Federal network of environmental monitoring in Argentina

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Abstract

The environmental pollution is one of the problems that worries the international community at present. Science is the key to identify the impacts nature and scale and to establish the needs for regulatory decisions corresponding to the local, regional and national levels.

The present work describes a particular project designed by researchers from the Universidad Tecnológica Nacional, in order to study the environmental situation in different regions of Argentina. The federal character of this University with Regional Faculties and Academic Unities located all over the country, allows an excellent distribution adequate to this kind of study.

The work plan is to study the present conditions of the contaminants main receptors: air, water and soil, in densely populated areas such as provincial capital cities, and others which are seat of industrial activities.

The main objective of this project is to analyze the environmental quality in the national territory not only by studying the present situation but also by establishing indexes that classify the quality of the mentioned receptors. Other important objectives of this plan are the environmental education and the human resources formation by means of several activities such as: seminaries, courses, and informative bulletins, students incorporation to the work groups in each point of study, and local staff training. The present work shows the main designed stages and the ways to carry them out.

1 Introduction

The environmental pollution is one of the worries of the international community at present. The human being uses means of transport, products and services which bring about impacts on the environment. As a general rule they are studied locally but it is becoming more frequent that the global effects on the human and environmental health are taken into account. Internationally there exist numerous examples of regulatory successes which minimized such impacts based on the knowledge and admission on the part of its "owners" of the environmental situation.

Science is the key to identify the nature and scale of the impacts and to establish the need for regulatory decisions in the processes. The impacts on the ecosystems will be predicted adequately and the effects of the local, regional, national and international changes, will be evaluated properly only if there is a continuous improvement of the knowledge on environmental pollution and its control possibilities.

The present project has been designed to carry out the study of the environment quality in different regions in Argentina, in order to build a representation of pollution levels and to determine the influence of the different industries and vehicles contributions, of the different geographies, meteorological conditions, etc.

The federal character of the National Technological University, with Regional Faculties and Academic Unities throughout the whole territory of the country allows a regional distribution adequate to this kind of study.

No only densely populated areas will be studied among which are the provinces capital cities and their industrial surroundings, other areas with low and no density will also be considered. The present situation of the contaminants basic receptors: air, water and soil will be determined.

1.2 Objectives and expected results

One of the main objectives of the present project is to study the quality of the environment in the national territory by means of the contaminants analysis in different points selected for their position and population density, another aim is to establish concentration patterns of the studied contaminants and also to establish the applicability of different diffusion models that allow to predict future situations.

Another important objective is the environmental education, that is to say, the diffusion of the environmental subject through seminaries, talks in educating centers, informative bulletins, etc.

The formation of human resources is also a fundamental objective that will be achieved with the incorporation of scholarship holders during the development of the proposed working plan and with the training of the local staff directly related to the project in each point selected for the study.

The expected results of this project are as ambitious as the project itself. The most important result to achieve is the characterization of environment quality in

Argentina, the local and national authorities knowledge of the situation, so as of the people of the different areas where the direct measures are taken, and an intense diffusion of the environmental issue locally, provincially and nationally together with formation of human resources. All these achievements will be regarded as the beginning of an environmental monitoring and controlling process in Argentina, and the start of collective awareness leading to a modification of individual actions. This would bring about an optimal use of the natural resources and a minimization of contamination.

2 Experimental

2.1 Receptor: air

The different primary and secondary contaminants originated during the combustion processes that take place at various sources will be analyzed. The main sources of air pollution in the urban areas are the production of energy, the industrial processes in general, motor vehicles and heating systems [1].

The gases that will be determined are nitrogen oxides (NO_X), sulphur dioxide (SO_2), carbon monoxide (CO), hydrocarbons (HC), and ozone (O_3). The presence of particles will also be studied, determining concentrations, and size distribution and analyzing their physicochemical characteristics.

The contaminants aggressiveness depends mainly on their concentration in the atmosphere. Consequently, the amount of pollution in a region does not depend solely on the sources but also on the dispersion in the air of the polluting agents. This is directly related with the meteorological conditions of the area, specially winds, rains, and temperature profiles of the surrounding   atmosphere, parameters that also will be determined in the present study.

This is when the mathematical models of pollutants diffusion become of prime importance. The main objective of these models is to predict the pollutants evolution in order to prevent the effects they have on the system. The environmental models best developed at present are those which predict the behavior in the atmosphere of the gaseous and particulate pollutants. In order for them to be applied, it is essential to know the specific contaminants, their physicochemical properties and the processes of reaction and degradation they can undergo. In this study it will be discussed the applicability of different models for different cases such as different seasons, traffic reduction, presence of industries that are considered dangerous generators, etc.

2.2 Receptor: water

The present conditions of the water sources pollution will be determined by means of basic analysis to establish the water quality. The main sources of water pollution are the industrial and urban effluents.

Some of the analysis performed to start the characterization are the typical analysis of physicochemical and biological parameters, such as temperature, pH, acidity, alkalinity, suspended solids, turbidity, dissolved oxygen, microbiological

condition, etc. Some chemical products will also be determined: nitrate, nitrite, lead, chromium, arsenic, cadmium, phenol, detergents, pesticides, fertilizers, etc. Other compounds will be analyzed more specifically taking into account the type of industries that are established in each studied area.

Concerning the water sources contamination study the contaminants diffusion models are also useful tools whose application requires knowledge of the specific characteristics of the pollutants and the chemical transformations that take place and the receptor own parameters, for example, pH, temperature, course velocity, etc.

2.3 Receptor: soil

When studying this receptor it is essential to know the natural elements and compounds that are in it in each region, due to the fact that, although they cannot be considered pollutants as they are present naturally, the concentration can be a threat to health when they reach the water sources.

It is essential to examine the texture and structure of the soil, as they are the keys to the air and water movement through its side [2]. The proportion of minerals of different sizes that make up the solid fraction and the structure units such as sand, clay, sediment, etc., are fundamental properties in the processes of contamination. The stability of them determines the capacity of the soil to avoid or permit the air and water movement.

Fortunately numerous studies have been performed in Argentina on the soil parameters [3]. Abundant information is available about the mineralogical compositions, porosities, presence of heavy metals or potentially dangerous elements throughout the country.

Essays of characterization of the different types of grounds in the different regions will be performed to establish the behavior of them during the processes for example lixiviation.

2.4 Quality indexes

In all these cases and taking into account the determined contaminants concentrations, its relationship with those levels established by the rules, and the effects on health, indexes that will classify the quality of air, water and soil will be designed to show the pollution level in each region under study.

3 Work plan and methodology

The project has three main stages, the first one involves local studies of environmental quality in densely populated spots among which are capital cities of the provinces and other important cities, together with areas which represent zones of medium, low or no population density. The second one is the zonal analysis of the results of those local studies. These results will be analyzed on the basis of mathematical models of data treatment. Maps showing the concentration of the different contaminants registered will be represented, and quality indexes

of the different receptors will be established for the studied areas. And the last stage which will be developed simultaneously with stages 1 and 2 is the environmental education.

3.1 Local studies of environmental quality

The general steps that will be followed for the development of the project in each determined point, within the national territory are:

      -Study of the zone to be analyzed.
      -Determination of the data acquisition points.
      -Assembly of the air quality monitoring stations.
      -Collection of meteorological data.
      -Analysis of the water courses.
      -Characterization and analysis of the soil.
      -Data treatment and results analysis.
      -Applicability of mathematical models to each case in particular.

The study of the zone implies the analysis of the geography, historical meteorological conditions, characteristics of the running motor vehicles, social behavior of the local people, local industries, etc. The results of these studies allow to determine the most convenient points for data acquisition and the most representative hours to take into account for the analysis depending on what is to be evaluated, whether the vehicular contributions, the industrial contributions, the seasons differences, etc.

The figure 1 show the map of Argentina where are located the different twenty three Regional Faculties and seven Academic Units of the National Technological University, points that constitute some of the acquisition data places. The selected analysis areas are indicated with arrows on the map.

3.1.1 Monitoring Systems

The *air quality monitoring system* will have automatic stations of data acquisition basically equipped with the following gases electrochemical sensors: carbon monoxide (CO), sulphur dioxide (SO_2), ozone (O_3), nitrogen oxides (NOx) and hydrocarbons (HC), and with a sensor of particulate matter with particle sizes smaller than or equal to 10 microns (PM10). It will also include a portable analysis station equipped with calibrated sensors which will enable constant verification of the stations calibration.

In order to have a continuous record of the meteorological conditions a station will be used that registers in an allotted time, the following parameters: wind course direction and speed, dry and wet bulb temperature, atmospheric pressure, humidity, rain and solar radiation. The data obtained by the National Meteorological Service will also be consulted.
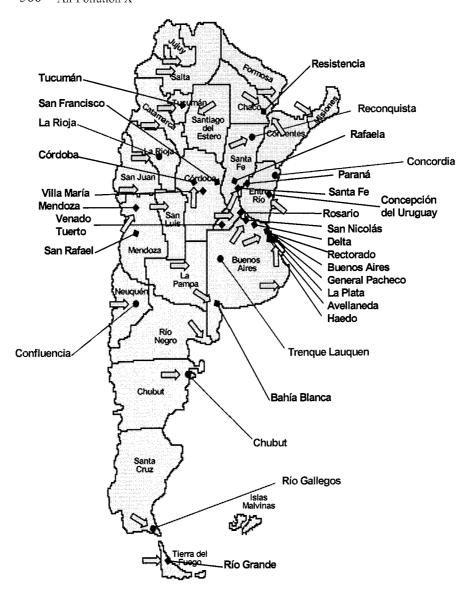
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Figure 1: ⇒ Location of some areas to be analyzed: capital cities and other important cities. ◆UTN-Regional Faculties. ●UTN-Academic Units

Apart from the semi quantitative data registered in the stations on the particulate matter, equipment will be installed for a more profound analysis of this contaminant; it will consist of a high volume pump and a system of differentiated filters, it will be placed like a stationary station in a determined

spot within each area subject to analysis. Unlike automatic remote stations, this equipment allows, on the one hand, the collecting of particulate material samples for its later physicochemical analysis and, on the other hand, the quantitative analysis discriminated by particle sizes which, in the case of the study planned with this project, is composed by total particulate matter, particles smaller than 10 microns and others smaller than 2.5 microns. These two last analysis bear supreme importance when it is studied the impact this kind of environmental contaminant has on health. A very important part of this project is based on the acquisition of these data, as they are a fundamental advance in the scientific knowledge that there is about this contaminant.

The physicochemical analysis of this contaminant will be performed by means of the scanning electron microscopy (SEM), and energy dispersion analysis (EDS) as in a previous work [4].

The *water analysis* will be performed by means of automatic equipments and chemical reagents specially designed to determine the basic contaminants concentration, previously mentioned. Other studies will be designed for specific contaminants in particular cases.

The *soil analysis* will be carried out in collaboration with laboratories specialized in mining and soil composition and structure.

3.2 Zonal analysis of the results of local studies

The development of this stage is based on the following steps:

3.2.1 Mathematical models application

Numerous pollutants diffusion models have been developed to be applied under different meteorological, geographical and seasonal conditions. The episodes of high environmental pollution occurred during stagnant meteorological and seasonal conditions differ in the contaminants involved.

The season difference are more evident in the case of the air contamination. The emissions and the meteorological conditions are the main factors that influence the air quality in summer and in winter. In winter the emissions of NOx, VOC, SO_2 and CO are larger than in summer due to additional sources such as heating [5]. An adequate model will consider, for example, a smaller ozone concentration in winter than in summer.

These mathematical models allow not only to establish what kind of relationship and reactions take place among the different air pollutants in the zone under study but also to predict concentrations of such pollutants at determined distances from the sources of emission or from the points where they were analyzed. Wherever possible the models developed by the Environmental Protection Agency (EPA) and recommended by the legislation in force in Argentina will be applied [6-8].

A similar treatment will be carried out in the case of contaminants diffusion in water.

3.2.2 Drawing of contaminants concentration maps.

Contaminants concentration maps together with a general representation of the main industrial sources that might, due to its magnitude, reach beyond the local frontiers and regionally affect the environment quality will be drawn taking into account the concentrations determined at the points under analysis and the ones estimated by using the models mentioned in the item above. This will be carried out by using the programs designed for that purpose, such as *Surfer*, widely spread for this type of representations. *Maple and Mathematica* programs will also be used for the maps making.

3.2.3 Setting up of environmental quality indexes.

The quality of the environment determined by the monitoring continuous stations placed in the different points of study will be interpreted by means of indexes. In order to reach a better understanding by the population in general an index will be used that classifies the environmental quality at various levels.

It is not easy matter to interpret an only index of environmental quality, therefore, the indexes of air, water and soil quality are usually expressed separately. In order to establish these indexes mainly the contaminants of greater concentration in each studied receptor are considered. In general, the higher the value, the poorer the environment quality.

To calculate the index corresponding to each receptor, one index per contaminant is established according to a concentrations scale or table that includes the threshold values indicated by regulations. The receptor general index is then determined taking into consideration the individual indexes of each contaminant affected by a factor that views the danger of such specific contaminant.

This quality index will be associated with a pollution level and its influence on health. Thus, levels of pollution can be obtained that may be good, moderate, bad, severe or dangerous, representing respectively: almost no influence, a slight effect in the long term, affections to sensitive organisms or a general effect in the short or immediate term.

3.3 Environmental Education

This stage of the project will be carried out simultaneously with the others.

The courses and seminaries that will be dictated in the different educating sectors, mainly universities, institutions and town schools constitute a fundamental part of this project, not because of the time devoted to it but because of the importance the diffusion of the environment problems has in this historical time. The environmental issue, together with the project characteristics will be presented in each region in particular. Seminaries will be dictated accompanied by informative bulletins, the results of the local studies of the environment quality will be published and joined activities with the educative community will be planned so as to establish concepts and generate consciousness.

In order to reach these objectives is necessary first to captivate the people attention, that will be the most arduous work of this project taking into account the present economical and social situation of Argentina.

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