

Technology Transfer

HIGHLIGHTS

The following technology transfer products were developed by the National Risk Management Research Laboratory's Center for Environmental Research Information (CERI) over the past year. These products are available and can be obtained from CERI using the form on page 13 or visiting our home page at: <http://www.epa.gov/ttnrmrl/>.

Technical Capsule Reports

Hard Chrome Fume Suppressants and Control Technologies (EPA/625/R-98/002)

The hard chromium electroplating industry has been affected by numerous air quality regulations on both the state and federal levels. In 1995, the U.S. Environmental Protection Agency promulgated its National Emission Standards for Chromium Emissions From Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks. Under these standards, facilities that perform industrial or functional chrome plating must demonstrate that chromium emissions do not exceed acceptable limits, and must also satisfy monitoring, record-keeping and reporting requirements. Various chemical and mechanical strategies for air pollution control exist to accomplish these goals.

This report evaluates the use of control technologies and fume suppressants to extract, recover or suppress chromium emissions prior to venting the exhaust air to the atmosphere.

Approaching Zero Discharge Processes in Metal Finishing Shops (EPA/625/R-99/008)

This capsule report shows what processes are available for achieving near zero discharge in all media for common metal finishing processes and emphasizes compliance with appropriate regulations, as well as, other pollution control treatment practices that exemplify best management practices. Information supplied within this summary report: (1) demonstrates a real-world baseline of typical electroplating source emission prevention / control techniques; (2) determines if the regulations can be met under job shop working conditions; (3) demonstrates low/lower cost emission pre-

vention/control techniques that emphasize pollution prevention; (4) demonstrates methods of reducing emissions into the environment; (5) determines which processes are at or near commercialization and may need to be researched further; (6) determines which processes may work well together, and (7) determines what percent of the waste problem they handle.

Cyanide Processes in Metal Finishing Shops (EPA/625/R-99/009)

This capsule report emphasizes compliance with appropriate regulations, as well as, other pollution control treatment practices that exemplify best management practices. Information supplied within this summary report: (1) demonstrates a real-world baseline of typical electroplating source emission prevention/control techniques; (2) determines if the regulations can be met under job shop working conditions; (3) demonstrates low/lower cost emission prevention/control techniques that emphasize pollution prevention; (4) demonstrates methods of reducing cyanide emissions into the environment; and (5) determines which processes need to be researched further. This capsule report, emphasizes pollution prevention techniques and includes, treatment and control techniques. A more general discussion is provided that will emphasize control techniques that are impacted by EPA and OSHA regulations. Process descriptions and principles, as well as, applications of state-of-the-art treatment of cyanide emissions from plating operations in all media (air, water, solid waste) are addressed. Where applicable, process equipment is presented with advantages and limitations of application along with operation and maintenance procedures. Special emphasis is placed upon best management practices.

Handbooks

Optimizing Water Treatment Plant Performance Using the Composite Correction Program - 1998 Edition (EPA/625/6-91/027)

The Composite Correction Program (CCP) has been developed and demonstrated as a method of optimizing surface water treatment

ATTENTION

The URL for the Technology Transfer Highlights homepage is: <http://www.epa.gov/ttnrmrl>. Visit us on a regular basis to keep updated on new products available from CERI

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plant performance to enhance public health protection from microbial pathogens. It focuses on effective use of the existing water treatment processes as barriers against passage of particles to the finished water. It consists of two components - a Comprehensive Performance Evaluation (CPE) followed by Comprehensive Technical Assistance (CTA). A CPE is conducted to identify the factors limiting treatment plant performance. A CTA is the performance improvement phase that can be implemented to address the performance limiting factors identified by the CPE. This handbook reflects the experience gained from over 70 CPEs and 9 CTAs. In addition, seven state pilot programs have provided the basis for the concept of area-wide application of the CCP, which is also described in the handbook.

EPA's National Risk Management Research Laboratory and Office of Ground Water and Drinking Water collaborated in the development of this handbook. This handbook will be useful to treatment plant operations and administrative personnel, consultants, technical assistance providers and state and local officials interested in fostering water treatment plant performance improvement.

Advanced Photochemical Oxidation (EPA/625/R-98/004)

The development and application of chemical oxidation technologies has gained much attention in recent years as a result of research and development in both the public and private sectors. Chemical oxidation technologies are useful in the treatment of a wide range of pollutants found in soil, air and aqueous solutions. The main research focus has been on groundwater, wastewater, and drinking water. Of particular interest is the use of ultraviolet light (photocatalysis) to enhance the degradation of volatile organic compounds present at low concentrations (< ppm) in contaminated media. Photochemical systems offer some distinct advantages over more conventional technologies, such as, air stripping, vapor extraction and carbon adsorption. Conventional separation technologies, merely, separate and transfer the contaminants from one phase to another. Moreover, when photocatalytic processes are carried out effectively, mineralization and complete destruction of contaminants occur. For example, cyanide, chlorinated aliphatics, and complex aromatic compounds can be treated in reaction times on the order of a few minutes to several hours. Photochemical oxidation systems have the propensity to generate powerful oxidants or hydroxyl radicals in the presence of ultraviolet light (UV) and chemical catalysts, such as: hydrogen peroxide (H_2O_2), titanium dioxide (TiO_2), Fenton's reagent ($FeSO_4/H_2O_2$) and ozone (O_3). Improved system configuration and photolytic efficiency have broadened the application and cost effectiveness of photochemical oxidation processes.

This handbook will serve as a guide and information resource for remedial project managers, on-scene-coordinators, regulators (federal, state and local), researchers, consultants, industry and other interested parties involved with the management of contaminated air, soil and water. This handbook consolidates and updates information related to advanced photochemical oxidation processes from a variety of sources. It is intended that this information will enable decision makers to evaluate the efficacy and applicability of advanced chemical oxidation processes for remediating, treating and controlling contaminated media and waste products.

Brownfields Technical Guides

Technical Approaches to Characterizing and Cleaning Up Automotive Repairs Sites under the Brownfields Initiative (EPA/625/R-98/008)

Technical Approaches to Characterizing and Cleaning Up Iron and Steel Mill Sites under the Brownfields Initiative (EPA/625/R-98/007)

Technical Approaches to Characterizing and Cleaning Up Metal Finishing Sites under the Brownfields Initiative (EPA/625/R-98/006)

Cost Estimating Tools and Resources for Addressing Sites under Brownfields Initiative (EPA/625/R-99/001)

CERI has developed three technical guidance documents to facilitate assessment and cleanup of brownfields sites and a companion resource document which describes cost estimating resources. Many communities across the country contain brownfields sites, which are abandoned, idle and underused industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination. The EPA's Brownfields Economic Redevelopment Initiative was established to empower states, communities and other stakeholders in economic redevelopment to prevent, assess, safely cleanup and sustainably reuse brownfields sites.

Each guide in this series contains information on a different type of brownfields site, classified according to former industrial use; the types of sites selected for the guides are iron and steel mill sites, metal finishing facilities and automotive repairs shops. The guides are technical in nature but also address nontechnical sources of information to assist the decision maker in developing as complete an understanding of the site as possible. The guides present a general overview of site information that should be obtained prior to site characterization, suggest where to obtain pertinent site information and, provide guidelines on how to access and apply this information.

Each of three technical guides contain a description of typical industrial operations that could have occurred at sites used for these purposes, matrix listing of contaminants typically associated with the site type and the media in which the contaminants can be found. Tables within the guides identify available site characterization tools and technologies and sample collection practices. Quality assurance and quality control guidance and data quality objective guidance are referenced. Estimates of the cost of site characterization are provided.

Factors to be considered in determining the necessary level of cleanup, including reference to state voluntary cleanup programs are discussed. Summaries of applicable cleanup technologies, typical costs associated with these technologies and their applicability to specific contaminants in various media are presented in tables.

The document that summarizes cost estimation techniques includes information on databases, web sites, computer software and services that can assist a decision maker to develop an order of magnitude cost estimate, or evaluate one that is presented to the decision maker. This cost document is intended to be used as a companion to one of the industry specific guides in the series.

Manuals

Constructed Wetlands Treatment of Municipal Wastewaters (EPA/625/R-99/010)

This new manual which is nearing completion (late 1999) will be a reliable engineering evaluation of constructed wetlands as systems for treatment of primary or lagoon-treated municipal wastewaters to meet secondary or advanced secondary effluent standards. It will take advantage of field studies and apply environmental engineering principles and mechanisms to the documented experiences of controlled pilot and well-documented studies to produce a reference which can be used by engineers with confidence when confronted by real problems of small communities to meet actual effluent standards set through the discharge permitting processes. It will discuss the commonly held biological myths that have characterized the constructed wetland literature to date, and replace them by application of the known environmental engineering principles of physical, chemical and biological treatment mechanisms which are universally recognized by the profession, and will offer some historical basis of how those myths were transported from other scientific fields.

This first comprehensive environmental engineering analysis of constructed wetlands as treatment devices is prepared in practical engineering terms for use by design engineers, prospective facility owners, regulators and planners to allow them to consider and evaluate these systems in the same way and comparatively to other systems of treatment in order to assure that the technology is properly applied on the basis of its capabilities and characteristic properties.

The manual will also provide information on the fate of pollutants, key construction and startup issues, case studies and cost information on several existing constructed wetland treatment systems. The engineering principles approach assists the reader in understanding what constructed wetlands can realistically be expected to accomplish regarding removal of specific and classes of pollutants when treating municipal wastewaters. Armed with such information, complete treatment trains may be conceived and evaluated in concert with other alternative approaches. There is also recognition of the inherent aesthetic values which the public associates with natural treatment systems, which goes beyond the traditional engineering evaluation of alternatives. This recognition gives an intrinsic value to these systems which does not exist for many alternative approaches, even when they are more effective in removal of pollutants. Therefore, social values may enter into the choice of the treatment system, even at some additional cost to the community.

This manual should be a valuable addition to the library and ready reference books of any wastewater practitioner or planner dealing with small community wastewater problems.

EMPACT Technology Transfer Manual on Ozone Monitoring and Mapping (EPA/625/R-99/007)

CERI is completing an Ozone Monitoring and Mapping Manual under the EPA EMPACT (Environmental Monitoring for Public Access and Community Tracking) program. The manual may be used by interested communities and states as a tool to plan, design and implement an ozone monitoring network; a real-time (or time relevant) data acquisition and delivery system, and an ozone mapping software package. The ozone mapping package generates static and animated maps that are similar to the weather maps used on television. The manual also provides guidance to risk communicators and the public as to the health impacts associated with elevated ozone levels and what actions may be taken to minimize those impacts. An interactive CD-ROM of the manual is being

prepared which will allow the user (via hyperlinks) to instantly access any desired section of the manual. The CD-ROM will also contain direct links to existing EPA and EMPACT websites.

The manual and CD-ROM are scheduled for completion in September 1999. These products will in turn be available for ordering in late 1999.

Compendiums of Test Methods for the Determination of Toxic Inorganic and Organic Compounds in Ambient Air (EPA 625/R-96/010a) (EPA/625/R-96/010b)

Until recently, limited guidance has been available to federal, state and local agencies and to other organizations concerned with the determination of pollutant concentrations in ambient air. As a result, agencies, industry, and the general public have had to develop their own monitoring strategies including selection of methods, sampling plan design, and specific procedures for sampling, analysis, logistics, calibration, and quality control. For the most part, these procedures have been based on professional judgement rather than on documented uniform guidance. Many agencies and professional/research organizations have developed ambient air monitoring methods and procedures, mostly to respond to specialized needs. But these methods and procedures have, in general, been neither standardized nor readily available to other agencies involved with ambient air monitoring.

To address these needs, CERI has completed two ambient air test method compendiums: "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air - Second Edition" and "Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air - First Edition". These compendiums have been prepared to provide regional, state, and local environmental regulatory agencies with step-by-step sampling and analysis procedures for the determination of select toxic organic and inorganic pollutants. The compendiums consist of a series of ambient air test methods prepared using a standardized format with a variety of applicable sampling procedures. The compendiums allow the user flexibility in selecting alternatives to complement his or her own background and laboratory capability.

Electronic versions of these two compendiums are also available for downloading from the Ambient Monitoring Technical Information Center (AMTIC) of EPA's Office of Air Quality Planning and Standards Technology Transfer Network via the Internet at: <http://www.epa.gov/ttn/amtic>.

Seminar Publications

Proceedings: Retrofit Opportunities for Water Resource Protection in Urban Environments (EPA/625/R-99/002) (EPA/625/C-99/001 - CD-ROM)

This national conference, co-sponsored by EPA, Northeastern Illinois Planning Commission, and Illinois Environmental Protection Agency, was held February 9-12, 1998, in Chicago, IL. The conference focused on modifying existing stormwater facilities to enhance water quality and retrofitting stormwater drainage systems to add water quality components. These retrofits include practices that will slow runoff, remove sediment and nutrients and provide a basis for restoring eroded stream channels.

The proceedings include forty-four papers delivered at the conference. Papers are from all over the United States and include several from Australia. Focus areas include monitoring design, modeling, education, innovative technologies, and evaluation. Please note that the proceedings are available in paper as one publication number, and on CD-ROM as another publication number.

Guides to Pollution Prevention

Industrial Assessments for Pollution Prevention and Energy Efficiency (EPA/625/R-99/003)

This document presents an overview of industrial assessments and the general framework for conducting an assessment. It describes combined pollution prevention and energy "industrial assessments," providing guidance to those performing assessments at industrial or other commercial facilities. In addition, basic information about waste generating industrial operations and energy consuming equipment is provided. This guide can be used by both facility personnel to conduct in-house assessments of operations and by third parties who are interested in providing industrial assessments.

Traditionally, assessments have been performed on singular problem areas, focusing on either pollution prevention or energy. An interagency agreement between the EPA and the Department of Energy combined pollution prevention and energy assessments into industrial assessments, looking at both areas for small and medium size facilities.

This guide is organized into four basic sections:

- Basic Concepts, Chapters 1-4 - Assessment methodology, fundamentals of an assessment, and evaluation of pollution prevention and energy conservation opportunities.
- Specific Waste Generation Information, Chapter 5 - Industrial operations, waste generated from each operation, and pollution prevention opportunities.
- Specific Energy Consumption, Information, Chapters 6-10 - Types of energy consuming equipment including electrical equipment, heat generating equipment like boilers and furnaces, prime movers of energy, thermal applications, and HVAC.
- References and Case Studies - References, sources of information, and pollution prevention and energy conservation case studies.

This guide is an effort by EPA to contribute to an understanding of both pollution prevention and energy assessments at industrial and commercial facilities. Companies from large to small, and government at all levels, as well as assistance providers, will find the information contained in this guide useful.

Environmental Regulations and Technology

Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge (EPA/625/R-92/013 - 1999 Edition)

Properly treated sewage sludge (biosolids) is used as a soil conditioner and partial fertilizer in the United States and many other countries. While sludge has beneficial plant nutrients and soil-conditioning properties, if it is not treated, it may also contain bacteria, viruses, protozoa, parasites, and other microorganisms that are harmful to humans. Sewage sludge that is to be applied to land or placed in/on a surface disposal site must meet federal and state requirements for the control of pathogenic microorganisms and vectors.

This document, previously published in 1989 and 1992, describes the federal requirements and provides guidance for meeting those requirements. It is especially intended for:

- Owners and operators of municipal wastewater treatment works.
- Developers and marketers of sludge treatment processes.
- Groups that distribute and market sludge products.
- Individuals involved in applying sludge or septage to land.
- Regional, state, and local government officials responsible for implementing and enforcing the Part 503 Subpart D regulation. These include the EPA Regional Sludge Coordinators, State Sludge Coordinators, and permit writers.
- Consultants to these groups.

This 1999 edition gives regulatory and wastewater treatment plant personnel more information about the public health issues and the impetus behind some of the regulatory requirements. There is more operational guidance included in order to provide facilities with information about meeting pathogen reduction standards to satisfy both regulatory and public health requirements. In addition, because we are aware that regulations and guidance documents cannot address every possible scenario of biosolids reuse, this document includes a variety of facility examples so that regulators and generators can see how facilities of comparable size and type are meeting the regulations.

Meetings/Conferences

Innovative Clean-Up Approaches: Investments in Technology Development, Results and Outlook for the Future

**November 2-4, 1999, Indian Lakes Resort, Bloomington, IL
(Chicago Metropolitan Area)**

Through a number of legislative programs and special initiatives, EPA has invested in the development and implementation of characterization and treatment technologies for hazardous waste remediation. The EPA has also sponsored and promoted the development, demonstration and commercialization of technologies both directly and with a number of partners in other federal agencies, academia, and the private sector.

The EPA's Office of Research and Development and Technology Innovation Office are jointly sponsoring this conference. The conference will provide an opportunity for stakeholders and partners to share the most recent information about the status of these efforts, and discuss future research and information needs. Stakeholders will also learn of opportunities to participate in EPA sponsored programs in the future such as those to be featured in special workshops.

The audiences for this conference are researchers, scientists and academia; developers and vendors of characterization and remediation technologies; federal and state remediation officials;

private clean-up contractors; and environmental consulting industry.

Technical presentations will address site characterization; treatment of recalcitrant compounds; monitored natural attenuation; dense non-aqueous phase liquids; groundwater treatment, including permeable reactive barriers, pump and treat enhancements and oxidation; in-situ soil treatment, including bioremediation and phytoremediation, and metals in soils.

Workshops topics will include Superfund Innovative Technology Evaluation (SITE) Program; Brownfields; EPA Research Grants; and Electronic Information Resources.

Attendees will have the opportunity to discuss technologies one-on-one with exhibitors and to participate in hands-on demonstrations.

If you wish to receive a copy of the conference program and registration in the mail, please send your name and address to: SAIC c/o Rebecca Glos, 11251 Roger Bacon Dr., Reston, VA 20191. You may also visit CERI's web site at www.epa.gov/ttnrmrl.

National Conference on Risk and Groundwater

Omni Hotel, Atlanta, GA

November 15-17, 1999

CERI is cosponsoring a National Conference on Risk and Groundwater with the National Groundwater Foundation, in Atlanta, GA, on November 15 - 17, 1999. Papers, case studies and posters, dealing with all aspects of human health and ecological risk will be presented. Visit www.groundwater.org for the complete agenda and registration information, or call Alan Everson at (513) 569-7046.

This conference is aimed at groundwater professionals in federal, state, tribal and other government and the private sector. Please note that this conference is back-to-back with the Groundwater Guardian National Conference.

Satellite Teleconference

EMPACT / AirNow Technology Transfer Tools and Public Outreach

CERI, in collaboration with EPA's EMPACT program and the Office of Air Quality Planning and Standards Ozone Mapping Project (referred to as AirNow) will be broadcasting a teleconference on technology transfer and public outreach tools available through AirNow. The previously described Ozone Monitoring and Mapping Manual (EPA/625/R-99/007) developed under the EMPACT program will be the principal focus of the teleconference. The teleconference will also provide guidelines for developing a public outreach program that effectively communicates the health impacts associ-

ated with ground-level ozone exposure as well as possible measures that can be taken to minimize exposure. In addition, it will highlight case studies of successful ozone mapping and outreach programs.

The teleconference is scheduled for December 15, 1999, and will be the second part of a three-part AirNow teleconference series. An announcement of the teleconference series will be placed on the CERI website (<http://www.epa.gov/ttnrmrl/>) and on the AirNow website (<http://www.epa.gov/airnow/>).

The 92nd Annual Meeting of the Air and Waste Management Association

St. Louis, MO

June 20-24, 1999

The Air & Waste Management Association (AWMA) has never skimped on the volume of information it delivers at its annual meeting and exhibition. This year's 92nd meeting in St. Louis, MO, June 20-24, 1999, was no exception. AWMA bills its annual meeting as one of the world's largest gatherings of environmental professionals. This year's event had 142 technical sessions, featuring over 600 paper titles covering 25 broad categories - all developed to attract profes-

sionals from all over the world. Exhibitors occupied nearly 1500 booth spaces marketing their products and services to a highly targeted audience. CERL coordinated EPA's involvement, which included participation by several labs, program offices, and other EPA groups. EPA is planning its involvement at the 93rd AWMA which will take place in Salt Lake City, UT, June 19-21, 2000.

American Water Works Association's National Conference

Chicago, IL

June 20-24, 1999

Chicago hosted the American Water Works Association's (AWWA) annual conference June 20-24, 1999. Approximately 14,000 individuals attended this conference. The National Risk Management Research Laboratory (NRMRL) and the Office of Ground Water and Drinking Water (OGWDW) again cooperated this year in the annual exhibit. EPA technical information products were made available to the attendees and over 500 exhibitors. Excellent infor-

mation was presented in two EPA papers at the Conference. One concerned the health effects of arsenic in drinking water - the National Academy of Science evaluation; and the other the risk management deliberations being undertaken by OGWDW. Next year's AWWA annual conference will be held in Denver, CO, June 11-15, 2000.

New Technology Transfer Products Coming Your Way

VOC Recovery Seminar Proceedings Summary Report and Videotape

CERI completed a summary report and videotape for the VOC (Volatile Organic Compounds) Recovery Seminar recently held in Cincinnati. The seminar focused on the following key issues:

- Status and future direction of EPA, DOE, and other major research programs.
- What are the latest technology innovations in VOC treatment and recovery?
- Performance and cost effectiveness of VOC recovery techniques.
- How are recovery techniques applied to air, water, and solid wastes?

Presenters were from industry, academia, EPA, and various consulting firms. The presentations were followed by several facilitated breakout sessions; these sessions allowed participants a chance to discuss their needs and opinions on VOC recovery trends, research, and other issues. The report contains summaries of the presentations and discussions that took place during the seminar. The videotape in turn contains the edited highlights of each of these presentations. The VOC Recovery Seminar Summary Report and edited videotape will be available for order in late 1999.

Facility Pollution Prevention (P2) Guide in Revision

"The Facility Pollution Prevention Guide", EPA/600/R-92/088, has been one of the most popular tools that ORD's Pollution Prevention program has developed. The Guide was preceded by the "Waste Minimization Assessment Manual", written in 1988. Both of these manuals have assisted many in performing waste and pollution prevention assessments. The practice of pollution prevention has evolved with many alternative approaches developed for source reduction, efficiency, environmental management, quality and conservation.

A focus group was conducted by CERI preceding the National Pollution Prevention Roundtable's Annual Spring Conference in Cincinnati, Ohio, in April of 1998. This group determined that this guide should be updated after tackling the problem of evaluating the present usefulness of the Facility P2 Guide and recommended changes and additions to a revision.

An Engineering Foundation Conference, in August, 1998, focused on improving the practice of pollution prevention. Many tools

were discussed, demonstrated and applied to case studies in an attempt to evaluate reaction to methodologies other than the typical worksheets used in the Facility Guide.

After these two workshops, a strategy was developed for revising the current guide. This guide will emphasize systems approaches, such as the Green Zia program in New Mexico and environmental management programs, providing the use of tools traditionally used in quality programs to enable the process. The traditional methods will also be discussed, providing new checklists and the standard worksheets approach. A CD-ROM will accompany the guide with tools for application with examples and expanded descriptions of methodology.

Many interested practitioners have been offered the opportunity to review the manual as it is revised. The Facility Planning Workgroup of the National Pollution Prevention Roundtable is also participating in the review as one of the group's projects. The new guide should be available in mid-2000.

Environmental Management Systems Publications

Two documents addressing ISO 14001 - Environmental Management Systems are being prepared for publication in spring of 2000. The first document is ISO 14001 - A Tool for Supporting Government Environmental Programs and Policies. This document will explain the background and development of ISO 14000 standards; explain the ISO 14001 Environmental Management System, providing the EMS model, discussing the elements of environmental policy, planning, implementation and operation, checking and corrective action, management review, and the ISO 14001 implementation and certification process. It will look at government environmental management related policies and pilot studies, from President Clinton's Executive Order 12856, EPA's Code of Environmental Management Principles, the Department of Energy's and the Department of Defense's Environmental Management activities, other government departments and agencies, to compliance, voluntary action programs, prevention of pollution, self-policing, environmental justice,

brownfields redevelopment and sustainability. Finally, the document will discuss using ISO 14001 as a tool in government activities.

The second document is entitled ISO 14001 - A Management Tool for Achieving Competitive Advantage and Environmental Compliance. This document will explain the background and development of ISO 14000 standards; explain the ISO 14001 Environmental Management System, providing the ISO 14001 EMS model and concept, discussing the elements of environmental policy, planning, implementation and operation, checking and corrective action, management review, and ISO 14001 implementation and certification process, and describe briefly twenty-five case studies for small, medium and large industries. Finally the document will discuss benefits of environmental management systems.

Keep visiting the Technology Transfer Highlights homepage at www.epa.gov/ttnbrnrl for new publications as they become available.

Technical Resource Document: In-situ Treatment of Groundwater Contaminated with Chromium

Chromium contamination of soils and groundwater is a persistent and widespread problem that has resulted from many years of neglect and poor management practices. Removal and reduction of heavy metals in the environment presents a great challenge to risk managers and decision makers in reducing the risk of metal contamination to human health and the environment. Solutions to this problem have been very evasive and difficult to come by. Regulators and RPM's have been challenged by this problem from the beginning of site remediation efforts. Many decision makers and stakeholders lack the resources and expertise to remediate these kind of sites, in a timely and cost effective manner. Several remediation strategies have been developed which use innovative in-situ technology approaches in remediating groundwater contaminated with chromium compounds. Geotechnical techniques, electrokinetics, reactive zones, permeable reactive subsurface barriers, bioremediation and natural

attenuation are examples of some of the technologies which are being applied.

A technology transfer document is being developed which will feature some of the technology applications being used to remediate contaminated groundwater and will be available for distribution in late 1999. This technical resource guide will be developed from results of treatability studies, case studies, field demonstration projects, as well as, current on-going work being conducted at contaminated sites. This document will include an expanded version of background information, an extensive literature review and field performance describing the state-of-the-art application of these technologies. Where applicable, cost information shall also be provided which will detail the actual costs associated with the implementation of each technology described.

TECHNOLOGY TRANSFER PRODUCTS

MANUALS

Land Treatment of Municipal Wastewater (Oct. 1981)	625/1-81/013
Supplement for Land Treatment of Municipal Wastewater (Oct. 1984)	625/1-81/013a
Odor and Corrosion Control in Sanitary Sewerage Systems and Treatment Plants	625/1-85/018
Phosphorus Removal	625/1-87/001
Dewatering Municipal Wastewater Sludges (Sept. 1987)	625/1-87/014
Fine Pore Aeration Systems (Oct. 1989)	625/1-89/023
Alternative Collection Systems for Small Communities (Oct. 1991)	625/1-91/024
Guidelines for Water Reuse (Sept. 1992)	625/R-92/004
Wastewater Treatment/Disposal for Small Communities (Sept. 1992)	625/R-92/005
Control of CSO Discharges (Sept. 1993)	625/R-93/007
Nitrogen Control (Sept. 1993)	625/R-93/010
Alternative Methods for Delivery and Recover (Oct. 1994)	625/R-94/003
Recycling and Reuse of Materials Found on Superfund Sites (Oct. 1994)	625/R-94/004
Ground Water and Leachate Treatment Systems (Jan. 1995)	625/R-94/005
Process Design Manual for Land Application of Sewage Sludge and Domestic Septage	625/R-95/001
Process Design Manual: Surface Disposal of Sewage Sludge and Domestic Septage	625/R-95/002
• Compendiums of Test Methods for the Determination of Toxic Inorganic Compounds in Ambient Air	625/R-96/010a
• Compendiums of Test Methods for the Determination of Toxic Organic Compounds in Ambient Air	625/R-96/010b
SITE: Rochem Separation System's Inc. (ROCHEM) Disc Tube™ Module (DTM)	
Innovative Technology Evaluation Report (ITER)	540/R-96/507
• EMPACT Technology Transfer Manual on Ozone Monitoring and Mapping	625/R-99/007
• Constructed Wetlands Treatment of Municipal Wastewaters	625/R-99/010

TECHNICAL CAPSULE REPORTS

Radon-Resistant Construction Techniques for New Residential Construction: Technical Guidance	625/2-91/032
Approaches For Remediation Of Uncontrolled Wood Preserving Sites (Nov. 1990)	625/7-90/011
Treatment Of Metal Finishing Industry Wastewaters: Evaporation Process Capsule Report	625/R-96/008
Treatment Of Metal Finishing Industry Wastewaters: Reverse Osmosis Process Capsule Report	625/R-96/009
Sources and Air Emission Control Technologies at Waste Management Facilities	625/R-97/002
Aqueous Mercury Treatment	625/R-97/004
• Hard Chrome Fume Suppressants and Control Technologies	625/R-98/002
• Approaching Zero Discharge Processes in Metal Finishing Shops	625/R-99/008
• Cyanide Processes in Metal Finishing Shops	625/R-99/009

SEMINAR PUBLICATIONS

Permitting Hazardous Waste Incinerators	625/4-87/017
Meeting Hazardous Waste Requirements for Metal Finishers	625/4-87/018
Transport and Fate of Contaminants in the Subsurface	625/4-89/019
Corrective Actions - Technologies and Applications	625/4-89/020
Solvent Waste Reduction Alternatives	625/4-89/021
Requirements for Hazardous Waste Landfill Design, Construction and Closure	625/4-89/022
Technologies for Upgrading Existing or Designing New Drinking Water Treatment Facilities	625/4-89/023
Risk Assessment, Management and Communication of Drinking Water Contamination	625/4-89/024
Design and Construction of RCRA/CERCLA Final Covers	625/4-91/025
Site Characterization for Subsurface Remediation	625/4-91/026
Nonpoint Source Watershed Workshop	625/4-91/027
Medical and Institutional Waste Incineration: Regulations, Management, Technology, Emissions, and Operation ...	625/4-91/030
Control of Biofilm Growth in Drinking Water Distribution Systems	625/R-92/001

- Listed for first time

TECHNOLOGY TRANSFER PRODUCTS (continued)

Organic Air Emissions from Waste Management Facilities	625/R-92/003
The National Rural Clean Water Program Symposium	625/R-92/006
RCRA Corrective Action Stabilization Technologies	625/R-92/014
Control of Lead and Copper in Drinking Water	625/R-93/001
Wellhead Protection: A Guide for Small Communities	625/R-93/002
Operational Parameters for Hazardous Waste Combustion Devices	625/R-93/008
Design, Operation, and Closure of Municipal Solid Waste Landfills	625/R-94/008
National Conference on Urban Runoff Management	625/R-95/003
National Conference on Environmental Problem Solving with Geographic Information Systems	625/R-95/004
Managing Environmental Problems at Inactive and Abandoned Metals Mine Sites	625/R-95/007
National Conference on Sanitary Sewer Overflows	625/R-96/007
Proceedings: National Watershed Water Quality Project Symposium	625/R-97/008
Proceedings of National Conference on Management and Treatment of Contaminated Sediments	625/R-98/001
• Proceedings: Retrofit Opportunities for Water Resource Protection in Urban Environments	625/R-99/002
CD-ROM	625/C-99/001

BROCHURES

Environmental Pollution Control Alternatives: Drinking Water Treatment for Small Communities	625/5-90/025
Regional Environmental Monitoring and Assessment Program (R-EMAP)	625/R-93/012

HANDBOOKS

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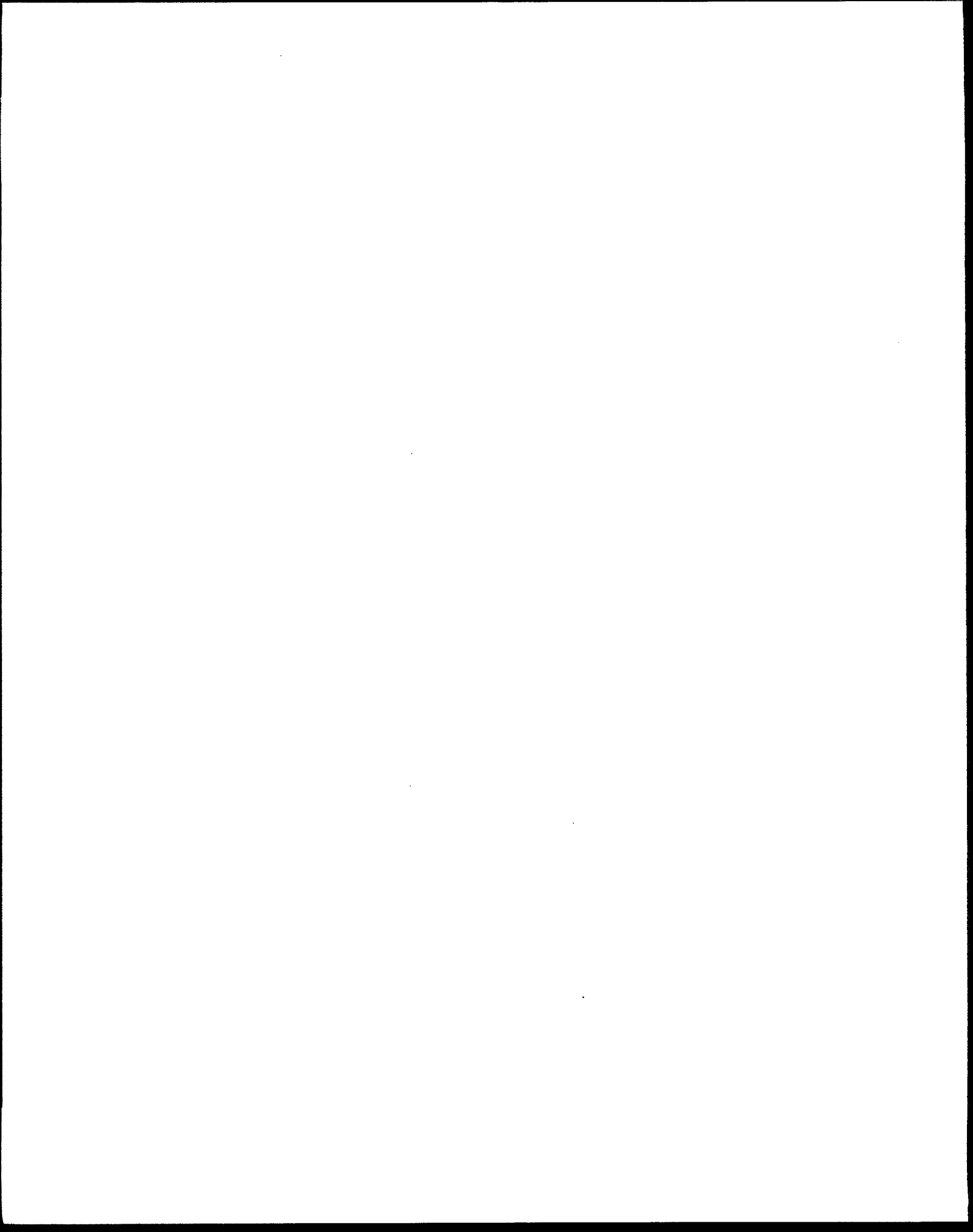
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