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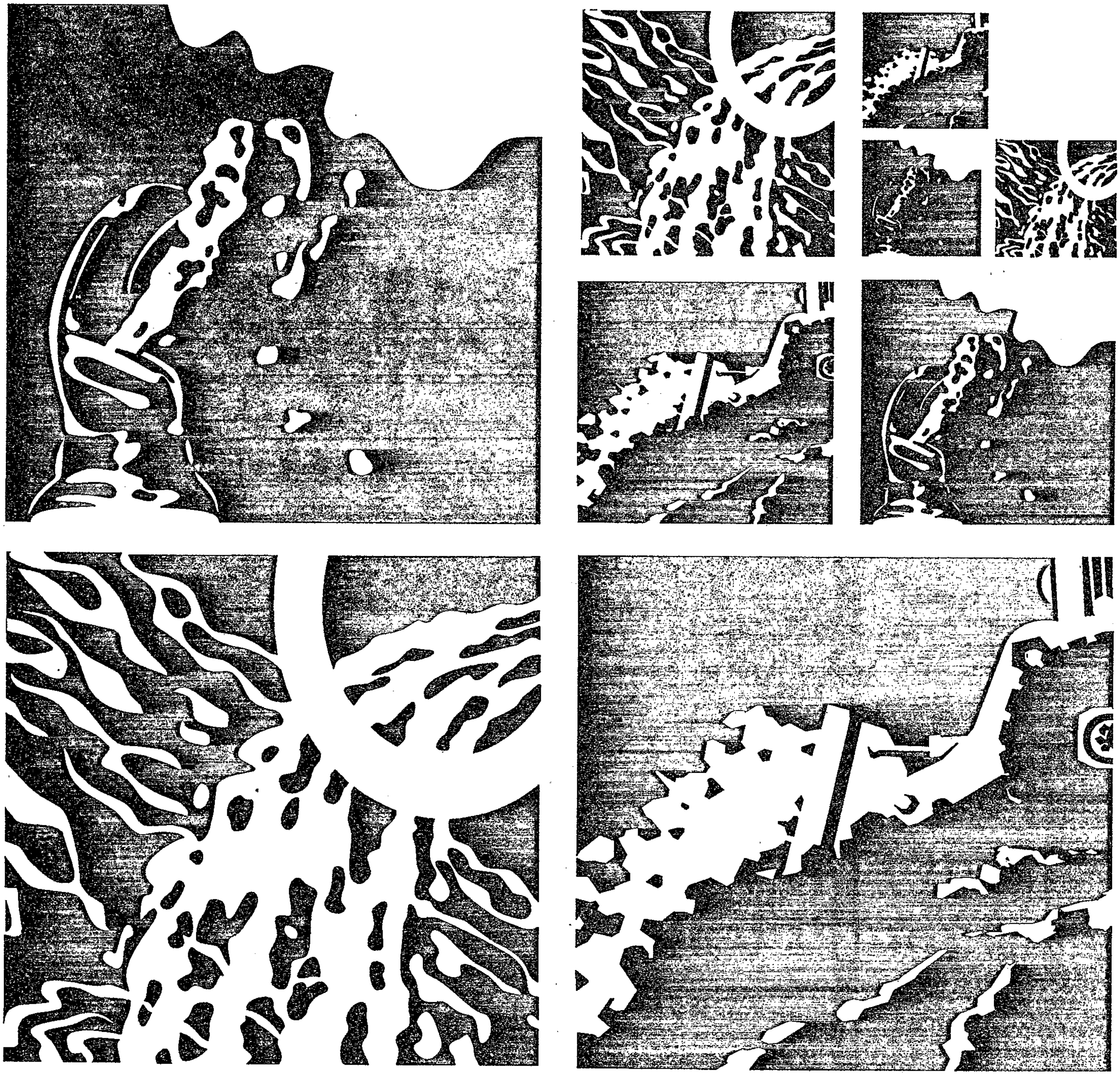
July 1992

EPA

Andrew W. Breidenbach Environmental Research Center Small Systems Resource Directory



EPA 600/R-92/098
July 1992

ANDREW W. BREIDENBACH ENVIRONMENTAL RESEARCH CENTER SMALL SYSTEMS RESOURCE DIRECTORY

OFFICE OF
RESEARCH AND DEVELOPMENT
CINCINNATI, OH 45268

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Notice

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Acknowledgments

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Introduction

This directory describes more than 50 projects conducted or sponsored over the past 5 years by the Andrew W. Breidenbach Environmental Research Center (AWBERC) of the U.S. Environmental Protection Agency's (EPA's) Office of Research and Development (ORD). These projects provide information and assistance to small systems in the areas of drinking water, wastewater, and solid and hazardous waste management. The purpose of the directory is to acquaint small system resource providers, managers, operators, and state and local officials with the capabilities of AWBERC in solving small system problems. Further, the Research Center is willing to help wherever possible.

What Is ORD?

ORD provides high quality, timely scientific and technical information in the service of EPA's goals. The Agency's research program is conducted through 12 environmental laboratories across the country. employing some 1,900 people, with an annual budget of about $490 million. The research focuses on areas identified by EPA's planning process as needing additional emphasis to provide the information required for Agency decisionmaking.

What Is AWBERC?

AWBERC, located in Cincinnati, Ohio, is one of EPA's largest research and development (R&D) facilities. Dedicated in 1975 and opened in 1976, it consolidated several environmental research laboratories that had established an international reputation for water research. With state-of-the-art facilities and a highly experienced staff, AWBERC has continued this tradition of excellence in water research and has become a leader in new areas of concern, such as solid and hazardous waste management, that have emerged in recent years. In addition, AWBERC supports many EPA programs by evaluating the risks posed by environmental pollutants, developing methods to analyze environmental media for pollutants, developing methods to treat and control pollution, and directing education and outreach programs to increase awareness about ways to lessen pollution. AWBERC's laboratories and offices collaborate with EPA program and regional offices, state and local governments, federal agencies, universities, industry, and international organizations to identify environmental problems and develop solutions.

AWBERC currently encompasses seven technical laboratories and offices that manage a diversity of research programs, and two administrative offices that provide essential administrative support.

Research Offices

The Risk Reduction Engineering Laboratory (RREL) develops technologies to prevent, reduce, treat, and control pollution—particularly pollution from hazardous and solid waste—and to treat drinking water and wastewater.

The Environmental Monitoring Systems Laboratory (EMSL) develops methods and quality assurance materials for monitoring pollutants in the environment.

Technical Support Offices

The Environmental Criteria and Assessment Office (ECAO) prepares human health-based risk assessments and methodologies for risk assessment.

The Technical Support Division (TSD) provides support to EPA in developing drinking water regulations and to communities in complying with the regulations.

Technical Support Offices (continued)

The Environmental Response Team (ERT) provides training and technical assistance for response to hazardous materials emergencies.

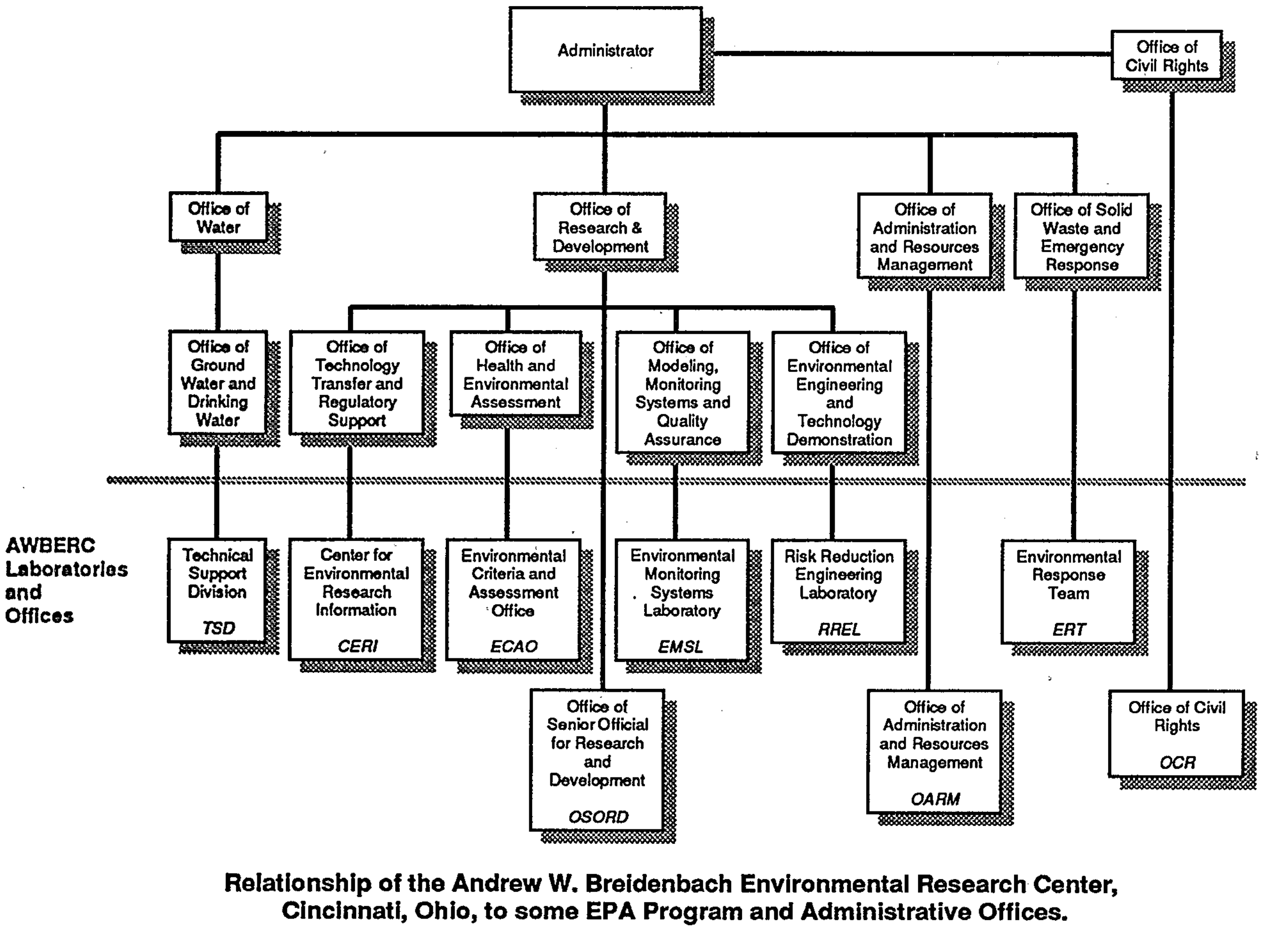
The Center for Environmental Research Information (CERI) communicates the results of EPA's R&D efforts to people who can use and apply the information.

The Office of the Senior Official for Research and Development (OSORD) fosters communication and exchange between AWBERC scientists and national and international representatives from government, academia, industry, and the public. In addition, it provides support services for AWBERC's R&D facilities.

Administrative Offices

The Office of Administration and Resource Management (OARM) provides the human resources and administrative support essential for AWBERC's R&D activities.

The Office of Civil Rights (OCR) is responsible for affirmative action and outreach to increase the contribution of minorities and women to AWBERC's environmental research.



Relationship of the Andrew W. Breidenbach Environmental Research Center, Cincinnati, Ohio, to some EPA Program and Administrative Offices.

AWBERC Activities to Assist Small Systems

EPA recognizes the difficulties faced by small systems in complying with environmental regulations. Small systems typically lack the financial and technical resources they need to meet their environmental responsibilities. AWBERC is playing an important role in helping small communities address these problems.

In the area of drinking water treatment, for example, AWBERC's RREL has been evaluating simple, cost-effective treatment technologies applicable to small systems. TSD has been working to facilitate implementation of appropriate technologies, such as developing an easy-to-understand monitoring guide for small system operators, and to find ways to increase the financial capabilities of small systems. TSD and CERI have developed and made available a comprehensive approach to solving the performance problems of small water treatment facilities through careful analysis and correction of factors limiting performance.

In the area of wastewater treatment, RREL is helping to develop control technologies that are cost effective for small systems. CERI is developing publications, workshops, and other tools to communicate information about wastewater treatment technologies and sludge disposal methods.

In the area of solid and hazardous waste, AWBERC is conducting pioneering work to help small industries reduce or recycle the waste they generate. AWBERC also is providing information to help ensure the safe disposal of waste.

AWBERC recently formed a Small Systems Workgroup to help its scientists and engineers focus their work in defining small systems problems and solutions. Members of the Workgroup include:

Walter Feige, RREL/OSORD (Workgroup Coordinator)

Donald Brown, RREL	James Kreissl, CERI
Robert Clark, RREL	Robert Landreth, RREL
Charlotte Cottrill, ECAO	James Lichtenberg, EMSL
Kim Fox, RREL	James E. Smith Jr., CERI
Emma Lou George, RREL	Thomas Sorg, RREL
James Goodrich, RREL	Barbara Wysock, TSD

Feedback about this Resource Directory will help the Workgroup plan a series of seminars addressing the needs of small systems.

How to Use This Directory

This directory is divided into four sections: Drinking Water, Municipal Wastewater, Solid and Hazardous Waste Management, and Multidisciplinary (projects that apply to more than one area). The reader can consult the table of contents to locate projects of interest. In each project description, the reader will find a summary of work conducted or sponsored by AWBERC, a list of publications generated by the project, and an AWBERC contact for further information about the project. For studies that were recently begun and for which written reports are not yet available, the reader can simply write or call the contact listed.

How to Order Publications Listed in the Directory

Most of the publications listed in the directory can be obtained through either EPA or the National Technical Information Service (NTIS).

To order a publication (free of charge) with an EPA document number, write:

ORD Publications
P.O. Box 19962
Cincinnati, OH 45219-0962

To order a publication (payment required) with an NTIS order number, call (703) 487-4650 or write:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

Drinking Water

Simplified Sampling Instructions for Small Water Systems

Introduction

EPA is developing a set of simplified sampling instructions for operators of small water systems (those serving fewer than 3,300 persons). These instructions will help small systems meet the requirements of the 1986 Amendments to the Safe Drinking Water Act (SDWA).

Project Description

To assist small systems in complying with the new drinking water regulations, EPA has developed the *Pocket Sampling Guide for Operators of Small Water Systems*. In the first version of the guide, four regulations are addressed: the Volatile Organic Chemical (VOC) Rule (Phase I), the Total Coliform Rule, the Surface Water Treatment Rule, and the Lead and Copper Rule. The second version will address monitoring requirements and sampling instructions for chemicals covered under Phase II (including VOCs, synthetic organic chemicals [SOCs], and inorganics) and radionuclides. The guide contains a brief overview of the monitoring provisions of the regulations, descriptions and photographs of sampling procedures, helpful tables and figures, sections on general sampling considerations and the new standardized monitoring framework, and a glossary. The guide is designed so that it can be updated easily as existing regulations are revised or new regulations are promulgated.

For ease of use in the field, the guide is pocket-sized and bound at the top. Coded tabs are used for fast look-up. Sampling instructions and photographs are reproduced on removable, foldout pages, printed on durable, waterproof paper, for use as a quick reference during actual sampling.

Publications

Pocket Sampling Guide for Operators of Small Water Systems. 1992. EPA/814-B-92-001 (in press).

AWBERC Contact

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Use of the Composite Correction Program Approach to Achieve Compliance with the Surface Water Treatment Rule

Introduction

EPA has developed the Composite Correction Program (CCP), a comprehensive procedure to systematically evaluate the design, operation, maintenance, and administration of a treatment plant. The CCP approach identifies and corrects the unique combination of factors preventing a plant's compliance with the Surface Water Treatment Rule (SWTR). EPA also has developed a handbook for conducting CCP evaluations.

Project Description

When the SWTR takes effect in June 1993, many public water systems that use surface supplies and filter may find themselves out of compliance. To help systems achieve compliance, EPA has developed the CCP approach. The first step in this approach is the Comprehensive Performance Evaluation (CPE), which systematically identifies the unique combination of factors preventing compliance. The second step is Comprehensive Technical Assistance (CTA), in which the performance-limiting factors identified in the CPE are corrected over a 6-month period.

EPA demonstrated the CCP approach at 36 plants. State regulatory personnel participated in the plant evaluations to identify whether and how they could use this approach to address their SWTR compliance problems. Implementing the approach through the state programs should ensure that small systems are directed to the activities that provide compliance with the SWTR at the lowest cost. EPA will continue to work closely with states to give them the capability to use the CCP approach to correct SWTR compliance problems. Approximately one CPE will be completed each month. These activities will focus on small systems.

This project has shown that most small systems evaluated do not need major construction to comply with the SWTR. Improved process control is the major element to achieve compliance, but improved administrative support may also be required.

The results of this project have been summarized in a CCP handbook for drinking water. The handbook presents the procedures and information necessary to complete CCP evaluations.

Publications

Handbook: Optimizing Water Treatment Plant Performance Using the Composite Correction Program. 1990. EPA/625/6-91/027.

Summary Report: Optimizing Water Treatment Plant Performance with the Composite Correction Program. 1990. EPA 625/8-90/017. March.

AWBERC Contact

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Drinking Water Treatment for Small Communities

Introduction

EPA has developed a publication describing drinking water treatment requirements and the treatment technologies suitable for small systems (those serving 25 to 1,000 people or having a flow of 2,500 to 100,000 gallons per day). The document is designed for small system owners, operators, managers, and local decisionmakers, such as town officials. It is not a comprehensive manual for water treatment; rather, it provides an overview of the problems small systems might face, treatment options available to solve specific problems, and resources for additional information.

Project Description

Small drinking water systems face a difficult challenge: to provide a safe, sufficient supply of water at a reasonable cost. Growing awareness of biological and chemical contaminants that can affect the safety of drinking water has led to the need for more frequent monitoring and reporting and, in some cases, additional or upgraded treatment by water suppliers.

To help address the information needs related to drinking water treatment in small communities, EPA has issued a publication covering the following topics: why drinking water treatment is necessary; federal regulations and how they affect small systems; how to select drinking water treatment technologies; special management issues for small systems; and descriptions of technologies that can help small systems meet regulatory requirements. The document discusses established and emerging technologies for filtration, disinfection, removal of organic and inorganic contaminants, and corrosion control. Appendices to the document cover resources for additional information, collection of bacteriological samples, a checklist of factors affecting water treatment system performance, selecting a consultant, chlorine residual monitoring, and calculation of contact time (CT) values.

Publications

Environmental Pollution Control Alternatives: Drinking Water Treatment for Small Communities. 1990. EPA/625/5-90/025. April.

AWBERC Contact

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Package Plants for Drinking Water Treatment: In-House Test and Evaluation

Introduction

EPA is conducting research at its In-House Test and Evaluation Facility to evaluate the use of factory-built, skid-mounted package plants and point-of-entry devices for drinking water treatment. Researchers will study the effectiveness of package plants in disinfection and removal of precursor material, evaluate state-of-the-art remote operations, and develop "hybrid" package plants to meet small system needs. A unique full-scale pipe loop system will examine distribution system effects of alternative disinfectants.

Project Description

Factory-built, skid-mounted package plants could effectively help small systems meet drinking water treatment requirements. They may offer low construction and operating costs, simple operation and maintenance, adaptability to part-time operations, and no serious residual problems. Few systematic evaluations have been performed on package plants, however. No studies have looked at the ability of these units to meet the Surface Water Treatment Rule or the pending disinfection/disinfection by-products rule.

For this reason, EPA is undertaking research to obtain data on the cost, performance, and long-term reliability of package plants for small systems. EPA will operate five different package plants at its Test and Evaluation Facility in Cincinnati, Ohio. This will entail acquiring the package plants, installing a transmission pipe to obtain surface water, and drilling a well to obtain ground water. The evaluations will focus on disinfection and removal of precursor material. To evaluate the impact of alternative disinfectants on biofilm and bacterial regrowth, pipe loops will be sampled for biofilm attachment, growth, and detachment. Nutrient levels and disinfectant residuals also will be sampled.

Another aspect of the research will include telemetering of significant operating parameters that could be monitored at EPA's Risk Reduction Engineering Laboratory and integrated into a Supervisory Control and Data Acquisition (SCADA) system. An expert system will be used to automatically change (or guide an operator to change) each package plant's operation (for example, when a plant is challenged by an influent spike of turbidity). This research could aid in the development of an electronic "circuit rider" to gain some of the benefits of regionalization. Finally, EPA will create and demonstrate new package plant designs and configurations for small systems. These "hybrid" package plants will be designed to respond to new regulatory needs, results of the package plant evaluations, and results of the pipe loop studies.

Publications

Goodrich, J.A.; Adams, J.Q.; Lykins, B.W.; and Clark, R.M. 1992. Safe Drinking Water from Small Systems: Treatment Options. *Journal AWWA*. 84(5):49-55.

Lykins, B.W; Clark, R.M.; and Goodrich, J.A. 1992. *Point-of-Use / Point-of-Entry for Drinking Water Treatment.* Lewis Publishers / CRC Press, Inc. Chelsea, MI.

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Package Plants for Drinking Water Treatment: Field-Scale Research

Introduction

In conjunction with in-house package plant research (see "Package Plants for Drinking Water Treatment: In-House Test and Evaluation," page 10), EPA is conducting research to determine package plant capabilities in the field. This research will focus on microbiological contamination; other types of contamination and operational problems will be examined as well. The projects will last 2 to 3 years, and the equipment will remain in the community following the study's completion. The goal is to provide safe drinking water to the communities and transfer the knowledge gained to small communities nationwide.

Project Description

This field-scale research will involve the placement of a package plant (or whole-house point-of-entry units) in communities experiencing drinking water compliance problems. To evaluate package plants providing innovative treatment plus disinfection, researchers will perform weekly sampling of microbiological contaminants. These data will help researchers determine package plants' capability to perform throughout seasonal weather changes and changes in raw water quality. Other analyses will include total trihalomethane (TTHM) formation and drinking water mutagenicity. These analyses also will be performed throughout the distribution system. In addition, the reliability and operation and maintenance costs of the package plants will be evaluated. Researchers may attempt automatic operation and/or remote control of the package plants.

To help ensure community acceptance and involvement, the researchers will survey each community's perceptions, wants, and needs regarding drinking water before starting treatment. Following installation of the equipment, they will continually assess community attitudes about problems that may arise, such as taste, odor, or cost increases.

Proposed field sites for this research include sites in West Virginia that receive water from aquifers under the influence of surface water; Chemehuevi Indian lands in California, where water is obtained from a surface water source with intense recreational use in the summer; and a hunting camp in Lakeville, Maine, which obtains water from a lake heavily impacted by clear-cutting logging practices.

Publications

No publications to date.

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Feasibility Study of Alternative Filtration Technology for a Small Community Water Supply

Introduction

EPA funded a cooperative demonstration project to enable the Village of Cayuga, New York, to install and demonstrate a prefabricated water filtration system. The project was undertaken because the existing facilities, built in the 1930s, were unable to meet turbidity limits. The feasibility study analyzed installation and start-up, costs, and water quality data developed over a 12-month period.

Project Description

The Village of Cayuga obtains its drinking water from a surface water source (Cayuga Lake). The treatment plant, which used aeration, sedimentation, and filtration, was occasionally unable to meet the standard for turbidity (1 nephelometric turbidity unit) set by EPA. In 1981, the Village received a grant to install, operate, and monitor a prefabricated 150 gallon per minute water filtration system. The system consisted of two cyclone separators in parallel followed by three parallel treatment trains, each employing a contact clarifier, a mixed media filter, and a granular activated carbon filter. Careful records were kept of the first year's operation to document water quality, operating labor needs, and operating costs.

The data showed that, with respect to turbidity removal, the performance of the treatment plant exceeded the goals set forth in the study. The study showed that the filtration equipment is well-suited to small systems. In this case, the equipment was installed in an existing structure without extensive structural retrofitting. The results also suggested that pilot studies should be conducted before filtration plants are designed and built, especially when direct filtration is proposed.

The capital cost for this system was $268,000; chemicals, 5 cents per 1,000 gallons; and power, 10 cents per 1,000 gallons, at a rate of 6.2 cents per kilowatt-hour. The system required about 2.7 hours per day for inspection, adjustments to inflow and feed rates, sample analysis, and maintenance.

Publications

Project Summary: Feasibility Study of Alternative Technology for Small Community Water Supply. 1985. EPA-600/S2-84-191. March.

Feasibility Study of Alternative Technology for Small Community Water Supply (the complete report). 1985. NTIS PB85-143 287.

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Evaluation of Erosion Feed Chlorinators

Introduction

EPA sponsored a study to evaluate the reliability of erosion feed chlorinators in delivering a constant chlorine dose for drinking water disinfection. These chlorinators have several advantages over gas chlorinators and liquid chlorinators: operator exposure to caustic chlorine dust is reduced, tablets are easier to handle and store than gas or powder, safety equipment is not required, and less technical knowledge is needed to operate the chlorinator. Prior to this study, the capabilities of erosion feed chlorinators had not been determined.

Project Description

Erosion feed chlorinators use pressed chlorine tablets that are eroded (or dissolved) as water passes over their surface. A canister stores a supply of tablets and positions them in a moving stream of water; a contact chamber provides an interface between the tablets and water. Adjustments to the chlorine dose rate are made by changing the tablet surface area immersed in the water stream.

Testing of these chlorinators was conducted in two phases: continuous flow and intermittent flow. The chlorinators were shown to provide unstable dose rates when operated in a continuous flow mode. Intermittent flow operation provided a more stable dose rate. The greatest degree of dose stability resulted from a flow of 40 gallons per minute (150 liters per minute) with operating periods of 10 minutes on and 10 minutes off for the units tested. The researchers concluded that the use of erosion feed chlorinators should be limited to intermittent flow operation. The greatest adverse impact on chlorinator performance was found to be moisture in the tablet canister.

Publications

Project Summary: Evaluation of Erosion Feed Chlorinators. 1985. EPA/600/S2-85/126. December.

Evaluation of Erosion Feed Chlorinators (the complete report). NTIS PB86-118 882/AS.

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Evaluation of Dry Pellet Feeder Chlorinators

Introduction

EPA sponsored a study to evaluate the effectiveness of a dry pellet feeder chlorinator in disinfecting small domestic water systems. Researchers evaluated the equipment's ability to dependably deliver the desired dose of chlorine, as well as its operating capabilities in a desert environment.

Project Description

In a cooperative effort between EPA, the Indian Health Service, and the Papago Indian Reservation, dry pellet chlorinators were installed at four wells near Tucson, Arizona. The chlorinators were designed to dispense chlorine pellets into the well during well pump operation. The equipment consisted of a modular designed thermoplastic device, with a storage bin and motor-driven rotating pellet plate that delivered dry chlorine pellets from the storage bin to a drop tube. The pellets fell from the drop tube into the well casing. Pellet feed rates were adjusted by changing the rotating speed of the pellet plate and by opening slots in the pellet plate.

The researchers found that the chlorinator produced acceptable average chlorine dosage in water systems of varied configurations. The chlorinator proved reliable and easy to operate, but required regularly scheduled monitoring and maintenance. Despite 2 years' exposure to the desert environment, the only weathering problems observed were deterioration of the plastic drop tubes and corrosion of the metal parts.

The chlorinators were found to be most appropriate for wells designed and operated to provide a sanitary water supply without requiring frequent adjustments in the chlorine feed rate. Water from one well, subject to transient contamination, was not easy to treat using a chlorinator that could not automatically change dose in response to changes in chlorine demand. The configuration of the water system was also important. The chlorinator was most effective when used in well water systems that pump directly to large storage tanks, which in turn act to equalize variations in chlorine dosages.

Publications

Project Summary: Field Evaluation of the Land-O-Matic Dry Pellet Chlorination System. 1988. EPA/600/S2-87/085. January.

Field Evaluation of the Land-O-Matic Dry Pellet Chlorination System (the complete report). 1988. NTIS PB88-113 667/AS.

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Limestone Bed Contactors for Corrosion Control

Introduction

EPA sponsored a study to investigate the use of limestone contactors to mitigate corrosion in systems that use dilute acidic water. In a limestone contactor, water is transported through a packed bed of crushed limestone. As the limestone dissolves, the water's pH, calcium ion concentration, and alkalinity increase, resulting in less corrosion of piping surfaces. These devices are potentially applicable for small systems because of their low cost, minimal maintenance, and few potential hazards resulting from improper construction, installation, or maintenance.

Project Description

In many areas of the United States, homeowners and small water supply systems use water that is potentially corrosive to metallic materials (copper, lead, and zinc) in the distribution system. Corrosion can be caused by the use of dilute acidic waters that generally have low pH, alkalinity, and concentrations of dissolved solids. Corrosion can result in potential health problems from ingestion of corrosion by-products, degradation of the aesthetic quality of the water, and increased costs due to piping system deterioration.

This study evaluated the use of limestone contactors to control corrosion in small systems using dilute acidic water. Researchers derived and tested a mathematical model for limestone contactor design, using laboratory packed-column reactors; examined the relationship between contactor-treated water quality and metal release from pipes; and monitored the field performance of full-scale contactors. The field studies indicated that limestone contactors can effectively reduce the tendency of water to take up corrosion by-products from surfaces in piping systems.

Publications

Project Summary: Limestone Bed Contactors for Control of Corrosion at Small Water Utilities. 1987. EPA/600/S2-86/099. February.

Limestone Bed Contactors for Control of Corrosion at Small Water Utilities (the complete report). 1987. NTIS PB87-112 058/AS.

AWBERC Contact

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Evaluation of a Radium Selective Complexer System to Remove Radium from Ion Exchange Waste

Introduction

EPA sponsored a study to evaluate the long-term performance of a Radium Selective Complexer (RSC) system to remove radium from ion exchange (IX) waste. This information will be used in the design and operation of systems to concentrate radium from a brine waste stream for disposal.

Project Description

This study monitored and evaluated a radium-removal system at a small water treatment facility in Redhill Forest, Colorado. The raw water comes from deep wells and contains naturally occurring radium and iron. The treatment system consists of aeration to remove radon gas and carbon dioxide, chemical clarification to remove iron and manganese, and an IX process to remove radium and hardness. A separate system removes only radium from the regeneration water of the IX process. The radium is permanently complexed on an RSC resin. The RSC resin containing radium is replaced with virgin resin, and the resin waste is transported to a final disposal site.

To evaluate the efficiency and capacity of the RSC system, researchers analyzed influent and effluent samples collected over a 2-year period. The system was found to be very efficient in the removal of radium from the IX wastewater, removing an average of 99 percent of the radium in the inflow to the RSC system. The resin did not affect the levels of iron, sodium, hardness, or total solids.

A followup study on the RSC system is currently under way; results will be available in 1992.

Publications

Project Summary: Radium Removal for a Small Community Water Supply System. 1988. EPA/600/S2-88/039. September.

Radium Removal for a Small Community Water Supply System (the complete report). NTIS PB88-235 551/AS.

Mangelson, K.A. and Lauch, R.P. 1990. Removing and Disposing of Radium from Well Water. *Journal AWWA.* 82(6): 72-76

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Evaluation of the Manganese Dioxide Precipitation Process for Radium Removal from Drinking Water

Introduction

The manganese dioxide (MnO_2) precipitation process is a promising new technology for removing radium from drinking water. EPA is conducting a study from September 1991 to March 1993, to obtain full-scale performance data on this process.

Project Description

During the past 5 years, EPA's Drinking Water Research Division has funded several cooperative agreements to investigate methods to remove radium from drinking water. One of the most promising new methods is the use of freshly precipitated MnO_2 for the sorption of radium and its subsequent removal by filtration. Laboratory studies have shown that this method has good potential for use by small communities. No information exists, however, on full-scale demonstration of this process. For this reason, water utilities are reluctant to use this method.

EPA is sponsoring a study on the MnO_2 precipitation process for radium removal in the City of Mount Pleasant, Iowa. This small utility will collect data for the study and a researcher at the University of Iowa will provide technical guidance. The information obtained will be used to assist other utilities in the design and operation of new systems.

A technical report on the MnO_2 precipitation process is expected to be available in mid-1993. The report will include a description of the system and equipment, a description of the operation and performance of the process, an assessment of effectiveness for radium removal, information on residuals produced and disposal methods used, and an estimate of operational costs.

Publications

No publications to date.

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Manganese Dioxide-Coated Filters for Removing Radium from Drinking Water

Introduction

EPA sponsored a study to examine the use of magnesium dioxide- (MnO_2-)coated filters for removing radium from drinking water. The study involved extensive testing in the laboratory, in a pilot plant, and in full-scale application at several small public water systems in North Carolina.

Project Description

At the time of this study, adsorption onto MnO_2-coated filters had been tested sparingly, but had never been used to remove radium from drinking water. Researchers designed, built, and operated a system to produce acrylic fibers coated with MnO_2. Bleed-stream tests of the filters showed that for a high hardness water (pH=7.4), total radium removal was 14,200 picoCuries per gram (pCi/g) MnO2 before the Maximum Contaminant Level (MCL) of 5 pCi/L was exceeded. For a low hardness water (pH=4.5) total radium removal was 5,000 pCi/g MnO_2 before the MCL was exceeded. The filters also can remove low concentrations of cadmium, calcium, cobalt, cesium, iron, and manganese. Radium was highly preferred over calcium and magnesium; hardness passed through the filter relatively unchanged.

To conduct in-line field tests, the researchers used three standard water filtration housings situated in series, each containing 21 filter elements coated with MnO_2. Removal efficiencies of total radium were less than those exhibited with the bleed-stream field tests. The rapid decrease in capacity of the in-line MnO_2 filters to adsorb radium was attributed to a high loading of clay and silt on the filter elements.

Publications

Project Summary: Manganese Dioxide-Coated Filters for Removing Radium from Drinking Water. 1989. EPA/600/S2-88/057. January.

Manganese Dioxide-Coated Filters for Removing Radium from Drinking Water (the complete report). NTIS PB89-110 126/AS.

AWBERC Contact

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A Study of Possible Economical Ways of Removing Radium from Drinking Water

Introduction

EPA sponsored a study to examine the incidental removal of radium from drinking water by iron removal plants using aeration and sand filtration. The study also evaluated the possibility of exploiting existing iron removal facilities as an inexpensive means of removing radium.

Project Description

More than 175 cities in the Midwest deliver drinking water containing radium in concentrations that exceed federal standards. To evaluate the removal of radium by typical iron removal plants, researchers carried out batch tests, pilot plant laboratory tests, and field evaluations. The batch studies tested synthetic ground waters and ground waters obtained from several sources in Iowa. The researchers observed the effect of water chemistry on sorption of radium to combinations of iron and manganese oxides and to filter sand. The pilot plant test evaluated radium removal from a simulated aeration-sand filtration iron removal system under various operating conditions. The field evaluation studied the use of a regenerable sand filter to sorb naturally occurring radium.

The researchers found that sorption of radium to iron and manganese oxides and filter sands appears to be controlled primarily by the presence of calcium and magnesium. Excessive pH values would be required to obtain significant sorption to iron oxides at concentrations typical of natural waters. The researchers found that sorption to manganese oxides could possibly be exploited to remove radium if iron did not interfere. Filter sand was found to be able to sorb significant concentrations of radium at typical hardness concentrations if the sand is periodically rinsed with a dilute acid.

Publications

Project Summary: A Study of Possible Economical Ways of Removing Radium from Drinking Water. 1988. EPA/600/S2-88/009. April.

A Study of Possible Economical Ways of Removing Radium from Drinking Water (the complete report). NTIS PB88-158 464/AS.

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Radon Removal Using Point-of-Entry Water Treatment Techniques

Introduction

EPA sponsored a 1-year study of radon removal from drinking water using three types of point-of-entry (POE) treatment systems: granular activated carbon (GAC) adsorption, diffused bubble aeration, and bubble plate aeration. Each treatment alternative was evaluated with respect to radon removal efficiency, potential problems (such as waste disposal, radiation exposure, equipment malfunctions, and intermedia pollution), and costs.

Project Description

Private ground-water supplies may require POE treatment to meet drinking water standards for radon. Through an EPA Cooperative Agreement, researchers evaluated POE systems using GAC adsorption (with and without ion exchange pretreatment), diffused bubble aeration, and bubble plate aeration. Because the systems were operated in a parallel flow configuration, each receiving the same influent from an abandoned small community ground-water supply, the researchers were able to make direct comparisons among the individual systems.

GAC adsorption was found to be the easiest to operate and maintain and the least expensive of the systems. The GAC systems, however, could not consistently reduce effluent radon concentrations to the 200 to 2,000 picoCuries per liter range (unless less than 80 percent removal was required). In addition, the resin, brine, and backwater from these systems may require special handling and disposal.

Both the diffused bubble and bubble plate aeration systems were very efficient in removing radon. These systems, however, are susceptible to problems associated with iron oxidation and may be more prone to operational problems than are GAC systems. Off-gas from these units must be discharged above the roofing of the dwellings.

Water from all three types of POE systems may require disinfection, and frequent monitoring for radon concentration is essential.

Publications

Project Summary: Radon Removal Using Point-of-Entry Water Treatment Techniques. 1990. EPA/600/S2-90/047. December.

Radon Removal Using Point-of-Entry Water Treatment Techniques (the complete report). NTIS PB91-102 020/AS.

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Low-Cost/Low-Technology Aeration Techniques for Removing Radon from Drinking Water

Introduction

EPA sponsored a study to investigate the effectiveness of low-technology/low-cost aeration techniques in removing radon from drinking water. The techniques consisted of flow-through storage and minimal aeration in various configurations. The University of New Hampshire and the New Hampshire Department of Environmental Services conducted this research through an EPA Cooperative Agreement.

Project Description

The researchers monitored radon reduction in a distribution system, radon release from an open air storage tank with no mixing, and radon reduction in a flow-through reservoir system. The evaluation of radon loss in a distribution system was conducted at a 33-home trailer park in New Hampshire. Samples were taken from kitchen taps in five homes located at various distances from the pump house. The greatest reduction (18.8 percent) occurred at the sampling point farthest from the pump house. Overall, the reductions observed were very low (0 to 10 percent).

To evaluate open-air storage, the researchers monitored radon reduction from a still pool of water. Radon removal was high (80 to 90 percent) with 5 to 6 days of storage (vs. a theoretical reduction by radon decay alone of 67 percent over 6 days). The researchers concluded that a small community that could store the water at atmospheric pressure for several days could effectively use this technique.

For the flow-through reservoir test, the researchers constructed a system consisting of a water storage tank with variable ports of influent entry above and below the water level. Minimal bubble aeration was added to several of the entry types using a plastic tube punctured with holes. The researchers observed good removals of radon in all test combinations except for the bottom entry tests, which provided the minimum water disturbance. In all cases where the water was allowed to fall to the reservoir surface or where minimal bubble aeration was added, high removal rates were observed.

The researchers concluded that simple low-technology/low-cost aeration treatment techniques can be applied easily in small communities to significantly lower radon concentrations in drinking water. Removal percentages of 60 to 87 percent can be achieved with only 9 hours of retention time and simple aeration. Better than 95 percent removal was observed with aeration applied during 30 hours of storage.

Publications

Environmental Research Brief: Low-Cost/Low-Technology Aeration Techniques for Removing Radon from Drinking Water. 1987. EPA/600/M-87/031. September.

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Radon Removal by Point-of-Entry Granular Activated Carbon Systems: Design, Performance, and Cost

Introduction

EPA sponsored a project to prepare a report on an 8-year study evaluating the effectiveness of commercial point-of-entry (POE) and small water supply granular activated carbon (GAC) units in removing radon from drinking water. The units were installed in households, schools, and small housing developments. The study found GAC to be an effective technique for radon removal.

Project Description

Researchers evaluated the design, installation, operation, monitoring, performance, and costs of 121 POE GAC units. The units were located in Maine, New Hampshire, New Jersey, and nine other states. The water for all sites came from ground-water supplies with varying quality characteristics.

The POE GAC units were single vessels containing 1 to 3 cubic feet of GAC. Most units were installed downstream of an existing pressure tank and were operated under the existing water pressure in the building. In general, the only maintenance required was twice-yearly replacement or washing of the sediment filter.

The monitoring program consisted of an initial sampling and analysis 3 weeks after installation and a performance check once every 6 months for a 2-year period. Eleven units were selected for more detailed analysis, in addition to these samplings. Most of the samples were collected by the homeowners and mailed to the Radon Research Laboratory at the University of Maine, where they were analyzed by liquid scintillation.

Results indicated that 113 of the 121 units achieved greater than 90 percent randon reduction. Seven of the units experienced premature failure, which the researchers attributed to regional water quality problems. For the 11 units monitored for 2 to 6 years, there were no clear indications of loss of efficiency over time. Although the long-term data are limited to a few units, the researchers concluded that a typical POE GAC unit may last a decade providing radon removals of greater than 90 percent.

Publications

Project Summary: Radon Removal by POE GAC Systems: Design, Performance, and Cost. 1991. EPA/600/S2-90/049. January.

Radon Removal by POE GAC Systems: Design, Performance, and Cost (the complete report). NTIS PB91-125 633/AS.

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Radon Removal Techniques for Small Community Public Water Supplies

Introduction

EPA sponsored a study to evaluate the performance of full-scale granular activated carbon (GAC) adsorption, diffused bubble aeration, and packed tower aeration techniques for removing radon from small community water supplies. In addition, researchers evaluated various low-technology alternatives and modifications of the liquid scintillation counting technique used for analysis of radon in water.

Project Description

The researchers installed GAC systems at two mobile home parks in New Hampshire supplied with well water. Radon and several general water quality parameters were monitored at each site. The researchers also took core samples of the GAC to determine if iron, manganese, microorganisms, and/or radionuclides were accumulating in the units. They assessed the effects on GAC performance of variations in water flowrate and raw water quality, high water flowrate, and backwashing. Results indicated that the effects of raw water quality on radon adsorption by GAC are poorly understood, and predictions about radon removal are difficult to make.

For the diffused bubble aeration study, a series of three aeration tanks was installed in a small community public water supply. Aeration was provided by a blower that forced outdoor air into diffusers located below the water surface. The radon stripped from the water was vented outside the building. The results showed radon removal efficiencies from 90 percent to more than 99.6 percent.

The packed tower aeration system was installed at a mobile home park. It consisted of a stainless steel tower randomly packed with plastic media. Raw water was pumped to the top of the tower and distributed into the tower using a nozzle. Despite widely varying operating conditions, the radon removal efficiency remained close to 93 percent. For both types of aeration systems, stack emissions monitoring indicated that the off-gasses would need to be significantly diluted to be similar to levels found in the ambient air.

One conclusion of this study was that, when designing a treatment system to remove radon from a small community water supply, good data on flowrates and influent radon activity are essential. A full report of this study discusses each technique evaluated with respect to radon removal efficiencies, potential problems (such as waste disposal, radiation exposure, and intermedia pollution), and economics in small community applications.

Publications

Project Summary: Radon Removal Techniques for Small Community Public Water Supplies. 1990. EPA/600/S2-90/036. November.

Radon Removal Techniques for Small Community Public Water Supplies (the full report). NTIS PB90-257 809/AS.

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Uranium Removal from Drinking Water Using a Small Full-Scale System

Introduction

EPA conducted a 9-month study on a small, full-scale ion-exchange (IX) system. The objective of this study was to determine the operating characteristics, removal and regeneration efficiencies, and costs of the facility. The project also investigated the disposal of the uranium-laden brine.

Project Description

Of approximately 60,000 community water systems in the United States, probably 100 to 200 must treat their water to reduce uranium levels to concentrations that meet federal regulations. The treatment system evaluated in this study was located at an elementary school in Colorado. It consisted of two prefilters, a commercial water softener system, a brine tank to batch regenerant, and holding tanks to store and transfer spent regenerant. The researchers conducted IX regeneration tests, observed regenerant wastewater disposal, and profiled gamma radiation. They also calculated capital and operation and maintenance (O&M) costs.

The study results showed that anion exchange can consistently remove radium at a reasonable cost for small systems. The system was efficient in removing more than 99 percent of the uranium present in the raw water. The gamma radiation profile tests showed that the potential dose to ion-exchange treatment operators would be minor.

Disposal of uranium-laden IX regenerant wastewater is the most complex task involved in uranium removal from water. In this case, the regeneration wastewater was disposed of by hauling it to a secondary domestic wastewater treatment facility and introducing it to an equalization basin at the headworks of the facility. Limited data indicated that uranium was present in the wastewater treatment plant effluent and might concentrate in the sludge generated by the plant.

The capital cost for the system, including equipment, labor, and engineering, was $8,900 in 1986, not including the well, well pump, pump controls, or the treatment facility building. The O&M cost for removing the uranium from the water and disposing of the regenerant wastewater was approximately $6.70 per 1,000 gallons of water treated. Because of the costs associated with regenerant disposal and the sophisticated analyses required, O&M costs for similar uranium removal systems will be significantly higher than costs for conventional treatment.

Publications

Project Summary: Uranium Removal from Drinking Water Using a Small Full-Scale System. 1989. EPA/600/S2-89/012. August.

Uranium Removal from Drinking Water Using a Small Full-Scale System (the complete report). NTIS PB89-169/AS.

Jelenik, R.T. and Sorg, T.J. 1988. Operating a Small Full-Scale Ion Exchange System for Uranium Removal. *Journal AWWA*. 80 (7): 79-83

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Removal of Uranium from Drinking Water by Ion Exchange and Chemical Clarification

Introduction

EPA sponsored a 3-month project to demonstrate pilot-scale ion-exchange (IX) and chemical clarification equipment for removing uranium from drinking water. The researchers also developed cost data, analyzed uranium waste disposal options, and analyzed conventional water treatment plants with feed water containing uranium.

Project Description

Uranium-contaminated drinking water is a common problem, particularly in the western United States. For this study, researchers tested four commercial-type IX columns and prefiltering and regeneration solution systems for their ability to remove uranium from a ground-water well in New Mexico. The uranium concentration of the water varied from 190 micrograms per liter (μg/L) to 400 μg/L.

Four ion exchange columns housing three different types of resins were tested. Pretreatment consisted of particulate filtering, and regeneration was by chloride ion. The chemical clarification unit consisted of a rapid-mix vessel and a continuous precoat rotary vacuum filter covered with diatomaceous earth. The system achieved greater than 99 percent removal of uranium when operating at 30 milligrams per liter (mg/L) of ferric chloride and a pH of 10. The precoat filter achieved complete solid-liquid separation.

In addition to conducting the pilot study, the researchers reviewed and analyzed the records of currently operating water treatment systems with feed supplies containing uranium. They found that conventional water treatment facilities can greatly reduce the uranium content of natural waters.

The full report of this project contains cost analysis data for capital equipment and a discussion of disposal methods for uranium-containing water treatment waste. The disposal methods considered included dilution and release, reuse and resale, and burial.

Publications

Project Summary: Removal of Uranium from Drinking Water by Ion Exchange and Chemical Clarification. 1987. EPA/600/S2-87/076. December.

Removal of Uranium from Drinking Water by Ion Exchange and Chemical Clarification (the complete report). NTIS PB88-102 900/AS.

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Point-of-Use Treatment of Drinking Water in San Ysidro, New Mexico

Introduction

EPA sponsored a study of point-of-use (POU) reverse osmosis (RO) units. The objective was to determine whether these units could be used in place of central treatment to remove arsenic and fluoride from drinking water. POU RO treatment units were installed in private homes in the small community of San Ysidro, New Mexico. They were evaluated for removal efficiency, cost, and management effectiveness.

Project Description

San Ysidro, New Mexico, is a rural community of 200 people. It has a long history of water supply problems, including arsenic and fluoride contamination. As a result of earlier research to solve the contamination problem (see "Arsenic Removal from Drinking Water in San Ysidro, New Mexico," page 27), POU treatment with RO units was selected for further evaluation. A contractor was selected to install and maintain approximately 80 under-the-sink RO units in private homes. Data collected over an 18-month period showed that the units lowered the levels of arsenic, fluoride, total dissolved solids, chloride, iron, and manganese to well below the federal standards.

The cost to the customer of POU treatment in San Ysidro was less than half of the estimated cost of central treatment. Special ordinances were necessary to address customer responsibilities, water utility responsibilities, and liability issues, and to require that the device be installed in homes obtaining water from the utility.

Publications

Project Summary: Point-of-Use Treatment of Drinking Water in San Ysidro, New Mexico. 1990. EPA/600/S2-89/050. March.

Point-of-Use Treatment of Drinking Water in San Ysidro, New Mexico (the complete report), NTIS PB90-108 838/AS.

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Arsenic Removal from Drinking Water in San Ysidro, New Mexico

Introduction

EPA sponsored a study on the removal of naturally occurring arsenic from ground water that also contained fluoride and a high level of total dissolved solids. The study objective was to establish a cost-effective means of removing arsenic and fluoride from drinking water. Researchers studied several different treatment processes: reverse osmosis (RO), electrodialysis, ion exchange, and activated alumina (AA) adsorption.

Project Description

The water supply for the small community of San Ysidro, New Mexico, exceeds federal drinking water standards for both arsenic and fluoride. Over a period of 9 months, field research was conducted at the University of Houston/EPA Mobile Drinking Water Treatment Research Facility. The results of the study indicated that San Ysidro can use AA adsorption, RO, or possibly electrodialysis to remove arsenic. The first two methods can be applied using either central treatment or point-of-use (POU) treatment. Preoxidation using chlorine to convert As(III) to As(V) will aid arsenic removal but is not essential. Mesh size and pH were found to significantly influence the effectiveness of AA. Ion exchange did not perform well enough to be considered seriously for treatment.

Because of the community size (70 dwellings), poor water quality, and the difficulty of central treatment, a POU RO treatment system study was recommended as a result of this research (see "Point-of-Use Treatment of Drinking Water in San Ysidro, New Mexico," page 26).

Publications

Project Summary: Arsenic (III) and Arsenic(V) Removal from Drinking Water in San Ysidro, New Mexico. 1991. EPA/600/S2-91/011. June.

Arsenic(III) and Arsenic(V) Removal from Drinking Water in San Ysidro, New Mexico (the complete report). NTIS No. PB91-181 925/AS.

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Field Experience with Point-of-Use Treatment Systems for Arsenic Removal

Introduction

At the request of EPA Region 10, a field project was carried out to evaluate point-of-use (POU) treatment systems for removing arsenic from drinking water. The systems studied employed activated alumina (AA), ion exchange (IX), and reverse osmosis (RO). The research project was designed to provide information for state and county agencies to assist homeowners or small communities with water supplies exceeding the federal standard for arsenic.

Project Description

The field project involved installing POU treatment devices in four homes in Alaska and Oregon. These homes had private wells supplying water containing naturally occurring arsenic in concentrations ranging from 0.1 to 1.0 milligrams per liter (mg/L). The pilot systems consisted of an AA tank, an anion exchange tank, and an RO system. Both single tap and whole house (point-of-entry) systems were used.

The study showed that all three of the treatment techniques tested can lower arsenic concentrations in water. Low-pressure RO systems were found to be effective when the arsenic concentration did not exceed 0.1 mg/L. High-pressure RO systems were very effective, but they required the use of a booster pump. Because RO removes other contaminants besides arsenic, these systems produce high-quality water. Potential disadvantages of RO include the small amount of finished water and the high volume of reject water produced. The IX units, when properly pretreated, were able to treat water containing as much as 1.16 mg arsenic/L. AA also worked well with proper pretreatment. Periodic monitoring after installation is essential to confirm the continued effectiveness of these techniques.

Publications

Fox, K.R. 1989. Field Experience with Point-of-Use Treatment Systems for Arsenic Removal. *Journal AWWA*. 81(2): 94-101.

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Nitrate Removal from Drinking Water in Glendale, Arizona

Introduction

EPA sponsored a 15-month pilot-scale study comparing the technical feasibility and economics of reverse osmosis (RO), electrodialysis (ED), and ion exchange (IX) for removing nitrates from well water. The study took place in Glendale, Arizona, where 10 of 31 drinking water wells had been shut down because of excess nitrates.

Project Description

The experiments in this study were carried out using the University of Houston/EPA Mobile Inorganics Pilot Plant. All three processes reduced the nitrate concentration of the drinking water to well below the Maximum Contaminant Level (MCL) of 10 milligrams per liter (mg/L). Anion exchange with chloride-form, strong-base resin was studied in the greatest detail because of the simplicity and low cost of this method. About 410 bed volumes (BV) of Glendale water (containing 18 to 25 mg/L of nitrate) could be treated for complete nitrate removal before nitrate breakthrough. IX regeneration brine disposal remains an unsolved problem with this method.

Based on these studies, the estimated capital plus operating costs for producing 1,000 gallons of product water containing 7 mg/L of nitrates in a 1 million gallon per day (mgd) plant are 30 cents for IX, 85 cents for ED, and 1 dollar for RO.

Publications

Project Summary: Nitrate Removal from Drinking Water in Glendale, Arizona. 1987. EPA/600/S2-86/107. March.

Nitrate Removal from Drinking Water in Glendale, Arizona (the complete report). NTIS PB87-129 284/AS.

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Nitrate Removal from Contaminated Water Supplies Using Ion Exchange

Introduction

EPA sponsored research to evaluate nitrate removal using the ion exchange process at a 1 million gallon per day (mgd) plant in McFarland, California. The study produced detailed information about the design, operation, performance, and cost of this treatment system.

Project Description

The McFarland nitrate removal plant treats water pumped from a well supplying water for domestic use. The plant treats close to 700 gallons of ground water per minute (gpm). It uses a three-vessel ion exchange process with conventional, commercially available anion-exchange resin that requires regeneration with a sodium chloride brine.

For this study, researchers kept daily records of flows, water quality, electrical consumption, salt usage, and personnel time to determine operating costs, performance, and reliability. The data showed that the facility reduced nitrate levels to well below the maximum contaminant level. The researchers also found that if the well was continuously pumped, the need for nitrate treatment decreased. Maximum automation was used successfully with the minimal staffing of a small water system. Total water recovery was high at over 96 percent. Based on the design capacity of 1 mgd, capital costs were 9.9 cents per 1,000 gallons, and operation and maintenance (O&M) costs were 8.5 cents per 1,000 gallons. The disposal of wastewater and waste salts from the plant are important concerns.

EPA has summarized the results of this study in two reports. The first report provides the performance and cost data obtained during the initial adjustment of the plant and the first 6 months of operation. The second report analyzes O&M costs and plant performance in the following 2 years.

Publications

Project Summary: Nitrate Removal from Contaminated Water Supplies: Volume I. Design and Initial Performance of a Nitrate Removal Plant. 1987. EPA/600/S2-86/115. April.

Project Summary: Nitrate Removal from Contaminated Water Supplies: Volume II. Final Report. 1987. EPA/600/S2-87/034. August.

The complete reports:

Nitrate Removal from Contaminated Water Supplies: Volume I. Design and Initial Performance of a Nitrate Removal Plant. NIS PB87-145 470/AS.

Nitrate Removal from Contaminated Water Supplies: Volume II. Final Report. NTIS PB87-194 577/AS.

Lauch, R.P. and Guter, G.A. 1986. Ion Exchange for the Removal of Nitrate from Drinking Water. *Journal AWWA.* 78(5):83-88

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Bacteria Colonizing Point-of-Entry Granular Activated Carbon Filters and Their Relationship to Human Health

Introduction

EPA sponsored a study to examine the potential health effects of exposure to bacteria discharged from whole-house granular activated carbon (GAC) filters. This study emphasized the respiratory exposure route (i.e., exposure to bacteria in shower-generated aerosols). An earlier study ("Bacteria Colonizing Point-of-Use Granular Activated Carbon Filters and Their Relationship to Human Health," page 32) focused on respiratory and skin exposure.

Project Description

GAC filters, commonly used for home drinking water treatment, can provide a favorable environment for the attachment and growth of microorganisms. Research has suggested that the bacteria associated with GAC filters do not cause disease. Little is known, however, about the health effects of many bacteria that can colonize these filters and enter drinking water in high concentrations.

EPA sponsored an epidemiological study to investigate these concerns. The study measured bacterial levels in discharge waters from GAC filters installed in 80 households where the water line entered the home. The control group consisted of 87 households with no water filters. All homes used water from the same filtration plant. Researchers took monthly hot and cold water samples from each household and analyzed them for bacterial and chemical content and bacterial levels. They also conducted a water use survey to quantify the various exposure routes to drinking water (i.e., through ingestion, skin contact, and breathing in steam during bathing). Researchers monitored respiratory, gastrointestinal, and skin-related infections experienced by the household residents. Health information was provided by test subjects, who filled out health diaries, and the physicians of patients who experienced health problems during the test period.

Study results indicate that whole-house GAC filters are colonized by heterotrophic bacteria (bacteria that require organic compounds as carbon and energy sources) from the water distribution system. Once colonized, the filters discharge significantly higher amounts of bacteria than were found in drinking water in the control households. The households using the filters, however, did not experience more upper or lower respiratory, gastrointestinal, or dermal symptoms compared to the control households. None of the infections reported to physicians were attributed to bacteria that had colonized the filters.

Publications

Calderon, R. *Bacteria Colonizing Point-of-Entry, Granular Activated Carbon Filters and Their Relationship to Human Health (Draft).* Department of Epidemiology and Public Health, Yale School of Medicine.

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Bacteria Colonizing Point-of-Use Granular Activated Carbon Filters and Their Relationship to Human Health

Introduction

EPA sponsored research to evaluate the health effects related to bacteria discharged from household point-of-use (POU) granular activated carbon (GAC) filters. This study examined effects from ingestion of and skin contact with water from GAC filters. A second study ("Bacteria Colonizing Point-of-Entry Granular Activated Carbon Filters and Their Relationship to Human Health," page 31) emphasized the respiratory exposure route (i.e., exposure to bacteria via shower-generated aerosols).

Project Description

GAC is an excellent adsorbent for common tastes and odors, some turbidity, chlorine, and many organic contaminants. It also provides a favorable environment for the attachment and growth of microorganisms. Research to date suggests that the bacteria associated with GAC filters do not cause disease in healthy people. Little is known, however, about the many bacteria that colonize GAC or the possible health effects of high concentrations of these bacteria in drinking water. This is of particular concern because infants, the elderly, and other people who are susceptible to infections may reside in homes in which GAC filters are used.

To investigate these concerns, EPA sponsored an epidemiological study of the health effects of exposure to the high concentrations of bacteria found in GAC filter effluent. The study population consisted of families in off-base Navy housing in Groton, Connecticut. The test groups used two types of POU GAC filters (bypass and faucet). Filters with blank cartridges were used in the homes of the control groups. Water samples, bacterial counts, and health data were collected and processed over a 17-month period. The health data consisted of information recorded in health diaries, survey responses, and information provided by the physicians of patients who experienced gastrointestinal or skin problems.

The study results indicated that both types of POU GAC filters are colonized by heterotrophic bacteria (bacteria that require organic compounds as carbon and energy sources) from the water supply system. The filters discharge significantly higher amounts of bacteria than are found in unfiltered tap water. The groups using the GAC filters, however, showed no increase in gastrointestinal or skin-related symptoms compared to the control group. None of the illnesses reported to physicians were related to bacteria that had colonized the filters. The researchers concluded that ingestion of GAC-filtered water was not a risk factor for disease in the populations examined in this study.

Publications

Calderon, R. and E. Mood. *Bacteria Colonizing Point-of-Use, Granular Activated Carbon Filters and Their Relationship to Human Health (Draft).* Department of Epidemiology and Public Health, Yale School of Medicine.

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Methods for the Determination of Organic Compounds in Drinking Water

Introduction

EPA has prepared two documents that present 22 laboratory analytical methods for identifying and measuring more than 250 organic compounds in drinking water and drinking water sources. The methods analyze volatile organic compounds (VOCs), certain disinfection byproducts, and a variety of synthetic organic compounds and pesticides. The documents are designed for public and private laboratories that wish to determine organic compounds in drinking water for regulatory or other purposes.

Project Description

EPA develops analytical methods to determine the quality of ambient waters and measure chemical and physical parameters affecting water quality. The methods described in these documents utilize capillary gas chromatography or high-performance liquid chromatography. Some methods require modest equipment and others require sophisticated instrumentation.

For each method, the documents include the following information: a summary, definitions, and scope and application of the method; interferences; safety; apparatus and equipment; reagents and consumable materials; sample collection, preservation, and storage; calibration; quality control; procedures; calculations; precision and accuracy; and references. Most of the methods include either a method detection limit (MDL) or an estimated detection limit (EDL) for each analyte as an indicator of the capability of the method.

The names of the authors of each method are provided to assist users in obtaining direct telephone support when required.

All of the methods described in these documents were developed for measuring relatively clean water matrices. The authors, therefore, recommend caution when applying these methods to more complex matrices such as wastewater, hazardous waste effluents, or biological fluids.

Publications

Methods for the Determination of Organic Compounds in Drinking Water. 1988. EPA/600/4-88/039. December.

Methods for the Determination of Organic Compounds in Drinking Water: Supplement I. 1990. EPA/600/4-90/020. July.

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Wellhead Protection Workshops and Technology Transfer Documents

Introduction

EPA is helping regional and state officials prevent ground-water pollution through wellhead protection programs. EPA, in conjunction with the National Rural Water Association (NRWA) and individuals from the Rural Water Association Affiliates, will develop a series of workshops and two technology transfer documents on wellhead protection.

Project Description

Ground-water protection and conservation provide some of the best available opportunities for pollution prevention. For this reason, EPA has initiated a three-part project focusing on wellhead protection. In the first part of this project, NRWA will assist EPA in assembling information about 156 wellhead protection programs under way in 14 states, as well as any additional programs initiated in FY 93. The second part of the project will consist of regional and state workshops and meetings to assist small communities in developing wellhead protection programs. The third part will consist of developing technology transfer materials focusing on wellhead protection.

Publications

Publications to be developed through this project include workshop handout materials, a technology transfer seminar publication, and a technology transfer handbook.

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Risk Assessment, Management, and Communication of Drinking Water Contamination

Introduction

EPA has issued a seminar publication on identifying, assessing, and managing the occurrence of potentially toxic chemicals in drinking water. The document presents a broad range of information from the fields of toxicology, chemistry, and engineering. It is designed to assist the reader in assessing and managing drinking water contamination problems in his or her region, state, or locality.

Project Description

This publication is based on a series of EPA workshops entitled "Assessment and Management of Drinking Water Contamination." These workshops were developed to provide information to local and state officials, consultants, utility employees, and others involved in the management of drinking water contamination incidents.

The seminar publication covers the essential steps in solving a drinking water contamination problem: review of available standards and advisories, review of toxicology, assessment of risk, review of risk reduction options, and risk communication. Technical information is presented on EPA programs, toxicology, chemistry, treatment principles, and media coverage and risk communication during an emergency. Appendices to the document include federal drinking water standards; health advisories for aldicarb, atrazine, trichloroethylene, and vinyl chloride; and exercises for a case study on risk assessment, management, and reduction for vinyl chloride contamination of drinking water.

Publications

Seminar Publication: Risk Assessment, Management and Communication of Drinking Water Contamination. 1990. EPA/625/4-89/024. June.

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Municipal Wastewater

Implementation of Sequencing Batch Reactor Technologies in the United States

Introduction

EPA has conducted an evaluation of Sequencing Batch Reactors (SBRs). These are variable-volume wastewater treatment units in which the aeration, settling, and decanting phases of the treatment process take place in a single reactor. The different phases are controlled by a programmable logic controller. SBRs may be appropriate for some small communities, because construction costs are lower than those for conventional wastewater treatment plants. In addition, SBRs offer great flexibility, because the programmable control of each phase of the treatment process can be easily changed to meet site-specific or changing requirements.

Project Description

The first modern SBR in the United States began operation in 1980. A 1984 EPA evaluation of this technology found only four SBR plants in this country. Of these, one had just started operation, and another was experiencing decanter problems.

During 1989-1990, EPA sponsored a followup evaluation of SBR technology. More than 100 SBR facilities were in operation in the United States in 1989, with an additional 50 facilities under design. The distribution of these facilities (in terms of average dry weather flow) was 32 percent less than 0.1 mgd, 69 percent less than 0.5 mgd, 81 percent less than 1.0 mgd, and 19 percent greater than 1.0 mgd.

The five major vendors were contacted to obtain installation lists. More than 40 operating SBR facilities were contacted by telephone to obtain preliminary operation, maintenance, and performance information. Site visits were made to 23 facilities to review plant operation first hand and to collect additional performance and cost data. Site visit reports and completed data analyses were subsequently sent to each facility to verify the accuracy of all information gathered.

Fifteen facilities had sufficient operating data to permit a detailed analysis of plant performance. Average effluent total suspended solids (TSS) and biological oxygen demand (BOD) for these facilities ranged from 3 to 25 mg/L and 3 to 21 mg/L, respectively.

A final report will summarize the results of the evaluation. The report will include information on plant operating conditions and performance, differences in hydraulic and operational strategies, different design options, and effluent probability distributions.

Publications

Deeny, K. et al. 1991. *Implementation of Sequencing Batch Reactor Technology in the United States*. Presented at the 1991 Water Pollution Control Federation Annual Conference. (Available from AWBERC contact below.)

A final report is expected to be available in Summer 1992.

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Pilot-Scale Research on Constructed Wetlands for Municipal Wastewater Treatment

Introduction

Constructed wetlands are a promising new technology for wastewater treatment. EPA is sponsoring a controlled pilot-scale research study on subsurface flow constructed wetlands through a cooperative agreement with the Tennessee Technological University in Cookeville, Tennessee.

Project Description

More than 600 wetlands have been constructed worldwide for treating wastes from municipalities, industry, agriculture, and mining operations. Constructed wetlands are generally divided into free water surface (FWS) and subsurface flow (SF) systems. SF systems are also known as "root zone method," "rock-reed filters," "reed bed treatment," "vegetated submerged beds," and "microbial rock plant filters."

SF systems have significant potential for small community wastewater treatment. They have relatively low capital and operation and maintenance (O&M) costs, small area requirements, and apparently simple O&M requirements. In addition, they can meet secondary effluent standards when preceded by at least primary or lagoon treatment. They may offer small communities a valuable alternative technology whose only competitor may be intermittent sand filtration. SF may have an advantage over sand filtration in nutrient, metals, and toxics removals. SF wetlands may meet the needs of many small communities where land-based alternatives are infeasible due to inadequate soils or hydrogeologic conditions. They may be used both for upgrading noncomplying facilities and for new systems.

In spite of the large number of constructed wetlands and their apparent potential, many questions remain concerning their design and performance. EPA is sponsoring a pilot-scale research study to better define the biological oxygen demand (BOD) and nitrogen removal kinetics in an SF-constructed wetland. The study also will evaluate operational procedures that might enhance nitrogen removal in these systems. The project will be carried out using fourteen 4 ft by 16 ft SF wetland cells with multiple sampling locations and a controlled wastewater source.

This project is just beginning. Construction of the pilot cells began in Fall 1991, and planting is scheduled for Spring 1992. Early results from the study are expected in Fall 1993. The project is scheduled to run for 3 years.

Publications

No publications to date.

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Constructed Wetlands for Individual Homes (Onsite Systems)

Introduction

EPA is sponsoring research to obtain information on the performance of constructed wetlands ("rock-reed filters") for individual homes. The goal of this project is to provide state departments of health with enough information to make decisions about the reliability and applicability of onsite systems in their states.

Project Description

Constructed wetlands for individual homes typically resemble long, narrow rectangular flower beds (about 70' by 3' by 1 1/2') planted with aquatic plants (bulrush, cattails, reeds). The filter is usually filled with 1 1/2" to 1" rock for the first 20' of length, and 1/2" to 1" rock for the rest of the length. The filter is usually lined. A perforated inlet pipe is buried about mid-depth and extends about 20' into the bed. A perforated outlet pipe also is buried about mid-depth and extends across the width of the bed at the outlet end.

The State of Louisiana has installed more than 40 rock-reed filters since 1987. In the past 2 years, the State of Kentucky has installed approximately 300 systems, and the State of Arkansas has installed more than 60 systems. The States of Colorado, Missouri, Texas, Virginia, and West Virginia have also installed a few of these systems. However, due to the lack of performance data from their rock-reed filters, the States of Arkansas and Louisiana have imposed moratoriums on further installations until more data are collected.

In spite of the great interest in these systems, very little reliable data exist documenting their performance. The State of Louisiana has performed limited effluent testing of these systems in a random manner. These data show that effluent biological oxygen demand (BOD), total suspended solids (TSS), and fecal coliform levels are low enough to meet surface discharge requirements. The Louisiana Department of Health is conducting the first well-planned study to measure performance, but this evaluation will be only 6 months long.

To meet the need for performance data on onsite rock-reed filters, EPA is sponsoring a project to collect detailed, reliable information of a known quality. This will be accomplished by monitoring several operating filters in Louisiana and Arkansas. Researchers will monitor influent and effluent flow, BOD, TSS, ammonia, nitrate, and fecal coliforms over a 2-year period. If possible, a failed system will be examined to determine the cause of failure. A quality assurance program will be followed to ensure the quality of the data.

Publications

No publications to date.

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Inventory of Constructed Wetlands in the United States

Introduction

Constructed wetlands are a promising technology for wastewater treatment. Subsurface flow (SF) constructed wetlands systems have significant potential for small community wastewater treatment (see "Pilot-Scale Research on Constructed Wetlands for Municipal Wastewater Treatment," page 40). To gain a better understanding of the performance of these systems, EPA conducted an inventory of all SF constructed wetlands systems in the United States.

Project Description

EPA's inventory of SF constructed wetlands systems consisted of two stages. In the first stage, researchers gathered information via mail and telephone. The only systems excluded from this stage were those serving individual homes or mine drainage sites. Few demands were placed on the individuals contacted. For example, people were asked whether they had cost and performance data rather than asked to provide their cost and performance data. The first stage was completed in Fall 1990. More than 60 operating systems were located out of 150 systems identified (including those in the planning, design, and construction phases).

The second stage of the inventory consisted of site visits to operating SF wetlands. Because of limited funds, only 20 of the more than 30 operating SF wetlands were visited. Each site visit resulted in an informal in-house EPA report. The reports include available information on design, performance, cost, and operation; a critique of the system; and slides or photographs of the system. This is a data collection effort; no new data are being produced. Information from both stages of the inventory will be incorporated into a larger constructed wetlands data base being produced by EPA's Corvallis, Oregon, laboratory.

Publications

Inventory of Constructed Wetlands for Municipal Wastewater Treatment in the U.S. 1991. EPA-600/D-91/087. (NTIS PB91-191 247.) May.

Reed, Sherwood and Donald Brown. 1991. *Constructed Wetland Design—The Second Generation.* Presented at the 1991 Water Pollution Control Federation Annual Conference (to be published in *Water Environment Research*).

Reed, Sherwood. Constructed Wetlands for Wastewater Treatment. 1991. *Biocycle.* January. pp. 44-49.

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Monitoring Operating Constructed Wetlands for Municipal Wastewater Treatment

Introduction

Constructed wetlands are a promising technology for wastewater treatment. Subsurface flow (SF) constructed wetlands systems have significant potential for small community wastewater treatment (see "Pilot-Scale Research on Constructed Wetlands for Municipal Wastewater Treatment," page 40). EPA is conducting a study to gather reliable data and information from a number of operating constructed wetlands.

Project Description

A major obstacle to the widespread application of constructed wetlands is the lack of acceptable system design and operating criteria. In addition, performance data are limited, because most facilities collect only the data needed to fulfill their NPDES permit requirements. Some of the performance data also are suspect because the analyses have been performed by laboratories that lack a quality assurance program.

To address these concerns, EPA is monitoring operating constructed wetlands to obtain reliable performance data. The monitoring consists of measuring flows and collecting samples at influent and effluent points over a 4-month period using established quality assurance guidelines.

Analysis of this information should yield a better understanding of system design, operation, and performance. For each system monitored, the goals are to confirm the design hydraulic residence time (HRT) and calculated hydraulic profiles; quantify the actual HRT via a tracer study; estimate the actual porosity of the constructed wetland by examining selected samples of the wetland bed; determine removal efficiencies for biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), volatile suspended solids (VSS), total Kjeldahl nitrogen (TKN), and fecal coliforms; and determine the degree of nitrification achieved by measuring ammonia and nitrate. For the combined data from all the monitored systems, the goals are to quantify the relationship of HRT to the removals of monitored parameters and quantify the relationship of HRT to the conversion of ammonia to nitrate.

Monitoring at the first two facilities, Carville and Mandeville, Louisiana, was completed in October 1991. Greenleaves (a subdivision of Mandeville) and Hammond, Louisiana, are being monitored in Spring 1992. Two or three additional locations will be monitored each year for 2 to 3 years, depending on funding.

Publications

No publications to date.

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Alternatives to Traditional Onsite Wastewater Treatment: A Demonstration Project

Introduction

EPA is conducting a project to demonstrate approaches to onsite wastewater treatment that include nitrogen removal capabilities. Nitrogen is of great concern in coastal areas where nitrogen enrichment can lead to eutrophication and accompanying problems in coastal water bodies. This project is a cooperative effort involving EPA Region 1's Near Coastal Waters Program, the Buzzards Bay National Estuary Project, and EPA/Cincinnati.

Project Description

Traditional onsite septic systems are used extensively throughout the United States. With appropriate design, installation, and maintenance, septic tanks can efficiently remove most biological and chemical contaminants. These systems do little, however, to remove nitrogen.

For this reason, EPA has undertaken a full-scale demonstration project for alternative approaches to traditional septic systems. The project focuses on conversion or retrofitting of existing septic systems, for two reasons: 1) septic systems can be a significant source of nitrate in ground water, and 2) homeowners who must comply with a nitrogen management strategy will need proven, technically sound systems that meet the objectives of the strategy.

The project consists of three tasks: 1) a literature review and technology selection; 2) site selection, system design, and installation; and 3) operation and monitoring for a 1-year period, followed by analysis and reporting. The project is scheduled to be completed by Spring 1993.

Preliminary research indicates that a form of recirculating sand filter system is likely to be selected because of the efficiency and cost-effectiveness of these systems.

Publications

No publications to date.

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Small Community Wastewater Management Manual

Introduction

EPA is preparing a manual for small communities on all aspects of planning, design, and management of wastewater facilities. The facilities addressed in the manual range from individual home onsite systems to cluster systems of several homes to complete centralized collection, treatment, and disposal facilities.

Project Description

Small communities have unique needs regarding wastewater management regimes, technology options, and planning. They generally lack skilled management and funding, while having ample available land. For this reason, low-cost, low-maintenance "natural" treatment systems are attractive options for these communities. EPA's Small Community Wastewater Management Manual will feature such systems, including stabilization ponds, constructed wetlands, slow sand filters, and soil-based treatment systems. (Soil-based systems include subsurface soil absorption and surface application approaches such as slow-rate infiltration, rapid infiltration, and overland flow.) In addition, some "mechanical" systems are included for special situations in which other types of systems are inappropriate.

The manual discusses the advantages of low-cost alternative wastewater collection systems as a way to avoid the expense of conventional sewer systems. It also describes residuals disposal alternatives (including technologies, management requirements, and implementation options) most appropriate to small communities.

This manual will be a companion to EPA's *Manual: Alternative Wastewater Collection Systems* (see page 48), *Handbook: Septage Treatment and Disposal* (see page 53), and a future field guide for onsite systems.

Publications

This manual is scheduled to be completed by October 1992.

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Design Manual: Constructed Wetlands and Aquatic Plant Systems for Municipal Wastewater Treatment

Introduction

EPA has developed a design manual for aquatic wastewater treatment systems. For small communities in particular, these systems can be an attractive alternative to conventional processes that require higher labor and energy costs.

Project Description

EPA's *Design Manual: Constructed Wetlands and Aquatic Plant Systems* describes three classifications of aquatic wastewater treatment systems: natural wetlands, constructed wetlands, and aquatic plant systems. *Constructed wetlands* include free water surface (FW) systems and subsurface flow (SF) systems. Potential advantages of these systems include simple operation and maintenance, process stability under varying environmental conditions, low construction and operating costs, and, in the case of free water surface systems, the possibility of creating wildlife habitat. Disadvantages can include mosquitoes and difficulty in establishing desired aquatic plant species. For constructed wetlands, the manual presents detailed information about site selection, performance expectations, process variables, preapplication treatment, vegetation, and physical design factors.

Aquatic plant systems are shallow ponds with floating or submerged aquatic plants (usually water hyacinth or duckweed). These systems can be designed and operated to accomplish a variety of wastewater treatment tasks. They can have a number of disadvantages, however. These include susceptibility to cold weather and biological controls for hyacinths in the natural environment, mosquitoes, and limits to treatment capacity and dependability in meeting low effluent values for nutrients. For aquatic plant systems, the manual discusses vegetation, process design criteria, physical features, performance expectations, and sample design problems.

The manual presents case studies of constructed wetlands and aquatic plant systems that are representative of current knowledge and practice. The manual also presents environmental and public health considerations (nitrogen, phosphorous, pathogens, metals, and trace organics). An appendix lists facilities with operating or abandoned constructed wetlands and aquatic plant systems, so that the manual user can visit nearby projects.

Publications

Design Manual: Constructed Wetlands and Aquatic Plant Systems for Municipal Wastewater Treatment, 1988. EPA/625/1-88/022. January.

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Process Design Manual: Land Treatment of Municipal Wastewater

Introduction

EPA, in conjunction with the U.S. Army Corps of Engineers, the Department of Interior, and the Department of Agriculture, developed a process design manual for land treatment of municipal wastewater. This manual provides criteria and supporting information for planning and process design of land treatment systems. The document updates an earlier process design manual published in 1977.

Project Description

Controlled application of wastewater onto the land surface can achieve treatment through natural physical, chemical, and biological processes. EPA's process design manual addresses three major land treatment processes: slow rate, rapid infiltration, and overland flow. The manual discusses recommended procedures for planning and designing each process, along with information about treatment performance. Equations and procedures are included to allow calculations of energy requirements. Potential health and environmental effects also are addressed. In addition, the manual presents special considerations for small systems (up to 1,000 m^3/d).

In addition to the process design manual, EPA has issued a supplement on rapid infiltration and overland flow. The supplement provides guidance to prevent problems encountered in some rapid infiltration systems, particularly with respect to capability to infiltrate and then percolate water at design rates. In addition, the supplement presents updated information on nitrogen removal, organics removal, and the need for disinfection in these systems. The supplement also provides updated information on overland flow, based on field investigations and data from research/demonstration projects.

Publications

Process Design Manual: Land Treatment of Municipal Wastewater. 1981. EPA 625/1-81-013. October.

Supplement on Rapid Infiltration and Overland Flow. 1984. EPA 625/1-81-013a. October.

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Manual for Alternative Wastewater Collection Systems

Introduction

EPA has produced a manual on alternative wastewater collection systems, including pressure, vacuum, and gravity systems. EPA also is planning a seminar series based on this manual for FY 1992-1993.

Project Description

For many small communities, conventional gravity sewers constitute most of the cost of wastewater treatment systems. Alternative collection systems using small-diameter, lightweight piping buried at shallow depths can be economical for communities with low population densities. *Pressure sewers* include grinder pump (GP) systems, which macerate sewage solids before pumping, and septic tank effluent pumping (STEP) systems, which use septic tanks to remove grit, grease, and settleable solids before pumping. These systems have been widely applied in North America and in some European and Asian countries. *Small diameter gravity (SDG) sewers* use septic tanks to remove settleable and floatable materials prior to entry into the sewer. These systems also are becoming popular because of their relatively low capital costs and operating requirements. *Vacuum sewers* draw wastewater and air through collection pipes to the central collection point. Interest in vacuum sewers is growing because they can serve denser developments in rural areas and provide wastewater in a fresher condition.

EPA's *Manual: Alternative Wastewater Collection Systems* contains the complete body of experience with these systems. The document outlines the history of nonconventional sewer systems, the situations in which they are more advantageous than conventional systems, their design and performance histories, operation and maintenance requirements, and cost examples. The manual documents the components of each system, including materials of construction, sizing, key features, and impact on performance. The material illustrates how different design approaches, construction materials, and construction/procurement procedures can affect operation and maintenance requirements and system performance. In addition, the manual provides examples of site conditions that have been effectively serviced by alternative systems. Common myths about these systems also are addressed.

Publications

Manual: Alternative Wastewater Collection Systems. 1991. EPA/625/1-91/024. October.

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Autothermal Thermophilic Aerobic Digestion

Introduction

Autothermal thermophilic aerobic digestion (ATAD) is a promising technology for controlling pathogens in municipal wastewater sludge. Between 1989 and 1990, EPA conducted a study to collect and analyze design and operating data from ATAD systems in Europe and Canada. Detailed information is available concerning the history, design, operation and maintenance, performance, and cost of ATAD systems.

Project Description

ATAD systems are two-stage aerobic processes that operate under thermophilic temperature conditions (40° to 80° C), usually without supplemental heat. Typical ATAD systems operate at 55° and reach 60° to 65° in the second stage. They rely on the heat released during digestion to reach and maintain the desired operating temperatures.

The benefits of the ATAD process include a high disinfection capability, low space and tankage requirements, and a high sludge treatment rate. These systems are relatively simple and easy to operate (automatic monitoring or control equipment and full-time staff are not required) and are economical, particularly for small facilities. ATAD systems have been successfully implemented throughout Europe and in Canada.

In 1989 and 1990, EPA conducted a study of ATAD systems in the Federal Republic of Germany (FRG), where more than 35 full-scale facilities are operating. Information was obtained from the following sources: a review of German and U.S. literature, telephone contact with FRG facilities, site visits to selected facilities, meetings with systems manufacturers, and discussions with researchers at Darmstadt University. Data were also obtained from three Canadian facilities operating in 1990. The study indicates that the ATAD process can be operated to meet the most stringent U.S. regulatory requirements for pathogen control and land application of municipal sludge.

EPA's Risk Reduction Engineering Laboratory and Center for Environmental Research Information developed a publication based on this study. Topics include process concepts and development, engineering and design criteria, performance data, costs, case study, and ability to meet U.S. regulatory standards.

Publications

Environmental Regulations and Technology: Autothermal Thermophilic Aerobic Digestion of Municipal Wastewater Sludge. 1990. EPA/625/10-90/007. September.

Denny, K. et al. 1991. Automated Thermophilic Aerobic Digestion. *Water Environment and Technology*. 3(10):65.

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Use and Disposal of Municipal Wastewater Sludge

Introduction

EPA has issued guidance on the five major sludge use/disposal options—land application, distribution and marketing of sludge products, landfilling, incineration, and ocean disposal—and factors affecting their selection and implementation. The document is intended for state and local officials, managers and operators of wastewater treatment systems, planners, resource managers, and concerned citizen groups.

Project Description

Sludge management can be the most complex and costly part of wastewater management. EPA has developed a document to provide guidance on the final step in the sludge management process—the ultimate use and disposal of municipal wastewater sludge. The document provides a framework for evaluating sludge use/disposal alternatives. It describes the federal regulations pertinent to sludge management and the accepted and proven use/disposal technologies. For each technology, the document discusses process, performance, and key parameters. Case studies are presented for most of the use/disposal options.

The document also provides guidance for determining which options are suitable for a particular community, depending on factors such as community size, hydrogeology of the region, sludge quality, public acceptance, and transportation requirements. Future trends in sludge management also are discussed and sources of further information provided.

Publications

Environmental Regulations and Technology: Use and Disposal of Municipal Wastewater Sludge. 1989. EPA 625/10-84-003. March.

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Control of Pathogens in Municipal Wastewater Sludge

Introduction

EPA has issued a document describing federal requirements for reducing pathogens in wastewater sludge and providing guidance in determining whether specific sludge treatment systems provide adequate pathogen control for land application. The document is intended for owners and operators of municipal wastewater treatment works; individuals involved in applying sludge to land; regional, state, and local officials; and others interested in understanding the federal pathogen and vector control requirements placed on land application practices.

Project Description

Wastewater sludge has beneficial plant nutrients and soil conditioning properties. EPA encourages the beneficial use of sludge, including land application, wherever environmentally feasible. Wastewater sludge, however, may contain bacteria, viruses, protozoa, parasites, and other microorganisms that can cause disease. This document explains why pathogen control is necessary and discusses pertinent federal regulations, including specified treatment technologies that provide acceptable levels of pathogen reduction. It also provides information about these technologies (including aerobic and anaerobic digestion, lime stabilization, air drying, composting, heat drying, and thermophilic aerobic digestion).

Sludge from treatment technologies not specified in the regulations can be applied to land if the alternative treatment provides a level of pathogen control equivalent to that provided by the listed technologies. The document explains how EPA evaluates equivalency, what information is needed for an equivalency evaluation, and what processes have been determined to be equivalent.

This document is currently being updated in light of new standards for the disposal of sewage sludge.

Publications

Environmental Regulations and Technology: Control of Pathogens in Municipal Wastewater Sludge for Land Application under 40 CFR Part 257. 1989. EPA/625/10-89/006. September.

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Process Design Manual: Land Application of Municipal Sludge

Introduction

EPA sponsored the preparation of a manual representing the state-of-the art for process design of municipal sludge land application systems. The manual is the third in a series of publications updating EPA's *Process Design Manual for Sludge Treatment and Disposal* (EPA 625/1-74-006).

Project Description

Many communities are considering the use of land application techniques for sludge because of increasing numbers of wastewater treatment facilities, constraints on many sludge disposal options, and increasing costs. This manual provides information about four options for land application of sludge: agricultural utilization, forest utilization, reclamation of disturbed and marginal lands, and dedicated high-rate surface disposal. These practices are discussed in detail, with design concepts and criteria presented where available. Manual topics include an overview of land application options; public participation; elements needed for technical assessment and preliminary project planning; detailed site evaluation and selection procedures; process design for land application options; and general facility design, cost, and operation and maintenance guidance. The manual also includes case studies of sludge utilization in agriculture and for reclamation of disturbed mining lands.

Publications

Process Design Manual: Land Application of Municipal Sludge. 1983. EPA-625/1-83-016. October.

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Handbook: Septage Treatment and Disposal

Introduction

EPA has developed a handbook presenting information about receiving, treatment, and disposal of septage. The manual covers design, performance, operation and maintenance, cost, and energy considerations. A full range of alternatives is presented along with technical advice to aid in evaluating each alternative.

Project Description

Proper treatment and disposal of septage (liquid and solid material pumped from a septic tank or cesspool) is becoming an increasingly difficult problem in communities where onsite sewage disposal systems are common. To address this problem, EPA has issued a handbook for planners, design engineers, state and federal reviewers, and local government officials. The manual presents information to facilitate the design of septage receiving stations, pretreatment processes, new sewage treatment plants with provisions for receiving septage, and independent septage treatment and disposal alternatives. The methods covered include land treatment and disposal, co-treatment at existing wastewater treatment facilities, and independent facilities for treatment and disposal (such as lagoons, composting, biological treatment, aerobic and anaerobic digestion, lime stabilization, and chlorine oxidation). A series of fact sheets provides summaries of selected treatment methods along with generalized capital and operation and maintenance costs.

Publications

Handbook: Septage Treatment and Disposal. 1984. EPA-625/6-84-009. October.

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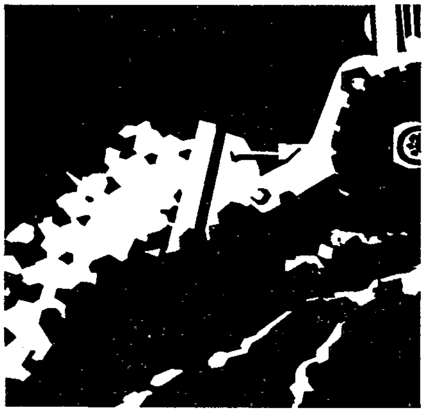

Solid and Hazardous Waste Management

Waste Minimization Assessments for Small Businesses

Introduction

EPA is conducting a pilot project to assist small- and medium-sized manufacturers who want to reduce or eliminate hazardous waste generation but lack the necessary expertise. The waste minimization assessments are performed at no out-of-pocket cost to the client. To qualify for the assessment, a business must fall within Standard Industrial Classification Codes 20 to 39, have gross annual sales not exceeding $50 million, employ no more than 500 persons, and lack in-house expertise in waste minimization.

Project Description

The amount of hazardous waste generated by industrial plants has become an increasingly costly problem for manufacturers and an additional stress on the environment. One solution to the problem of hazardous waste is *waste minimization*—reducing or eliminating the waste at its source. Through waste minimization, businesses can reduce costs; meet state and national waste minimization goals; reduce potential environmental liabilities; and protect public health, worker health and safety, and the environment. Many small businesses, however, lack the expertise needed to develop and implement successful waste minimization programs.

Under an agreement with EPA's Risk Reduction Engineering Laboratory, University City Science Center in Philadelphia, PA, has established three Waste Minimization Assessment Centers (WMACs) at selected universities. The WMACs assemble assessment teams consisting of individuals who have considerable direct experience with process operations in manufacturing plants, as well as the knowledge and skills needed to minimize hazardous waste generation.

The teams use procedures adapted from EPA's *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). The assessment team locates the sources of hazardous waste in a plant and identifies the current disposal or treatment methods and their associated costs. It then identifies and analyzes a variety of ways to reduce or eliminate the waste. The team recommends specific measures to minimize waste and develops the necessary technological and economic information. A confidential report detailing the findings and recommendations is prepared for the client.

Publications

Waste Minimization for:

Manufacturer of Printed Plastic Bags (EPA/600/M-90/017)
Metal Parts Coating Plant (EPA/600/M-91/015)
Outdoor Illuminated Signs (EPA/600/M-91/016)
Manufacturer of Rebuilt Railway Cars and Components (EPA/600/M-91/017)
Manufacturer of Aluminum Braised Oil Coolers (EPA/600/M-91/018)
Manufacturer of HVAC Equipment (EPA/600/M-91/019)
Bumper Refinishing Plant (EPA/600/M-91/020)
Multilayered Printed Circuit Board Manufacturer (EPA/600/M-91/021)
Manufacturer of Printed Circuit Boards (EPA/600/M-91/022)
Paint Manufacturing Plant (EPA/600/M-91/023)
Manufacturer of Compressed Air Equipment Components (EPA/600/M-91/024)
Manufacturer of Aluminum Cans (EPA/600/M-91/025)
Manufacturer of Refurbished Railcar Bearing Assemblies (EPA/600/M-91/044)
Manufacturer of Prototype Printed Circuit Boards (EPA/600/M-91/045)
Manufacturer of Speed Reduction Equipment (EPA/600/M-91/046)
Manufacturer of Printed Labels (EPA/600/M-91/047)

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Guide to Technical Resources for the Design of Land Disposal Facilities

Introduction

EPA has issued numerous technical documents on hazardous waste land disposal facilities to assist preparers and reviewers of Resource Conservation and Recovery Act (RCRA) permit applications in processing applications in a timely way and achieving consistency in permitting decisions. These documents include RCRA Technical Guidance Documents, Permit Guidance Manuals, and Technical Resource Documents. EPA has written a guide to these EPA documents to help permit applicants and reviewers find answers to questions about permit applications.

Project Description

The *Guide to Technical Resources* describes information sources useful for demonstrating that the design, construction, and operation of a land disposal unit meets RCRA performance standards and minimum technology requirements for hazardous waste landfills and surface impoundments. The topics addressed include foundations, dike integrity and slope stability, liner systems, cover systems, and run-on and run-off controls. The Guide itself provides little primary information. Instead, it directs the reader to other documents where specific technical subjects are addressed.

The first part of each chapter provides a brief summary of the existing regulations and describes the major technical parameters commonly used to evaluate permit applications. In subsequent sections of each chapter, the reader is referred to technical documents that can help in selecting the appropriate methodology to evaluate permits and determine acceptable ranges for the technical parameters. References to nontechnical documents are also included when appropriate. In addition to describing resources for the RCRA permit process, the guide also may be useful in designing and operating other types of land disposal units, such as waste piles, land treatment units, and land disposal facilities for nonhazardous wastes.

Publications

Guide to Technical Resources for the Design of Land Disposal Facilities. 1988. EPA/625/6-88/018. December.

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Manual for Solid Waste Disposal Facility Criteria

Introduction

EPA has developed a draft technical manual on the revised municipal solid waste landfill (MSWLF) criteria. The manual is not a regulatory document and does not provide mandatory technical guidance. Rather, it provides assistance to landfill owners/operators and their consultants for demonstrating compliance with the revised standards.

Project Description

On October 9, 1991, EPA promulgated revised MSWLF criteria (Chapter 40, Part 258 of the Code of Federal Regulations). These are minimum national criteria for all solid waste landfills that are not subject to federal hazardous waste regulations and that either receive municipal solid waste, accept nonhazardous combustor ash, or co-dispose sewage sludge with municipal solid waste.

EPA has developed a draft manual to help landfill owners and operators comply with the revised landfill criteria. The manual will also be useful for state regulatory personnel involved in reviewing permit applications for landfills. It presents technical information to be used in designing, operating, and closing landfills, but does not present a mandatory approach for demonstrating compliance with the design criteria.

The manual follows the general order of the criteria, covering their general applicability, location restrictions, operating requirements, design standards, ground-water monitoring and corrective action, and closure and post-closure care. Each section includes the regulatory language, a general explanation of the regulations and who must comply, key technical issues in ensuring compliance, and resources for further information.

Publications

Draft Technical Manual for Solid Waste Disposal Facility Criteria—40 CFR Part 258. 1992. April.

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Requirements for Hazardous Waste Landfill Design, Construction, and Closure

Introduction

EPA has prepared a seminar publication explaining the Agency's minimum technology guidance and proposed regulations for hazardous waste landfill design. The document also offers practical and detailed information about the construction of hazardous waste facilities that comply with these requirements.

Project Description

EPA's minimum technological requirements for hazardous waste landfill design were set forth by Congress in the 1984 Hazardous and Solid Waste Amendments (HSWA). HSWA covered requirements for landfill liner and leachate collection and removal systems, as well as leak detection systems for landfills, surface impoundments, and waste piles. In response to HSWA and other Congressional mandates, EPA issued proposed regulations and guidance on the design of these systems, and on construction quality assurance, final cover, and response action plans for responding to landfill leaks.

In 1988, EPA held a series of 10 technology transfer seminars on requirements for hazardous waste landfill design, construction, and closure. The information presented was compiled in a seminar publication. The topics addressed include an overview of minimum technology guidance and regulations for hazardous waste landfills; clay liner design; flexible membrane liners; elements of liquid management at waste containment sites; securing a completed landfill; construction of hazardous waste facilities; construction quality assurance and control; construction of flexible membrane liners; and liner compatibility with wastes. Long-term considerations, final covers, problem areas and unknowns, and response action plans for responding to landfill leaks also are addressed.

Publications

Seminar Publication: Requirements for Hazardous Waste Landfill Design, Construction, and Closure. 1989. EPA/625/4-89/022. August.

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Design and Construction of RCRA/CERCLA Final Covers

Introduction

EPA has produced a publication on the design, construction, and evaluation requirements for cover systems for RCRA/CERCLA hazardous and nonhazardous waste landfills. The document is based on papers presented at the U.S. Environmental Protection Agency Technology Transfer Seminars on Design and Construction of RCRA and CERCLA Final Covers. It is not a design manual, but it does include detailed, practical information about RCRA/CERCLA final covers.

Project Description

Cover systems are an essential part of all land disposal facilities for controlling moisture and limiting the formation of leachate and its migration to ground water. The Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) include requirements for cover systems, and many states have their own more stringent requirements.

To disseminate information regarding these cover systems, EPA held seminars in 1990 in each of the 10 EPA Regions. Presentations were given by representatives of EPA, the U.S. Army/Corps of Engineers, academia, and the private sector. A seminar publication was produced following the seminars. Topics include an overview of cover systems for waste management facilities, soils used in typical cover systems, geosynthetic design for landfill covers, durability and aging of geomembranes, alternate cover designs, construction quality assurance for soils and geomembranes, gas management systems, and postclosure monitoring. The publication also discusses the Hydrogeologic Evaluation of Landfill Performance (HELP) model for design and evaluation of liquids management systems. Case studies of RCRA/CERCLA closures are presented.

Publications

Design and Construction of RCRA/CERCLA Final Covers. 1991. EPA/625/4-91/025. May.

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Integrated Solid Waste Management Planning for Small Communities

Introduction

EPA is developing a series of seminars designed to help rural counties and small communities produce integrated municipal solid waste (MSW) management plans. The seminars will present information developed by EPA about waste management technologies and planning techniques appropriate for small communities.

Project Description

In response to the growing shortage of land for land disposal operations, EPA has established a 25 percent reduction goal for waste going to landfills. Several states have implemented regulations for diverting waste from land disposal, and counties generally are responsible for producing a plan to meet these regulations. Many counties, however, cannot afford engineering services and must develop a plan based on existing information.

EPA's *Decision-Maker's Guide to Solid Waste Management* (EPA/530/SW-89-072) provides the technological basis for developing plans. In addition to this guidance, decision-makers need the most up-to-date information on management technologies, as well as more detailed information about integrating different processes. To meet these needs, EPA is developing detailed technical, environmental, public health, and social information on waste management technologies, including recycling/reuse, material recovery facilities (MRFs), and composting.

EPA, in conjunction with states and the National Association of Counties (NACO) will present a series of seminars based on the *Decision-Maker's Guide* and other information being developed by EPA. The seminars will focus on the special needs of rural counties and small communities, emphasizing appropriate technologies, planning approaches, and planning techniques. They will employ national experts, case studies, and health risk information specifically designed for small communities. Topics will include MSW characterization, source reduction, recycling, composting, thermal processes for energy recovery, and management options. In addition, the seminars will include a demonstration of a new user-friendly EPA-sponsored software package that integrates rural options into an MSW plan development.

EPA's *Handbook for Material Recovery Facilities for Municipal Solid Waste* (EPA/625/6-91/031) will be featured at the seminars. Handouts will include a handy matrix on recyclable products, their uses, typical market value, markets, and health and safety concerns. Several other EPA publications also will be distributed.

Publications

No publications to date.

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Innovative Clean Technologies Project

Introduction

EPA is providing selected small businesses with awards of up to $25,000 to demonstrate innovative pollution prevention techniques and technologies, and up to $50,000 to conduct research in reducing pollution at the source in selected operations. The results of both efforts will be evaluated, published, and transferred to the relevant industries through a variety of methods.

Project Description

The Innovative Clean Technologies Project has two primary objectives: to support small businesses in implementing and demonstrating promising pollution prevention techniques and technologies, and to provide a vehicle for small businesses to conduct research on promising pollution prevention ideas.

Demonstrations of pollution prevention technologies have been conducted in the following areas: printed circuit boards, aerosol substitution, solvent substitution, pesticides, plastics, wood preserving, coaxial cable, metal finishing, and printing.

Beginning in 1993, EPA's annual solicitation will include an additional request for proposals that represent promising, technically credible ideas for cooperative research among the proposer, EPA, and a university. These research proposals will be required to meet a more stringent set of technical criteria than those for currently funded projects. Four proposals will be funded at $50,000 each. In 1995, eight research projects will be selected.

To develop forums for technology transfer, 18 trade associations have agreed to participate in the program and provide assistance to small businesses in the areas of technology and information transfer. Demonstration and research results will be presented at annual industry conferences and workshops and published in appropriate trade newsletters.

Publications

Between 1992 and 1996, 77 Technology Demonstration Reports and 12 Research Briefs will be produced.

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Evaluation of Antifreeze Recycling Technologies in a New Jersey Maintenance and Repair Facility

Introduction

EPA is evaluating antifreeze recycling technologies that have the potential to reduce engine coolant waste. This evaluation is being conducted at a New Jersey vehicle maintenance and repair facility.

Project Description

Used antifreeze can be highly contaminated and is considered dangerous to the environment. Disposal of used antifreeze has become a costly and serious problem for automotive repair facilities and fleet operators nationwide. For this reason, EPA is conducting a study of filtration-type and distillation-type technologies for recycling antifreeze.

Site testing and sampling were conducted for both types of technologies. Analytical laboratories performed corrosion potential tests and chemical characterization. The recycled samples also underwent the aluminum corrosion test methods, since many new engines are made of aluminum rather than cast iron. In addition, the recycled samples were analyzed for the presence of degradation products in the form of salts of organic acids (such as glycolates) by ion chromatograph. This information is critical because organic salts formed during the neutralization of acids could contribute to corrosion.

Publications

Randall, P.M. 1990. *Prototype Evaluation Initiatives in a New Jersey Maintenance and Repair Facility*. Presented at the International Conference on Pollution Prevention: Clean Technologies and Clean Products, Washington, DC, June 12. (Available from AWBERC contact below.)

Automotive and Heavy-Duty Engine Coolant Recycling by Filtration (the full report). 1992. EPA 600/2-91/066. NTIS PB92-126 804. (Project summary will be available mid-1992.)

A second report, *Automotive and Heavy-Duty Engine Coolant Recycling by Distillation,* will be available mid-1992.

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Meeting Hazardous Waste Requirements for Metal Finishers

Introduction

EPA has produced a publication summarizing federal regulations affecting hazardous wastes discharged by metal finishers. This document is based on a series of three EPA technology transfer seminars held in 1986.

Project Description

EPA's Office of Solid Waste and Emergency Response has an ongoing outreach program to disseminate information to the community regulated by the Resource Conservation and Recovery Act (RCRA) and the Hazardous and Solid Waste Amendments (HSWA). The metal finishing industry was selected under this program as the focus of a series of seminars to help plant managers and engineers achieve compliance in a cost-effective manner. Three such seminars were held in 1986, with the support of the American Electroplaters and Finishers Society, National Association of Metals Finishers, and the Metal Finishing Suppliers Association.

A technology transfer document was prepared based on the information presented in these seminars. The regulatory information was updated to include regulatory developments occurring through Spring 1987. Topics covered by the document include the impact of RCRA on small and large generators, the "delisting" of specific facility waste from hazardous waste regulation, land disposal bans on hazardous wastes, the use of used oil and hazardous wastes as fuel, criteria for the use of underground storage tanks for hazardous wastes, and the relevance of the Clean Water Act to the hazardous wastes discharged by metal finishers. The document also discusses the selection of a hazardous waste transporter and management facility, the costs and benefits of source reduction in metal finishing, materials use and recovery, the treatment and management of organic liquids, and the characterization and treatment of hazardous wastes.

Publications

Seminar Publication: Meeting Hazardous Waste Requirements for Metal Finishers. EPA/625/4-87/018.

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Handbook: Operation and Maintenance of Hospital Medical Waste Incinerators

Introduction

EPA has issued a handbook summarizing technical information on the proper operation and maintenance of hospital waste incinerators and associated air pollution control systems. The document is intended for use by federal, state, and local agency personnel; hospital waste management personnel; and hospital incinerator operators.

Project Description

Incineration can be an attractive option for the disposal of infectious waste for hospitals faced with high disposal costs, refusal of their waste by treatment and disposal facilities, and tighter regulation. Hospital waste incinerators, however, can emit a number of pollutants, such as particulate matter, acid gases, toxic metals, toxic organic compounds, carbon monoxide, sulfur oxides, nitrogen oxides, and pathogens. Proper incinerator operation will reduce the emissions of most of these pollutants. Air pollution control devices are available to further control these emissions.

EPA has produced a handbook to identify operation and maintenance (O&M) procedures that will minimize air emissions from hospital waste incinerators and associated air pollution control equipment. The document presents information on hospital waste incineration systems, add-on air pollution control systems, key operating parameters and good operating practices, maintenance, control and monitoring instrumentation, common operating problems and solutions, recordkeeping, and safety guidelines. The document provides a general overview of proper O&M procedures; it is not intended to substitute for manufacturers' O&M recommendations.

Publications

Handbook: Operation and Maintenance of Hospital Medical Waste Incinerators. 1990. EPA/625/6-89/024. January.

AWBERC Contact

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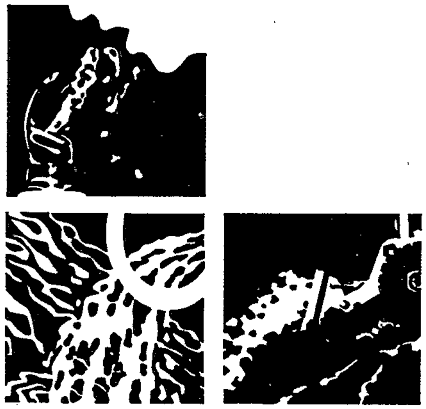

Multidisciplinary

Integrated Risk Information System (IRIS)

Introduction

The Integrated Risk Information System (IRIS) is a data base containing summaries of health risk and regulatory information on more than 500 chemicals. IRIS contains EPA consensus risk assessment information used in health risk assessment and risk management activities. The information in IRIS can be accessed without extensive training in toxicology, although some knowledge of health sciences is useful.

Project Description

The heart of the IRIS system is its collection of computer files covering individual chemicals. Each chemical file in IRIS contains the following technical information: oral reference doses and inhalation reference concentrations, qualitative and quantitative carcinogenicity assessments, and summaries of drinking water health advisories and EPA regulatory actions. The reference dose/concentration and carcinogenicity risk assessment information on IRIS is developed by two workgroups of EPA scientists, and represents EPA consensus. The summarized entries provide references to supporting scientific studies and telephone numbers of EPA scientific contacts.

The primary users of IRIS include EPA staff and state environmental health agencies. The data base is available publicly on the National Library of Medicine's (NLM's) Toxicology Data Network (TOXNET). Registered NLM online service users can access IRIS through the COMPUSERVE, TYMNET, TELENET, or INFONET telecommunications networks or by direct dial. IRIS is available 24 hours a day, 7 days a week, except for a brief daily maintenance period. Online and offline printing of entire or specified portions of records is available.

To aid users in accessing and understanding the data in IRIS chemical files, extensive documentation is available. This includes an alphabetical list of the chemical files and list of chemicals by Chemical Abstract Service (CAS) number; background documents describing the rationales and methods used to arrive at the results shown in the chemical files; a user's guide with step-by-step procedures; and glossaries defining acronyms, abbreviations, and risk assessment terms.

Publications

Documentation for IRIS is available from the Environmental Criteria and Assessment Office.

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Drinking Water and Wastewater Treatment Workshops for Small Communities

Introduction

Increasing drinking water and wastewater treatment requirements are especially burdensome to small communities. In most cases, small communities lack the financial resources and technical expertise to address these, and many other, environmental control responsibilities. EPA, in conjunction with several other organizations, has developed workshops to help small communities in the areas of drinking water and wastewater treatment.

Project Description

EPA has developed and conducted two pilot workshops to help small communities meet their responsibilities for drinking water and wastewater treatment. The Agency worked with several organizations that provide technical assistance to small communities, including the National Rural Water Association (NRWA), the Rural Assistance Program (RCAP), the U.S. Department of Agriculture Cooperative Extension Service (CES), and the Coalition of Environmental Training Centers (CETC).

The 2-day workshop program addresses drinking water and wastewater treatment technologies and effective small community environmental management. It is designed to bring together small community administrators and treatment systems operators to improve communication between decision-makers and system personnel within a community. In addition, the workshop attempts to initiate communication between communities to share ideas on addressing common problems. The workshop focuses on effective team building within a community and identifying external technical and financial assistance.

Pilot workshops were held in Lafayette, Louisiana, and Eugene, Oregon. These workshops demonstrated that the core workshop material could be supplemented with local and regional information and effectively presented by local and regional representatives of the small community resource organizations.

EPA has developed the workshop materials and will provide them to the resource organizations for local workshops around the country. In addition, EPA is developing a workshop publication that will provide information on small community treatment technologies and environmental management.

Publications

The workshop publication will be available in early 1992.

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Methods for the Determination of Metals in Environmental Samples

Introduction

This document presents 13 laboratory analytical methods for 35 metals that may be present in drinking water, marine water, industrial and municipal wastewater, ground water, and landfill leachate. The document also includes methods to analyze biological tissues, sediments, and soils. The document is designed for public and private laboratories to determine metals in environmental media for regulatory or other purposes.

Project Description

The methods described in this manual involve a wide range of analytical instrumentation, including inductively coupled plasma (ICP)/atomic emission spectroscopy (AES), ICP/mass spectroscopy (MS), atomic absorption (AA) spectroscopy, ion chromatography (IC), and high-performance liquid chromatography (HPLC). For each method, the document provides the following information: a summary, definitions, and scope and application of the method; interferences; safety; apparatus and equipment; reagents and consumable materials; sample collection, preservation, and storage; calibration and standardization; quality control; procedures; calculations; and precision and accuracy. References are also included.

The names of the authors of each method are provided to assist users in obtaining direct telephone support when required.

Publications

Methods for the Determination of Metals in Environmental Samples. 1991. EPA/600/4-91/010. June.

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Workshops, Seminars, and Conferences Available through EPA

Workshops, Seminars, and Conferences Available through EPA

EPA's Office of Technology Transfer and Regulatory Support (OTTRS) can work with AWBERC to develop a workshop, seminar, or conference that addresses your small system needs. EPA can provide technical assistance and resources for meetings tailored for your organization. Examples of workshops given by EPA include:

Drinking Water

Assessment and Management of Drinking Water Contamination (including modules on toxicology, risk assessment, standards and health advisories, treatment technologies, and biofilm control)

Emerging Technologies for Drinking Water Treatment (including modules on filtration; organics and radon removal; corrosion control, including lead and copper; and disinfection/disinfection by-product control)

Wastewater

Improving POTW Performance with the Composite Correction Program

Sludge Composting

Field Evaluations of Municipal Wastewater Treatment Technology

Sewer System Rehabilitation

Solid and Hazardous Waste Management

Waste Minimization/Pollution Prevention in Cottage Industries

Solvent Waste Reduction Alternatives

Medical/Institutional Waste Incineration

Design/Operation/Closure of Municipal Landfills

AWBERC Contact

If you would like to set up a workshop, seminar, or conference, please contact:

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