Energy From Waste Systems
Tailor made systems for reliable and safe operation under all circumstances

Europem is a leading supplier of Environmental Payback Projects. Our Technologies and Processes transform an environmental problem into a revenue stream for our clients.

Since its foundation, Europem has consistently been at the forefront of technological innovation and today we offer Best Available Technologies to provide sustainable, reliable, flexible and robust solutions for:

• **Energy production** using industrial effluents, waste streams and by-products
  - Advanced multifuel/flexifuel low NOx burners
  - Thermal oxidisers and incinerators including redu-reox systems, High Intensity Incinerators, tailgas incinerators for SRU’s, Recuperative thermal oxidisers, Ledenox incinerators, fluidised bed and rotary kiln furnaces
  - Heat recovery boilers and heaters including flame tube boilers, water tube boilers, thermal oil heat exchangers, bath heaters and tube and shell heat exchangers
  - Direct fired heaters and boilers

• **Product recovery**
  - Vapour recovery units (VRU) using adsorption and/or condensation technology
  - Flare gas recovery (FGRU)
  - Sulphur recovery units (SRU) including main reactor burner, main thermal reactor and tail gas incinerator w/wo waste heat recovery boiler

• **Safety and environmental protection**
  - ATEX zone 0 vapour extraction and treatment systems
  - Flare systems including elevated flares, air, gas or steam assisted flares, ground flares, enclosed ground flares, temperature controlled ground flares
  - deNOx and flue gas cleaning systems

Our team has built and commissioned over 300 installations in more than 35 countries worldwide.

Europem maintains an Environmental, Health and Safety Management System in accordance with ISO 14001, OHSAS 18001 and VCA-p. Our quality assurance and control plan is ISO 9001-2008 certified.
Overview of systems and processes: Feeding Systems and Gasification Combustion Systems

Incinerator types

On the right a table with the overview of Incinerator Systems and their optimal solutions for a variety of characteristics.

<table>
<thead>
<tr>
<th>Feeding System</th>
<th>Gasification Combustion System</th>
<th>Heat Recovery System</th>
<th>Flue Gas Cleaning System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic Ram Feeders</td>
<td>EQUIPMENT</td>
<td>Water Tube Boilers</td>
<td>Wet</td>
</tr>
<tr>
<td>Feeding Screw Conveyor</td>
<td>Static Horizontal Reaction Chamber</td>
<td>Semi-Wet</td>
<td></td>
</tr>
<tr>
<td>Spreader Stoker</td>
<td>Static Vertical Reaction Chamber</td>
<td>Semi-Dry</td>
<td></td>
</tr>
<tr>
<td>Overhead Crane with Grapple</td>
<td>Multiple Reaction Chambers</td>
<td>Dry</td>
<td></td>
</tr>
<tr>
<td>Skip Hoist Conveyor</td>
<td>Rotary Kiln</td>
<td>Heat Exchangers</td>
<td>SCR DeNOx</td>
</tr>
<tr>
<td>Container Elevator</td>
<td>Fluidised Bed</td>
<td>PROCESS</td>
<td></td>
</tr>
<tr>
<td>MultiWaste Injection Lances</td>
<td>Oxidation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Mixing Injection Lances</td>
<td>OXIDATION-REDUCTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultrasonic Injection Lances</td>
<td>Oxidation-Reduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MultiFuel Burners</td>
<td>SRL (Sulphur Recovery Units)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FlexiFuel Burners</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Feeding System

**Bulk solid waste**
Bulk solid waste transport and feeding is achievable in many ways such as hydraulic ram feeders, feeding screws, spreader stokers, conveyor belts or screws, overhead crane with grapple, skip hoist conveyor, container elevator.

**Pre-packed waste**
Palletised & direct feeding of waste drums is achievable in a controlled conveying system.

**Sludge waste**
Sludge waste is pumped using positive displacement pumps and injected via tailor made lances based on sludge characteristics. Preheated air is used to break loose the sludge cake in order to avoid clogging.

**Liquid & Gas waste**
Liquid and gaseous waste can be injected either via dedicated injection lances or through multifuel burners. Europem offers Multifuel and Flexifuel burners that can burn up to 15 different waste streams in one burner assembly. Injection lances can be equipped with internal mixing or external mixing injection nozzles for the combustion of liquid fuels, waste liquids and suspensions. Air or Steam are used as atomizing agents.

Gasification Combustion System

EUROPEM can offer a comprehensive range of gasification - combustion systems for a wide range of waste gases, waste liquids, sludge and solid waste.

These designs include amongst others:

- Horizontal incinerators for waste gases and liquids with minimal ash/salt formation
- Vertical incinerators including slagging furnaces for salt and ash containing wastes
- Vertical temperature controlled combustors/thermal oxidisers for waste gases and vapours
- High intensity incinerators for lean waste gases and liquids
- Recuperative thermal oxidisers for lean waste gases and liquids
- Reduction-reoxidation (Redu-Reox) low NOx incinerators for compounds containing bound-nitrogen
- Oxidation reduction low NOx incinerator for ammonia and waste streams containing bound-nitrogen (Ledenox incinerators)
- Oxidation reduction furnaces for sulphur recovery units (SRU)
- Tail gas incinerators for SRU’s or other processes
- Pyrolysis furnaces for hazardous waste
- Rotary kiln incinerators for mixed waste including drums and packaged waste, hospital waste, solid waste, sludge
- Fluidised bed incinerators for chemical and biological sludge, solid waste with high moisture content such as RDF from pulping operations, refuse derived fuel and bio-waste
Overview of systems and processes: Heat Recovery Systems and Flue Gas Cleaning Systems

Heat Recovery Systems

Depending on the required operational pressure & temperature, efficiency, steam quality & power generation, OPEX & CAPEX, a variety of heat recovery systems can be designed.

Water tube boilers: (Water flows through the tubes and flue gas surrounds the tubes). Main characteristics: Operated at higher capacity, higher pressures & temperature, load fluctuations can be easily managed, high steam quality is required and it is suitable for power generation, suitable for high dust load, high maintenance. Typical areas of application: RDF waste, MSW waste, Waste wood firing, mixed solid industrial waste including hospital waste. Cleaning system: Cleaning by vibration of free hanging tube bundles that is initiated by pneumatic hammers, shock wave soot blowing system.

Smoke (fire) tube boilers: (Smoke flows through the tubes and water surrounds the tubes). Main characteristics: They are operated at lower capacity, lower pressures & temperature, load fluctuations are not easily handled, low steam quality is sufficient, not suitable for power generation, suitable for low to moderate dust load, low maintenance. Typical areas of application: Paper reject, paper sludge, clean wood firing. Cleaning system: Shock wave soot blowing system.

Thermal oil boilers: (A special thermal oil liquid is used as a heat carrier) Main characteristics: They are operated at high operating temperatures up to above 300°C at atmospheric pressures without pressurization, no water treatment, low maintenance, no risk of corrosion or freezing, highly achievable part load operations, closed circuit. Typical areas of application: In steam generators, storage tanks, bath heaters, reactors, pressing and molding, fryers, ovens. Cleaning system: Filtration, flushing.

Split boiler design with integrated flue gas cleaning: Combination of one high temperature boiler, a high temperature filter (for acids, dust and NOx removal) and a low temperature boiler. Boiler can be two smoke tube boilers in series, one water tube + one smoke tube boiler or two water tube boilers in series.

Tail-end boiler design: Vertical radiation pass(es) with horizontal or vertical convection pass and economiser.

Heat exchangers: Organic Rankine Cycle heat exchangers for small scale electricity production from low waste heat. Main characteristics: Shell tube heat exchanger design, a secondary circuit transfers waste heat to an ORC module. Energy from the waste heat is used to evaporate an organic solvent inside the tubes. The expanding solvent drives the turbine to generate power. Typical areas of application: In combined heat and power plants, energy is recovered from flue gases using hot water or thermal oil boilers. Two standard modular ORC units with 1MW and 4 MW thermal input generates electrical power between 50 and 750 kW.

Flue Gas Cleaning System

Depending on the required operational temperature, emission and residue production criteria, water usage and OPEX & CAPEX, a variety of tail end flue gas cleaning solutions are available.

Wet scrubbing:
Equipment: Packed bed scrubber, spray tower, jet scrubber, venturi scrubber, double-stage scrubber.
Reagents: Lime, limestone, caustic soda.
Removed pollutants: HCl, SO2, HF.

Semi-Wet / Semi-Dry scrubbing:
Equipment: Spray-dryer.
Reagents: Quick lime, hydrated lime.
Removed pollutants: HCl, SO2, HF.

Dry scrubbing:
Equipment: At the ducting upstream of the bag filter.
Reagents: Hydrated lime, sodium bicarbonate.
Removed pollutants: HCl, SO2, HF.

Dioxines & furans (PCDD/F), volatile metals and PCB removal:
Equipment: Injection of sorbent in the ducting upstream of the bag filter OR catalytic elements integrated in filter or SCR reactor.
Reagents: activated carbon, zeolite.

Non catalytic NOx removal:
Equipment: SNCR in combustion chamber.
Reagent: Ammonia / urea injection in the combustion chamber.

Catalytic NOx removal (low or high temperature):
Equipment: SCR at the downstream of the filter.
Reagent: Ammonia or urea injection.

Dust removal:
Equipment: Bag Filter, Ceramic Filter, Wet Electrostatic Precipitator (WESP)
Europem’s Rotary Kiln Gasifier-Combustors burns a wide range of waste fractions

Rotary Kiln Gasifier-Combustor

Rotary kiln furnaces are the workhorse of industry to burn solid waste in combination with sludge, waste gas and/or waste liquids and where the rotating motion transports the solid burning waste through the incinerator. Ashes are collected at the end of the rotating kiln and then combustion gases are completely oxidised in the static post combustion chamber.

Rotary kiln furnaces typically feature different types of solid waste feeding systems for the bulky solid waste, containers and drums such as feeding screws and ram feeders. Waste gases and liquids are either injected into the rotary kiln, or the (vertical) post combustion chamber behind the rotary kiln. It provides for flexible and versatile incineration technology, but is characterised by a lower thermal efficiency with the associated higher operating and maintenance costs.

Key Features

- Rotary kiln furnace with pre-set inclination and variable rotation speed
- Labyrinth type seal with cooling and/or flushing with inert gas
- Different feeding systems for solid waste, waste liquids and waste gases
- Can be operated in a reducing or oxidizing environment
- Different drive mechanisms such as chain or direct drive, depending on the size of the kiln and the capacity

Key Advantages

- Robust and flexible design to burn a wide range of waste fractions
- Proven technology
- Destruction efficiency over 99.999% and less than 3% carbon in the ashes
- Low NOx and CO emissions possible
- Flue gas treatment train needed to meet acid, heavy metal, dust and PCDD/F emission levels
- Redu - Reox process for high thermal efficiency and low emissions

Energy from Waste Systems

Fluidised Bed Furnaces
A fluidised bed furnace is the technology of choice for the combustion of many sludge streams or solid waste streams with a high moisture content. In a fluidised bed reactor, an inert material, typically calibrated quartz sand, is fluidised by blowing air through the bed. The sand bed expands and provides an ideal medium for the mixing of waste with combustion air. Because the fluidised bed is maintained at an elevated temperature, typically between 650°C and 800°C the water evaporates and volatile organic compounds mix with combustion air whilst escaping from the fluidised bed.

EUROPEM fluidised bed reactors are bubbling fluidised beds with high turbulence. Different feeding systems can be supplied ranging from feeding screws and over spreader stokers to injection lances.

Key Features
• Turbulent bubbling fluidised bed of inert material
• Different feeding systems for solid waste, waste liquids and waste gases
• Can be operated in a reducing or oxidising environment

Key Advantages
• Robust and flexible design to burn sludge or solid waste with high moisture content
• Stable combustion process of waste with varying moisture content over time
• Proven technology
• Destruction efficiency over 99.99% and less than 1% carbon in the ashes
• Low NOx and CO emissions possible
• Flue gas treatment train needed to meet acid, heavy metal, dust and PCDD/F emission levels

Waste Heat Recovery
Most of the Europem incinerators are equipped with waste heat recovery systems. Europem has supplied a wide range of waste heat recovery installations including steam boilers, thermal oil heaters, gas-liquid heat exchangers, gas-gas heat exchangers, bath heaters and air heaters. All waste heat recovery installations are tailored to the needs of the client and the optimal design of the overall installation. Our range of waste heat recovery systems include:

- **Fired tube boilers with or without economizer**
  - Single pass and multi-pass systems can be supplied
  - Boilers can be equipped with an on-line cleaning system to allow operation with dust-loaded (flue) gases
  - Boilers up to 25 MW capacity can be supplied with pressures from 10 to 22 bar

- **Water tube boiler boilers with or without economizer**
  - Superheated or saturated steam
  - Horizontal or vertical boiler arrangements
  - Bundles in refractory lined casing or with membrane walls
  - Capacities up to 100 MWth with pressures ranging from 15 to 65 bar

- **Thermal oil heaters**
- **Bath heat exchangers**
- **Air - flue gas tube and shell heat exchangers**
- **Flue gas - liquid tube and shell heat exchangers**
- **Air heaters**

Heat exchangers can be manufactured in carbon steel or high grade alloys e.g. Duplex, Hasteloy, Inconel, AISI 316, AISI 304.
Offices

Belgium: Europem NV
Duwigckstraat 17 – B-2500 Lier
Phone: +32 3 491 98 78
Email: info@euro-pem.com

France: Europem Energie et Environnement
130 Boulevard de la Liberté, 59000 Lille – France
Phone: +32 3 491 98 78
Email : europemfrance@euro-pem.com

India: Europem India Pvt Ltd
8th Floor, A-Wing, Reliable Tech Park, Airoli, Thane-Belapur Road,
MIDC Navi Mumbai- 400 708, India
Phone : +91 22 66 87 46 21 / 22 / 23
Email : india@euro-pem.com

UAE: Europem Thermal Technologies FZCO
Dubai Silicon Oasis – PO Box 341041 Dubai
Phone: +971 50 708 03 77
Email: bpeckitt@euro-pem.com

Partners – Agents

Belgium, China, Egypt, France, Italy, Kazakhstan, Korea, Kuwait, Oman, Poland, Qatar, Russia,
Singapore, Spain, Sweden, Saudi Arabia, The Netherlands, Turkey, UAE.

www.euro-pem.com

We reserve the right to implement technical modifications without prior notice.

02-2018