The Effects of Freeze/Thaw Treatment on Wastewater Sludge Characteristic

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Research Objectives

- Purpose: Finding a sustainable and cost effective solution for wastewater sludge management in Northern Communities by taking advantage of cold climate condition
- Evaluating the freeze/thaw treatment as a sludge pretreatment technique
- Measuring the potential of nutrient recovery from the water obtained after freeze/thaw process
- Investigating the enhancement of sludge biogas production after freeze/thaw treatment

Wastewater Treatment

Disposing the waste without any hazard to natural environment and human health.

Producing and recovering some valuable resources such as nutrient and energy

Sludge Components

Sludge: by-product of wastewater treatment process left as a semi liquid residue

> Water (99%)

- > Organic and inorganic particles
- Heavy metals
- Pharmaceuticals
- Microorganism



Untreated sludge can cause environmental pollution and increase the risk of disease transmittance

Sludge Treatment

Volume and weight reduction

Stabilisation of organics and odour removal

Recycling of substances: nutrient and biogas

Elimination of pathogenic microorganisms

Sludge resource recovery

Phosphorus (essential minerals for plants and living organisms) is a valuable product in sludge since it is limiting resources in nature (useable as a fertilizer). It is beneficial to develop a methods to recover as much as phosphorus from sludge as feasible.



Sludge resource recovery

Anaerobic digestion is used for sludge stabilization and methane gas produced as a source of renewable energy (useable for heat and electricity)



Sludge Treatment



Sludge Dewatering

Typical methods of dewatering:

Filter press

Horizontal belt filter

Centrifuge



Need complex and expensive equipment and skilled operator and special care.

Natural method (freezing bed, drying bed)

Freeze/Thaw Treatment

Freeze/thaw is a natural dewatering method.

Easy to operate and can build with local materials.

> The process can take place in freezing bed.

Sludge is added in thin layers during the winter months and allowed to freeze.

Sludge is melted during the summer, the water is drained out and dry residue is left.

Methodology

Freezing the sludge sample in layers





Methodology

Thawing under room temperature





 Dewatered solid is analysed for methane production potential

 Collected water is analysed for nutrient recovery potential

Results

Water from freeze/thaw sludge

- Freeze/thaw treatment could effectively dewater sludge. The process could remove about 90% of the sludge water.
- Reduction of Volume : Saving money on storage, disposal and transportation



Water from raw sludge

Freezing can change sludge flocs into a denser and more compacted form.



Results

 Effective in solubilisation of sludge solids(Soluble COD increased Significantly)

The concentrations of ammonianitrogen and orthophosphates in collected water were increased about 124, 68 mg/L.



Benefits

- Freeze/thaw is a simple, practical and low-cost solid-liquid separation technology for sludge management in remote and cold regions (volume reduction and easy disposal).
- Release of phosphorus and nitrogen in the water after treatment shows its capability for agriculture purpose (transform sludge into marketable product).
- Freeze/thaw could maximise energy efficiency of biogas plant (the more biogas the more power).

Thank You