DETECTION OF WATER POLLUTION BY A MICROWAVE CAVITY SENSOR

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ABSTRACT

Water pollution can be defined as any chemical, physical or biological variation in the quality of water which exceeds some reference values and may cause injuries to human health. Nowadays, the quality of water for human consumption is generally high when it leaves the purification plant, but it can deteriorate on its way to the consumers for the presence of chemical substances, or because of stagnation in reservoir which may facilitate the growth of algae and bacteria. As a result, water monitoring is of primary concern for most health and security authorities.

The European Directive 98/93/EC [1] has set quality standards of drinking water on the basis of the guidelines from the World Health Organization. It establishes the maximum allowed concentrations for several chemical and microbiological substances based on their maximum daily consumption over long period of times, their nature, and their potential toxicity.

Water quality sensors exploiting different technologies (e.g. chemical, optical, etc.) have been presented in the literature and are currently available on the market. They allow to analyze specific parameters of interest such as PH, conductivity, free and residual chlorine concentration, dissolved oxygen, turbidity, etc. However, non-specific sensors can represent valuable tools for the real-time analysis of water quality along the distribution network and may enable a reduction of the costs of the whole monitoring system.

This contribution demonstrates the possibility to detect water contaminants by using microwave technology. A portable measurement system having a relatively low cost is presented. The sensing device is a rectangular cavity resonator working at 1.91 GHz in the fundamental TE101 mode [2]. A water sample is introduced inside the cavity by means of a low loss capillary. The presence of pollutants in water alters the complex permittivity of the solution (i.e. the dielectric permittivity and conductivity) thus modifying the cavity response in terms transmitted power, resonance frequency, and 3-dB bandwidth [3]. As a result, it is possible to detect the pollutants by monitoring these parameters in real-time. The sensor is non-specific, i.e. it is not capable to discriminate the types of contaminants and their respective concentrations without a-priori information on the solution composition and the availability of proper calibration curves. Experimental tests on water samples contaminated with chlorides and nitrates have been carried out in controlled conditions. They confirm that the system is effectively capable to detect pollutant concentrations in excess of 10 mg/L.

Keywords: microwave sensor, water contaminant detection