

Benefits and challenges related to thermal processing of Very Low Level Waste (VLLW)

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27/09/2019 VTT – beyond the obvious

The waste hierarchy

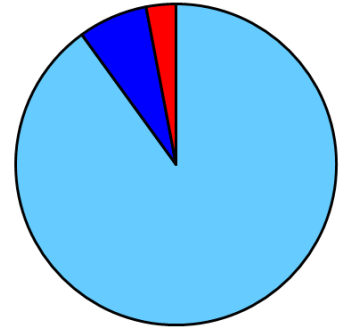
- Environmental impacts of waste has to be minimised
- Priority on waste prevention and the lowest priority on disposal
- Disposal only when no other alternatives are available
- **The amount of waste to be disposed should be minimised**
- Should also be applied for radioactive waste, though with due regard to safety standards and regulations



Source: [European Commission](#).

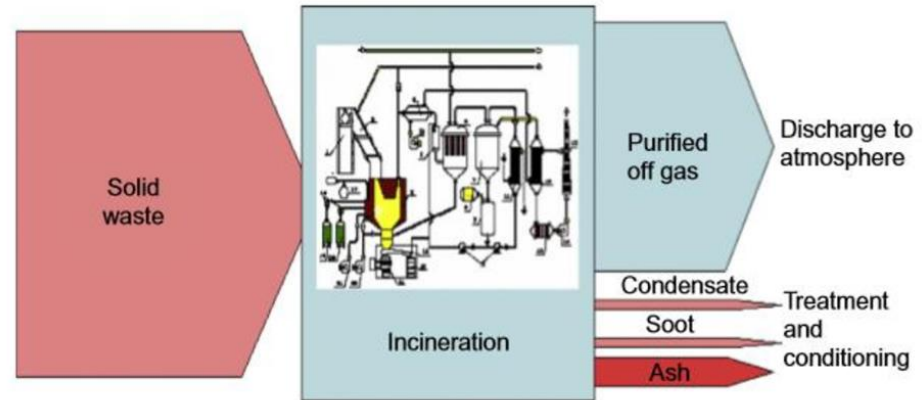
Very Low Level Waste (VLLW)

- At NPP: In many cases rich in organic matter contaminated by some radioactive components
- Volume is large but radioactive inventory low
- Incineration could enable significant reduction of volume



Incineration of radioactive waste

- Combustible waste
- Thermal processing will
 - reduce volume
 - enhance safety
 - reduce toxicity



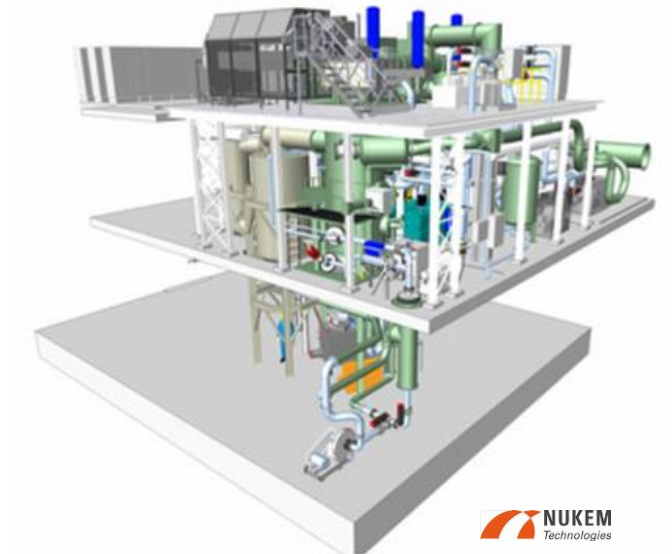
Ojovan M.I., Lee W.E., Elsevier Ltd, 2014, An Introduction to Nuclear Waste Immobilisation (Second Edition), ISBN 978-0-08-099392-8

- Thermal processing is not free of charge and risk but it might save money and improve safety in longer term

Several technical alternatives for incineration

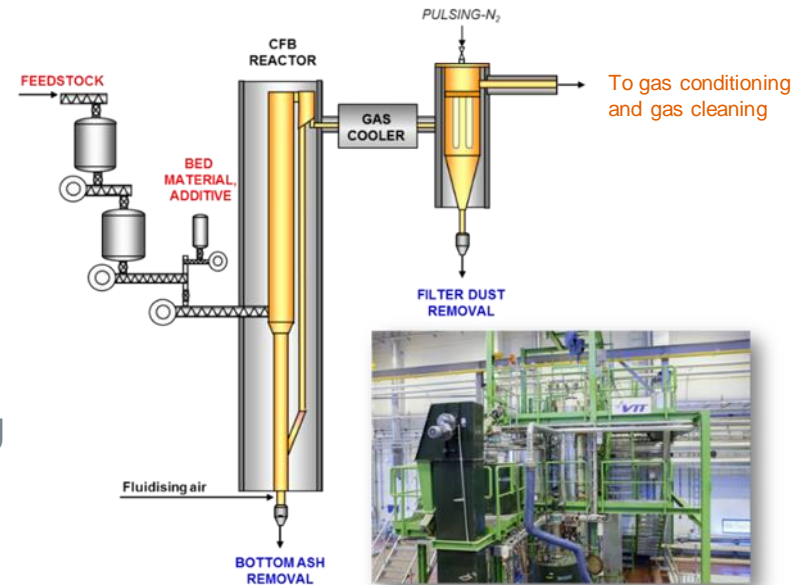
■ Incineration:

- Rotary kiln incineration
- Grate firing
- Pyrolysis
- Gasification
- Underwater plasma incineration
- Hydrothermal oxidation



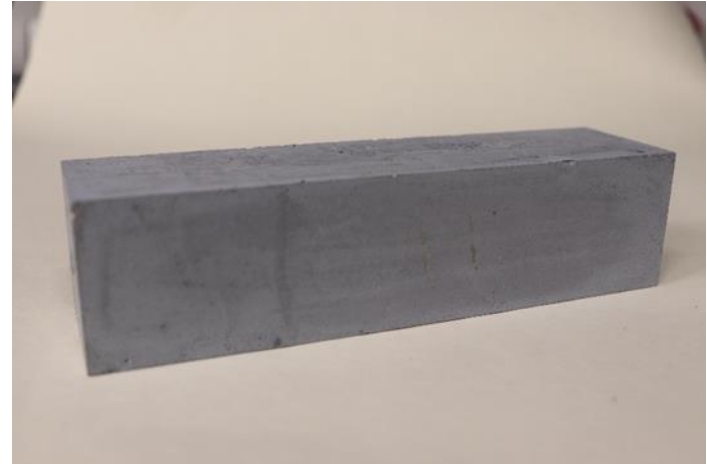
Thermal gasification (VTT)

- Designed for processing of high organic matter containing ion exchange resins and organic operational waste
- Product: solid residue (filter dust and bottom ash), spent scrubber liquid (can be solidified)
- VTT has developed geopolymerisation for immobilisation of the product ash
- **THERAMIN project**: demonstration test trial: 325 kg organic ion exchange resin was treated and solid residue was geopolymerised => 40...70 kg geopolymerised final product



Products of incineration

- Cleaned flue gas
 - Released to atmosphere
- Solid ash
 - => To be immobilised
 - Powder, slag
 - Contains most of radionuclides
- Liquid waste from wet scrubber
 - => To be solidified/immobilised
 - Contains some radionuclides



Gasified resin /geopolymer –sample, VTT

Challenges

- Incineration removes (most of) organic matter
=> Radionuclides are concentrated into (solid) incineration residues

- Incineration residues need immobilisation
 - Cementation
 - Geopolymerisation
 - Melting/vitrification
 -

- Specific activity of the immobilised incineration residue can be much higher than original VLLW => Requirements for the disposal route

The Horizon 2020 funded **THERAMIN** project

VTT

- Thermal treatment for radioactive waste minimisation and hazard reduction
- The main objectives of the project are to
 - promote thermal treatment of LILW by piloting/demonstrating several thermal treatment technologies
 - improve the overall understanding and knowhow on thermal treatment
 - make thermal treatment technologies more well-known technologies



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