COLLEGE OF ENGINEERING

Chemical, Biological, and Environmental Engineering

Landfill Leachate Treatment

The TCL requires development of a pilot-scale system targeting the removal of iron and ammonia is required to investigate treatment processes that allow for direct discharge of leachate from the landfill.

Motivation and Significance

10 - 15 million gallons of leachate flow from the Tillamook Closed Landfill (TCL) every year. The leachate is currently pumped to a field and disposed of via spray irrigation. This land application system is not a sustainable long-term solution. A treatment system with promising methods that enables direct discharge of leachate will be tested during the summer.

Methodology and Design Approach

Iron

- Aeration increases the dissolved oxygen available to oxidize the iron.
- Increasing the pH with lime will allow faster oxidation of the iron.

$$[Fe(II)] = [Fe(II)]_0 \exp(k[OH^{-1}]^2 K_H C_{O_2} t)$$

- Oxidized iron will be captured with a sedimentation basin.
- Allowing adequate time for sedimentation and oxidation to occur is critical to capturing all reacted iron.

Ammonia

- Nitrification is the targeted process for ammonia removal.
- Wetland nitrification rates are influenced by temperature, dissolved oxygen and contaminant concentrations, retention time, etc.
- Kinetic and volumetric models were used for wetland design and removal estimates.
- EPA wetland design guidelines were utilized.

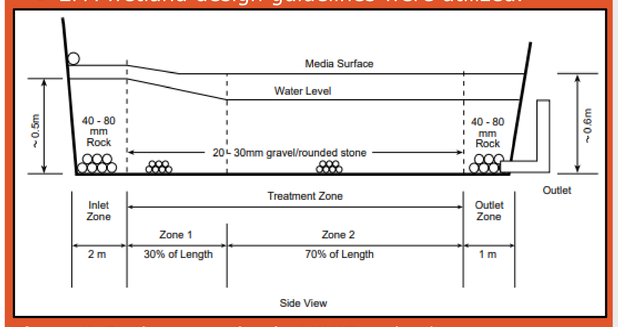

Figure 3. Design example of a HSSF wetland.

Figure 1. Site area available for a leachate treatment system at the landfill.

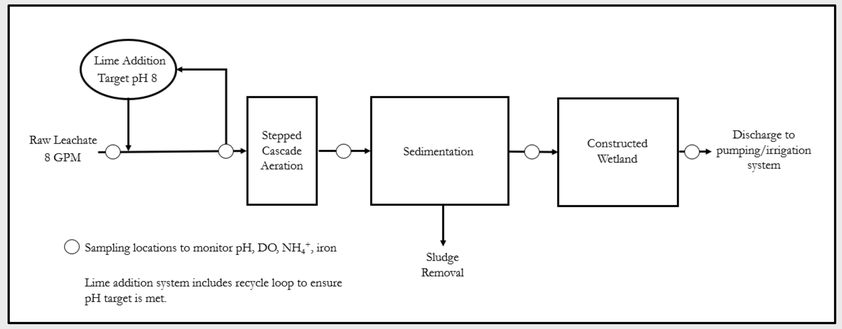

Figure 2. Process flow diagram of pilot-scale design.

Conclusion and Future Work Considerations

Ammonia

- The required full-scale wetland area is too large for the land available at the landfill
- A pilot-scale wetland could be used to more accurately determine the nitrification rate of ammonia
- A higher than predicted nitrification rate would reduce the land requirement

Iron

- Cascade aeration is predicted to sufficiently aerate the leachate
- Iron settling velocities are too slow, resulting in a required sedimentation basin volume that is too large.
- Polymer coagulation instead of chemical pH change will be investigated

Design Description

Cascade Aeration

A stepped cascade aerator is used to increase the dissolved oxygen content in the leachate.

Chemical pH Change

Chemical pH adjustment is achieved with lime dosing to reach a target pH of 8 and increase the rate of iron oxidation.

Sedimentation

A sedimentation basin facilitates iron removal via precipitation and settling.

HSSF Wetland

A horizontal subsurface flow wetland targets the removal of ammonia from the leachate prior to discharge.

Figure 4. Iron build up inside of previously tested treatment system.

Oregon State University