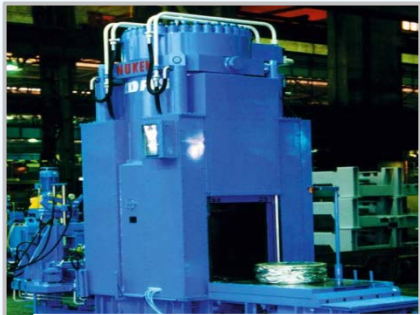


# Pyro(hydro)lysis of Spent Ion Exchange Resins for Disposal of Organic-Free Radioactive Waste

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# NUKEM at a glance



Radioactive  
Waste Management



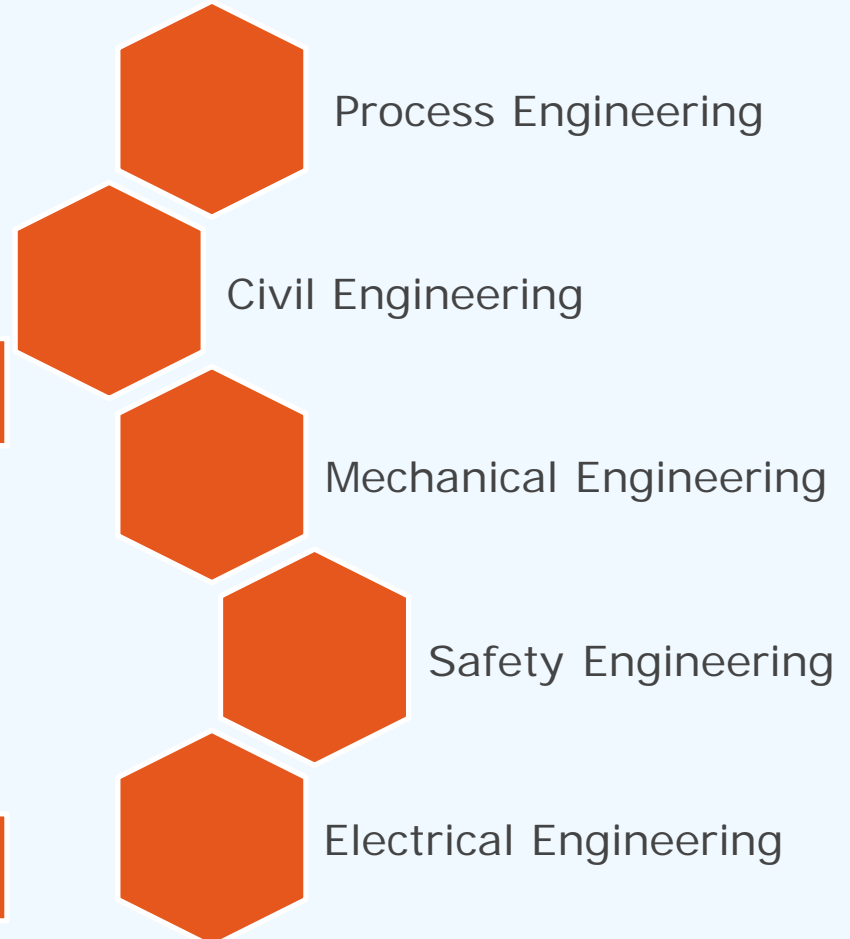
Spent Nuclear Fuel  
Solutions



Decommissioning



Operational Support  
& Consulting



# NUKEM's services for radioactive waste disposal

NUKEM supports disposal by providing technical systems and relevant consulting:

- Design and construction of above-ground facilities (of underground repositories)
- Waste treatment/conditioning (in line with Waste Acceptance Criteria)
- Waste package handling
- Radiation protection/monitoring
- Safety assessments



## One of NUKEM's competencies: Pyro(hydro)lysis

- Waste Acceptance Criteria (WAC) require organic-free waste:
  - Flammability under accidental conditions
  - Lack of long-term stability (gas generation)
- Why is this of importance for deep underground/geological disposal ?
  - Not just SNF, but also several other organics containing wastes need to be disposed of underground
- Technology of pyro(hydro)lysis ensures decomposition of organic compounds
  - Advantage in comparison with conventional combustion ?

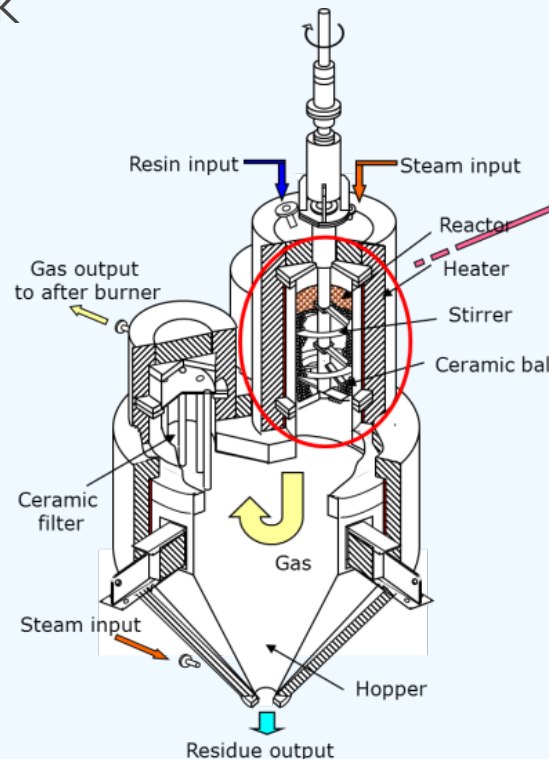
## Pyrolysis - Pyrohydrolysis - Burning

- Pyrolysis:** Thermal cracking of organic substances at medium temperatures (500-900° C).  
Large hydrocarbons will be converted into smaller hydrocarbons and residual coke. Small volatile hydrocarbons will be released to the gas phase.
- Pyrohydrolysis:** Complete thermal cracking and oxidation of organic substances at medium temperatures (500-900° C) in presence of steam.  
The oxidation process is endotherm and requires an continuous external energy supply. The reactions stops immediately, if the energy supply is stopped.
- Burning:** Oxidation of organic substances by exothermic reaction with oxygen at high temperatures (up to 1250° C). Volatilization of Cs possible (release with gas phase).



## Features of pyro(hydro)lysis

- Adapted to nuclear technology originally by NUKEM together with NGK
- High volume reduction (depending on inorganic content : 5 – 100)
- Excellent safety features (stops immediately after shut down of power and steam supply)
- Low temperature of 550° C, no Cs volatilization
- Dosing of steam in excess (and/or wet feed)

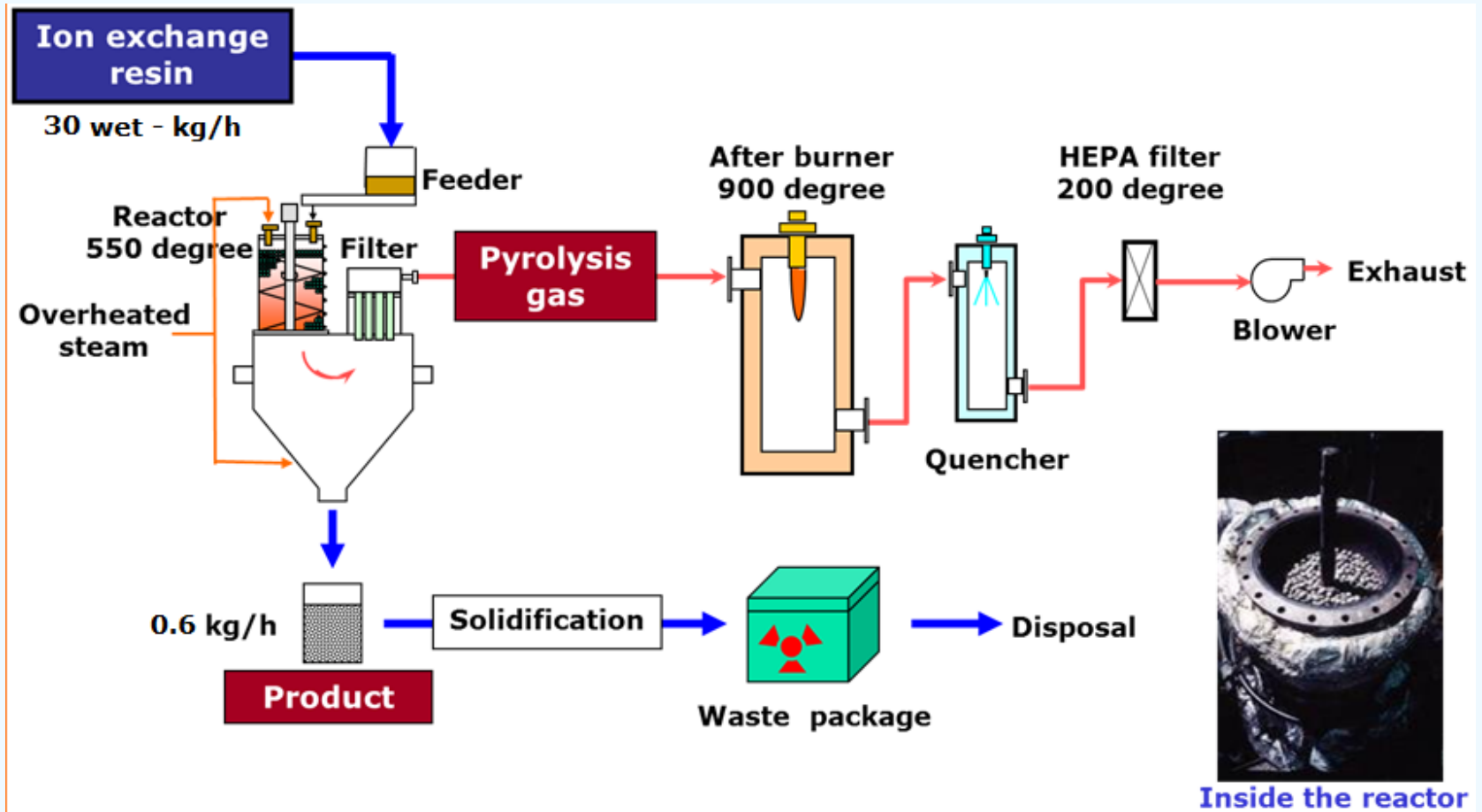


## Radioactive waste types to be pyro(hydro)lysed

- Rubber, PVC, radioactively contaminated oil / oil sludge etc.
- Spent ion exchange resins (IEX)
- Re-treatment of bituminized waste
- Spent tributylphosphate (TBP)
- $\alpha$ -Waste bearing organic compounds (fuel production or reprocessing) etc.

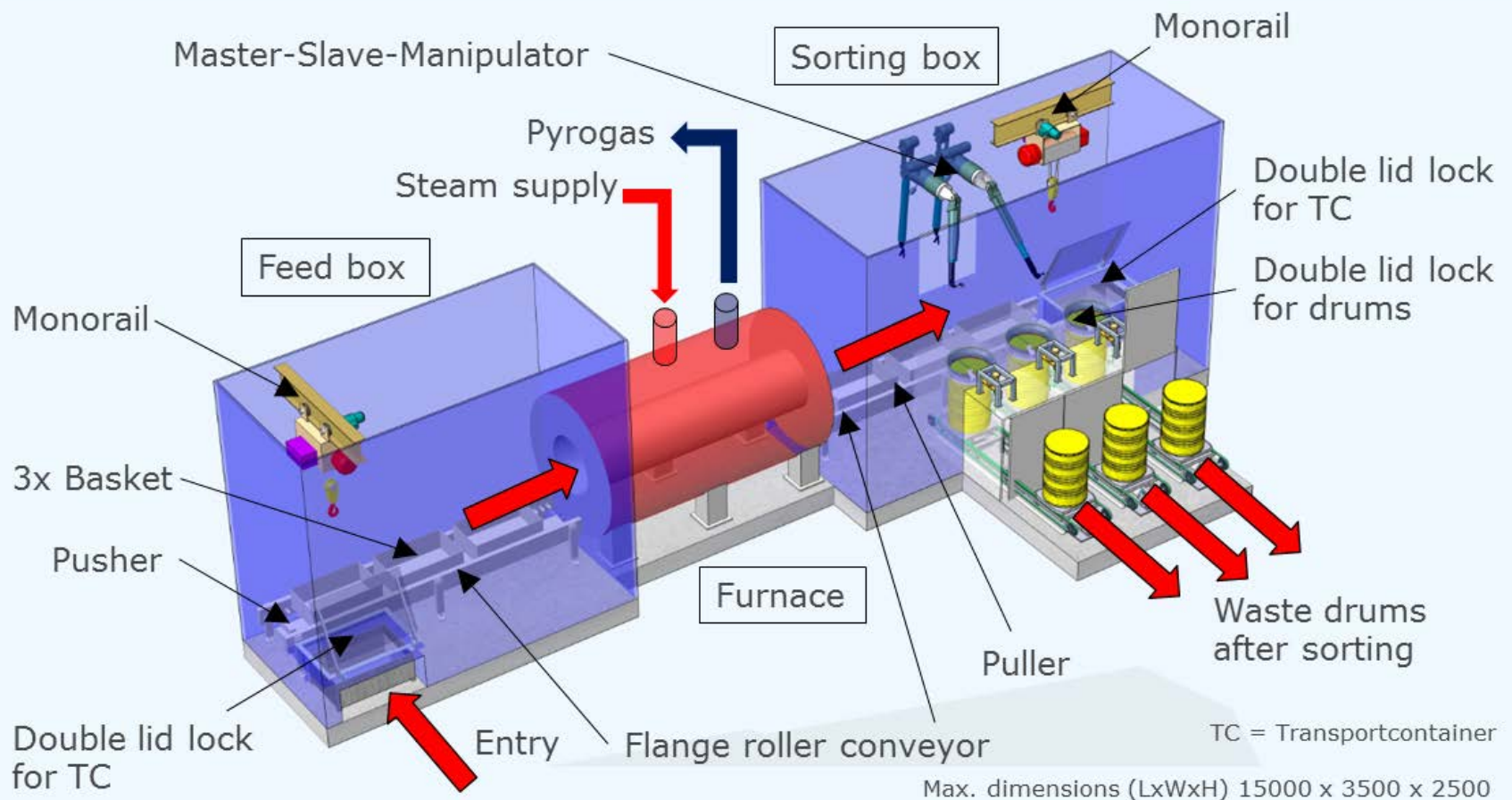


# Pyro(hydro)lysis of spent IEX





# Re-treatment of bituminized waste



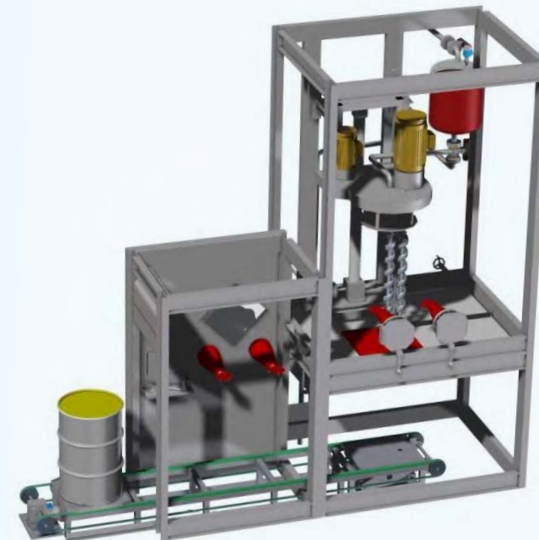
## Conditioning of waste product (pyrolysate)

- Inert and chemically resistant product (pyrolysate), no additives necessary
- The main constituent of the pyrolysate is carbon + inert compounds
- Radioactive inventory remains in the pyrolysate

High-force  
compaction  
of LLW



In-drum  
cementation  
of ILW



## Conclusions

- Pyrohydrolysis is capable to entirely meet Waste Acceptance Criteria:  
no organic content remains in the product
- The low process temperatures prohibits the transfer of volatile radionuclides like Cs-134/137
- The endothermic process offers unique safety features

Thanks for your attention!



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