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INTERNATIONAL CENTRE FOR SCIENCE AND HIGH TECHNOLOGY
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Organized with the contribution of : Ministerio del Medio Ambiente, Corporación
Autonoma Regional del Canal del Dique and Fundación Mamonal

Final Report - SCIENTIFIC REPORT

Workshop
on

ENVIRONMENTAL POLLUTION AND APPLICABILITY OF REMEDIATION
TECHNOLOGIES IN LATIN-AMERICAN COUNTRIES

Cartagena de Indias, Colombia
4-7 December 2000

Final Report

Title: ENVIRONMENTAL POLLUTION AND APPLICABILITY
OF REMEDIATION TECHNOLOGIES IN LATIN-
AMERICAN COUNTRIES
Date: 4 - 7 December 2000
Venue: Cartagena de Indias, Colombia
Coordinator: Dr. A. Lodolo, ICS-UNIDO, Trieste, Italy

BACKGROUND

One of the most urgent problems to be faced at a global level is the decontamination of soil and waters due to domestic and industrial activities. Large polluted areas, besides having lost their eco-functionality often represent a serious risk for human health. The policy for the restoration of natural resources is thus a priority in developing as well as in industrialized countries.

In the last years several remediation technologies have been developed for the decontamination of polluted sites and many of them have been proved to be very promising to clean up contaminated water and soils.

Bio-remediation is a very effective and widely applied clean-up technology. This technology is able to degrade hazardous, toxic or merely offensive pollutants by means of the enhancement of naturally occurring micro-organisms or the selection and amplification of specialized metabolic capabilities. In situ bio-remediation is indicated to clean-up sites contaminated by a wide range of compounds, such as pesticides, industrial chemicals, gasoline and many components of crude oil. It has also the important capability to degrade compounds that were once believed to be recalcitrant, such as chlorinated solvents, PCBs, chlorofluorocarbons and other stable compounds. It can therefore be stated that most organic compounds, both natural and synthesized, can be degraded by micro-organisms, either through direct use or through co-metabolic processes.

Another environmentally friendly remediation technology, which is only recently emerging, is phyto-remediation. Particular species of plants can be used to clean up contaminated sites through different mechanisms: direct destruction of organic pollutants, indirect degradation by the support of microbial communities and by taking up inorganic contaminants from soil or water and concentrating them in the plant tissues or roots. This method, even if still more research has to be done in order to optimize it, is likely to become a promising environmental clean-up approach in selected applications.

In conclusion, bio-remediation technologies, in combination with physical, chemical and thermal methods, are an important way of approaching the problems of decontamination of polluted sites; research and development efforts are extending their applicability and it is expected that there will be an increase use of these technologies for the restoration of contaminated soils and waters, leading, especially in developing countries, to a very promising industrial market development in this field.

The International Centre for Science and High Technology (ICS), within the area of Pure and Applied Chemistry, with the aim of facing the pollution problems in developing and in transition countries and improving their capacity building in environmental issues is presently carrying out a subprogramme on Remediation Workshop on "Environmental Pollution and Applicability of Remediation Technologies in Latin American Countries" has been scheduled for implementation from 4-7 December 2000 to be held in Cartagena de Indias, D.T.,

JUSTIFICATION

Recent investigations have shown that in Colombia large areas are

contaminated or damaged with consequent impoverishment of natural resources and serious effects on human health. This is partly due to the introduction and use of dirty industrial technologies with consequent heavy production of liquid and solid wastes, to the insufficiency of treatment plant facilities in the industrial and urban areas and, more in general, to an inefficient environmental strategy and management in the past years.

The introduction and implementation of new remediation technologies for the restoration of the quality of the polluted sites, the introduction of environmental friendly industrial technologies together with a proper planning and management of environmental issues seem to be the only possible policy to face these pollution problems in the Country/Region.

For these reasons there is the need of enhancing activities in this field and of helping the developing regions in particular countries like Colombia and other Latin-American countries to form an indigenous class of experts/technologists who are able to act as experts in their own countries. Education and training of the greatest number of professionals towards the application of modern techniques in the art of abatement of contaminants and remediation of polluted sites is an urgent requirement. These trained professionals will have to embrace the responsibility of transmitting the acquired knowledge to other professionals and to the public in general.

With the international co-operation and the correspondent support, ICS is therefore promoting development and application of remediation technologies in developing countries and contributing with adequate programmes for local experts.

The Workshop on "Environmental Pollution and Applicability of Remediation Technologies in Latin American Countries " will try to face this environmental problems giving an up dated review on remediation technologies and their applications. The Workshop will also try to focus on the proper local policy for pollution prevention and control, and in general for an environmental friendly industrial development.

It will be useful for the Industry of the Region as it represents an opportunity for the regional and local industry to make contact with up-to date techniques devoted to remediation and control of pollution. It will be also useful for regional and local Authorities dealing with environmental matters and for the development and the implementation of projects for remediation of polluted soils and waters.

The workshop will be hosted by the Corporación Autonoma Regional del Canal del Dique (CARDIQUE) located in Cartagena de Indias, D.T, in the Caribbean Region in Colombia. CARDIQUE was established to protect environment and develop its natural resources. This agency is part of the National Environment System (SINA), which is conformed by various agencies, under the direction of the Ministry of the Environment, this system support the environmental protection in large cities, natural regions and basic research.

OBJECTIVES

The aims of the Workshop were:

To provide the participants from the region with updated knowledge on modern technologies for abatement of contaminants and remediation of polluted sites,

envisaging its application in the Andean Region in order to strengthen the national expertise in mastering, using and further developing remediation technologies for local applications and adaptations;

To review, assess and collect the latest information on the methodologies for assessment of environmental pollution, waste management and remediation technologies.

To stimulate international research and technology transfer and enhance international co-operation through possible joint or follow-up projects and feasibility studies by identifying regional R&D Centers in developing countries through contacts established with the participants of the workshop, thus giving ICS the possibility of identifying qualified and academic centers for future joint ventures for the development of remediation technologies and their applications.

OUTPUTS

The expected outputs of the Workshop were:

To train technologists and researchers Workshop attendees on up-to-date abatement and remediation technologies.

To report on up-to-date pollution assessment techniques and methodologies, remediation technologies, and their applications, and on strategies for selecting the adequate technologies in the specific regulatory framework of each Latin American country;

To identify of suitable co-operating industries/institutions and possible common initiatives and projects in remediation, in order to establish an international network for the diffusion of knowledge and awareness in remediation.

PROGRAM AND TOPICS

Participants

A total number of 28 participants, of which 5 international lectures, 4 lectures from the country, 8 participants from neighbouring countries and 10 participants from the country, coming from industry, R&D institutions, international and national organizations and universities attended the workshop. The approved agenda and title of contributions is enclosed (Annex1), together with the list of participants (Annex 2).

Program

Recognition and definition of local problems

- Industrial areas
- Agricultural land contamination
- Water resources contamination

State-of-the-art of remediation technologies: technical and economic aspects

- Toxic wastes (PCB's and Heavy metal): remediation, management, collecting, incineration
- Industrial waste remediation and management: main industrial wastes
- General organic pollutants and pesticides. Inorganic contaminants

Site characterization: Investigation and strategies

- Analytical Techniques: detection and identification of soil and ground-water pollution
- Methods of soil contamination assessment
- Hydrogeology's aspects
- Models of diffusion and transport of contaminants in soils and waters

Risk Assessment.

- Risk analysis criteria
- Risk analysis methods: RBCA, API DSS.
- Environmental risk analysis: Applications and Case Studies

Remediation technologies

- Bio-remediation: techniques, applicability, advantages, limitations
- Thermal and physical-chemical: techniques, applicability, advantages, limitations
- Containment systems: techniques, applicability, advantages, limitations
- Natural attenuation and treatment techniques of ground waters
- Remediation projects (case studies)

Country and institutional reports

- The situation of dismantled industrial areas
- The situation of agricultural land contamination
- The situation of water resources contamination
- Remediation regulatory framework
- Remediation interventions: ongoing and in- preparation projects

Discussion on follow-up activities

- Identification of possible common initiatives/projects and relevant financial resources.

COURSE OF THE WORKSHOP

The workshop was divided in three main sessions. During the first session, lecturers presented methods and technologies for risk assessment, site characterization, remediation Technologies and cases studies.

During the second session, country reports of Argentina, Brasil, Chile (two participants), Ecuador, Panama and Peru, were presented, as well as multilateral programmes on environmental issues.

In the third session the participants were divided in working groups to discuss next topics:

WORKING GROUP 1:	NET WORK FOR CONTAMINATED LAND MANAGEMENT
WORKING GROUP 2:	EVALUATION, PREVENTION Y REMEDIATION OF ORGANIC AND INORGANIC POLLUTANTS IN LATIN AMERICAN ECOSYSTEMS
WORKING GROUP 3:	CRITERIA OF INVENTORY

The final part was a round table plenary discussion, where the Working Groups exposed their conclusions and agreed recommendations.

CONCLUSIONS

Regarding remediation technologies different needs were indicated, namely:

- Necessity of information exchange. To organize, develop and update the information services (web sites, reports, regulation, and networks) in order to have a better access to information.
- Encourage information and know-how transfer.
- To assure technologies fit for Latin American standards, including site investigation methods, remediation technologies and risks assessments.
- Legislation at Latin American level. To create a compilation package of existing regulations. Involvement in development of regulations.
 - To reinforce the research on remediation technologies through joint research project and initiatives for joint development projects.

RECOMMENDATIONS

Different initiatives were proposed to follow up:

WORKING GROUP 1: NET WORK FOR CONTAMINATED LAND MANAGEMENT

Background / justification

No existing channel for communication within Latin American countries and toward the rest of the world.

Objectives

Save money

Exchange of information on various levels (government, technical, scientific).

Find common approaches to solutions and harmonize protocols.

Contents

Gathering and distribution of qualified information on various levels.

Participation in joints projects.

Tools

Meetings , web page, e-mail, reports, translations.

Time Frame

Start 2001

Option 1 : permanent network

Option 2 : initial network for 4 years.

Outputs / Deliverables

Reports

Web page

Translations

Projects emerging from the network

Budget

100.000 US\$ / year

Partners

Country representatives

Scientific and technical advisors (industry).

Ad Hoc International Working Group on Contaminated Land.

Possible Financial Support

Unido

World Bank

Contribution from participating countries

European Union

WORKING GROUP 2: EVALUATION, PREVENTION Y REMEDIATION OF ORGANIC AND INORGANIC POLLUTANTS IN LATIN AMERICAN ECOSYSTEMS

Antecedent

Latin American countries are in need of appropriate modern technologies to identify, risk assessment and remediation of polluted sites.

Justification

The activities industrial, agrarian and mining have generated contaminations of which amount and quality are not known in the external costs that have taken place. In effect, some risks to the health and damages to the Ecosystems have been detected later to the activities and in some cases, they have been outside control.

Objectives

- To evaluate, to adapt and to develop methodologies for the identification of contaminated sites.
- To identify of contaminated sites.
- To evaluation of risks and the implementation of the strategies for its handling.
- Standardization of methodologies.
- Development of a strategy for the handling of the risk.
- Pursuit and control of the project.
- Diffusion of results.

Tools

Interregional Technical Committee.

Interdisciplinary and interinstitutional interchange of information by means of discussion forums, Internet, meetings and published documents.

Time Frame

Activities

Identification of contaminated sites: Geographical Information System.

Overhaul of secondary information.

Infrastructure of laboratory. Exercises of intercalibration.

Elements of sampling and diagnose fast in site.

Analysis of the information.

Evaluation of the unified risk: Latin American regional workshop.

Design of the strategy.

To develop to the methodological capacity for the processing of the inventory and To characterization of area and contaminated sites.

Evaluation of technologies adapted and validated for its use in Latin-American.

Data base of control and pursuit. Indirect results Information bases for Normalization, Politics and Strategies

Outputs/Deliverables

- Strategies of handling for Latin-American contaminated sites, with priority stops: hydrocarbons, heavy metals and pesticides
- 10 projects documented on applicability of technologies like bioremediation and Phytoremediation in Latin American countries assigned to the Network .

Budget

Tests Pilot (10 P, 3c/u)	US\$ 3,0 Mill
Investigation.(10P, 2I/P)	US\$ 0,6
Diffusion and Transference (4)	US\$ 0,2
Expenses of Operation	US\$ 0,2
<hr/>	
Total	US\$ 4.0 Million

Partners

Environmental Authority of each country.
Private Companies.
Universities and Research Technologic centres
NGO's of communitarian environmental work

Possible Financial Support

- National
private Company
Environmental Authority
Local Banks
Environmentalist NGO's
- Foreign
World Bank
International Funds
United Nations International Agencies assigned to a Cooperation for developing countries

WORKING GROUP 3: PROGRAM FOR THE DEVELOPMENT OF CRITERIA TO INVENTORY CONTAMINATED SITES (SOIL AND GROUNDS WATERS) IN LATIN AMERICA .

Justification

Lack of inventories
Lack of experience
Lack of development of specific criteria

Main Objective

Recognition of sites contaminated according to our Latin American realities and of mechanisms of remediation

Objective 1

Development of technique capacities of Latin American for formulation of criteria and Processing of a manual with common criteria for the development of the national inventories.

Tools: Meeting of experts, Hiring of expert and publication

Time Frame: 8 months

Partners: Governmental agencies (benefited) and advisers (expert)

Objective 2

Guide practices for methods of sampling, diagnose, analyses and evaluation of quality of contaminated grounds waters.

Tools: Meeting of experts to determine terms of reference for expert contraction, Hiring Of Expert, Validation And Publication.

Time Frame: 18 months

Partners: Experts in analyses (private and government laboratory assistants)

Objective 3

TRAINING TO EVALUATE RISKS IN CONTAMINATED GROUNDS WATERS

Tool: Regional workshop on practice evaluation

Time Frame: 15 days

Partners: Governmental agencies (benefited) and advisers (expert)

Objective 4

DEVELOPMENT OF 5 EXPERIENCES PILOT OF EVALUATION OF RISKS AND HANDLING OF REMEDIACION OF SITES

Tools: 5 advised specify projects and diffusion of the results to the other members of the network

Partners: Governmental agencies (benefited) and advisers (expert)

Time Frame: 6 to 12 months

FINAL RESULTS

Existence of own criteria to inventory contaminated sites

Technical capacities for the accomplishment of inventories and

Selection of actions to follow

Diffusion of criteria and methods

TOTAL COSTS: \$ US 2 million

FINANCIAL SUPPORT: 50% the international and 50% governments

TOTAL DURATION: 3 years