Keeping your water safe

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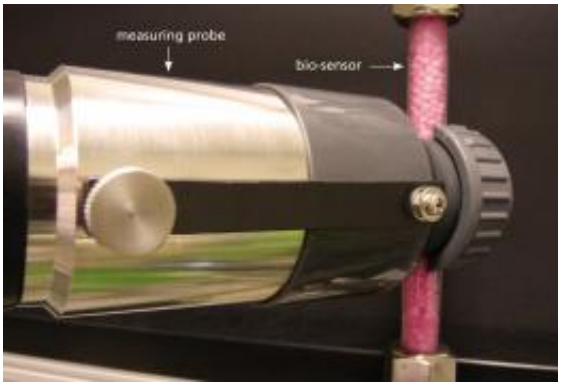

The red fluorescent bacteria in the glass tube change their color whenever the microorganisms in the bio-sensor come into contact with toxic substances. The measuring probe shows the intensity of fluorescence. Credit: Fraunhofer IGB

Although drinking water is monitored more strictly than almost anything, our water supply network is still not immune to accidents, wear and tear or targeted attacks. A one-minute warning system for toxins and other substances in water hazardous to health could set off alarms in future if there is a danger.

It is supposed to be cool, colorless, tasteless and odorless. It may not have any pathogens or impair your health. This is the reason why drinking water is put to a whole series of screenings at regular intervals. Now, the AquaBioTox project will be added to create a system for constant real-time drinking water monitoring. At present, the tests required by the German Drinking Water Ordinance are limited to

random samples that often only provide findings after hours and are always attuned to specific substances.

In contrast, the heart of the AquaBioTox system is a bio-sensor that reacts to a wide range of potentially hazardous substances after just a couple of minutes. It works on the taster principle. That is, some drinking water is diverted from the main line through the sensor in a branching descending line and it contains two different strains of bacteria and mammalian cells. On the one hand, these microscopically small bacteria have a large surface that guarantees quick material turnover and reacts to toxic substances within minutes. On the other hand, the mammalian cells clinch the results because of their close relationship to the human organism and they also extend the range of reactions.

This is how Dr. Iris Trick from the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB in Stuttgart, Germany sees it: “We tested various classes of substances that might occur in water – even though they shouldn’t – and to date our sensor has reacted to each of these substances.” She developed the bio-sensor in joint efforts with her colleague Dr. Anke Burger-Kentischer.

The micro-organisms in the sensor were modified so that they produce a protein that has a red fluorescence. The fluorescence changes if it comes into contact with toxic substances. A highly sensitive camera system that the Karlsruhe, Germany-based Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB came up with has an analysis unit that registers even the most minute changes in fluorescence and then analyzes them automatically. Dr. Thomas Bernard, the group manager at the IOSB, tells us why: ”The monitoring unit has a machine-learning process for learning from historical data which fluctuations in the physical, chemical and biological parameters are normal. It sets off an alarm if an unusual pattern shows up in the signals.” The bio-sensor

reacts to the smallest quantities of hazardous substances and Dr. Trick provides the explanation: “Our sensor can document even very slight concentrations.” Let’s not forget that classical poisons such as cyanide or ricin as well as plant protectives or toxic metabolic products from bacteria can be fatal even in concentrations of nanograms per liter.

They have to guarantee optimum life conditions for the microorganisms to operate the bio-sensor on a permanent basis. This is the reason why the researchers at the IOSB have come up with a system that automatically monitors and regulates important parameters such as temperature and inflow of nutrients. Another component of the Aqua-BioTox system is a daphnia toximeter of their Kiel, Germany-based project partner bbe Moldaenke, who noticed that water fleas react particularly sensitively to nerve poisons. They are testing this monitoring system in a closed performance route on the grounds of Berlin‘s water company, that is incidentally another partner in this project. The idea behind it is making the system as small and cost-effective as possible so that a network of sensor units communicating with one another could be installed that is distributed over sensitive points in the drinking water network.

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