Energy-from-Waste

State of the art of best available techniques to abate dust, acid gases, heavy metals, NOx and POPs present in flue gas

23rd EGTEI Annual Meeting
Convention on Long-Range Transboundary Air Pollution
10th of October 2014
Brussels, Belgium

Christophe CORD'HOMME
CNIM Group
Business & Products Development Director
And Flavio MATOS

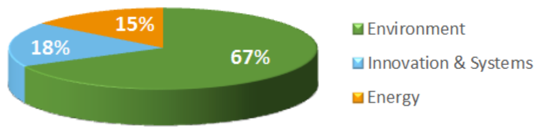
ESWET Lab CNIM INNOVATE AND ACT

Agenda

1) CNIM/ Lab Presentation
2) Energy-from-Waste (EfW) Plants in Europe
3) Waste Composition and Pollutants
4) Energy-from-Waste Scheme
5) Emission Limit Values (ELVs) to air according to IED 2010/75/EU
6) Pollutants Abatement Performances
7) Pollutants Emissions from EfW Plants
8) Air Pollution Control Technologies
9) Pollutants Abatement Cost/ Benefit Analysis

CNIM 2013 key figures

- 2013 revenue: **782 M€**
  including **67% from exports**
- Revenue **by sectors**



- Order book: **€1,109 million**
- **2,800** employees (out of which **1,300** engineers)
- Listed on the stock exchange since **1986**

Figures at December 31, 2013

CNIM Environment activities

Multi-channel approach to master the processing cycles of municipal and industrial waste management

CNIM **main fields of activities are:**

- Turnkey waste valorisation plants with a unique offer of Design and Build as EPC for Waste-to-Energy, Biomass-to-Energy, Waste Sorting and Composting…
- Flue gas cleaning , Bottom ash & residues treatment — Lab
- Plant Operation & Maintenance and revamping

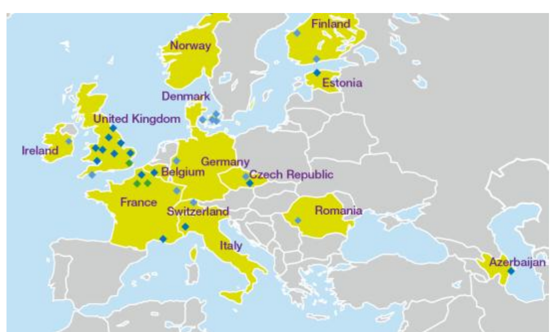
CNIM Environment references

CNIM is one of the top European specialists of Waste-to-Energy recovery

- **281** CNIM MSW Waste-to-Energy lines built allowing the treatment of about **25** million tons of waste per year
- **19** MSW Waste-to-Energy lines operated by CNIM
- **412** LAB Flue Gas Treatment installations built cleaning the combustion gases of around **34** million tons of waste per year

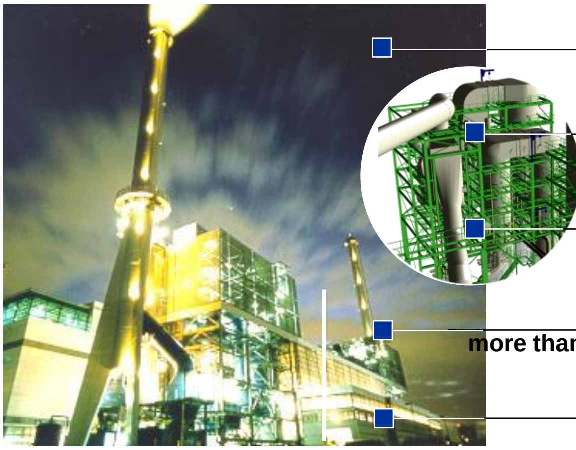
CNIM latest and ongoing WtE & BtE projects

Waste-to-Energy Plants		
Location	t/h	Commissioning year
Marseille (FR)	2x20	2010
Brno (CZ)	2x14	2011
Baku (AZ)	2x33	2012
St Omer (FR)	1x12,5	2012
Thumaide L6 (BE)	1x13	2012
Lincolnshire (UK)	1x19	2013
Tallin (EE)	1x31	2013
Torino (IT)	3x22,5	2013
Oxfordshire (UK)	2x19	2014
Staffordshire (UK)	2x20	2014
Cardiff (UK)	2x23	2015
Suffolk (UK)	2x16	2015
Shropshire (UK)	1x12	2015
Yorkshire - Leeds (UK)	1x20,5	2016
Wilton - Middlesbrough (UK)	2x29,2	2016



Biomass Plants in t/h		
Location	t/h	Commissioning year
Kogeban (FR)	1x29,6	2014
Ridham Dock (UK)	1x22	2015
Estrées-Mons (FR)	1x23	2016

Flue Gas Treatment



A CNIM Group company
LAB turnover 2013: 76 M€

Turn key supplier in
flue gas cleaning

A wide range of processes
and more than 50 patents

60 years of experience
more than 412 supplied installations

200 FGC specialists
4 main offices

CNIM

Flue Gas Treatment

An integrated
FLUE GAS TREATMENT company
with 3 activities

POWER

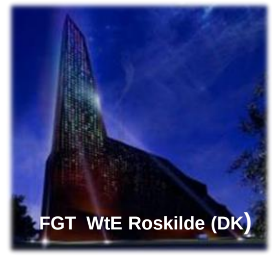
WASTE

INDUSTRY

CNIM

Lab latest and ongoing projects

Flue gas-treatment (LAB)		
Location	Nm³/h	Commissioning year
Meath (IE)	1x128.000	2010
	1x88.000	2011
Winterthur (CH)	1x105.000	2012
Düsseldorf (DE)	1x220.000	2012
Vaasa (FI)	1x172.000	2013
Dombasle (FR)	2x126.000	2014
Kara (DK)	1x157.000	2014
Paroseni (RO)	1x660.000	2014
Plymouth (UK)	1x207.000	2014
Vantaa (FI)	1x118.000	2014
Odense (DK)	1x159.000	2014
Trebovice (CZ)	1x375.000	2015
Longyearbyen (NO)	1x45.000	2015
Horsholm (DK)	1x63.000	2015
Copenhagen (DK)	2x213.000	2016



deSOx Power Plant Paroseni (Ro)

Energy-from-Waste (EfW) Plants in Europe

447 EfW plants in EU (2011)

77 million tons of waste turned into energy

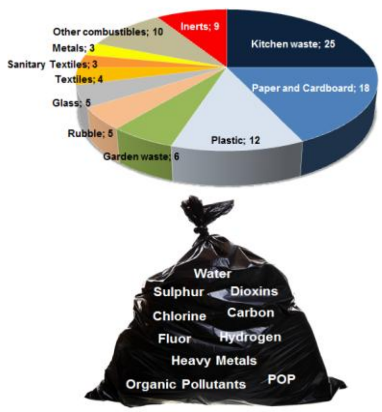
- In blue: Nr of Waste-to-Energy Plants operating in the country (not including hazardous waste incineration plants)
- In orange: Amount of Waste thermally treated in Waste-to-Energy plants, in million of tons/year

Data supplied by CEWEP members unless specified otherwise
* From Eurostat

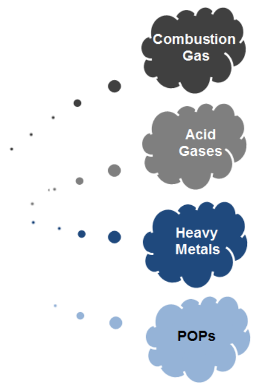
CEWEP
info@cewep.eu
www.cewep.eu

Waste Composition and Pollutants

Typical MSW Composition in Europe



Pollutants from MSW Combustion



- CO_2
- H_2O
- N_2
- CO
- **NOx (NO, NO_2)**

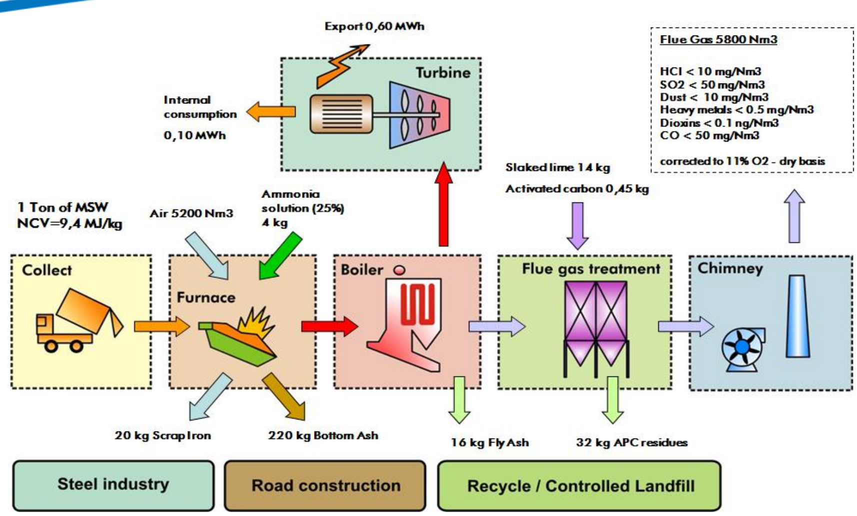
- HCl
- HF
- SOx (SO_3, SO_2)

- Gas (Hg, Cd)
- Particles (Pb, Cu, Cr, Co…)

- Dioxins (PCDD/F) …

Fly Ash and Bottom Ash

Energy-from-Waste Scheme



Daily Emission Limit Values (ELVs) to air according to IED 2010/75/EU

Industrial Emission Directive of 24/11/2010 for different industrial activities using solid fuels

SUBSTANCES/ ACTIVITIES	ELVs in mg/Nm3 (dioxins & furans in ng/Nm3)		Thermal Input (MW_{th})	Dust	TOC	CO	HCl	HF	SO_2	NOx	Dioxins and furans	Cd + Tl	Hg	Heavy Metals (Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V)
Waste incineration & Co-incineration	at 11% O_2 dry	New & Existing > 3 t/h	~ 7	10	10	50	10	1	50	200 (expressed in NO_2)	0.1	0.05	0.05	0.5
Combustion Plants (coal, lignite and other solid residues)	at 6% O_2 dry (converted to 11% O2 dry)	New & Existing	< 50	-	-	-	-	-	-	-	-	-	-	-
		Existing (started operation until 7/01/2014)	50-100	30 (20)	-	-	-	-	400 (267)	300 (200) [450 (300) pulverized lignite]	-	-	-	-
			100-300	25 (17)	-	-	-	-	250 (167)	200 (133)	-	-	-	-
			> 300	20 (13)	-	-	-	-	200 (133)	200 (133)	-	-	-	-
		New	50-100	20 (13)	-	-	-	-	400 (267)	300 (200) [400 (267) pulverized lignite]	-	-	-	-
			100-300	20 (13)	-	-	-	-	200 (133)	200 (133)	-	-	-	-
			> 300	10 (7)	-	-	-	-	150 (100) [200 (133) fluidized bed]	150 (100) [200 (133) pulverized lignite]	-	-	-	-
Combustion plants (biomass)	at 6% O_2 dry	Existing (started operation until 7/01/2014)	50-100	30 (20)	-	-	-	-	200 (133)	300 (200)	-	-	-	-
			100-300	20 (13)	-	-	-	-	200 (133)	250 (167)	-	-	-	-
			> 300	20 (13)	-	-	-	-	200 (133)	200 (133)	-	-	-	-
		New	50-100	20 (13)	-	-	-	-	200 (133)	250 (167)	-	-	-	-
			100-300	20 (13)	-	-	-	-	200 (133)	200 (133)	-	-	-	-
			> 300	20 (13)	-	-	-	-	150 (100)	150 (100)	-	-	-	-

'EfW': Strictest European Environmental Legislation

- **Incineration:** 20 components and lower ELVs **(most stringent EU environmental Legislation)**
- **Combustion Plants > 50 MWth.** Higher ELVs and for 3 pollutants only
- **Combustion Plants < 50 MWth:** no emissions limits

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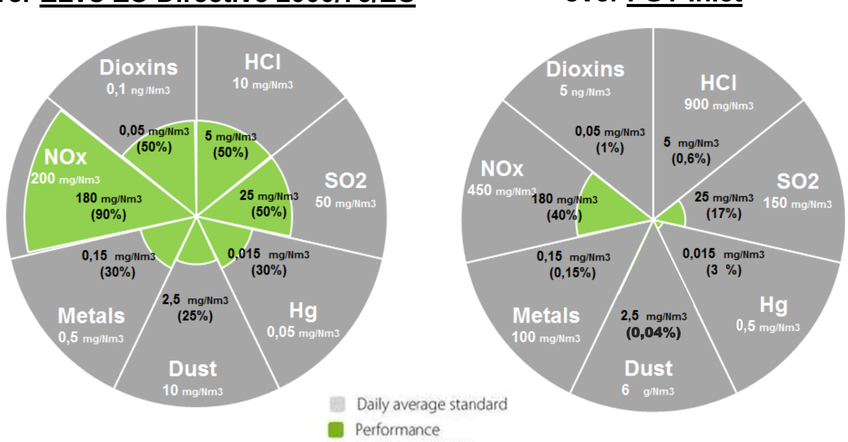
Abatement Performance of Pollutants in EfW

Measured values << ELVs (Emission Limit Values)

Typical Measured Values at Stack over ELVs EU Directive 2000/76/EC | **Typical Measured Values at Stack over FGT Inlet**

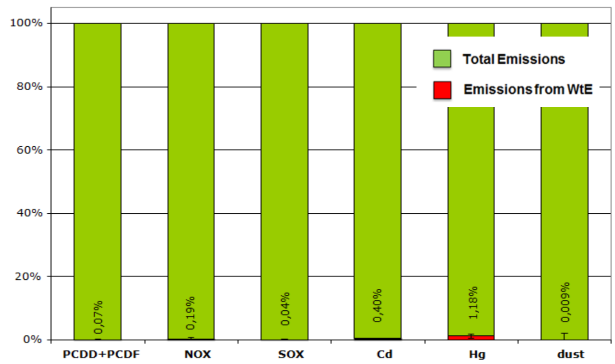


Pollutants Emissions from EfW Plants

Share of EfW in Total Emissions

Data from 50 WtE plants in selected countries

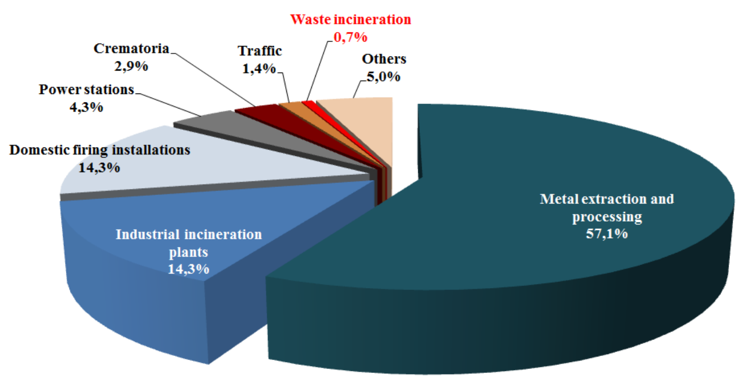
(Czech Republic, France, Germany, Italy, Netherlands and Sweden)



Source: Helmut Rechberger & Gerald Schöller, TU Vienna
Institute for Water Quality, Resources and Waste Management

Pollutants Emissions from EfW Plants

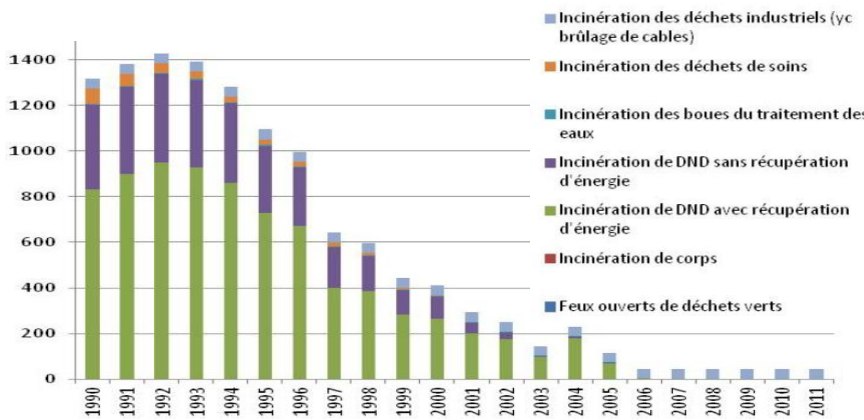
In Germany only 0,7% of total dioxins/furans released in the atmosphere in 2000 were from EfW plants



Source: Federal Minister for the Environment, Nature Conservation and Nuclear Safety.
http://www.bmu.de/fileadmin/bmu-import/files/english/pdf/application/pdf/muellverbrennung_dioxin_en.pdf

Pollutants Emissions from EfW Plants

Dioxins Emissions Reduction in France



Source: CITEPA, Colloque AMORCE - Transition Énergétique, 28/05/2013

Flue Gas Cleaning Systems

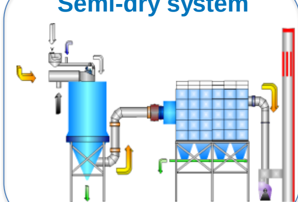
Lab

A complete portfolio of proprietary processes

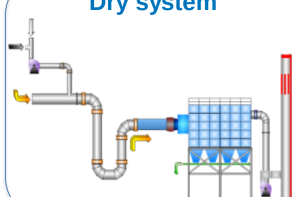
- All types can be offered, depending on local conditions
  - With Electrostatic precipitators and/or Baghouse filters
  - Wet, Semi dry, Dry processes
  - SCR or SNCR de-NOx
  - Activated carbon de-diox and/or SCR de-diox
- Mature and very performing processes

Wet system

Semi-dry system

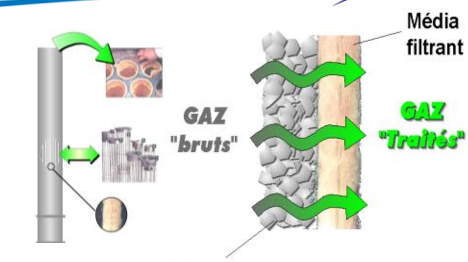


Dry system

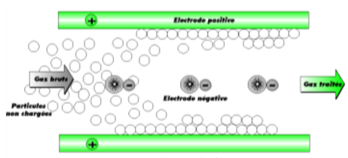


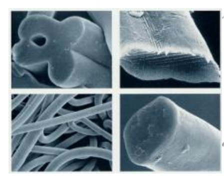
Abatement Technologies Dedusting

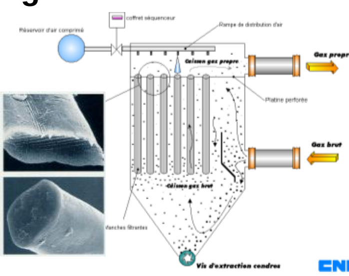
Electrostatic precipitator



Bag house filter

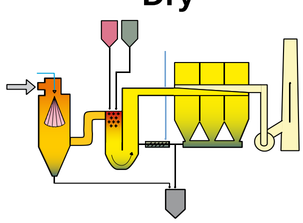




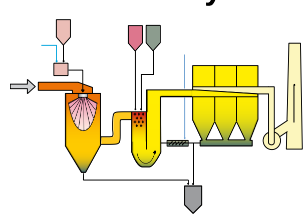


Abatement Technologies Acid Gases

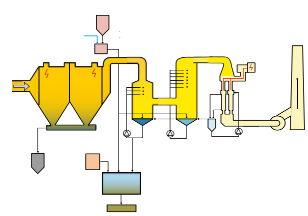
Dry | **Semidry** | **Wet**



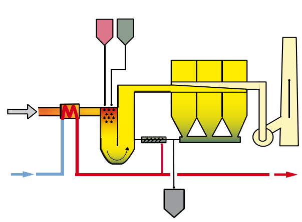
SecoLAB®



SemisecoLAB



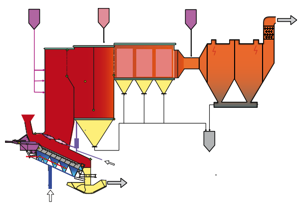
GraniLAB,CycloLAB
DedioxLAB

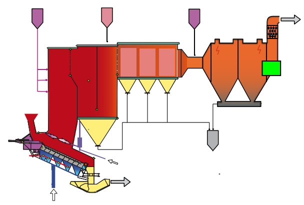


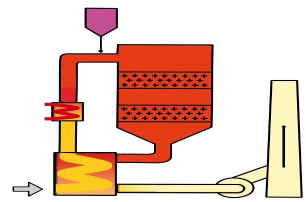
VapoLAB®

Abatement Technologies deNOx

DeNOx Technologies

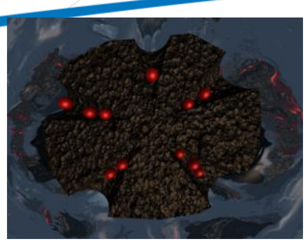


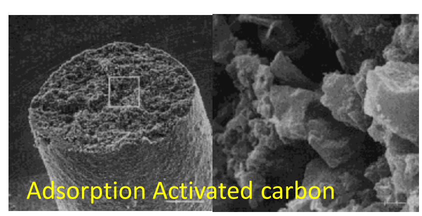




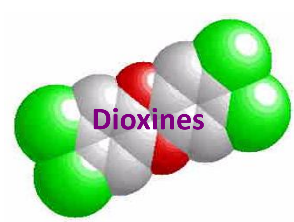
SNCR (non catalytic)	TerminoxLAB®	CataLAB® (catalytic)
950 – 1050 °C	200 – 280 °C	180 – 250 °C

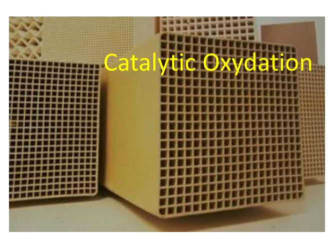
Abatement Technologies : dedioxs





or

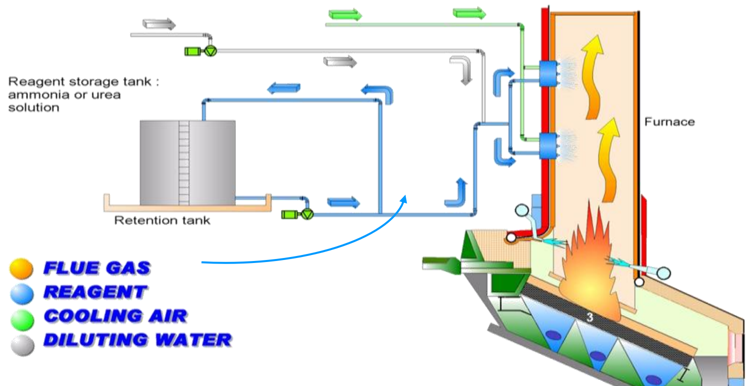




Abatement Technologies

Flue Gas Cleaning, 1st STAGE:
SNCR de-NOx (Selective Non Catalytic Reduction)

In the combustion chamber at high temperature (800 – 850°C)

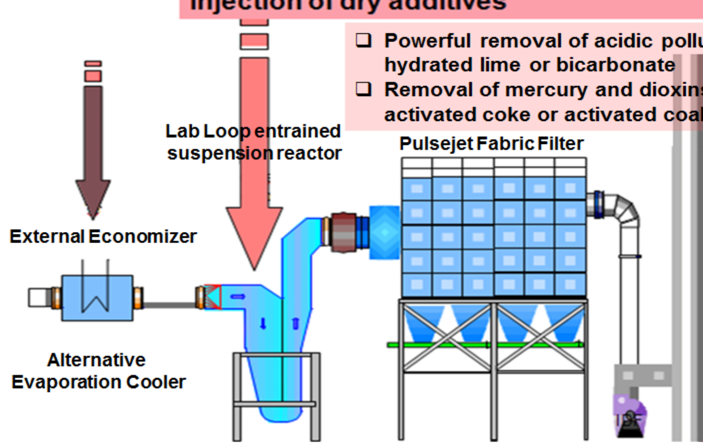


Abatement Technologies

State-of-the-art high performance Dry System

2nd step
Injection of dry additives

- Powerful removal of acidic pollutants by hydrated lime or bicarbonate
- Removal of mercury and dioxins by activated coke or activated coal

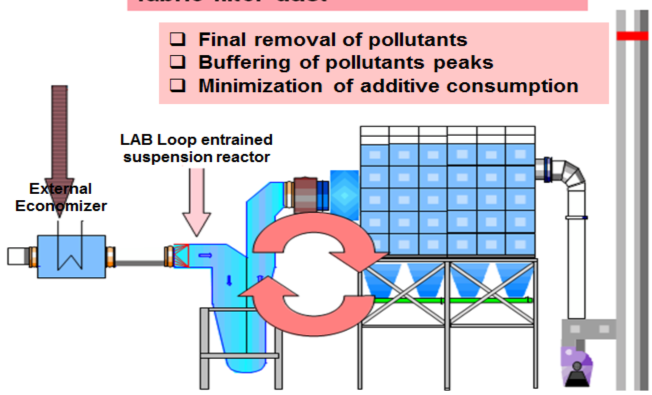


Abatement Technologies

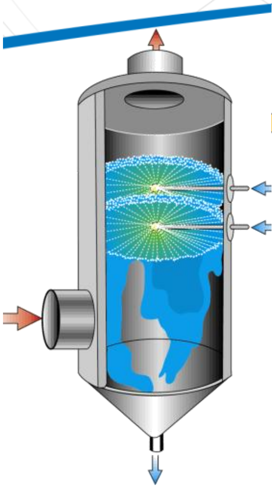
State-of-the-art high performance Dry System

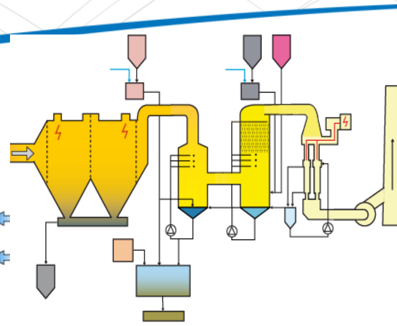
3rd step
Reactivation and recirculation of fabric filter dust

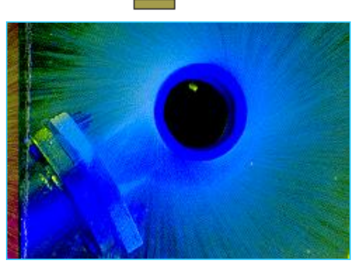
- ❑ Final removal of pollutants
- ❑ Buffering of pollutants peaks
- ❑ Minimization of additive consumption



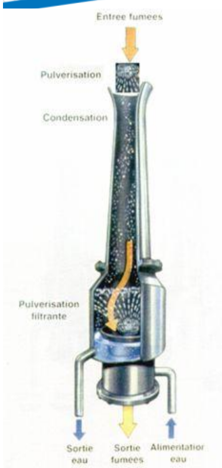
Abatement Technologies Wet System

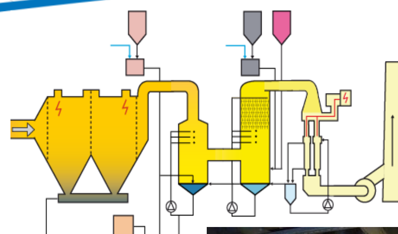


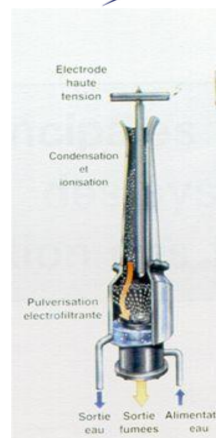




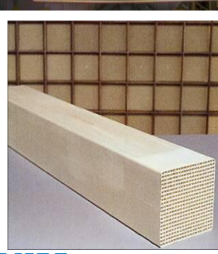
Abatement Technologies : Aerosol in Wet System

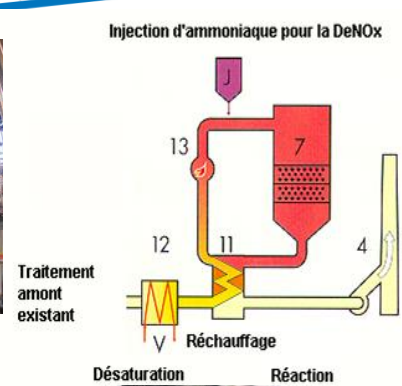


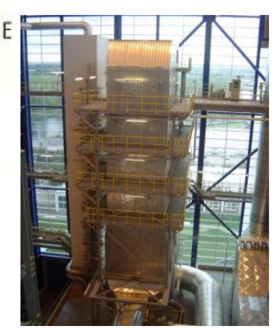




Abatement Technologies SCR de-NOx (Selective Catalytic Reduction)

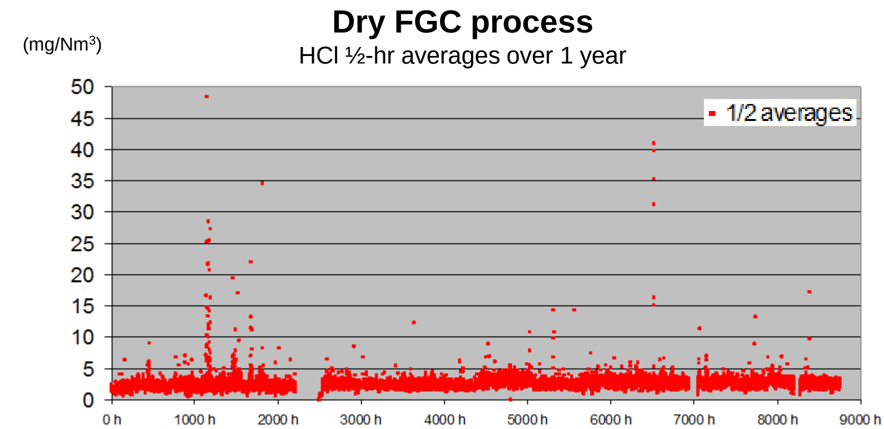






Cost / Benefit analysis

Typical ½ hourly average values over one year ≈ 17000 values



http://www.eswet.eu/tl_files/eswet/Articles/2014.04.13_WI-BREF-ESWET.pdf Graph by L. Kosior, SITA

Cost / Benefit analysis (assuming plant capacity is 10 t/hr)

Lowering the ELV of HCl **from 60 to 10 mg/Nm³** would :

- **Reduce the HCl emitted flow by 11 kg/year**

→ **Increase the lime consumption* by 240,000 kg/y**

→ **Increase the FGC residues by 240,000 kg/y**

* Assuming 15 kg $Ca(OH)_2$ per t_w and 20% additional consumption