ICS-UNIDO programmes with the focus on the subprogramme of remediation - Overview and strategy -

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Introduction

The International Centre for Science and High Technology (ICS-UNIDO) is an Institution operating within the legal framework of the United Nations Industrial Development Organisation, with headquarters located in Trieste, Italy.

UNIDO is a specialised agency of the United Nations dedicated to promoting sustainable industrial development in developing countries and countries with economies in transition.

The mandate of ICS-UNIDO relates to the transfer of know-how and technology in favour of developing countries, and is justified by the perception that a competitive industrial technological capability cannot be built-up without adequate scientific knowledge and commitment to a sustainable development approach utilising new and environment friendly technologies.

The last century was characterised by the positive economic and social results of industrial growth, which have been accompanied by the reversal effect of a global environmental crisis. The growing technology-based industry has had an important environmental impact, being the industry the major consumer of natural resources and the major contributor to the overall pollution load. In particular, four sets of factors are causing environmental problems at a global level:

- spoiling of the natural environment with the resultant loss of the bio-diversity,
- emission of gases which contribute to "green house effect" of global warming;
- emission of gases which are causing the destruction of the ozone layer;
- pollution of water and soil caused by domestic and industrial activities.

The resolution of this apparent paradox between economic development and environmental global crisis can be addressed by sustainable development. This implies the agreement on necessary changes in people's lives and business philosophies, based on economic and technological development, prosperity and conservation and improvement of the environmental quality. The concept of sustainability lies in integrating economic, ecological and social dimensions into a broad overall system. Sustainable development requires harmonisation of economic growth with environment conservation and protection. In this way, the three main parts - economy, environment and health of society - can be sustained into the future.

On the basis of the above, the activities of ICS follow an integrated pragmatic approach which includes awareness and capacity building in developing countries, dissemination of scientific and technological information and transfer of know-how and technologies, consulting and advisory services, training activities, scientific workshops, high level seminars, fellowships, promotion of training arrangements, publication and editing of frontier issues.

ICS' role

In the present work programme the ICS's activities focus on specific sectors within the area. In selecting the specific subprogrammes and their related *Pure and Applied Chemistry, Environment, High Technology & New Materials* activities special consideration was given to their relevance in relation to the scientific and technological development of developing countries.

Considering that sustainable development depends upon the harmonisation of economic growth and environment conservation and protection, the ICS Area of Pure and Applied Chemistry has identified as priority fields in its work programme the following themes (subprogrammes), which are of key relevance to economic and industrial development as well as to environmental protection and recovery:

Combinatorial chemistry and combinatorial technologies: developing countries need to get acquainted with and gain expertise in combinatorial technologies to help local enterprises remain competitive and economically viable in the coming decades. Combinatorial chemistry and combinatorial technologies have a potential influence not

only on industrial growth, but also on environment protection. In fact, by optimising industrial processes and production, with the lowering of relevant costs, fewer amounts of waste and by-products are created. ICS is promoting this technique based on a "random" approach in combination with "rational" molecular modelling, in design of new drugs, fine chemicals, catalysts and new materials.

Environmentally degradable plastics: the expanding global production and consumption of polymeric materials coupled with increasing public awareness of environmental issues have created serious concern about the problems related to the disposal of plastic waste generated by various sectors of human activity. Besides recycling, re-use and incineration combined with composting, new technological development of environmental degradable plastics contribute to the tackling of the environmental issue in specific sectors of plastics use. Another driving force for EDP promotion, and of increasing importance, is the need to exploit renewable resources in closed cycle through EDP and composting.

Catalysis and sustainable chemistry, which is an important scientific and technological area for the development of environment friendly chemical processes; they in turn form the basis for cleaner industrial technologies development and are also the key elements for an industrial pollution prevention approach. New, less polluting processes together with the optimisation of existing processes depend to a great extent upon the improvement of catalyst performance in heavy and fine chemical production with a direct impact on the quality and quantity of by-products and/or waste generated.

Remediation technologies, which are becoming an important tool to solve the problem of polluted sites, especially in developing countries and economies in transition where the environmental issue has been until recently neglected and where large polluted areas, beside having lost their eco-functionality, often represent a serious risk for human health.

Among the different kinds of contamination, Persistent Toxic Substances (PTSs) and especially POPs (such as some pesticides and related chemicals, PCBs, etc.) represent one of the most serious and urgent problem to be faced because of their large diffusion in the environment on one hand, and because of their particular characteristics and properties which determine their persistence in the environment on the other hand. To face these problems, several remediation technologies have been developed in the last years and novel promising technologies, methodologies and solutions are emerging for various applications and are becoming day by day more economically viable and feasible to clean-up contaminated water and soils.

Bioremediation, in all its variations, is a very effective and widely applied clean-up technology, which is able to degrade hazardous, toxic or merely offensive pollutants. In situ as well as ex-situ applications have proved to be able to clean-up sites which have been contaminated by a wide range of compounds that were once believed to be recalcitrant, such as chlorinated organics, PCBs, pesticides and other stable chemicals.

Other technologies, based on thermal and/or physico-chemical processes, have already been developed on an industrial basis and many emerging techniques seem to be very promising to handle different kinds of contamination as they have proved to reach significant results both in pilot scale and in full-scale applications.

In conclusion, bio-remediation technologies together with physico-chemical and thermal methods represent an important way of facing the crucial problems of environmental recovery. Research and development efforts are extending their applicability and it is expected that there will be an increased use of these technologies leading, especially in developing countries, to a very promising industrial market development.

ICS's subprogramme of remediation

Following the ICS' general strategy, the main tools for the implementation of the activities within the Subprogramme of Remediation of the Area of Pure and Applied Chemistry, are the following:

- **Organisation of Expert Group Meetings (EGMs), training courses and workshops**

All awareness and capacity building activities (workshops, training courses, etc.) are organised at a regional (or sub-regional) level. These training events, which are held either at ICS, in Italy, or in the various interested developing countries, are the main tools for the spreading of information, technology transfer and awareness building in the field of remediation technologies and their applications. The following events have been organised:

Scientific Planning and Coordination Meeting on *"Bio-remediation"* Trieste, Italy - November 1996;

Training Course on *"Soil Environmental Assessment and Bio-remediation Technologies"* Budapest, Hungary - June 1997;

Training Course on *"Technological and Economic Aspects of Soil Bio/Phyto-remediation"* Plovdiv, Bulgaria - October 1997;

Expert Group Meeting on *"Environmental Pollution and BATEV in Remediation"* Trieste, Italy - March 1998;

Workshop on *"Waste Management and Remediation of Polluted Sites for Sustainable Development"* Hanoi, Vietnam - May 1998;

Training Course on *"Remediation Technologies: New Trends and Tools for Soil Decontamination"* Katowice, Poland - December 1998;

Workshop on *"Remediation Technologies: Applicability and Economic Viability in Northern Africa and the Middle East"* Cairo, Egypt - October 1999;

Expert Group Meeting on *"POPs and Pesticides Contamination: Remediation Technologies"* Trieste, Italy - April 2000;

Workshop on *"Persistent Toxic Substances: Environmental Pollution and Remediation Technologies in the Central Asia Region"* Tashkent, Uzbekistan - September 2000;

Workshop on *"Contamination of Food and Agroproducts"* Varazdin, Croatia - October 2000;

Workshop on *"Environmental Pollution and Applicability of Remediation Technologies in Latin America Countries"* Cartagena, Colombia - December 2000;

Expert Group Meeting on "Food/Agroproducts & Environment. Contamination Monitoring and Prevention" Trieste, Italy - March 2001.

Moreover, the following events are scheduled for the next period (2001- 2002):

EGM on *"Emerging Technologies for the Treatment of Contaminated Land and Water: Applicability in CEE countries"*, Trieste, Italy 4-6 July 2001;

Workshop on *"Remediation Technologies Applications for Soil and Water Treatment"*, Enugu, Nigeria, 16-19 July 2001;

Workshop on *"Advanced Technologies for Cleaning Oil-Polluted Waste Water and Oil Sludge Treatment "*, Russia, 3-6 October 2001;

Workshop on *"Environmental Pollution and Applications of Remediation Technologies"* China, 2002;

Seminar on *"Remediation Technologies Applications for PTS Contamination"*, Czech Republic, 2002;

Expert Group Meeting on *"New Technologies for Soil Contamination Investigation and Water Monitoring"*, Trieste, Italy, 2002.

- **Information packages, databases and publication activities**

Information and data collected are compiled and organised in databases, information packages and in different kinds of publications (such as the books of proceedings of the various events) in the field. The following information packages and publications have been prepared within the subprogramme of Remediation:

Four Country Reports on *"Pollution Problems, Available Remediation Technologies and their Economic Viability"* (Brazil, Egypt, Russia, Vietnam);

Compendium on Remediation *"Soil Clean-up Technologies and Soil Remediation Companies"*, 2nd Edition, 2000, published in cooperation with UNECE;

ICS Proceedings of the Expert Group Meetings on *"POPs and Pesticides Contamination: Remediation Technologies"* and on *"Clean Technologies for the Reduction and Elimination of POPs"*.

and a series of papers have been prepared and published in different issues.

Moreover, among others, the preparation of the following information documents and publications is foreseen for the near future:

- ***Country Reports*** from China, Thailand, Czech Republic and Mediterranean Countries. By means of these reports, information on specific environmental problems, hot spots, application of remediation technologies, on-going initiatives in the field, etc., will be collected and published.
- ***Compendium on wastewater treatment and water purification technologies***. Specific up-dated information on wastewater treatment and water purification technologies suitable for developing countries will be collected, assessed, organised and published in form of compendium.

- **Development of "in-house" expertise tools**

ICS is developing a series of decision-support instruments, built up in-house. As core elements, these are used in training technical experts from target countries and are also applied diagnostically in the formulation of project proposals by enabling technological, economic, environmental and societal pre-assessments. In particular, within the subprogramme of Remediation, databases of best available technologies economically viable and a decision-aid for remediation technology evaluation and selection are being developed:

With the objective to create new tools for technical evaluation and analysis of applicability of remediation technologies and for helping decision-makers dealing with remediation initiatives, a prototype software called *"Decision Support Tool on Remediation Technologies - DARTS"* is being developed at ICS. The software is continuously implemented and, according to the latest developments in the field, is up-dated by using assessed latest information/ data on applications of remediation technologies and from advanced research of world recognised centres/institutes.

- **Evaluation and development of project proposals**

Project promotion and formulation is obviously a key area at ICS. After assessment for economic, environmental, technological and social viability, projects are put forward for funding to possible donors. The following projects have been and are being prepared within the subprogramme of Remediation:

The above-mentioned ICS in-house project *"Decision Support Tool on Remediation Technologies - DARTS"* will be further developed. Together with its continuous up-dating, the validation of the system by means of a series of test-runs utilising data gathered from assessed full-scale applications and case studies is foreseen.

With the aim of carry out feasibility studies, evaluate suitable and viable remediation technologies and to develop selected pilot projects and disseminate knowledge and information in the field of used oil treatment, a preliminary project on *"Development and Application of Novel Technologies for Used Oil Treatment in NIS and CEE Countries"*, particularly addressed to face the problems of used oil management in CEE and NIS countries, has been prepared.

With the aim of surveying POPs' polluted sites and to select hot-spots, to evaluate suitable and viable remediation technologies, to carry out feasibility studies and develop selected pilot projects and to disseminate knowledge and information, a preliminary project on *"Remediation of POPs Contaminated Sites in NIS and CEE Countries"* has been prepared.

With the aim of collecting and assessing the latest information and data in the field of POPs destruction technologies, a project on "Survey and Assessment of POPs (PCBs) Destruction Technologies" is also being developed.

- **Fellowships**

ICS grants fellowships (lasting from 6 months to 1 year) for junior researchers coming from developing countries. Their job at ICS focuses on issues related to follow-up project proposals (or case studies), on the assistance in the preparation of databases (e.g. survey of technologies) and on the preparation of information packages and publications.

Within the subprogramme of Remediation, *fellows* coming from Nigeria, Mexico and Colombia have been hosted at ICS to carry out a training programme on remediation technologies and their applications.

- **Networking and participation of ICS in international initiatives**

ICS participates in international initiatives and events and promotes the development of multilateral collaborations. The activities relevant to the Area of Pure and Applied Chemistry are being developed within the framework of a number of global and regional initiatives and in co-operation with several international bodies. Within the subprogramme of Remediation, besides substantial participation and co-operation with UNIDO branches and integrated programmes, projects and initiatives are promoted in the context of major international effort, e.g.: UNECE, OECD, EU Programmes, CEI, UNEP Chemicals, etc.. To further promote information and know-how transfer and define possible co-operations, operational relationships among already defined network partner organisations/institutions (e.g. US-EPA, NATO/CCMS, CLARINET, etc.) will also be implemented, in particular regarding the issues relevant to persistent toxic substances decontamination problems in EU, CEE and NIS countries.