

ICS-UNIDO: PROMOTING SUSTAINABLE POPs DISPOSAL AND REMEDIATION TECHNOLOGIES

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Introduction

It is well known that a significant stock of polychlorinated hazards, including POP and PTS, has been produced and is stored nowadays or dispersed in the environment in many of Developing Countries and Countries with Economies in Transition. The obsolete industrial processes, giving rise to formation of dioxins, as well as former/current POP production/use (e.g. PCBs), coupled with uncontrolled use of polychlorinated pesticides in agriculture and improper storage of POP stockpiles have rendered vast territories in these countries highly contaminated and raised urgent issues of disposal of hazards and remediation of territories.

The International Centre for Science and High Technology (ICS), www.ics.trieste.it, is an autonomous institution within the legal framework of the United Nations Industrial Development Organization (UNIDO) promoting a global programme on environmental protection, sustainable chemistry, catalysis, and clean technologies. An important part of its work programme is focused on the promotion of new technologies which can be helpful for the reduction of the formation of POPs (like dioxins and furans) in incineration processes and in obsolete technologies used in some industrial processes. Another hot issue is to promote safe technologies for the destruction of PCBs and polychlorinated pesticides.

Particular efforts of ICS-UNIDO are directed towards the transfer of clean technologies to developing/transition countries. ICS-UNIDO, through its initiatives, seeks to establish a dialogue with local administrative, research, NGO, and industrial bodies in order to adopt sustainable technologies for POP disposal and management of contaminated sites.

The relevant issues are stressed in the current ICS-UNIDO work programme, within its (1.1) Catalysis and Sustainable Chemistry and (1.3) Remediation areas, and have been also covered in the former programmes in the last years, where the following key activities and accomplishments had place:

1. Preparation of Decision Support Tools (DST) for selection and evaluation of remediation technologies
2. Organization of events (workshops, expert group meetings, fellowship schemes, etc.) on the issues relevant to POPs destruction and remediation

REMEDATION METHODS AND CONTROL TECHNIQUES

3. Preparation of reports, surveys, and guidelines on existing and emerging technologies for POPs destruction/reduction and remediation
4. Preparation of international projects and project participation/coordination on the issues of POP remediation, disposal, removal from production processes, etc.
5. Training and education

The above mentioned activities and their outputs/progress are discussed in more detail in this paper.

Discussion

Decision Support Tools. Soil remediation and water reclamation are generally difficult, time-consuming and expensive operations. A number of different remediation technologies are nowadays available and the continuous competition among environmental service companies and technology developers generates a further increase in the clean-up options. A prototype of “Decision Aid for Remediation Technology Selection” (DARTS) has been recently developed¹ and a similar “Decision Aid for Water Treatment Technologies Assessment and Selection” (DAWTS) is currently underway at ICS-UNIDO. These software based instruments were created on the basis of the previously developed at ICS remediation technology databases and aim at providing decision makers (site owners, local community representatives, environmentalists, regulators, etc.) with a tool to assess the available technologies and preliminarily select the preferred remedial options.

DARTS and DAWTS have been designed and implemented over a Multi Criteria Analysis system and utilizes a reference data-base in which remediation technologies have been grouped in classes and categories. For example the structure of DARTS technology DB is divided according to the type of application (*in-situ* and *ex-situ*) and to the main mechanism involved in the process (physical, chemical, biological, thermal). Over 30 existing and new/emerging technologies are included in DARTS, including thermal, biological, physical, chemical ones which approach the sites contaminated by all basically known pollutant classes, namely nonhalogenated VOCs (Volatile Organic Compounds), halogenated VOCs, nonhalogenated SVOCs (Semi-Volatile Organic Compounds), halogenated SVOCs, fuels, heavy metals, explosives, radionuclides, and inorganics. For the technology evaluation performed by DARTS, some key parameters (criteria) have been selected and a specific rating system has been developed. Each technology is rated according to its performance under each criterion. The criteria included in the current stage of DARTS prototype are 1) applicability, 2) overall cost, 3) minimum achievable concentration, 4) clean-up time required, 6) reliability and maintenance, 7) data needs, 8) safety, 9) public acceptability, 10) development status, 11) stand alone character, and 12) residuals produced.

The commercial software and web-based versions of DARTS and DAWTS will be made available to users very soon, and will be distributed for free to the interested parties from developing and transition countries.

The future initiative of ICS lies in the development of an Integrated Package for the Management of Polluted Sites by combining the existing DST with other available tools dedicated to site assessment and risk analysis.

REMEDIATION METHODS AND CONTROL TECHNIQUES

Events. Following a constantly growing number of actions and programmes of other UN bodies, especially of UNEP and UNDP, on the specific topic of POP problem, ICS-UNIDO has organized in 2000 two expert group meetings (EGM) on “POP and Pesticides Contamination: Remediation Technologies” (17-19 April 2000, Trieste) and “Clean Technologies for the Reduction and Elimination of POPs” (4-5 May 2000, Trieste).

A Book of Proceedings has been published subsequentlyⁱⁱ which summarize a number of comprehensive case studies and country reports on a variety of POP relevant issues, namely 1) soil remediation technologies, 2) destruction technologies for PCBs and polychlorinated hazards, 3) analysis of POP and monitoring/site inventory, 4) risk assessment and policy making, 5) country cases (pollution levels, programmes, initiatives), etc. The latter issue has covered a number of transition countries which experience the most urgent POP problem, such as Slovenia, Slovak Republic, Russia, Latvia, Estonia, Croatia, Hungary, and GCC countries.

Formerly, in 1997 and 1998, three Training Workshops of ICS-UNIDO: “Soil Environmental Assessment and Bioremediation Technologies” (2-13 June 1997, Budapest, Hungary), “Technological and Economic Aspects of Soil Bio/Phyto Remediation” (5-17 October 1997, Plovdiv, Bulgaria), “Remediation Technologies: New Trends and Tools for Soil Decontamination” (30 November - 5 December 1998 Katowice, Poland) were organized.

Since then, a number of other meetings (EGM and Workshops) have been held by ICS-UNIDO, focused mainly on the general issue of pollution reduction/prevention and remediation, where the abovementioned POP issues were regularly addressed. Numerous specific events have been organized regarding the situation in CEE, African countries, Mediterranean Basin Countries, NIS, etc. (see the detailed list of ICS events inⁱⁱⁱ and links therein). Country reports and selected papers presented at these meetings have been published thereafter^{iv}.

In the nearest future the ICS-UNIDO is organizing the international conference on “Environmental pollution and remediation” (7-9 October 2004, Trieste, Italy), 2 EGMs on “Environmentally degradable plastics” (28-29 October 2004 Trieste, Italy) and “Remediation technologies and promotion of related projects” (17-18 May 2004, Trieste, Italy), and a workshop on “Environmental pollution and application of remediation technologies” (17-19 November 2004 Brazil/Venezuela).

Publications. As it has been already mentioned the numerous events organized by ICS-UNIDO resulted into publication of reports, surveys, proceedings and other materials, such as teaching course guidelines, handbooks, etc. where the abovementioned POP issues were addressed.

Apart from the proceedings and country reports on remediation of POP and other polluted sites following from the abovementioned EGMs, the “Surveys of Soil Remediation Technology” (2000)^v, “Guidelines on POPs” (2000)^{vi}, the second edition of “Compendium of Soil Clean-up Technologies and Soil Remediation Companies” (2000, cooperatively with UNECE and UNIDO)^{vii}, “Compendium of Waste Water Treatment and Water Purification Technologies” (2002)^{viii}, “Overview of pesticides and PCBs remediation technologies” (1999)^{ix}, and “An overview of Soil Remediation Technologies”^x have been published (see the detailed list of

REMEDIATION METHODS AND CONTROL TECHNIQUES

publications in ^{xi}). Some of these publications are freely available online or can be sent as paper copies upon request.

Projects. ICS-UNIDO actively supports the initiatives of developing countries in preparation and implementation of joint projects on the mentioned POP related issues, where the role of ICS is either that of coordinator or of consulting body. In several projects, ongoing or pending, the role of ICS is focused on the preparation of the abovementioned DST or their application/validation in different countries. The emphasis of ICS projects is mainly made on the remediation issue, where as a rule both POP/PTS and other pollution types are approached, and which is a more “specific problem” targeted and more urgent issue in most developing countries.

For example, in 2003 three project proposals have been prepared (ICS as coordinator, now pending) on “Development and application of novel technologies for used oils and oil sludge treatment in Russia and the Newly Independent States”, “Remediation of contaminated sites in Central and East European countries – Establishment of CEE forum on Remediation”, “Development of a Decision Support System on remediation technologies”. Participation of ICS in the demonstration project “Non-combustion technologies for destroying POPs” is pending.

The POP remediation and development/application of related technologies is indirectly addressed in a number of regional projects on soil remediation and water reclamation, e.g. the recently approved by EC “Sava River Basin: Sustainable Use, Management and Protection of Resources” (2004), “Network on governance, science and technology for sustainable water resource management in the Mediterranean. The role of DSS tools” (2004), and “Ecological Protection and Remediation of the Modrac Reservoir Water System as Basic Resource for Water Supply of Citizens and Industry in the Municipalities of Tuzla Canton, Danube Basin” (2003) (for detailed list of ICS-UNIDO projects see ^{xii}).

Since 2003, ICS is participating in the European Groundwater and Contaminated Land Remediation Information System (EUGRIS, www.eugris.org - the EUGRIS website is still to be finalized but many EUGRIS functions are already available at the web address), a project funded by the EC which aims at developing a web-based and user-friendly information platform for contaminated land and groundwater management. The ICS role in the project is to promote this initiative at a world-wide level.

Training and education. Each year, around 3 fellows from target countries come to ICS for training studies and research in the areas of ‘catalysis and sustainable chemistry’ and ‘remediation’, spending an average of one year at the Centre. Fellows are able to enhance their skills, work on theses, collaborate on international projects, develop computer skills, and so on, according to the type of fellowship. ICS fellows are given a grant to cover their subsistence costs. Travel to and from home countries to the ICS Centre is provided at the beginning and end of the fellowship. ICS fellows collect information on technologies for destruction of POP and PTS, and participate in all of the abovementioned activities.

Another educational activity of ICS-UNIDO in the field of POPs elimination/reduction and remediation lies in preparation of training materials, such as “Remediation Technologies: New

Trends and Tools for Soil Decontamination” and of software-based training packages. One such package on the training of the DARTS system usage is now in preparation.

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