems

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Aim

Within water distribution systems surface deposits can act as sink and source for contaminants.

For successful decontamination the focus have to be on deposit removal or minimization.

For the assessment of the success of such decontamination or cleaning procedures a monitoring of the deposits is necessary.

The aim of the presented work was the **optimization and evaluation of a suitable sensor system**.

Conclusions

- Detection of biofilms was possible by use of fluorescence signal. Detection limit was around 10^5 bacteria/cm².
- Detection of inorganic particles was possible by scattering measurement. Detection limit was < 1 μm deposit thickness.
- Quantification of deposits and differentiation of its components (biologic / inorganic) should be possible by combined use of fluorescence, scattering and transmission signals of the OPTIQUAD sensor system.

Material and Methods, Results

Online sensor

An optical sensor system (OPTIQUAD, Krohne Optosens GmbH, Fig. 1) was used for online detection of surface deposits.

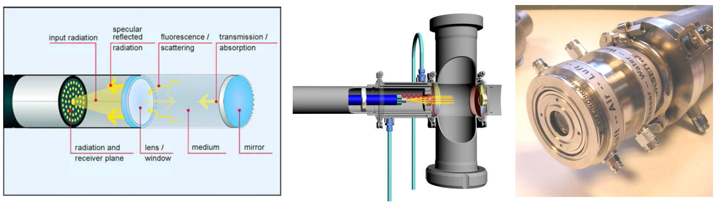

Fig. 1: Principle, schematic drawing and photo of the used sensor system.

Based of preliminary results, a customized sensor configuration was used to enable detection and differentiation of biological (biofilms) and inorganic deposits (e.g. scaling) (Table 1).

Table 1: Customized sensor configuration used in OPTIQUAD sensor

Measurement	Wave length	Target
Fluorescence 1	UV	Biofilm
Fluorescence 2	UV	Bacteria
Scattering	UV/VIS/NIR	Deposit characterization at surface
Refraction	VIS/NIR	Particles in deposit
Transmission	UV/VIS/NIR	Deposit characterization & amount

Pilot test system

Drinking water biofilms were grown in a pilot scale test system on i) online sensor and ii) pipes and coupon surfaces for off-line detection and validation:

- Natural drinking water flora used as inocculum
- PE-HD 100 drinking water pipe material used as growth surface
- 4 – 5 weeks recirculating operation
- Continuous dosing of nutrient medium to accelerate biofilm growth

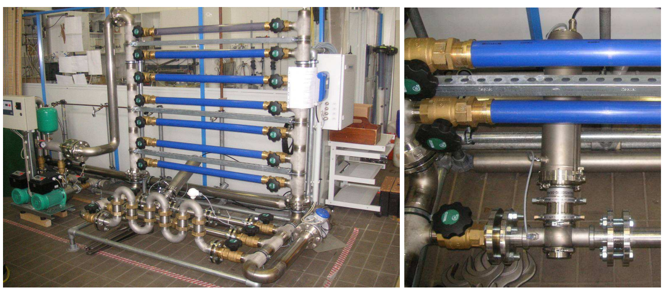

Fig. 2: Pilot test system for the generation of drinking water biofilms on test surfaces and sensors

Detection of biofilms and inorganic deposits

The sensor measurements (fluorescence, scattering, refraction and transmission) were recorded during biofilm growth experiments over ~4 weeks. In order to compare and to quantify biofilms on surfaces (coupons & pipes) the total amount of cell numbers were determined from time to time. Good correlation between both results was observed (Fig. 3). Detection of biofilm growth by fluorescence signal was possible in the range of 10^5 to 10^8 bacteria/cm².

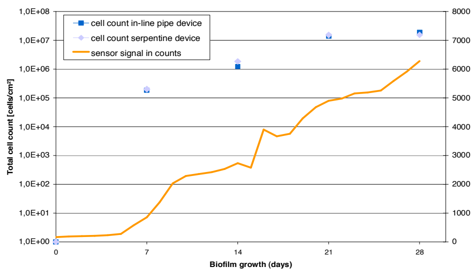

Fig. 3: Sensor signal (fluorescence = biofilm) and off-line total cell count data

Inorganic deposits were generated by deposition of particles on the sensor window. Defined deposit layer thicknesses were generated ranging from 0,1 to 30 μm. Good correlation between deposit thickness and scattering signal of the sensor was observed (Fig. 4).

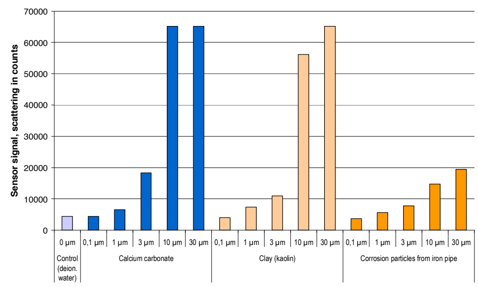

Fig. 4: Sensor signal (scattering) for different inorganic deposit layers at various thicknesses.

Acknowledgement

The research leading to these results was part of the European joint research project "SecurEau" and has received funding from the European Community's Seventh Framework Programme (FP7/2007-2011) under grant agreement n°217976.

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