# NEW METHOD FOR THE DETERMINATION AND MONITORING OF THE ORGANIC AND INORGANIC POLLUTION LEVELS IN WATERS OF VARIOUS NATURE

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## ABSTRACT

During the past five years, the Group of Atomic Spectrometry and Environmental Analysis of the Department of Analytical Chemistry of the University of Alicante has been developing new methods and strategies for the determination of several pollution parameters in waters of different procedure. Among these parameters we can highlight the Chemical Oxygen Demand, the Total Organic and Inorganic Carbon and the concentration of several heavy metals. Currently, the Department of Analytical Chemistry has the instrumentation required to carry out this kind of determinations.

## TECHNICAL DESCRIPTION

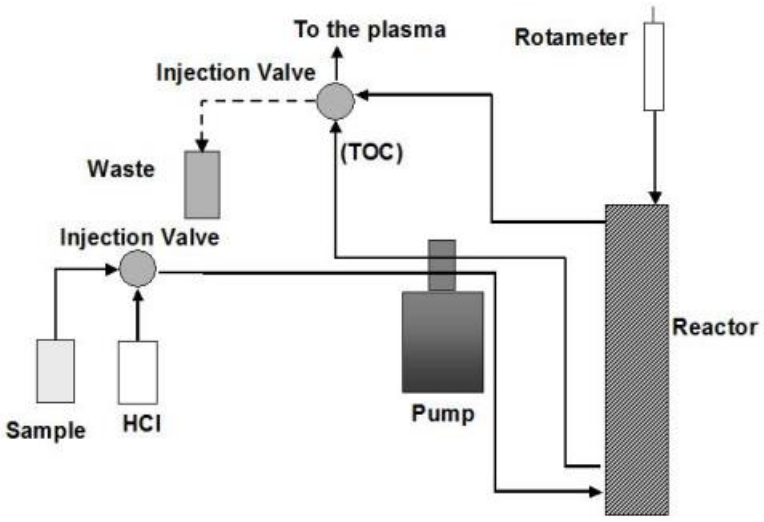
Atomic Spectroscopy comprises a number of techniques for elemental analysis such as Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) that are routinely used in modern laboratories. This technique is very advantageous for elemental analysis. So far the main applications of ICP-AES have been the determination of heavy metals in solid, liquid and gaseous samples. However, non metals, such as carbon, can also be determined through this spectroscopic technique.

a) Determination of metals in waters The determination of the concentration of several heavy metals in a given sample of water is crucial in order to assess its pollution levels and health risks. There are two points that should be considered in order to carry out reliable water analysis.

a.1.- The limits of detection obtained in ICP-AES are, in some instances, on the same order of magnitude as the maximum concentrations allowed by the legislation. On this subject our group has been working on the development of new instrumentation giving rise to a significant reduction in the Limits of detection. We have been working on: (i) development and characterization of new nebulizers; (ii) design and evaluation of new spray chambers; and (iii) design and characterization of new desolvation systems. By using some of our developments in this field, the limits of detection can be improved by one or two orders of magnitude depending on the element which is being determined.
a.2.- In some cases, the matrix of the sample is complex and gives rise serious interferences. As a result, non accurate data are obtained. We have
carried out several studies and developed spray chambers which eliminate in many cases the interferences caused by elements present in waters such as sodium (seawater samples), calcium, potassium, etc.

b) Assessment of total organic pollution (carbon related parameters) Chemical Oxygen Demand (COD) and Total Organic Carbon (TOC) are two parameters widely used to monitor the total organic pollution level in a water sample. Between them the TOC is becoming more interesting because of the limitations in interpreting the COD data. Furthermore, the methods for TOC determination have many advantages over those for COD. Recently, a new method for the determination of the TOC by ICP-AES has been developed in our laboratories. Usually, the TOC consists of non volatile organic compounds.
b.1.- Besides TOC, it can be also interesting to determine the different fractions of Non volatile Organic Carbon. Thus one can find the dissolved and non dissolved organic carbon (DOC and NDOC, respectively). The method offered is also able to provide information about the content in these two fractions of organic carbon.

b.2.- Not only organic carbon is useful in environmental studies, but also inorganic carbon (IC) can be determined in a water sample through the present method. Moreover, by an easy modification of the system developed, it is possible to discriminate between the concentration of dissolved carbon dioxide, on one hand, and that of carbonate and bicarbonate, on the other.
Basically the system developed for the simultaneous determination of the concentration of heavy metals and the carbon related parameters consists of a reactor which has been placed before the ICP-AES spectrometer. A modified sample introduction system could be used according to the requirements of the analysis in terms of limits of detection or matrix effects. Finally, in order to automatize the method, two injection valves have been adapted. Next figure shows a basic outline of this system.




## TECHNOLOGY ADVANTAGES AND INNOVATIVE ASPECTS

a.- The determination of heavy metals by using new sample introduction systems lowers the detection limits and the extent of the interferences.

b.- The determination of TOC, DOC and NDOC through ICP-AES eliminates some of the problems encountered with conventional methods (i.e., poor recoveries, instrument failure in presence of high sodium concentrations, etc.).

c.- The determination of IC through ICP-AES allows the inorganic carbon speciation.

d.- The simultaneous determination of metals and carbon related parameters through ICP-AES reduces the laboratory investment in instrumentation and qualified personal.

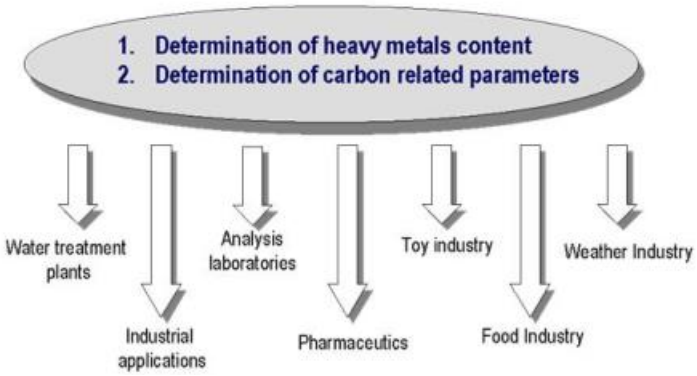
## CURRENT STATE OF DEVELOPMENT

The system developed has been applied in our laboratory for the analysis of standards containing refractory as well as non refractory organic compounds and, unlike with the common method, the nature of the compound has not affected the recoveries found.

## MARKET APPLICATIONS

The method described can be used by any company willing to control the quality of both the water used in industrial processes and the wastewaters.

The following figure details the possible applications of the present method.




## COLLABORATION SOUGHT

Currently we have the technology required to:

a. Developing and implantation of the method in an analysis laboratory

b. Developing of an on-line monitoring system in industrial processes

c. Developing of a method for the analysis of solid wastes

## INTELLECTUAL PROPERTY RIGHTS

All the information is protected by know – how.

## RESEARCH GROUP PROFILE

This group was created in 1990. Nowadays, the group consists of one Professor, 3 Senior Lecturers and several pre-doctoral students.

We have experience on the following research subjects:

(i) Development of new liquid sample introduction systems for plasma spectroscopy;

(ii) Development of new flow injection methods for the determination of molecular species in swimming pool waters;

(iii) New strategies for the dissolution of solid samples;

(iv) Methods for the digestion and analysis of plastic materials;

(v) Development of methods for the determination of the Chemical Oxygen Demand in wastewaters;

(vi) Metal speciation.

## MARKET APPLICATION (2)

Pollution and Environmental Impact
Chemical Technology