

Doctoral thesis summary



UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Escola de Doctorat

DNI/NIE/passport	<input type="text"/>
Full name	<input type="text" value="Ramón Manuel López Roldán"/>
Title of the thesis	<input type="text" value="Integration of advanced off-line and on-line systems for the monitoring of surface and drinking water quality"/>
Structural unit	<input type="text" value="Departament d'Enginyeria Química"/>
Programme	<input type="text" value="Enginyeria ambiental"/>
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(Minimum 1 and maximum 4; see the codes at <https://doctorat.upc.edu/academic-management/formsfolder/thesis-registration-and-deposit/unesco-codes>)

Thesis summary of a maximum of 4,000 characters (if you exceed this number it will automatically cut you off).

An optimal strategy for monitoring water quality should be based on a combination of different technologies depending on the particularities of the system being observed. The final solution will be a combination of laboratory techniques, on-line instruments and statistical methods. In this case, the investigation was based on the Llobregat River basin in order to monitor natural and drinking waters after treatment in the Sant Joan Despi Water Treatment Plant (Barcelona).

The thesis includes an optimization method for laboratory analysis of pharmaceuticals in surface waters. 23 of the 28 compounds tested were detected. The highest concentrations were obtained for β -blockers metoprolol and sotalol; the antibiotic ofloxacin; and lipid regulator gemfibrozil. Within the group of estrogens, estrone and estrone-3-sulfate were identified. The latter showed concentrations in some points high enough to induce estrogenic effects on aquatic organisms.

A series of indexes have been developed for the assessment of the risks posed by certain substances found in the Llobregat River to the ecosystems. The methodology is based on comparison of average concentrations with the higher concentrations that have been proved to show no effect on the environment. According to the results, the studied metals (barium, copper, nickel and zinc) had higher rates than 1 for aquatic organisms. For the organic compounds, the most significant indexes are referred to the pesticides terbutylazine, diazinon and MCPA; and the antibiotics ciprofloxacin and clarithromycin. When the relationship is established to the legal threshold, chlorpyrifos and lindane showed indexes above 1 over some months.

The work also includes the development of indexes for measuring the potential danger of these substances to human health. The methodology considers the systemic and carcinogenic effects caused by the ingestion of water based on data from the World Health Organization (WHO) and the Information System Risk Assessment (RAIS). Over 5 years, systemic RAIS index drops from 0.64 to 0.42 for surface water and from 0.61 to 0.31 for potable water; the carcinogenic index is insignificant for the water inlet and varies from 4.2×10^{-5} to 7.4×10^{-6} for drinking water; WHO systemic index ranges from 0.41 to 0.16 for surface water and from 0.61 to 0.31 for potable water. All indices are below the thresholds, except for the carcinogenic risk in treated water in 2008 and 2009, where the rate is slightly above the limit.

One of the technologies being explored to provide useful information for operators of water is UV-Visible spectrophotometry. A probe based on this technology along with statistical methods have been used to obtain a multivariate model that will predict the origins of water in the drinking water network of Barcelona. The analysis of the combination of the spectral fingerprints with conductivity, boron and fluoride was performed to improve predictability.

The information that reports on the physical and chemical parameters in the water can be combined with toxicological information. An automatic biosensor was tested to measure its response to a series of priority pollutants. EC50 values (effective concentration that causes a 50% decrease in the activity; in mg L⁻¹) were calculated for nonylphenol (0.03 and 0.06 for 15 and 30 min), triclosan (0.13 and 0.13), terbutylazine (2.88 and 2.74), dimethoate (6.80 and 6.20), diclofenac (10.26 and 9.82), DBSS (50 and 39), diazinon (193 for 15 min), propanil (1594 for 15 min) and MCPA (2.0 for 15 min). For heavy metals, results were obtained with copper (II) (10.61 and 4.68), nickel (II) (317 and 222), chromium (III) (190 and 123) and iron (III) (52 for 15 min).

Place	<input type="text" value="Barcelona"/>	Date	<input type="text" value="27 April 2015"/>
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