

REPORT SUMMARY

This manual provides an approach to evaluating, designing, constructing, and maintaining passive treatment systems for select contaminants found in wastewaters. It is intended for use by environmental managers and engineering design staff to assess the applicability of passive technologies to treat wastewater discharges. The guidelines presented in this manual are work in progress as the understanding of passive treatment increases with time. Readers are advised to seek expert advice when encountering wastewater conditions varying significantly from those discussed in this manual.

Background

Passive treatment uses natural physiochemical and biological processes to remove contaminants from wastewater without the continuous input of energy or consumable reagents. It has proven to be a cost-effective alternative to conventional physiochemical treatment for some types of wastewaters, and work is underway to develop new applications and treatable parameters. A number of passive treatment approaches are still experimental or have limited field results, but several have long-term success records for selected wastewater contaminants. The design criteria for these successful technologies are also relatively well established.

Objectives

The objectives of this manual are as follows:

- To detail the data collection and analysis methods necessary for characterizing wastewater sources for passive system design purposes.
- To provide a background understanding of passive treatment processes, including removal mechanisms for acidity, aluminum, arsenic, hexavalent chromium, iron, manganese, and selenium, with commentary on potential treatment effectiveness for other parameters.
- To provide guidance in the evaluation of passive treatment applicability and system construction feasibility.
- To present a set of design criteria and construction practices for passive treatment systems and passive technology components with established success records, including anoxic limestone drains, vertical flow wetlands, oxidation/precipitation basins, surface flow wetlands, and manganese-oxidizing bacteria systems.
- To summarize the construction management considerations specific to passive treatment systems, including detailed cost estimating, project timing, contractor selection, and construction management.

- To provide guidance for long-term operation and maintenance of passive systems to maintain their treatment effectiveness.
- To develop the Passive Treatment Planning Tool (PT2 Version 1.0) as a desktop utility to allow rapid conceptual evaluation of the applicability of passive treatment, basic system component requirements, and approximate cost to construct, operate, and maintain a passive system to treat the selected parameters.

Approach

The design and implementation approach presented in this manual for passive systems is based on the experience of the authors and on results from existing passive systems for the electric utility industry and similar types of wastewater. Where applicable, simplified sizing calculations and materials specifications are provided. Additional information is included to provide the reader with a thorough background understanding of the functions of passive systems and their specific advantages and limitations.

Results

Existing passive treatment systems designed according to the guidelines in this manual have all proven to be cost-effective and reliable for maintaining discharge compliance. Design approaches presented for specific contaminants will allow environmental managers to design and implement passive systems using internal staff in cases where this technology is readily applicable. The PT2 Passive Treatment Planning Tool V1.0 has been developed in support of this manual as a desktop planning tool to allow rapid evaluation of conceptual passive system designs, construction requirements, and cost estimates. PT2 V1.0 is included with this manual.

EPRI Perspective

Keywords

Passive Treatment
Discharge Compliance
Trace Metals Removal