On-line chemical sensors for an early warning system

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Category: Monitoring
Preferred presentation: Oral
Summary of presentation:

The aim of the SECUR'EAU project is the security and the decontamination of drinking water distribution systems following a deliberate contamination. The size of the system, the difficulty of cleaning pipe walls, the need to rapidly identify the point(s) of intentional contamination, and the extension of the contaminated area represent many bottle necks to be overcome. In this context, the Early Warning System (EWS) is the first bulwark against terrorist attacks.

The project builds on experience gained in past and ongoing NATO, USEPA and EU projects. The SecurEau consortium brings together the expertise on drinking water distribution systems gained in many national programmes, the EU framework programmes (e.g. SAFER; Techneau; COCERSI; CAREW, CARE-S and TENAWA), as well as international programmes (e.g. Battle of the water sensor network). In this state of the art, two main projects, funded by US EPA Project [1] and Israeli government with Mekorot water company, have been especially studied because of their similarity with our present topic.

The EPA project has found very interesting results by testing the sensors' behaviour when a contaminant gets injected within the network. These results have led to the development of a "library of contaminants" [2]. Moreover, several contaminants tend to have an effect [3] on all parameters and provide the interest of using multiparameter measurements for our purpose. The variations observed could be used as a fingerprint for each contaminant. The solutions provided rely on the integration of classic analysers in a large bay [4]. Constraints of implementation, cost (more than 160 k$), energy, water losses, maintenance cost and maintenance frequency, and pipe derivation allow this system to be installed only at a few strategic points in the network [4]. This kind of setting is not fitted to the entire network survey.

This project plans to install a large number of non-specific sensors but highly integrated to have an indicator of water quality level. New progress made by nano and microelectronic industries allow us to reconsider measurement principles integration with a 'low-cost' approach. A sensor with lower cost is likely to exhibit lower performance (lower sensitivity for instance). It is expected that this will be compensated by (1) larger implementation and (2) the creation of a real water quality sensors network including data treatment to minimize false alarms and to improve rapid detection of the contamination..

In this paper, parameters of major interest have been chosen according to the World Health Organization (WHO) recommendation [5]. A state of the art on multi-parameter probes on the market gives an overview of the existing solution. The constraints of this kind of application allow selecting 3 multi-parameter probes according to the manufacturer's specifications. These 3 probes have been tested considering a normalized test protocol, and one was selected. This test protocol is inspired from the ISO Norm 15839. It has been developed and applied in another European project called AQUAFIT4USE. This protocol is divided into 2 main parts: the first is the "laboratory tests" on synthetic sample to evaluate the performances of sensors in a controlled and simple sample. In the second part the sensor behaviour is evaluated in real conditions. This second part allows us to study the long term drift of the sensor in a real matrix. This paper will present the results obtain for this benchmark.

[1] US EPA. U.S. EPA Water Security Initiative. EPA 817-F-07-002. April 2008. 2p.

[2] John Hall, Alan D. Zaffiro, Randall B. Marx, Paul C. Kefauver, E. Radha Krishnan, Roy C. Haught, and Jonathan and G. Herrmann. On-line Water Quality Parameters as Indicators of Distribution System Contamination. April 2006. 31p.

[3] John Hall and Jeff Szabo, WaterSentinel Online Water Quality Monitoring as an Indicator of Drinking Water Contamination. EPA 817-D-05-002. Decembre 2005. 27p.

[4] US EPA. Cincinnati Pilot Post-Implementation System Status. EPA817-R-08-004. September 2008. 135p

[5] World health organization (WHO). Guidelines for drinking-water quality, third edition, Chapter 4 - Water safety plans. 2008. 668p.