NANYANG TECHNOLOGICAL UNIVERSITY

Nanyang Environment & Water Research Institute

CHEMILINK ZERO WASTE ENGINEERING

ENHANCED BIOLOGICAL AND PHYSICAL STABILIZATION IN LANDFILLS

Project Scope

Objectives

The target of the project is to develop a method for accelerated landfill stabilization, and to transform the landfill into a source of energy and a site for carbon sequestration. The developed method may be test-bedded at one of Singapore's landfill sites.

Brief Background

Landfilling is expected to be the most commonly employed waste disposal method worldwide since it is seemingly simple and economical. Poorly designed and operated landfills can, however, compromise human health and environmental quality with uncontrolled emissions of gas and leachate.

Even when properly operated, sanitary landfills can still potentially cause environmental difficulties because the natural decomposition process occurring within these landfills is slow and hence a long period of time is needed for stabilization. Given their widespread application and large land footprint, the environmental impacts from landfills may last for decades and likely into centuries. Nevertheless it is noted that the waste materials in the landfill are typically high in carbonaceous content – i.e. a potential source of energy

Description

The project seeks to mitigate the impact of a landfill site by using novel techniques to recover biogas through enhanced biological means by controlling the acidogenic and methanogenic microbial consortia and to sequest carbon dioxide (CO_2) which is produced during the process. To enhance the biogas recovery, the completed landfill cells shall be operated with bias towards acidogenesis. The generated fatty acids is then extracted to produce methane (CH_4) and CO_2 under methanogenesis condition. CO_2 is harvested and converted into polysaccharides with microbial intervention.

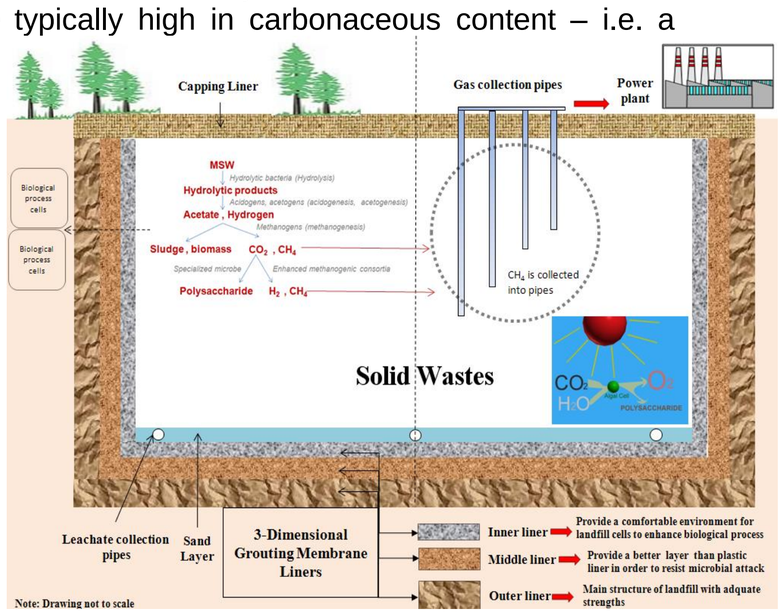

Illustration of sanitary landfill structure

The project also seeks to address another potential solid waste management challenge faced by Singapore which is the disposal of incineration ash. The ash can, however, possibly have pozellanic activity and it may be compatible with a carefully selected membrane liner material for the landfill. The project will look into the development of a landfill membrane material incorporated with incineration ash and hence address the issue of ash disposal.

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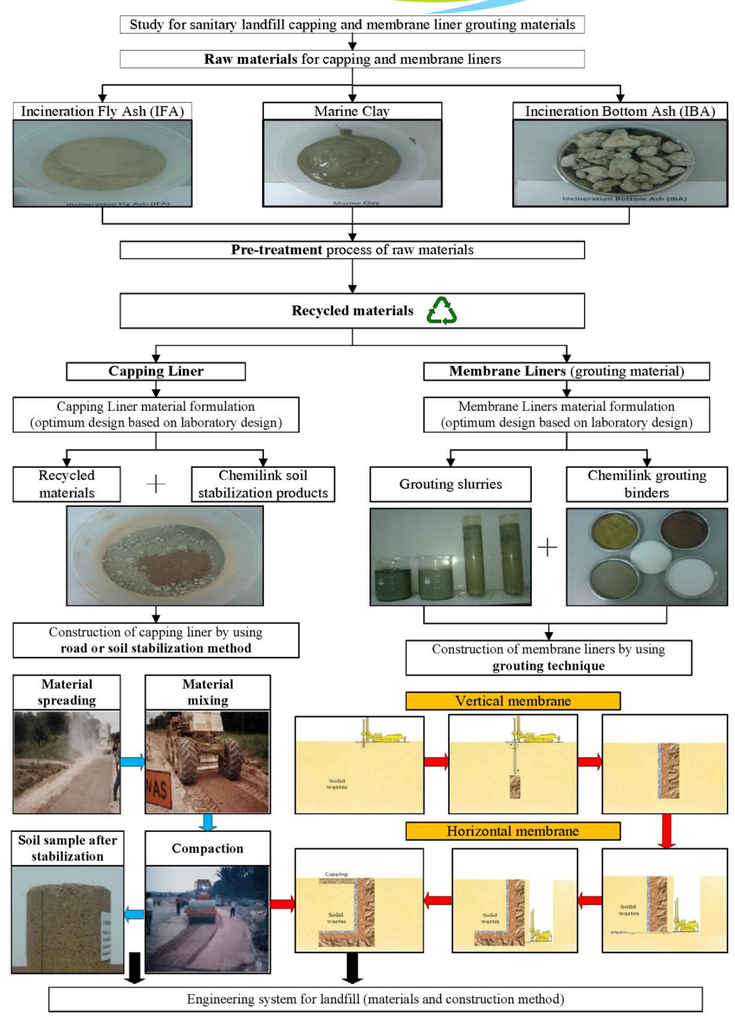
AEBC-NEWRI is a member of the NEWRI Ecosystem; Chemilink Technologies Group is a subsidiary of Chemilink International Holdings.

Contributions to Singapore's Environmental Sustainability

The project outcomes allow for an enhanced solid waste management system based on the developed landfill technique and also provides a useful application for incineration ash. The accelerated stabilisation of closed landfills would enable early return of the land for other useful applications. The enhanced biological process converts the landfill into a source of energy and such waste to energy effort represents resource reclamation. The conversion of CO_2 into polysaccharides to be used as landfill binder represents a method for carbon sequestration. A business model which can arise from the preceding would include landfill construction or remediation, landfill operation, energy recovery, carbon sequestration technology and higher value use of the remediated landfill site because of better ground condition.



Key Deliverables

- Operating protocol for fatty acids production.
- Enhanced methane and polysaccharides production process.
- An engineered system based on the above.
- Membrane liner formulation.
- Construction method for utilization of the membrane liner.

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Ministry of the Environment and Water Resources

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