SLOW-RATE LAND TREATMENT

AUTHOR

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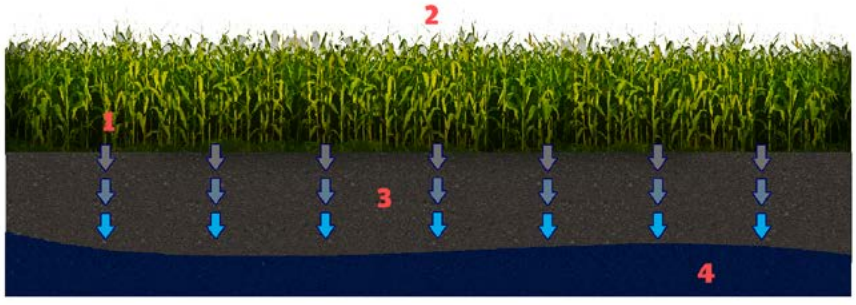

1 - Inlet
2 - Agricultural field
3 - Slow infiltration in soil media
4 - Ground water

Description

Slow-rate land treatment is the controlled application of primary or secondary wastewater to a vegetated land surface. Standard irrigation methods are used to distribute the water to agricultural fields, pastures, or forest lands. Wastewater infiltrates from the vegetated soil surface and flows through the plant root zone and soil matrix. Water may percolate to the native groundwater or to underdrains or wells for water recovery and reuse of the effluent.

Advantages

- Low energy usage possible (feeding by gravity or siphon)
- No specific hazard with mosquito breeding
- Robust against load fluctuations
- Groundwater recharge, controlled groundwater levels

Disadvantages

- Soil structure dispersion resulting from high dissolved salts concentrations if not properly designed into the application system

Co-benefits

High	Water reuse				
Medium					
Low	Biodiversity (fauna)	Biodiversity (flora)	Temperature regulation	Storm peak mitigation	Aesthetic value

Compatibilities with Other NBSs

Slow-rate land treatment works well with pond treatment systems, especially pond-in-pond systems and as a final infiltration unit for treatment wetlands.

Case Studies

In publication

- Wastewater reuse through a slow-rate land application system preceded with aerated and settling lagoons for primary treatment in Muskegon County, Michigan, USA
- Advanced wastewater treatment through slow-rate land application preceded with activated sludge system in Lubbock, Texas, USA

Other

- Forested system in Dalton, Georgia, USA in Lubbock, Texas, USA (https://www.dutil.com/land-application-system/)

Operation and Maintenance

Regular

- Monitoring of influent wastewater quality, groundwater, soil, and vegetation
- Harvesting needed on a routine basis
- Regular inspections of infrastructures, pumps, valves, and mechanical elements

Troubleshooting

- Typical agricultural operation management for any cropping system with irrigation

Literature

Adhikari, K., Fedler, C. B. (2020). Water sustainability using pond-in-pond wastewater treatment system: Case studies, Journal of Water Process Engineering, 36, 101281

Bhargava, A., Lakmini, S. (2016). Land treatment as viable solution for waste water treatment and disposal in India. Journal of Earth Science and Climatic Change, 7, 375.

U.S. Environmental Protection Agency (2002). Wastewater Technology Fact Sheet Slow Rate Land Treatment. Washington, D.C.

U.S. Environmental Protection Agency. (2006). EPA Process Design Manual: Land Treatment of Municipal Wastewater Effluents (EPA/625/R-06/016; September 2006).

NBS Technical Details

Type of influent

- Primary treated domestic wastewater
- Secondary treated domestic wastewater
- Greywater

Treatment efficiency

- COD ~0%
- BOD_5 90–99% (<2 mg/L)
- TN 50–90% (<3 mg/L, depending on loading rate, C:N ratio, and crop uptake and removal)
- NH_4-N ~80%
- TP 80–99% (<0.1 mg/L)
- TSS 90–99% (<1 mg/L)

Requirements

- Net area requirements:
  - Field area requirements: 60–740 m^2 (field area not including buffer area, roads, or ditches for 1 m^3/day flow)
  - Soil depth: at least 0.6–1.5 m
  - Soil permeability: 1.5–51 mm/hour
- Electricity needs: energy for pumps required
- Other
  - Minimum pretreatment: primary sedimentation
  - Application techniques: sprinkler, surface or drip
  - Vegetation: required
  - Climate, slope of the land, and soil conditions require accurate design

Design criteria

- Annual loading rate: 0.5–6 m/year

NBS Technical Details

Commonly implemented configurations

- Slow-rate land treatment involves the controlled application of wastewater or to a vegetated land surface. There are two basic types of slow-rate system:
  - Type 1: maximum hydraulic loading, i.e. apply the maximum amount of water to the least possible land area; a 'treatment' system.
  - Type 2: optimum irrigation potential, i.e. apply the least amount of water that will sustain the crop or vegetation; an irrigation or 'water reuse' system with treatment capacity being of secondary importance.

Climatic conditions

- Ideal for warm climates, but also suitable for old climates if seasonal crops are grown. Lower temperature limit: −4 °C.