



Wastewater treatment

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Wastewater treatment







Wastewater treatment



Getting rid of honey bucket bags is a wastewater collection problem, not a treatment problem.

Wastewater treatment

- Tundra ponds and lagoons
- Septic systems (surface or subsurface discharge, sludge?)
- Conventional activated sludge (pure oxygen)
- Extended aeration
- Fixed film
- Lagoons in series (sludge?)
- Facultative lagoons
- Aerated lagoons
- Constructed wetlands



Wastewater treatment

- Primary and secondary Sludge





Lagoon Design Criteria

- Primarily based on influent loadings and desired effluent quality, but limited by
 - Eligible technology
 - Treatment goal
 - Required detention time
 - Depth
 - Also based on effect of climatic conditions on performance



Design and Operation of Lagoons in Cold Climates

- Loading rates
 - Volumetric loading rates: “Up to 33 lb BOD5/100,000 gallons/day” (continuous flow)
 - Up to 200 lb BOD5/acre/day (primary settled!) - odors
 - 10-20 lb BOD5/acre/day - no odors (T!!) Water line bleeding v. honey bucket/septic input
 - Nitrogen and phosphorus removal (cycling of aerobic and anaerobic conditions, T!!)
 - Disinfection (longer detention the better...?)

Design and Operation of Lagoons in Cold Climates

- Loading rates
 - Canadian guidelines -
<30 lb BOD/acre/day,
minimum 2 cells,
treatment, storage
requirements, depth
requirements,
detention time
requirements



Lagoon Challenges

- Low DO during ice covered conditions
- Long pathogen detention times
- Cold soils/water
- Sensitive discharge environment
- Short circuiting
- Depth (changing) - SLUDGE
- Nutrient removal
- Operations irregularities



Water Stabilization Pond Design and Performance Study

- 3 phase study
 - Inventory and design (funded, done)
 - Operation and performance (not funded)
 - Recommendation for design standards (not funded)

Lagoon Inventory Methodology

- Compile a list of 200 systems in operation which included:
 - Systems with discharges from piped sewer systems
 - “Truck and haul” dump sites
 - Septage tank collection/settling basins
 - Active honey bucket ponds
- Systems receiving no liquid influent or containing little to no water not included

Lagoon Inventory Methodology

- 130 systems with supporting documentation
- Generally design documents were available - as-built or operating conditions not commonly available
- 100 fields of information
- 2000 performance data recorded

Lagoon Design Parameters

- Number of cells in a lagoon system
- Volume estimates
- Lined (to prevent percolation and infiltration) vs. unlined
- Sludge accumulation rates
- Freeboard above the water surface
- Percolation rates
- Aerial BOD loading

Lagoon Classification

- Each lagoon cell grouped into one of four classes:
 - Short-detention
 - Long detention
 - Storage lagoon
 - Subsurface-discharge



Lagoon Classification

- Larger systems also grouped by type:
 - Single-cell, discharging
 - Single-cell, subsurface discharging
 - Multiple-cell, surface discharging
 - Multiple-cell, subsurface discharging
- Aerated Lagoon
 - Lagoons using a physical aeration system

Lagoon Classification

- Larger systems also grouped by type:
 - Single-cell - 65
 - Two-cell - 62
 - Three-cell - 11
 - 4, 5, 6 cells, 3, 2, 2
- No primary anaerobic sedimentation

Lagoon Results

- Smith and Prince recommended
 - 1 long detention (>50 days) and 1 storage percolation if less than 66,000 gal/day (115 systems). Only 58 had both, 51 were single cell, 6 were short detention/storage
- 2 short detention cells up to 132,000 gal/day, and 4 cells for more.

Lagoon Results

- Of 115 systems, 40 were lined, 9 unlined, remaining unknown
- Sludge accumulation rates available for 15 systems
- Most had freeboard to accommodate ice (1-4 ft depending on system)
- 10 included precip., a few had evaporation

Lagoon Results

- Recommended percolation rates - 0.17 inch/day in Alberta
- This was less than the lowest of the Alaska percolation rates of 0.4 inch/day
- Range 0.4 inch/day minimum, 4800 in/day maximum, 2.29 in/day median

Lagoon Results

- Recommended BOD5 loading rates 15-40 lb BOD5/acre/day
- 46 lagoons w/info. Range 1.1 lb BOD5/acre/day minimum, 840 lb BOD5/acre/day, 2.29 in/day median
- 18 in range, 10 lower, 18 higher
- Average detention time 477 days (8-2,100 days)

2 Cents

- Constructed lagoons are often overloaded
- Percolation rates are high
- Lack of multiple cell lagoons
- Lack of primary sedimentation



2 Cents

- Phases 2 and 3 would be helpful to determine performance and new design standards
- Systematic study is challenging but needed. There are virtually no replicates
- Don't give up on secondary wastewater treatment
- Don't give up on lagoons
- Wastewater collection is a big deal
- Sludge is a big deal
- Operation is a big deal



Thank you!

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