



# *Thermal Oxidation plants*

June 2020

# Thermal Oxidation of gaseous waste

## Typical Processed Stream:

- Contaminated Air by Hydrocarbons
- Contaminated Air by Solvents
- Contaminated Air by Stripping/Scrubbing
- Vent stream
- Vent containing Chlorinated compounds
- Vent containing Nitrogen compounds

## Process Solution:

- Thermal Oxidizer (TO)
- Recuperative Thermal Oxidizers
- Regenerative Thermal Oxidizers (RTO)
- Catalytic Thermal Oxidizers



# Thermal Oxidation with flue gas treatment

## Process Data

- **Type:** Thermal Oxidizer
- **Source of wastes:** air from copper scrap foundry
- **Pollutants in Air:** HCl, HF, SO<sub>2</sub>, CO, VOC particulate
- **Oxidation Temperature:** 850 °C
- **Residence Time:** 2 sec
- **Plant sections:** Quench, Dry abatement with chemical injection and final scrubber



# Thermal Oxidation with heat recovery

Combustion treatment of  
30'000 m<sup>3</sup>/h stream

Vertical combustion chamber  
configuration with heat  
recovery through production  
of overheated water



Gas combustion plant.  
Incineration of gas streams  
coming from solvent polluted  
water stripping plant.



# Thermal Oxidation with flue gas treatment + heat recovery

## Process Data

- **Type:** Thermal Oxidizer
- **Source of wastes:** gaseous waste from barium sulphate production
- **Flow rate:** about 9'000 Nm<sup>3</sup>/h
- **Oxidation Temperature:** 850 °C
- **Residence Time:** > 2 sec
- **Heat recovery:** about 3'500 kW
- **Plant sections:** Ceramic filter, Dry abatement with chemical injection



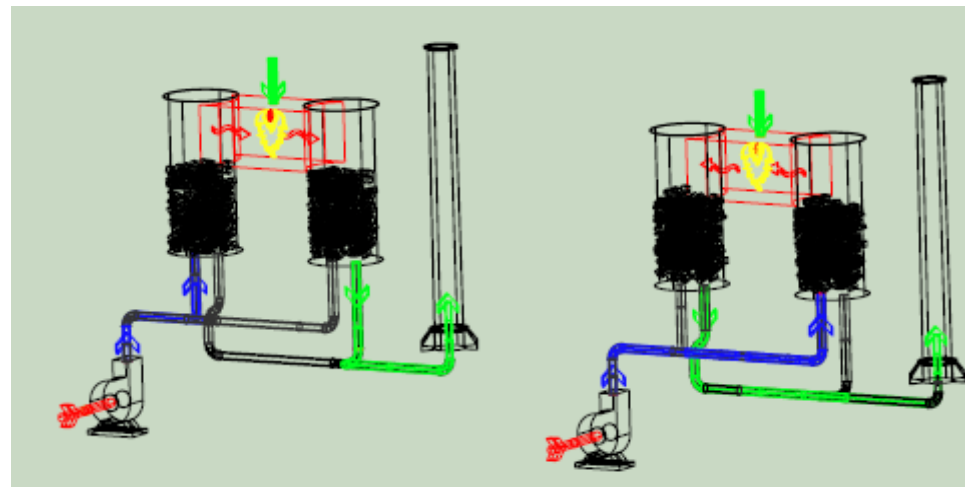
# Regenerative Thermal Oxidizer (RTO)

## Principal features:

- ❖ Low fuel consumption
- ❖ Internal heat accumulator by ceramic media
- ❖ Possible autothermal condition (depending on solvent concentration )



## Operative scheme:



# Regenerative Thermal Oxidizer (RTO)

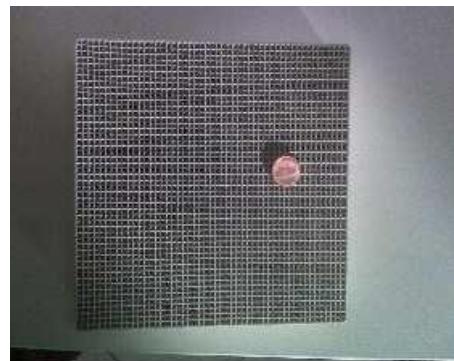
Different **types of packings**, depending on application and desired heat recovery

- Standard ceramic media



For all types of applications  
(for fouling air application)

- Honeycomb ceramic media



To improve heat recovery

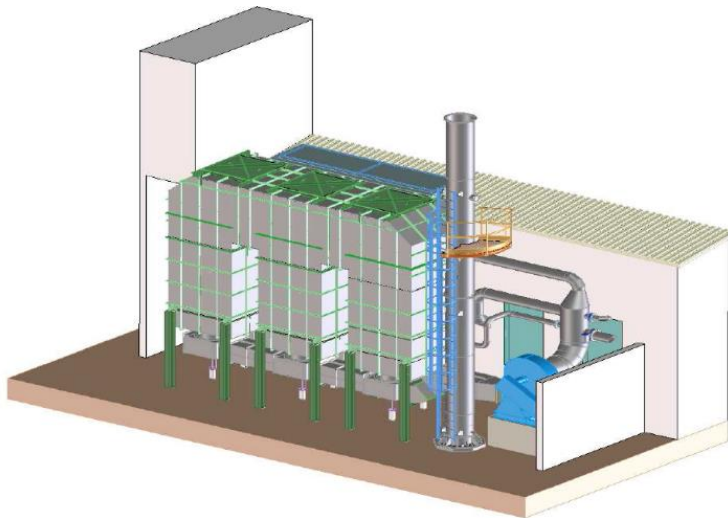


# Configurations

RTO can be designed using different number of ceramic media canisters, depending on flow rate.

Typical configurations are:

## 3 canisters



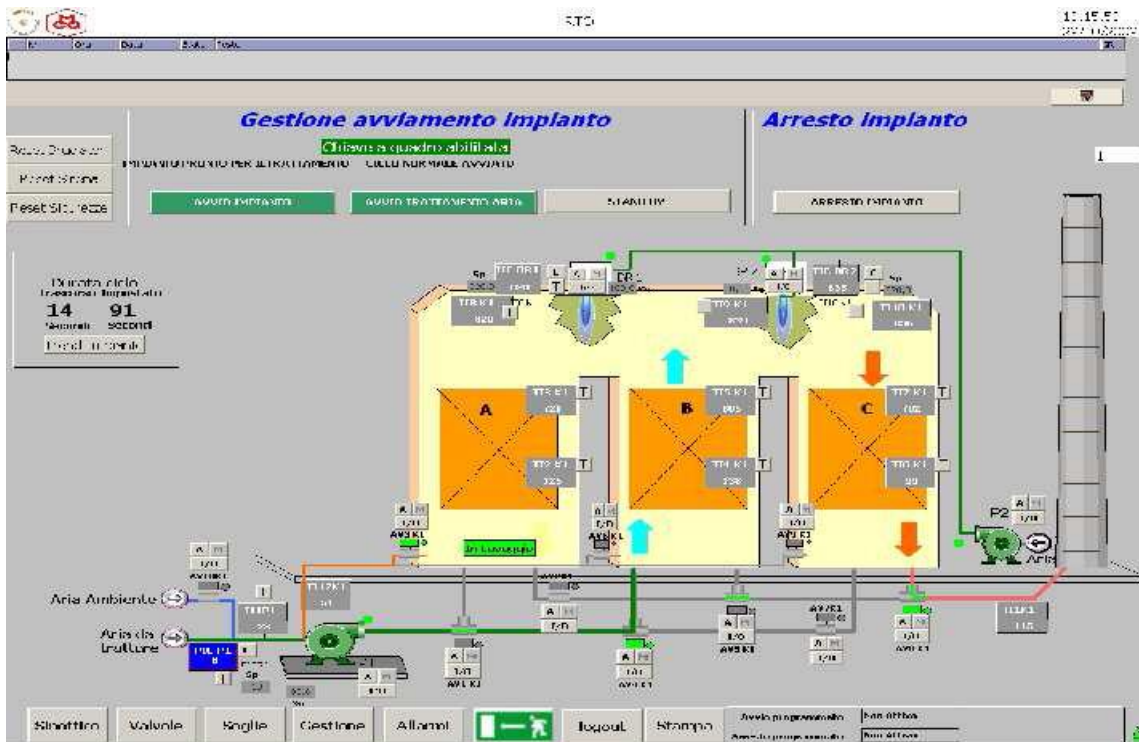
## 5 canisters





# Control system

**TM.I.P. oxidizers are completed by a control system** which permits to manage all the variables in the plant, such as switch times, pressure and temperatures.



The control system is designed to permit real time plant checking.



# RTO with heat recovery

## Process Data

- **Type:** RTO
- **Source of wastes:** Air from Film Metalization
- 5 canister with heat recovery by thermal oil
- **Capacity:** 65'000 Nm<sup>3</sup>/h
- **Solvent:** Ethyl Acetate, MEK 1-3 gr/Nm<sup>3</sup>



## Process Data

- **Type:** RTO
- **Source of wastes:** Air from Plaster bandages production
- 3 canister with heat recovery by thermal oil
- **Capacity:** 15'000 Nm<sup>3</sup>/h



# RTO with heat recovery



**Flow-rate:** 10'000 Nm<sup>3</sup>/h coming from a solvent coating line for the production of plasters.

## **HEAT RECOVERY SYSTEM**

for the Production of THERMAL OIL

**Flow-rate:** 20'000 Nm<sup>3</sup>/h coming from a production line of fire and mildew resistant tapestry  
**HEAT RECOVERY SYSTEM**  
for the production of hot water



# RTO with flue gas treatment

## Process Data:

- **Type:** RTO for Air contaminated by Chlorinated Compounds - 2 canisters with compensation chamber
- **Source of wastes:** Wastewater treatment plant and Pharmaceutical production plant
- **Capacity:** 5'000 Nm<sup>3</sup>/h
- **Hydrocarbons in Air:** 2-5 g/Nm<sup>3</sup> (Xilene, Toluene, Methylene Chloride, IPA, Acetone, n-Heptane)
- **Guarantee:**
  - Outlet NOx concentration: < 150 mg/Nm<sup>3</sup>
  - Outlet TOC concetration: < 20 mg/Nm<sup>3</sup>
- **Plant sections:** Final scrubber and Dry abatement



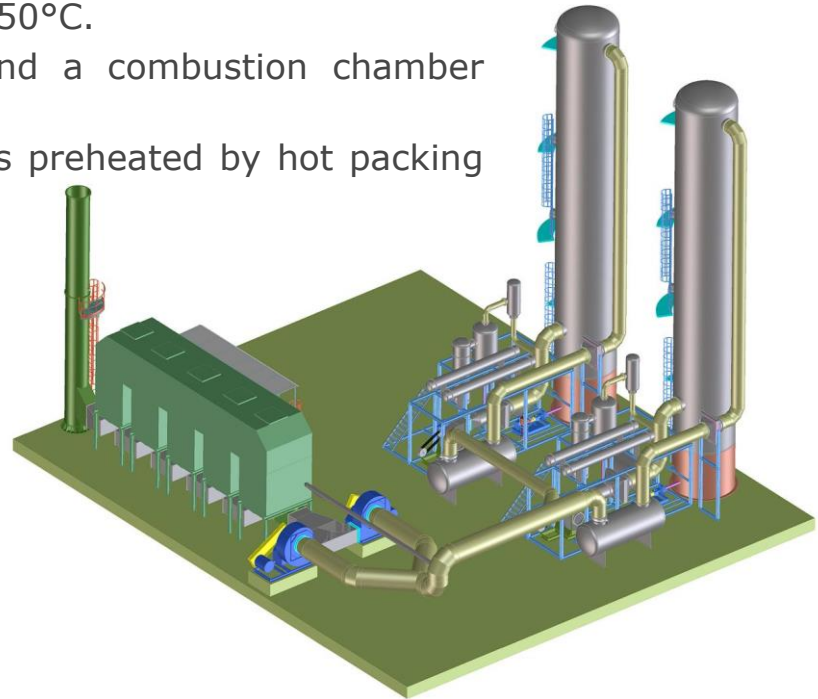
# RTO downstream stripping process

Exhausted process air, containing stripped solvent vapours is fed directly to the oxidation system "RTO" (Regenerative Thermal Oxidation) of gaseous stream and vents.

Due to very high heat recovery in RTO system, difference between inlet and outlet temperature of gas doesn't exceeds  $70^{\circ}\text{C}$ , with a working temperature in combustion chamber of about  $850^{\circ}\text{C}$ .

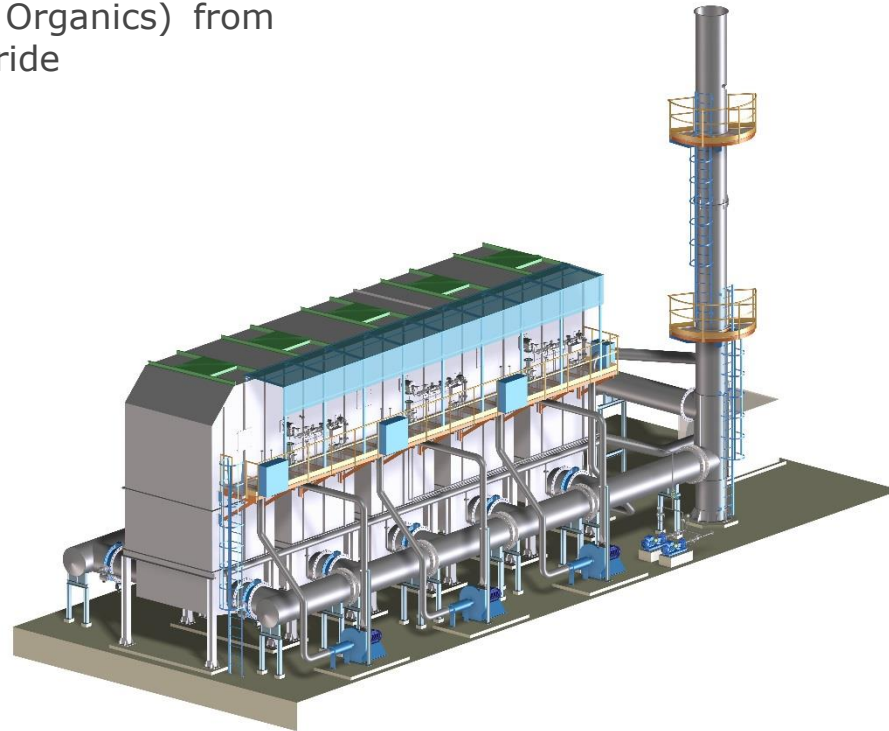
RTO plant consists of three packing beds and a combustion chamber where burned is installed.

Waste gas passes through two beds where it is preheated by hot packing heated during previous cycles.



# RTO downstream scrubbing process

- **Process Data**
- **Type:** RTO 5 Canister
- **Source of wastes:** Solvent scrubbing
- **Flow rate:** 75'000 Nm<sup>3</sup>/h Air from maleic anhydride production and 1600 kg/h waste liquid (15% Organics) from scrubber of maleic anhydride



# Catalytic Thermal Oxidizers

Catalytic combustion plants operate pollutant oxidization through the use of a catalyst in order to lower combustion temperature.

While thermal combustors normally operate at temperatures above 800°C, catalytic combustor never exceed 500°C (normally 300°C – 450°C).

Catalytic combustors cannot operate in presence of streams that contain substances that could foul the catalyst reducing its efficiency.





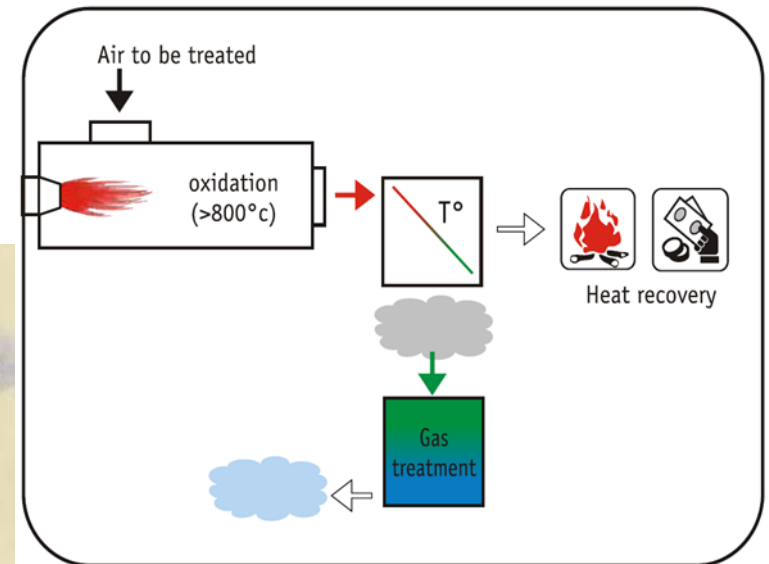
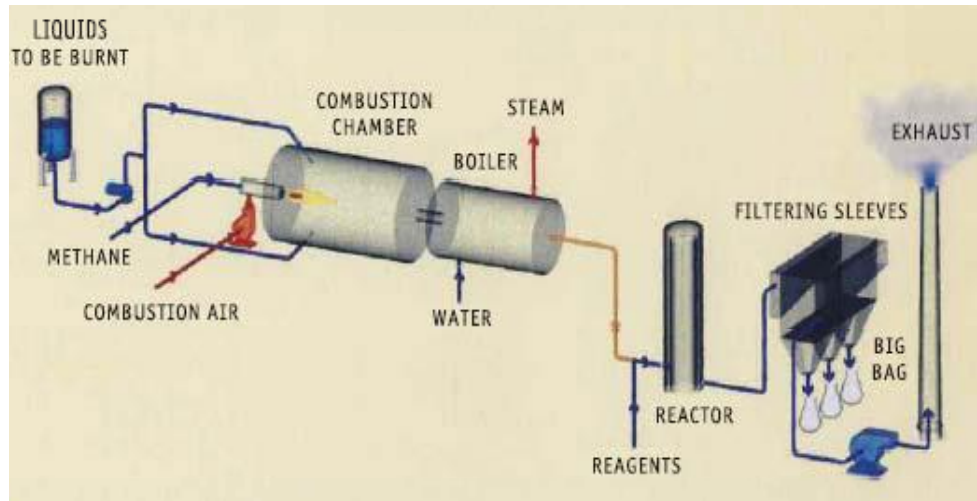
*Thermal Oxidation  
of “liquid waste +  
gaseous waste”*



# Thermal Oxidation of «liquid waste + gaseous waste»

Some industrial process produce highly pollutants liquids and gaseous containing solvents or organic compounds, which can not be treated in conventional plants. There are also a huge quantity of distillation residuals and sludge

TM.I.P. build thermal oxidizers working up 1200°C completed with heat recovery system and flue gas cleaning section (dry or wet removal acids).



# Thermal Oxidation of «liquid waste + gaseous waste»

## Typical Processed Stream

- Liquid waste
- Water contaminated by organics
- Vent stream
- Stream containing Chlorinated compounds
- Stream containing Nitrogen compounds

## Process Solution

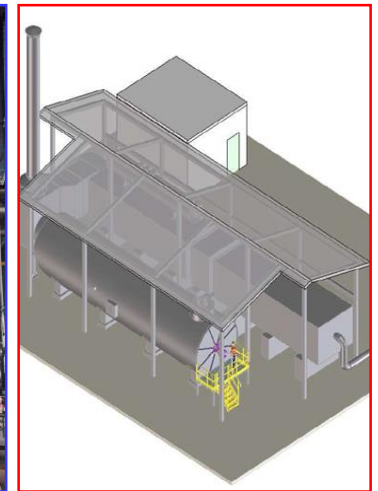
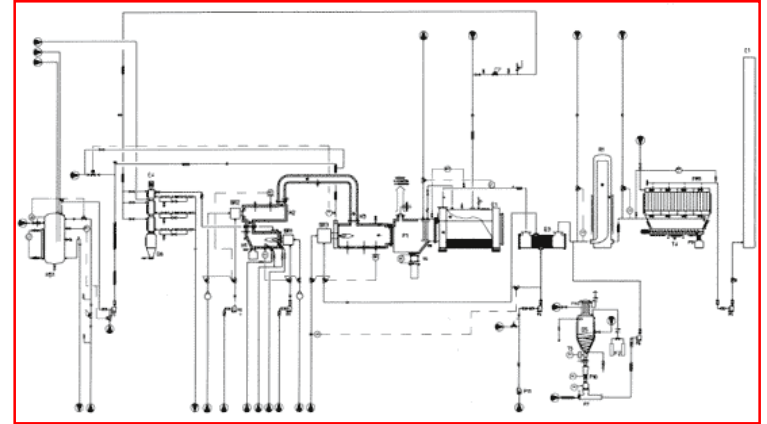
- Static Chamber with Injection Nozzles for liquid waste and distributor for Vent streams
- Afterburner
- Heat Recovery
- Flue gases treatment



# Thermal Oxidation of «liquid waste + gaseous waste»

## Process Data

- **Type:** Horizontal Static Chamber with Injection nozzles for liquid waste and distributor for Vents
- **Source of wastes:** Pharmaceutical Wastes
- **Oxidation Temperature:** up to 1100 °C
- **Residence Time:** 2 s
- **Oxygen Concentration Flue Gases:** 6 % vol.
- **Plant sections:** Steam Boiler, Flue Gases Treatment

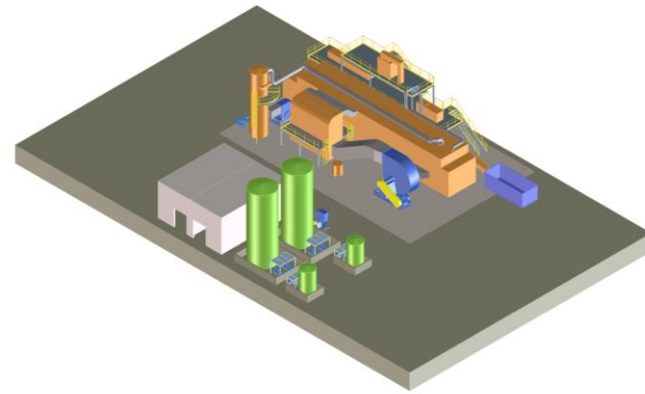
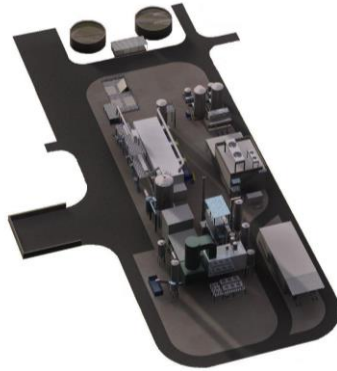


# Thermal Oxidation of «liquid waste + gaseous waste»

## Process Data

- **Type:** Horizontal Static Chamber with Injection nozzles for liquid waste and distributor for Vents
- **Source of wastes:** Solvent Stripping from Wastewater
- **Oxidation Temperature:** 950 °C
- **Residence Time:** 2 s
- **Plant sections:** Steam Boiler, NO<sub>x</sub> thermal reduction with Ammonia injection, Dry Treatment for Flue Gases





# *Thermal Oxidation of Sludge*

# Technologies for Sewage Sludge

The company TM.I.P. S.r.l. should supply “Turn Key” plant for sewage sludge that coming from Municipal and Industrial Wastewater Treatment Plant (WWTP).

As a consequence of the sludge production which is increasing, whereas disposal routes are narrowing, is a progressive further rising in costs. There are two aims with regard to sludge:

- the reduction of the amount of sludge produced by thermal drying;
- the recovery of energy by thermal valorization of dried sludge;

A complete plant with both drying and thermal valorization decrease utilities consumption and completely reduce sludge disposal .



# Sludge treatment characteristics

Dewatering Machine:

- Plate filter;
- Belt Filter press;
- Centrifuge;

Wet Sludge Typical Mass Rate	50-200 ton/day
Wet Sludge Solid content	20-30 % wt.
Dried Sludge Solid content for Thermal Valorization	90-95 % wt.
Operating Hours	8000 hr/y, 24 hr/day

Guide line for this project:

- To reach 90-95 % of dried solid;
- To reach solid suitable for Pyrolysis treatment and synterization;
- To respect EU rules for gaseous emission;



# Main sections

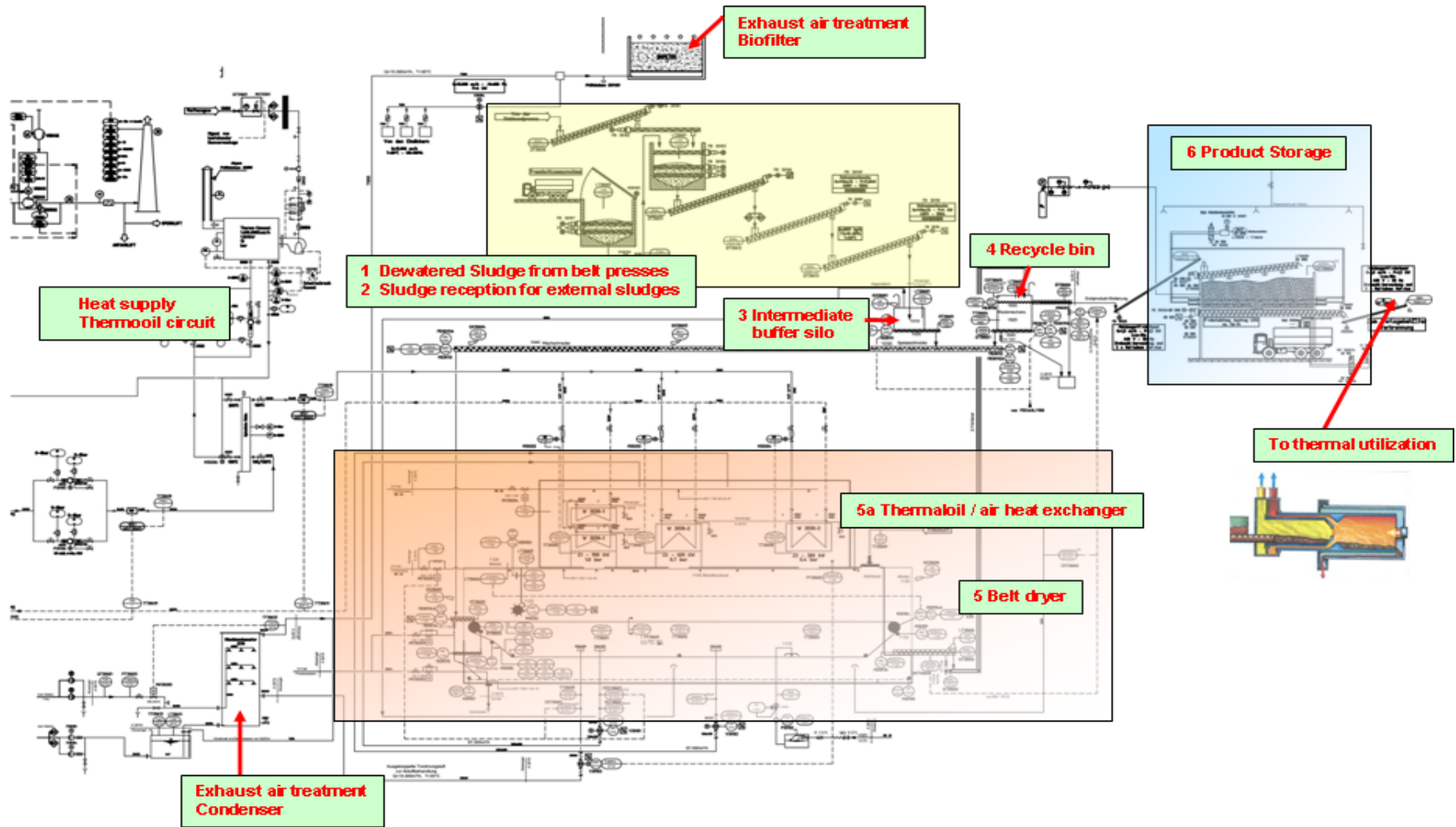
## SECTIONS THAT COULD BE SUPPLIED :

- ✓ Dried Sludge Storage (Underground Pit, Storage Tanks, Chain Conveyors)
- ✓ Drying Plant (Belt Drier, Heat Exchangers, Air Fan, Condensation Tower)
- ✓ Steam Boiler
- ✓ Washing Treatment for Exhaust Gas coming from Drier (Scrubbers, Bio-Filter, RTO)
- ✓ Dried Sludge Storage
- ✓ Thermal Valorization of Dried Sludge (Rotary Kiln, Chemicals Injection Systems, Thermal Oil/ Steam production)
- ✓ Electricity Production (ORC, Steam Turbine)
- ✓ Flue Gas Treatment (Dry and Wet Treatment)





# Flow scheme of drying plant



# Exhaust air treatment

## Outlet Composition from chemical washing system for exhaust air coming from belt drier (CHEMICAL SCRUBBERS + BIO FILTER):

Odor Unit	1000 OU/Nm <sup>3</sup>
Particulate	10 mg/Nm <sup>3</sup>
VOC	250 mg/Nm <sup>3</sup>
NH <sub>3</sub>	20 mg/Nm <sup>3</sup>
H <sub>2</sub> S	2 mg/Nm <sup>3</sup>



# Exhaust air treatment

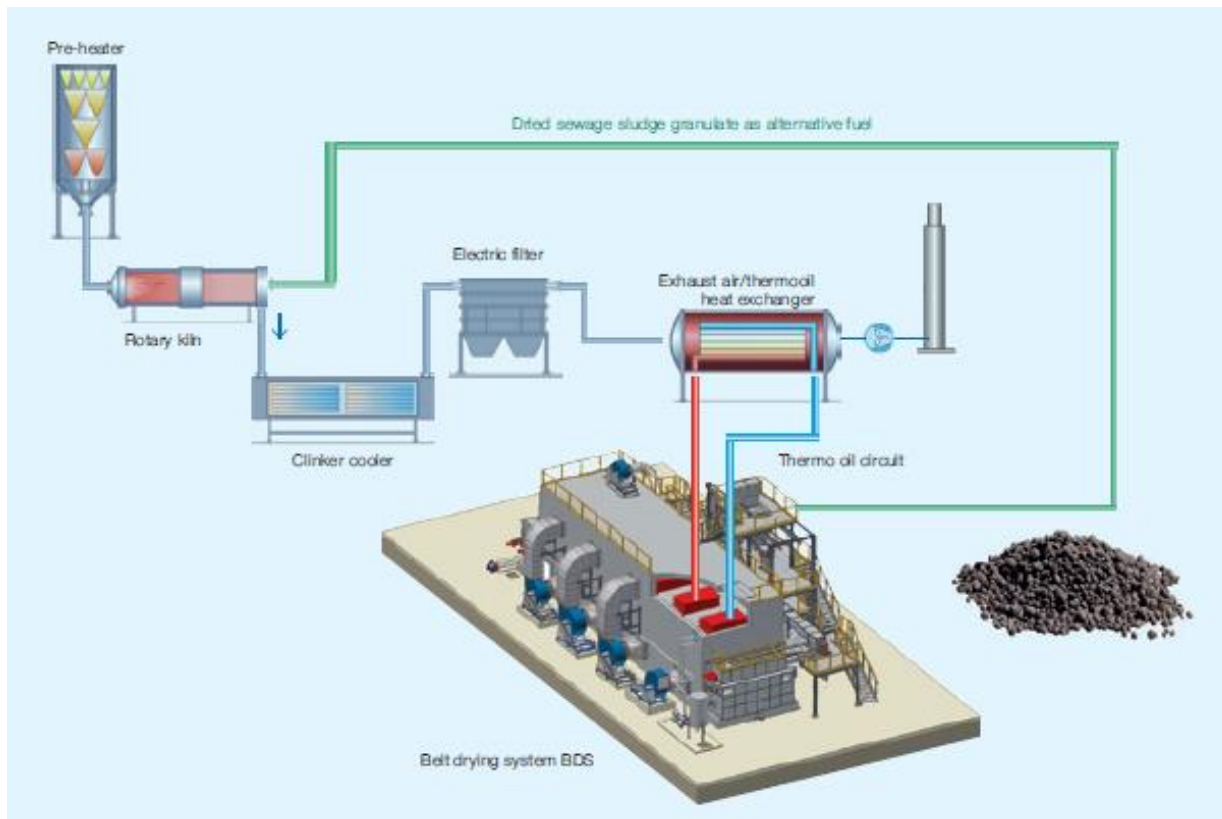
For some applications , where is very difficult to remove odours by bio-filter (odours of ammine, sulfur compounds and others ) a Regenerative Thermal Oxidizer (RTO) system is foreseen instead chemical washing and it can be guaranteed followings limit: :

OUTLET COMPOSITION REGENERATIVE THERMAL OXIDIZER	
Odor Unit	200 OU/Nm <sup>3</sup>
VOC	20 mg/Nm <sup>3</sup>
SO <sub>x</sub>	50 mg/Nm <sup>3</sup>
CO	100 mg/Nm <sup>3</sup>
NO <sub>x</sub>	150 mg/Nm <sup>3</sup>



# Thermal valorization and heat recovery

Because of very high costs of fuel there is possibility to thermal valorize dried sludge to produce electricity and recover heat that can be use for sludge drying.



*thank you*



**Termomeccanica Industrial Process**

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