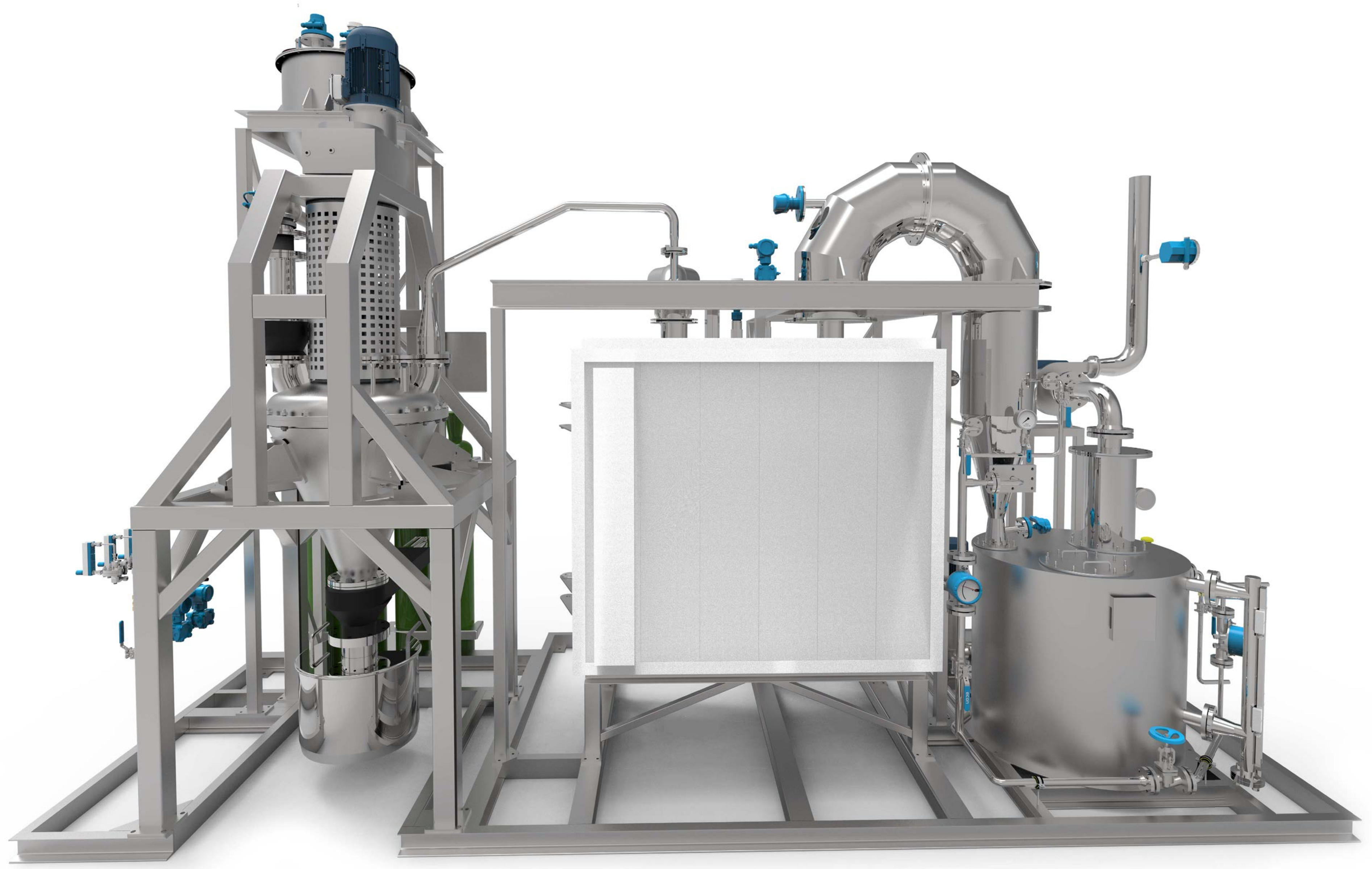
PYROLYSIS OF RADIOACTIVE SPENT RESINS IN THE PRIME INSTALLATION

MONTAIR ENVIRONMENTAL SOLUTIONS
member of mandersgroup

BELGOPROCESS



PRIME installation

A state of the art, innovative technology for the treatment of spent ion exchange resins; that's our PRIME installation (Pyrolysis of Resins In Mobile Electric installation).
The patented PRIME installation is especially designed to separate transport water, if any, dry the wet resins and directly pyrolyze the spent resins in one single reactor/installation.

Our main goal: designing, building and demonstrating a simple installation with significant throughput. The capacity of the installation is the treatment of 2 batches of 100 liters resins each in 24 h or 8.33 liters/hour. The installation is fully electrically powered, no other secondary gas or fuel is needed, making it safe and simple to install and operate. The compact skid-mounted design has a footprint that fits 20 ft ISO containers and allows a mobile installation.

Spent resins

Ion exchange resins are used by nuclear power plants for purification of the primary cooling water. Spent resins contain radioactive isotopes and must therefore be treated according to the severe criteria for radioactive organic waste content. Low level waste (LLW, < 2 mSv/h) as well as medium level waste (MLW, > 2 mSv/h) can be treated in the installation. Additionally, the simple and small design allows adding and reinforcement of required shielding and makes executing maintentance easy. Moreover, the installation is designed conform the ALARA principle. Once the PRIME pyrolysis process is completed, a fully mineralized waste product remains. This result makes safer long term storage of spent resins possible.

Test results

- Successful test runs with batches of 100 liters of wet cationic and anionic resins
- Mineralized waste product contains mostly carbon in the shape of small beads
- Under inert atmosphere, no agglomeration of the resins takes place.
  This is a major advantage opposed to regular incineration which usually leads to agglomeration into large chuncks
- A minimum volume reduction factor of 7 is realized
- Very limited formation of dust / carryover
- No swelling of the end product was observed
- Innovative NOx reduction directly in the oxidizer
- Continuous operation tests ongoing
- New opportunities for other problematic organic waste investigation ongoing

Wet resins

Dry resins

Pyrolized resins

Main data

Electrical capacity	~120 kW
Treatment capacity	~200 Liters/24 hours (resin + water)
VRF	~7 to 8
Compressed air consumption	~16 Nm³/hour at 8 bar(g)
N_2 consumption	~20 Liters/min
H_2O consumption	~44 Liters/hour evaporated in quench for cooling
NaOH 33% consumption	~65 Liters/hour with Cationic resins
Urea 25% consumption	~1 Liter/hour with Anionic resins
Dimensions (L x W x H)	~5.7 x 2.3 x 3.8 meters
Assembled weight	~3.500 kg

Dosing system

The dosing system is designed to handle wet resins with or without transport water as well as dry resins. Transport water can be separated in the dosing system prior to feeding the resins to the reactor.

Evaporation, Drying and Pyrolysis reactor

Combined evaporation of the transport water, drying of the resins and finally pyrolysis in one single reactor. Pyrolysis treatment takes place from 300 up to 600 °C. The low temperature process results in low carry-over of semi-volatile isotopes such as Caesium. Resins are converted into a dry, mineralized (inert) product with a volume reduction factor of 7.

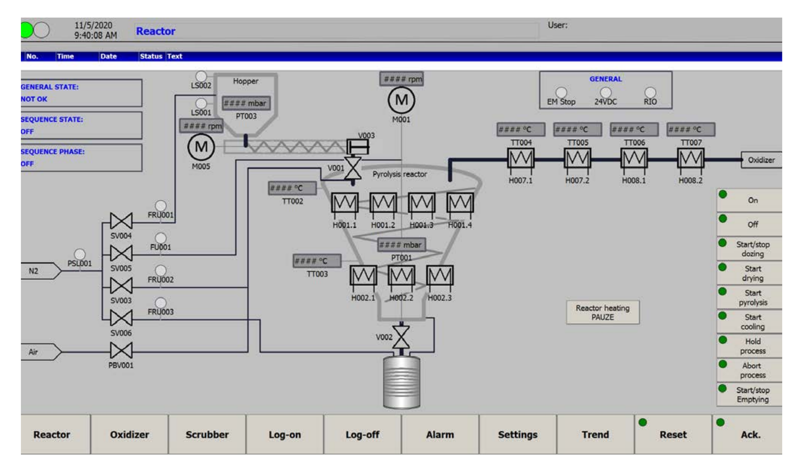
- Cationic ion exchange resins
  Molecular formula: $C_{25}H_{25}S_3O_9$
- Anionic ion exchange resins
  Molecular formula: $C_{34}H_{52}N_3O_3$

The final product contains mostly carbon and ions captured by the ion exchange resins.

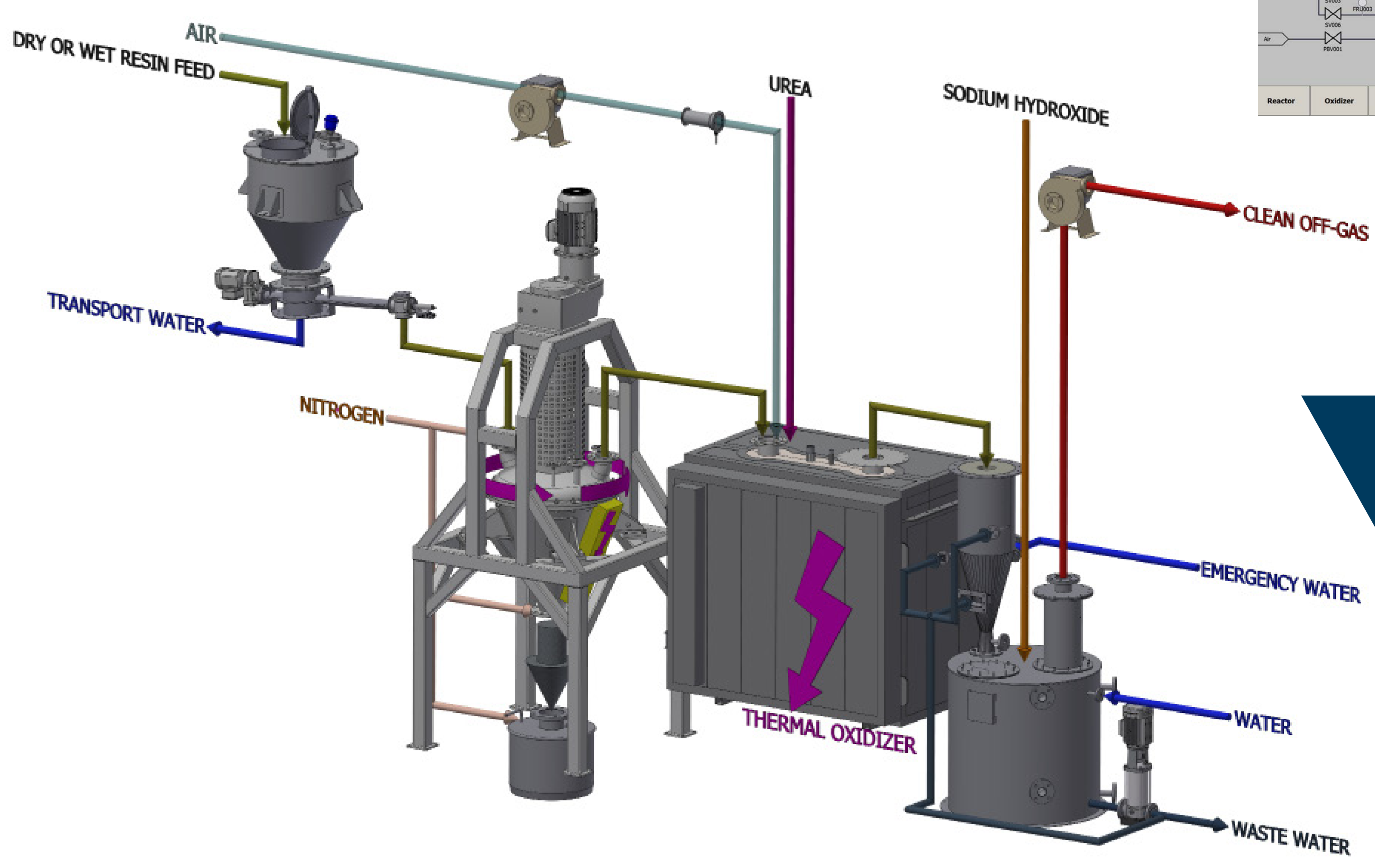
Off-gas treatment system

In a completely new design of the electrically operated oxidizer, the pyrolysis gases are treated at > 850°C for a minimum of 2 seconds with a minimum oxygen volume of 6%. The hot off-gases are cooled down in the quench. Finally, sulphur dioxide is captured and neutralized in the wet gas scrubber. An additional R&D experiment is ongoing to eliminate NOx in the oxidizer.

Control System



Flow Chart



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