

Study to determine if Semakau waste can be used to build Tuas Port

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Research is under way to determine if the incineration ash from Semakau, Singapore's only landfill, can be repurposed for other uses, such as building Tuas Port.

As the Semakau landfill is expected to reach full capacity by 2035, Minister for Sustainability and the Environment Grace Fu said at the Bloomberg Sustainable Business Summit recently that the Government is mulling over the possibility of recovering the ash for a second lease of life.

The 350ha landfill, which can hold 28 million cubic m of waste, has two phases. Phase 1 contains 11 landfill cells that are separated by internal bunds, and Phase 2 is 157ha of sea space converted into landfill space. Phase 1 is full, and Singapore has been dumping its waste into Phase 2.

There are mainly three types of waste on the island. Incineration bottom ash makes up the bulk, which is the heavier, solid residues found at the bottom of incineration furnaces; incineration fly ash, which are air pollution control residues; and non-incinerable waste such as wastewater sludge.

The National Environment Agency (NEA) and the Maritime and Port Authority of Singapore are looking into using this waste as an alternative fill material for use in Tuas Port Phase 3.

During the National Day Rally in August 2022, Prime Minister Lee Hsien Loong said that land reclamation work for Tuas Port Phase 2 is in progress and planning for Phase 3 has begun. There are four phases in all, costing a total of \$20 billion.

Conventional fill materials include sand, soil and other construction debris.

The study, which involves institutes of higher learning and consultants, will evaluate appropriate treatment methods and cost-benefit analyses to determine the viability of mining the landfill.

Assistant Professor Fei Xunchang of Nanyang Technological University's School of Civil and Environmental Engineering told The Straits Times that his research team is currently investigating the various waste residues found in Phase 1 to see if they can be repurposed for other uses, like construction materials.

"The waste there is all mixed together. They have been exposed to rainfall, wind, sunshine for up to 20 years. The quality of the mixed materials is also very different, so the way they behave may also be quite different compared with ash that is produced fresh from the incinerator," he added.

He and his team have visited Semakau many times to collect waste samples, and to do site investigations, such as using non-intrusive

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methods to determine the properties of the waste up to 20m deep.

Waste that is more similar in quality to fresh incineration ash can be easily washed, chemically treated or gasified to be converted for other uses.

For instance, gasifying incineration ash – essentially burning it at high temperatures – can create a glass-like substance known as NEWSand, which has so far been used for building footpaths and concrete products.

Using the same technique to treat mixed waste materials produces a similar glass-like residue, which can hopefully be used as an alternative fill material without much further treatment, said Prof Fei.

But the challenge is in determining what to do with the waste that has been “weathered” over time.

“Sometimes, these older materials might be cleaner as they have been drained over time after being exposed to the elements. But sometimes they are contaminated with more hazardous materials,

which makes treatment difficult,” said Prof Fei.

“There are also no records on how much waste was dumped in each cell or how long ago it was dumped there, which is what we are trying to investigate,” he added.

The team is now trying to create a detailed map of Semakau, separating the area into “pockets” so that researchers can identify areas with “good” waste that can be excavated and reused immediately, areas where the waste may need further treatment, and areas where waste is too contaminated and should therefore be avoided for the time being.

The research project essentially entails determining the varying quality of the waste on Semakau, and coming up with possible suggestions on how to deal with the mixture, so that engineering companies can determine the eventual use of the waste there and help design the relevant treatment facilities needed, said Prof Fei.

Asked how the waste could be used in Tuas Port, he said that one possibility would be as fill material



The 350ha Semakau landfill, which can hold 28 million cubic m of waste, is expected to reach full capacity by 2035. A study is under way to determine if waste there could be used as an alternative fill material. ST PHOTO: LIM YAOHUI

for caissons, which are watertight, retaining structures for the foundation of the port.

He added that the construction of the port creates a huge demand for such fill materials, and since construction is ongoing, it would make sense for waste to be sent directly from Semakau to the port if it is found viable for use.

Aside from its use as fill material, other potential uses for the mixed waste include land reclamation, road construction or integrating it into concrete blocks, which could help to lock the incineration ash in place and isolate it from the surrounding environment, said Prof Fei.

However, many of these options would require further treatment of the waste to ensure that no contaminants, including heavy metals, end up leaching out, he noted.

This would be of particular concern if the mixed waste was used for land reclamation, as it could be damaging to the marine environment if anything were to leach from it.

ST understands that global engineering consultancy Aecom is currently studying the economic costs of excavating the entire Semakau, but it declined to comment, citing confidentiality.

NEA said the study will continue into 2024, with some preliminary indications on the viability of the project expected by end-2023 or early 2024.

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