Use of secondary resources in Greenland


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Residues from waste incineration

There are six waste incineration plants in the largest Greenlandic towns and the resulting particulate residues are fly ash (900 tons/annually) and bottom ash (6000 tons/annually) which are disposed of. Removing heavy metals from the fly ash by electrodialytic treatment significantly reduces the hazardousness (Fig. 1) and makes it eligible for reuse.

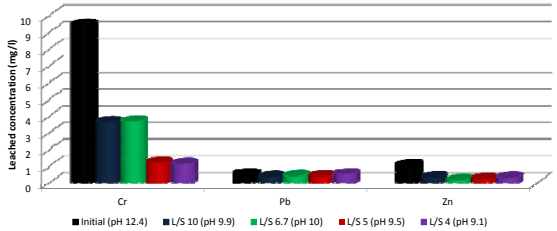


Figure 1: Leached concentrations of heavy metals before and after electrodialytic treatment for 5 hours.

Substitution of cement by fly ash in mortar could be a solution, if the fly ash is environmentally safe. Due to the ash characteristics and behaviour of the mortar, 5 % replacement (Fig. 2) would be most beneficial and is feasible compared to the approx. 20,000 tons of cement being used in Greenland.

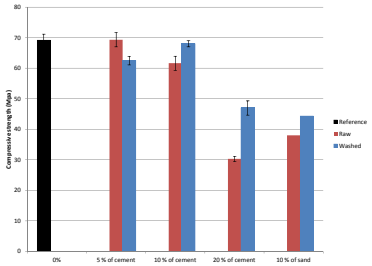


Figure 2: Compressive strength of mortar with fly ash substituting either cement or sand

The bottom ash has shown potential for use as subbase in road construction, both technically and environmentally (Kirkelund et al., 2012). Wear resistance and bearing capacity showed acceptable results however in the lower range of similar studies and could be improved by removing some fractions, especially metal and concrete pieces. Another approach to improve the quality of the bottom ash could be to sort the waste prior to incineration to remove primarily glass and metal which will result in a completely different residue.

Interested?

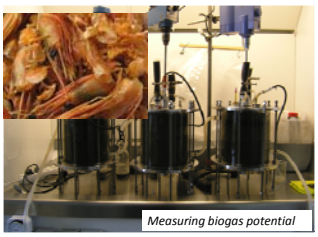
We are continuously looking for new collaboration partners, who work in the Arctic, especially through Ph.D. studies.

Shrimp shells

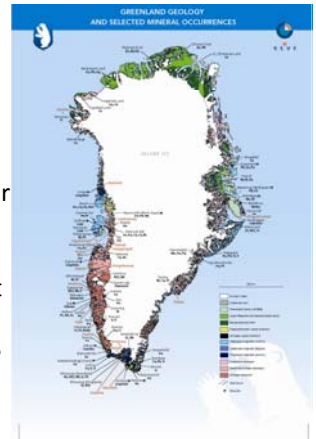
Annually, 30,000 tons of shrimp shells are produced, where some are used for shrimp meal production and the rest is disposed of at sea. Energy could be utilized from the shells to substitute energy from fossil fuels. Current research includes finding the optimal mix of shrimp shells, fish waste, sewage sludge (the first experiments with wastewater treatment in Greenland were made this summer) and algae for biogas production.

Biogas potentials:

- 50-70 m^3/ton (black wastewater)
- 800 m^3/ton (halibut waste)
- 450 m^3/ton (shrimp waste)
- 85-110 m^3/ton (sewage sludge)


Measuring biogas potential

Mine tailings



There are at present 4 exploitation licences for mining in Greenland and a few mining projects that are in an advanced stage towards exploitation. The more dilute is the ore, the greater is the quantity of rock that must be excavated, crushed, and treated to extract the desired metal. Dependent on the ore and metal, a ore grade between 0.01 -30 % can be profitable for mining, leading to 70 - 99.9 % tailings. These resulting mine tailings can cause environmental disasters, thus precautions should be made when mining in the pristine and vulnerable Arctic environment. Especially, attention should be paid to tailings handling and disposal.


Nalunaq gold mine

Electrodialytic treatment of tailings has shown potential for removal of toxic elements and even increase the extraction potential of the ore (Jensen et al., 2013).

References
Kirkelund et al., 2012: Characterisation of MSWI bottom ash for potential use as subbase in Greenlandic road construction. Proceedings from WasteEng 12.
Jensen et al., 2013: Suspended electrodialytic remediation for detoxification of copper-mine tailings. Proceedings from ARTEK event 2013.

ARCTIC TECHNOLOGY CENTRE

Arctic Technology Centre (ARTEK) educates engineers and carries out research and innovation projects in Arctic technology. The centre and its activities are anchored both in Greenland and in Denmark at DTU. The activities take place in close collaboration with the Greenlandic society i.e. the Government of Greenland, local Greenlandic authorities and industries.

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