6-th International Conference

Cooperation for Waste Issues

April 8-9, 2009

Kharkiv, Ukraine

Waste-to-Energy Plants: Italian references, technological issues and improvements

Ing. Pietro Corrente, Milano (Italy)

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DIRECTIVE 2008/98/EC

of the European Parliament and of the Council, of 19 November 2008

(22.11.2008 EN - Official Journal of the European Union L 312/23)

Article 3 - Definitions

…….

'recovery' means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfill a particular function, or waste being prepared to fulfill that function, in the plant or in the wider economy. *Annex II* sets out a non-exhaustive list of recovery operations;

'disposal' means any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy. *Annex I* sets out a non-exhaustive list of disposal operations;

'best available techniques' means best available techniques as defined in Article 2(11) of Directive 96/61/EC.

Article 4 - Waste hierarchy

1. The following waste hierarchy shall apply as a **priority order** in waste prevention and management legislation and policy:

(a) Prevention ➔ (b) preparing for re-use ➔ (c) recycling ➔ ➔ (d) other recovery, e.g. energy recovery ➔ (e) disposal.

2008/98/EC, ANNEX I - DISPOSAL OPERATIONS

D 1 Deposit into or on to land (e.g. landfill, etc.)

D 2 …, …, D 15 …

2008/98/EC, ANNEX II - RECOVERY OPERATIONS

R 1 Use principally as a fuel or other means to generate energy (*)

R 2 …, ..., R 13 …

(*) This includes incineration facilities dedicated to the processing of municipal solid waste only where their energy efficiency is equal to or above

- **0,60** for installations in operation and permitted in accordance with applicable Community legislation before 1 January 2009,
- **0,65** for installations permitted after 31 December 2008, using the following formula:

$$\text{Energy efficiency} = (E_p - (E_f + E_i))/(0{,}97 \times (E_w + E_f))$$

In which:

Ep means annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2,6 and heat produced for commercial use multiplied by 1,1 (GJ/year)

Ef means annual energy input to the system from fuels contributing to the production of steam (GJ/year)

Ew means annual energy contained in the treated waste calculated using the net calorific value of the waste (GJ/year)

Ei means annual energy imported excluding Ew and Ef (GJ/year)

0,97 is a factor accounting for energy losses due to bottom ash and radiation.

This formula shall be applied in accordance with the reference document on Best Available Techniques for waste incineration.

Article 22 - Bio-waste

Member States shall take measures, as appropriate, and in accordance with Articles 4 and 13, to encourage:

(a) the separate collection of bio-waste with a view to the composting and digestion of bio-waste;

(b) the treatment of bio-waste in a way that fulfils a high level of environmental protection;

(c) the use of environmentally safe materials produced from bio-waste.

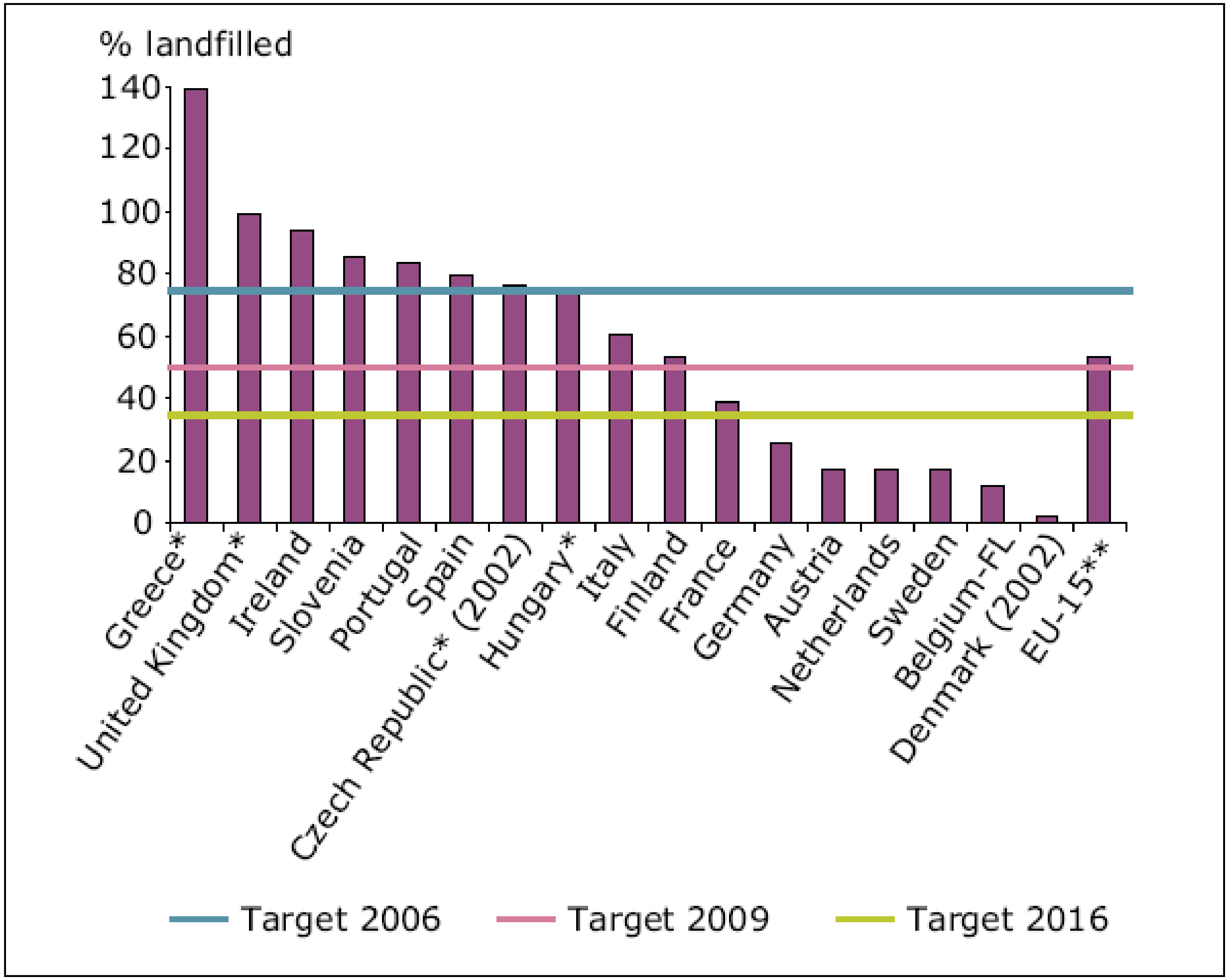
The Commission shall carry out an **assessment** on the management of bio-waste with a view to submitting a proposal if appropriate. The assessment shall examine the opportunity of setting minimum requirements for bio-waste management and quality criteria for compost and digestate from bio-waste, in order to guarantee a high level of protection for human health and the environment.

NOTE (***Source:*** *http://ec.europa.eu/environment/waste)*

The main environmental threat from biowaste is the production of methane in landfills, which accounted for some 3% of total greenhouse gas emissions in the EU-15 in 1995.

The **Landfill Directive 1999/31/EC** obliges Member States to **reduce** the amount of biodegradable waste that they landfill to **35%** of 1995 levels by 2016, which will significantly reduce the problem.

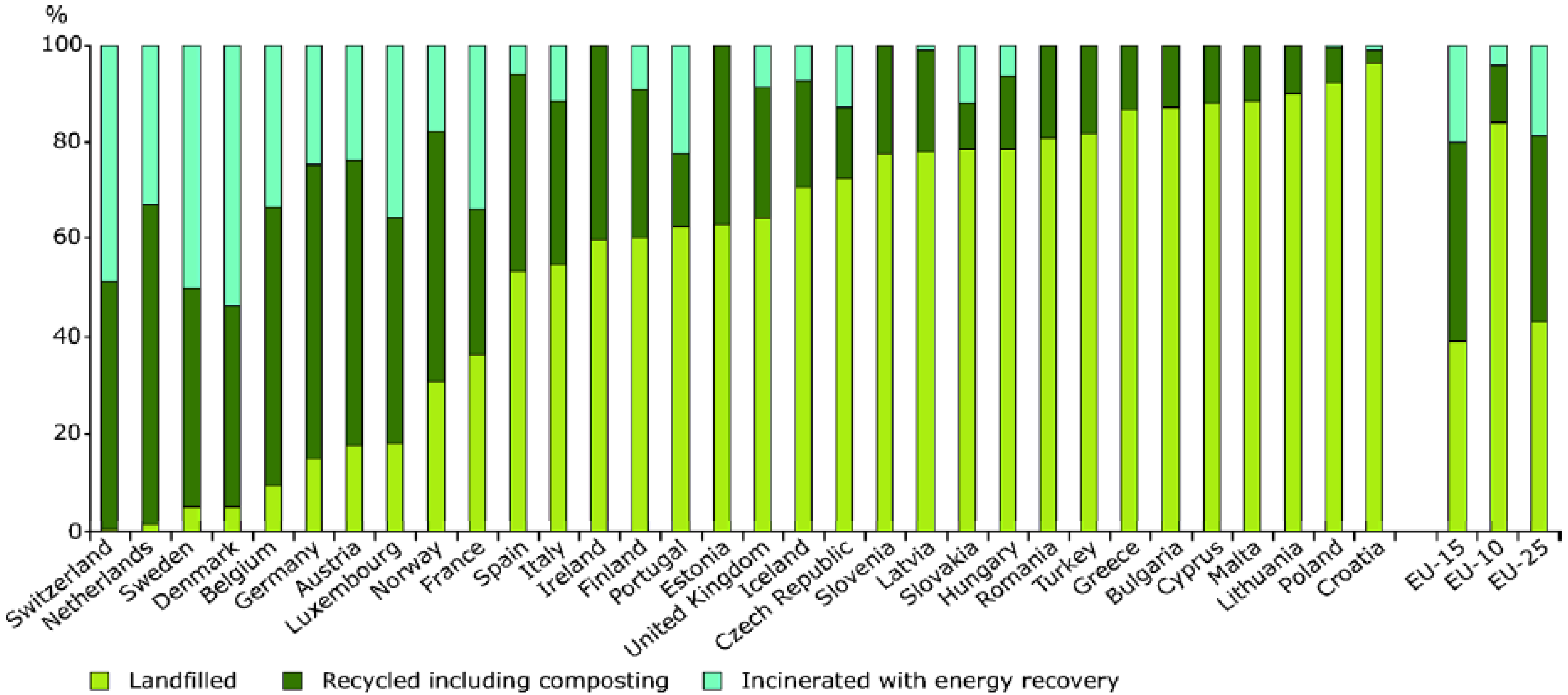
Biodegradable Municipal Waste landfilled in 2003 compared to generation in 1995



Note: *** Marks countries with different target years** (2010, 2013, 2020). The figure shows BMW landfilled in 2003 as a percentage of BMW generation in 1995, which is the reference year for the reduction targets set in the Landfill Directive. Most EU-10 countries are not represented in the graph due to lack of recent data.
** Excluding Luxembourg and the Belgium regions Wallonia and Brussels.

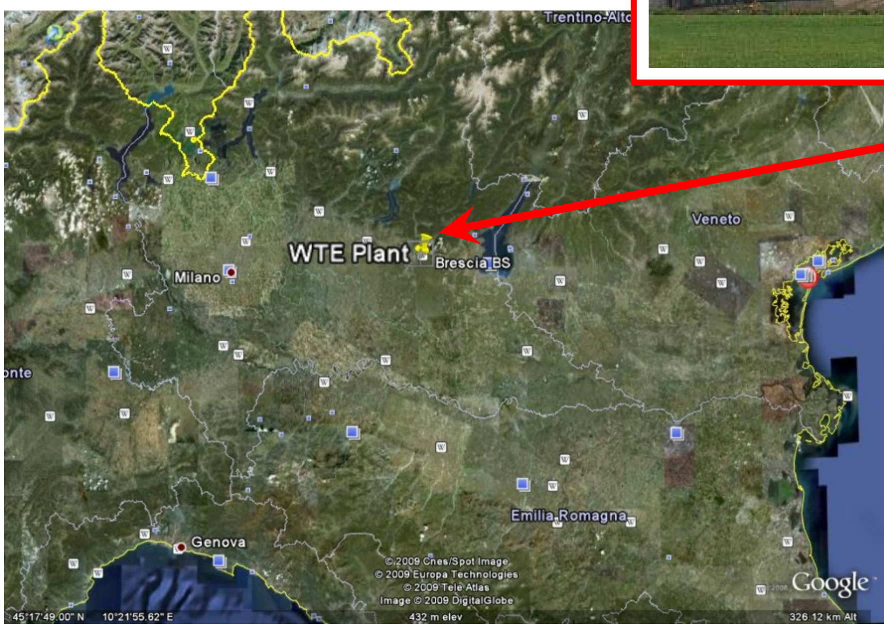
Source: CEC, 2006. EEA Landfill Brochure

Recycling, incineration and landfilling of MSW



Source: EEA, 2007 (from: Jean-Pierre Schosger, Joint Research Centre DG JRC, Int. Conference on W&B Combustion , Milan , 08 Oct 08)

Brescia Waste-to-Energy plant
(owner: A2A SpA)



Source: Ing. Lorenzo Zaniboni, A2A Brescia, *International Conference on Waste and Biomass Combustion*, Milano 8-10 October 2008

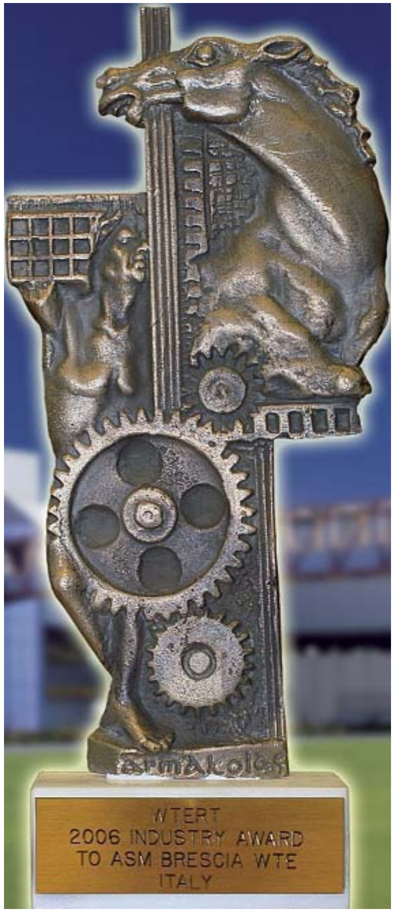
Northern Italy

Source: *Rapporto dell'Osservatorio sul funzionamento del termoutilizzatore di Brescia relativo agli anni 2006-2007*, Comune di Brescia, Settore Ambiente ed Ecologia

WTERT 2006 INDUSTRY AWARD

In 2006, the WTERT (Waste-to-Energy Research and Technology Council), Columbia University of New York, announced that the Brescia Waste-to-Energy Plant was the best of the world, according to following criteria:

- high energy efficiency
- low gas emissions
- quality in reuse and treatment of residues
- acceptance by the local community
- look and architectural quality



More then 20 candidates among main international WtE plants took part in the competition; the first ones in the final classification list were:

1st Brescia - ASM
2nd Malmoe (Sweden)
3rd Amsterdam

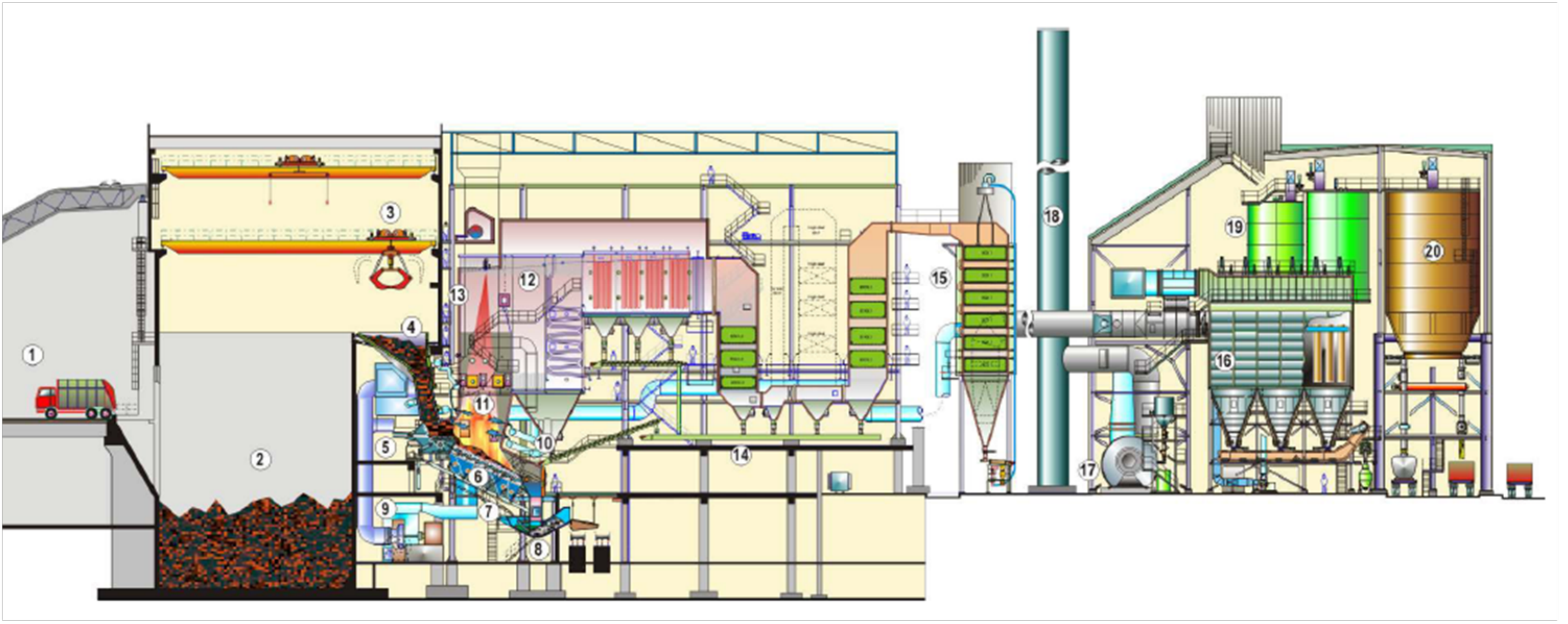
Source: *Rapporto dell'Osservatorio sul funzionamento del termoutilizzatore di Brescia relativo agli anni 2006-2007*, Comune di Brescia, Settore Ambiente ed Ecologia

Plant Capacity	
Plant start-up	1998 (2 lines) 2004 (3^{rd} line)
Waste throughput	3 x 33 t/h
Thermal capacity (3 boilers)	3 x 101,5 = 305 MW
Electric generation capacity (net)	75 Mwel
Heat generation capacity	160 MWth

Source: Ing. Lorenzo Zaniboni, A2A Brescia, INTERNATIONAL CONFERENCE, Milano 8-10 October 2008

Performances in Year 2007	
Municipal Solid Waste (MSW) + Biomass	803.396 tons
Heat for District Heating	526 GWh
El. Energy (net)	569 GWh
Fossil fuels saving (Tons of Oil Equivalent)	> 150.000 TOE
CO2 avoided emissions	> 400.000 tons
Corresponding Nr. families (E.E. needs)	190.000
Corresponding Nr. apartments (Heating needs)	50.000

Source: *Rapporto dell'Osservatorio sul funzionamento del termoutilizzatore di Brescia relativo agli anni 2006-2007*, Comune di Brescia, Settore Ambiente ed Ecologia



1	*Tipping hall*	6	*MARTIN reverse-acting grate*	11	*Furnace*	16	*Fabric filter*
2	*Waste bunker*	7	*Grate siftings conveyor*	12	*Steam boiler*	17	*ID fan*
3	*Waste crane*	8	*Ram-type discharger*	13	*MARTIN SNCR*	18	*Stack*
4	*Feed hopper*	9	*Underfire air system with air preheater*	14	*Fly ash transport*	19	*Additive silo*
5	*Feeder*	10	*Overfire air system*	15	*External economizer*	20	*Residue silo*

Source: brochure *Waste-to-Energy Plant ASM Brescia, Italy*, MARTIN Gmbh, Feb. 2007

MARTIN reverse-acting grate

Source: brochure MARTIN reverse-acting grate, MARTIN Gmbh, Feb. 2007

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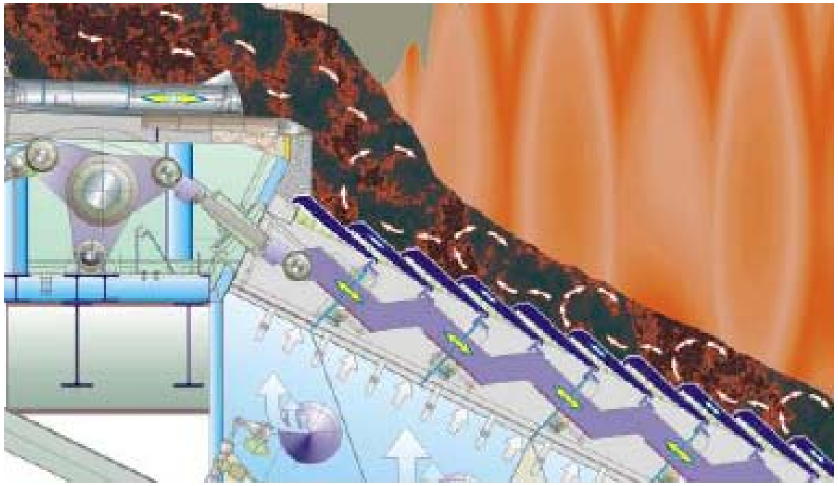
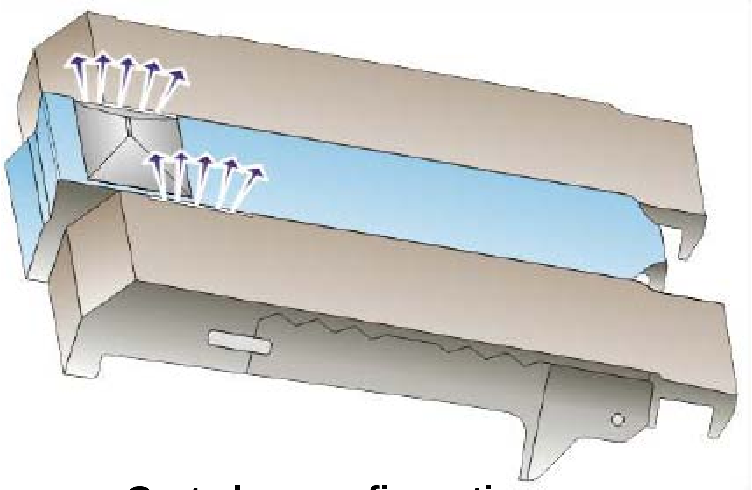
seit 1925

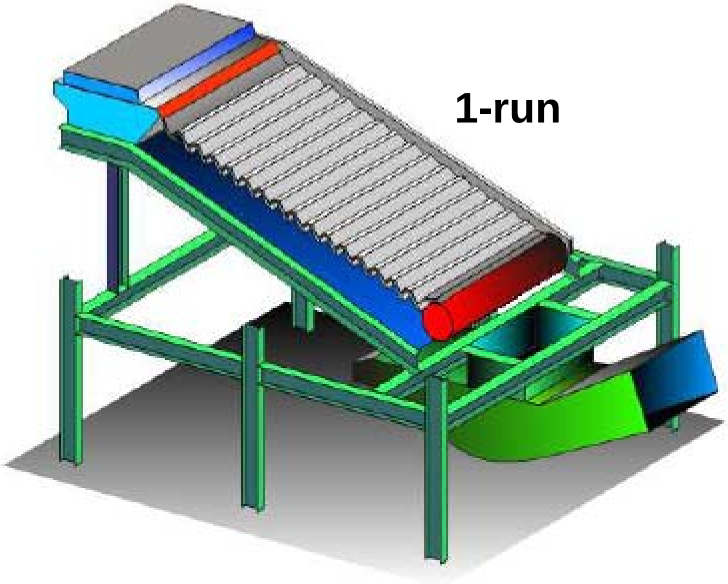
MARTIN reverse-acting grate



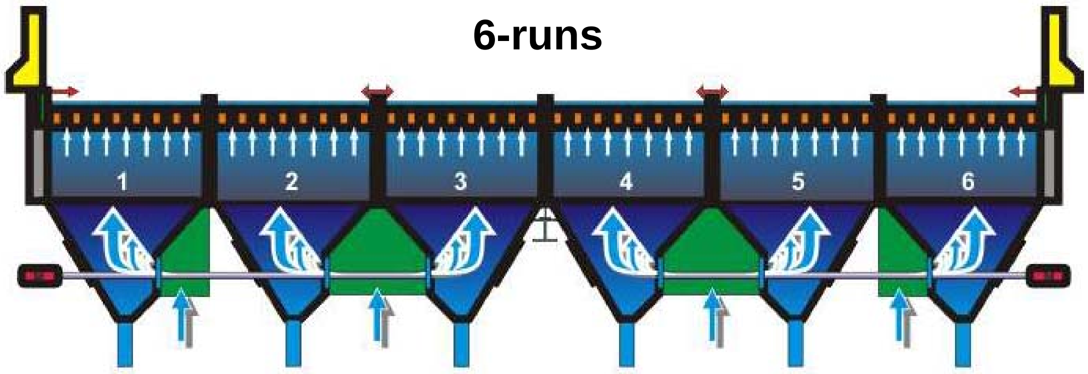
Motion of the grate bars



Grate bar configuration



1-run



6-runs

Source: brochure MARTIN reverse-acting grate, MARTIN Gmbh, Feb. 2007

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"Autorizzazione Integrata Ambientale (AIA)"

On August 31st 2007, the local regional Authority *Regione Lombardia* granted the permission *AIA (Autorizzazione Integrata Ambientale)* for the WtE Plant of Brescia, according to the Italian decree DLgs 59/2005. This Italian decree implements the European Community Directive 96/61/CE, well known with the name *IPPC (Integrated Pollution Prevention and Control)*.

Decree AIA entitles to operate an industrial plant, defining the operating conditions of the plant and substitutes any other permit previously issued.

For the WtE plant of Brescia it introduced new emission limits for NO_X and NH_3:

- **NO_X** new daily-limit in force from October 31st 2007: **120 mg/Nm3**
(previous limit: 200 mg/Nm3)

- **NH_3** daily-limit in force from January 1st, 2011*: **10 mg/Nm3**
(at the moment no limit for NH_3 in the European and Italian regulation)

(*) According to the European research project *NextGenBioWaste* in progress, to develop a high efficiency catalyst "High Dust" type.

Source: *Rapporto dell'Osservatorio sul funzionamento del termoutilizzatore di Brescia relativo agli anni 2006-2007*, Comune di Brescia, Settore Ambiente ed Ecologia

European research project for the development of a new catalytic NOx reduction system: "High Dust" SCR

Each combustion line is equipped with a Selective Non Catalytic Reduction system (**SNCR**), with ammonia solution injection in combustion chamber:

$$4\ NO + 4\ NH_3 + O_2 \rightarrow 4\ N_2 + 6\ H_2O$$

$$6\ NO_2 + 8\ NH_3 \rightarrow 7\ N_2 + 12\ H_2O$$

➔ NOx at the stack no lower then 70-80 mg/Nm3, with trails of not reacted NH_3 ("Ammonia Slip").

A new catalytic NOx reduction system (**SCR**) has been installed on line 2 in march 2006. This allows a further reduction both of NOx and NH_3 emissions.

See NOx emission data: compare line nr. 1 and 3 (not equipped with a SCR system) with line nr. 2.

The sperimentation of this innovative technology is part of a 4 years project, promoted by the European Community within the 6th Framework Programme for research, technological development and demonstration activities, called ***NextGenBioWaste*** *(Innovative Demonstration for the Next Generation of Biomass and Waste combustion plants for energy recovery and renewable electricity production)*.

Source: *Rapporto dell'Osservatorio sul funzionamento del termoutilizzatore di Brescia relativo agli anni 2006-2007*, Comune di Brescia, Settore Ambiente ed Ecologia

ANNO 2007 – Medie mensili delle concentrazioni delle emissioni in atmosfera

YEAR 2007 – Mounthly average concentrations of gaseous emissions to atmosphere

	Valori limite		Gen.	Feb.	Mar.	Apr.	Mag.	Giu.	Lug.	Ago.	Set.	Ott.	Nov.	Dic.
CO Monossido di carbonio	50 mg/Nm³	L1*	7,6	7,3	10,8	13,9	17,3	18,7	18,8	16,8	13,9	13,0	12,5	14,1
	50 mg/Nm³	L2*	10,0	9,3	11,4	10,4	16,2	13,7	19,3	15,4	11,7	12,0	9,9	10,9
	50 mg/Nm³	L3**	31,1	31,2	32,2	28,2	29,6	24,7	21,7	21,6	25,0	24,2	20,1	23,4
SO_2 Biossido di Zolfo	50 mg/Nm³	L1*	2,3	2,6	2,5	11,5	5,9	3,7	3,7	4,4	3,5	1,9	3,0	2,7
	50 mg/Nm³	L2*	0,5	0,5	0,4	0,6	3,0	0,6	0,8	0,5	0,8	0,8	1,1	0,7
	50 mg/Nm³	L3**	0,5	0,1	0,1	0,1	0,1	0,1	0,2	0,2	0,4	0,0	0,0	0,7
NOx Ossidi di Azoto	200 mg/Nm³	L1*	73,5	70,5	72,4	73,6	71,5	85,9	86,0	89,8	88,3	79,9	77,6	70,1
	200 mg/Nm³	L2*	54,0	52,8	55,3	69,5	60,1	61,4	63,6	58,3	60,6	60,0	66,3	67,9
	200 mg/Nm³	L3**	71,1	70,2	70,9	70,5	70,9	80,9	74,7	70,2	72,4	72,7	67,9	73,8
HCl Acido Cloridrico	10 mg/Nm³	L1*	2,1	3,8	3,7	4,2	3,9	4,1	4,3	4,1	4,5	4,6	4,2	4,9
	10 mg/Nm³	L2*	3,3	4,3	4,2	4,4	3,9	4,3	4,0	3,9	4,4	4,7	4,9	5,2
	10 mg/Nm³	L3**	3,7	4,8	4,7	4,8	4,6	4,8	4,7	4,1	3,7	4,7	4,8	4,9
PTS Polveri Totali Sospese	10 mg/Nm³	L1*	0,3	0,2	0,3	0,3	0,2	0,2	0,3	0,3	0,5	0,3	0,3	0,3
	10 mg/Nm³	L2*	0,3	0,3	0,4	0,4	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,4
	10 mg/Nm³	L3**	0,9	0,9	0,8	0,7	0,6	0,2	0,2	0,3	0,3	0,4	0,4	0,4
COT Carbonio organico totale	10 mg/Nm³	L1*	0,7	0,6	0,6	0,5	0,6	1,0	0,8	0,8	0,6	0,6	0,6	0,8
	10 mg/Nm³	L2*	0,7	0,6	0,5	0,5	0,6	0,7	0,6	0,6	0,6	0,6	0,6	0,8
	10 mg/Nm³	L3**	0,4	0,4	0,4	0,3	0,6	0,4	0,3	0,3	0,3	0,3	0,4	0,4

L1 *LINEA 1*
L2 *LINEA 2*
L3 *LINEA 3*

(*) *Valori limite giornalieri stabiliti dal D.Lgs. n°133 del 11/05/2005*

Source: *Rapporto dell'Osservatorio sul funzionamento del termoutilizzatore di Brescia relativo agli anni 2006-2007*, Comune di Brescia, Settore Ambiente ed Ecologia (http://www.comune.brescia.it)

Assessment of Institute "M. Negri" on behalf of ARPA (year 2007)

Indagine Istituto "M. Negri" per conto ARPA relativa all'anno 2007

(Slide 1/2)

Inquinanti	Inquinanti espressi come	Unità di misura	FEBBRAIO 2007			GIUGNO 2007			NOVEMBRE 2007			Valori limite D. Lgs 133/2005			
			Linea 1	Linea 2	Linea 3	Linea 1	Linea 2	Linea 3	Linea 1	Linea 2	Linea 3	Media 24 h	Media 1 h	Media 30 min	Media 8 ore
Ossidi di azoto (NO+NO2) NOx	NO_2	mg/Nm³	-	-	-	-	-	-	-	-	-	200		400	
Monossido di Carbonio	CO	mg/Nm³	-	-	-	-	-	-	-	-	-	50		100	
Ossidi di Zolfo	SO_2	mg/Nm³	2,57 **1,13**	3,1 **1,76**	0,78 **0,53**	15,05 **0,61**	7,78 **3,13**	0,57 **0,54**	3,60 **7,39**	3,86 **3,54**	0,25 **1**	50		200	
Cloruri	HCl	mg/Nm³	5,19 **3,12**	4,1 **4,68**	3,37 **3,90**	2,89 **1**	3,44 **3,28**	2,50 **3,80**	3,16 **2,98**	3,35 **6,93**	4,02 **2,89**	10		60	
Fluoruri	HF	mg/Nm³	<0,039 **< 0,160**	<0,028 **< 0,397**	<0,025 **<0,22**	<0,037 **<0,147**	<0,227 **<0,94**	<0,016 <0,15	<0,02 **<0,12**	<0,03 **<0,14**	<0,02 **<0,11**				
Sostanze organiche (SOV-COT)	C	mg/Nm³	-	-	-	-	-	-	-	-	-				
Polveri Totali Sospese	PTS	mg/Nm³	0,12 0,06	0,14 0,12	0,33 0,15	0,04 0,09	0,07 0,11	0,03 0,07	0,1 0,16	0,11 0,23	0,06 0,04	10		30	
Mercurio	Hg	mg/Nm³	0.00010 <0.00007	<0,00008 <0,00011	<0.00008 <0.00009	<0,00008 0,00009	0.00008 <0.00007	<0,00003 <0,00005	0,00024 0,00079	<0.00013 <0.00014	0,00013 0,00012		0.05		
Cadmio	Cd	mg/Nm³	0,00053 <0,00036	0,00005 <0,00059	0,00006 0.00006	0,00039 <0,00048	<0,00041 <0,00038	<0,00015 <0,00024	0,00025 0,00081	0,00007 0,00009	0,0008 <0,00060				
Tallio	Tl	mg/Nm³	<0,00052 <0,00036	<0,00043 <0,00057	<0.00039 <0.00044	<0.00039 <0,00048	<0.00041 <0.00038	<0,00015 <0,00024	0,00024 0,00079	<0.00007 <0.00009	0,00066 0,00059				
Cadmio+Tallio	Cd+Tl	mg/Nm³	0,00105 <0,00072	0.00047 <0,00116	0,00044 0.00050	0,00078 <0,00096	<0,00083 <0,00076	<0,00030 <0,00048	0,00049 0,00160	0,00015 0,00019	0,00146 0,00119		0.05		

nnn = valore medio su 24 ore; nnn = valore medio su 8 ore; **nnn** = media di 3 valori su 1 ora

Source: *Rapporto dell'Osservatorio sul funzionamento del termoutilizzatore di Brescia relativo agli anni 2006-2007*, Comune di Brescia, Settore Ambiente ed Ecologia (http://www.comune.brescia.it)

Indagine Istituto “M. Negri” per conto ARPA relativa all’anno 2007 - (Slide 2/2)

Inquinanti	Inquinanti espressi come	Unità di misura	FEBBRAIO 2007			GIUGNO 2007			NOVEMBRE 2007			Valori limite D. Lgs 133/2005			
			Linea 1	Linea 2	Linea 3	Linea 1	Linea 2	Linea 3	Linea 1	Linea 2	Linea 3	Media 24 h	Media 1 h	Media 30 min	Media 8 ore
Metalli pesanti totali	MetDRL	mg/Nm³	0,00485 0,00160	0,00281 0,00205	0,00391 0,00903	0,00309 0,00403	0,00318 0,00315	0,00128 0,00177	0,05783 0,02069	0,00486 0,00540	0,02241 0,02526		0.5		
Antimonio	Sb	mg/Nm³	<0,00014 <0,00013	<0,00011 <0,00018	<0,00011 <0.00013	<0.00012 <0.00015	<0,00013 <0.00016	<0.00008 <0.00005	0,00028 0,00117	<0,00018 <0,00024	<0,00019 0,00088				
Arsenico	As	mg/Nm³	<0.00014 <0.00013	<0,00011 <0,00018	<0,00011 <0.00013	<0.00012 <0.00015	<0,00013 <0.00016	<0.00008 <0.00005	0,00009 <0,00027	<0.00018 <0,00024	<0.00019 <0.00017				
Piombo	Pb	mg/Nm³	0,00018 0,00007	0,00011 0,00009	0,00039 0,00027	0,00047 0,00051	0,00043 0,00043	0,00018 0,00024	0,00120 0,01324	0,00016 0,00019	0,01255 0,01366				
Cromo	Cr	mg/Nm³	0,00009 0,00008	0,00007 0,0001	0,00013 0,00014	0,00042 0,00051	0,00042 <0,00038	0,00018 <0,00024	0,00032 0,00091	0,00021 0,00031	0,00072 0,00066				
Cobalto	Co	mg/Nm³	<0.00052 <0.00036	<0.00043 <0,00007	<0.00039 <0.00044	<0.00039 <0.00048	<0.00041 <0.00038	<0.00015 <0,00024	<0,00025 <0,00081	<0.00064 <0,00072	<0,00067 <0,00060				
Rame	Cu	mg/Nm³	0,00159 0,00006	0,00054 0,00059	0,00066 0,00178	<0,00039 0,000054	<0.00041 0,0004	<0.00015 <0,00024	0,05452 0,00082	<0.00064 <0,00072	0,00526 0,00543				
Manganese	Mn	mg/Nm³	0,00009 <0,00036	0,00015 0,00009	0,00129 0,0056	0,0004 0,00073	<0.00041 0,00048	0,00015 <0,00024	0,00036 0,00092	0,00021 0,00026	0,00076 0,00070				
Nichel	Ni	mg/Nm³	0,00157 0,00005	0,00087 0,00015	0,00044 0,00012	0,0004 0,00049	<0.00041 <0,00038	0,00017 <0,00024	0,00032 0,00091	0,00135 0,00254	0,00073 0,00195				
Vanadio	V	mg/Nm³	<0.00052 <0.00036	<0,00043 <0.00059	<0.00039 <0,00044	<0.00039 <0.00048	<0.00041 <0,00038	<0.00015 <0,00024	<0,00025 <0,00081	<0.00064 <0.00009	<0.00067 <0.00060				
Stagno	Sn	mg/Nm³	<0,00055 <0,00040	<0.00045 <0.00059	<0,00041 0,00047	<0.00039 <0.00048	<0.00041 <0,00038	<0.00015 <0,00024	0,00026 0,00083	<0.00064 <0.00009	<0.00067 <0.00060				
Poli Cloro Dibenzo Diossine + Poli Cloro Dibenzo Furani	TCDD(Teq)	ng/Nm³	0,00586	0,00071	0,00044	0,00081	0,00038	0,00035	0,0020	0,00494	0,00143				0,1
Idrocarburi Policiclici Aromatici	IPA	ng/Nm³	30	2,67	1,85	14,98	1,55	1,47	0,446	3,11	0,32				10.000
Poli Cloro Bifenili	PCB	ng/Nm³	9,87169	6,16399	2,71273	2,36774	0,31662	0,2170	22,64277	6,89971	38,47257				
Poli Cloro Bifenili (◆)	PCB(Teq)	ng/Nm³	0,00016	0,00009	0,00004	0,00004	0,00002	0,00001	0,000293	0,00008	0,000106				

nnn = valore medio su 24 ore; nnn = valore medio su 8 ore; **nnn** = media di 3 valori su 1 ora

(◆) per poter correttamente valutare e comparare i valori di emissione di PCB, per i quali le normative non stabiliscono un esplicito limite, in conformità agli standard definiti dall WHO (World Health Organization – Organizzazione Mondiale della Sanità) i dati sono stati espressi in termini di TEQ (tossicità equivalente)

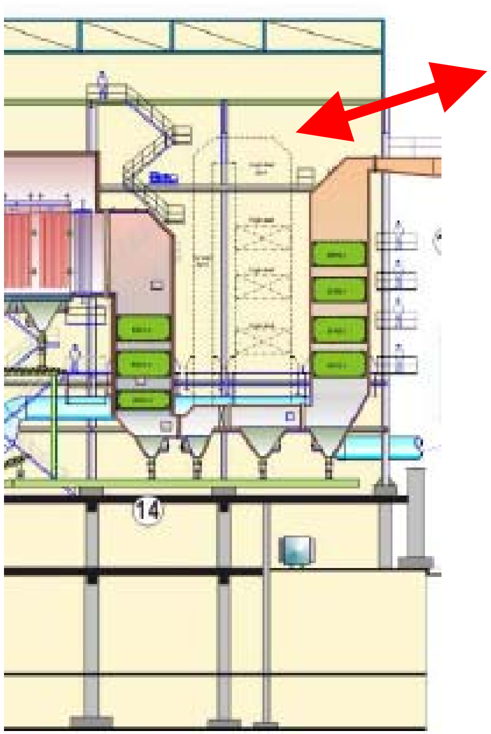
Source: *Rapporto dell’Osservatorio sul funzionamento del termoutilizzatore di Brescia relativo agli anni 2006-2007*, Comune di Brescia, Settore Ambiente ed Ecologia

Gas emissions to atmosphere: summary

All values in mg/Nm3 (except for Dioxin - ng/Nm3) Values referred to dry gas, normal conditions, 11 % O2	PLANT AUTHORIZATION LIMITS 1993	PLANT DESIGN DATA 1994	EUROPEAN UNION LIMITS 2000	ACTUAL OPERATION DATA
Particulate matter	10	3	10	<0,5
Suplhure doxide	150	40	50	10
Nitrogen oxides (NOx)	200	100	200	80
Chlorine acid (HCl)	30	20	10	5
Fluorine acid (HF)	1	1	1	0,2
Carbon monoxide	100	40	50	15
Heavy metals	2	0,5	0,5	0,01
Cadmium (Cd)	0,1	0,02	0,05	0,002
Mercury (Hg)	0,1	0,02	0,05	0,002
PAH (Policyclic aromatic hydrocarbon)	0,05	0,01	-	0,001
Dioxin (TCDD Teq) ng/Nm3	0,1	0,1	0,1	0,01

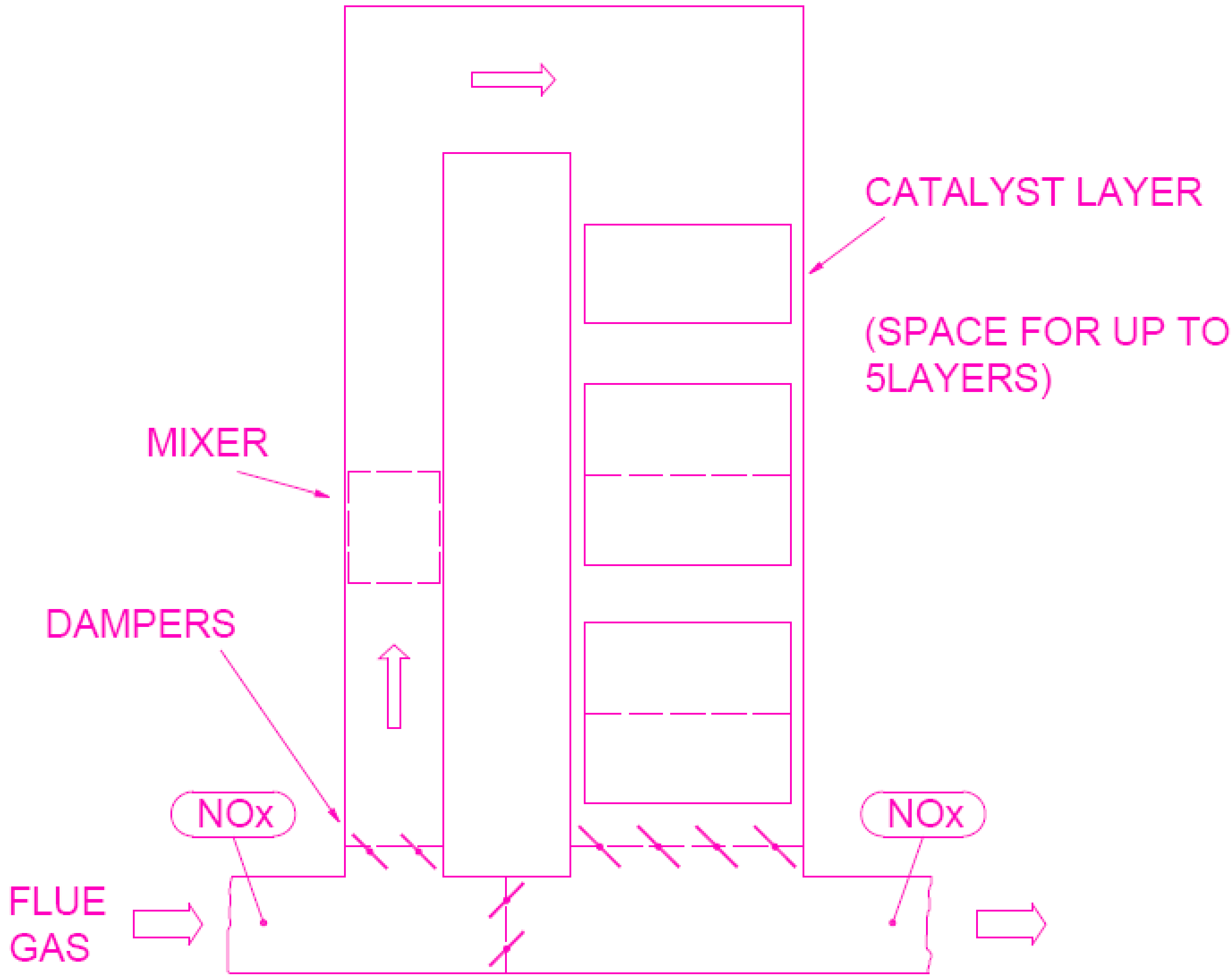
Source: Ing. Lorenzo Zaniboni, A2A Brescia, *International Conference on Waste and Biomass Combustion*, Milano 8-10 October 2008

Room foreseen within combustion line nr. 2 for the "High Dust" SCR



Source: Ing. Lorenzo Zaniboni, A2A Brescia, *International Conference on Waste and Biomass Combustion*, Milano 8-10 October 2008

"High Dust" SCR – Side view



Source: Ing. Lorenzo Zaniboni, A2A Brescia, *International Conference on Waste and Biomass Combustion*, Milano 8-10 October 2008

"High Dust" SCR

HIGHLIGHTS:

- installation: 2005 Sep. – 2006 Feb.
- operation: started 2006 Mar. (1st phase – one cat. layer)
- inspection: Sep. 2006 (cleaning and catalyst analysis showing some <u>pore plugging and catalyst poisoning with sulphates</u>)
- 2nd phase: started 2006 Oct. after inspection (2 cat. layer)
- inspections: 2007 Apr. and Sep. (only cleaning), 2008 Apr. (<u>erosion</u> starts to become evident)
- November: removal of one layer and installation of a new layer with <u>modified geometry</u>

FUTURE TEST STEPS (2009 – 2010):

- monitoring of fouling and activity of catalyst with new geometry
- optimization of catalyst layout (single / multiple layers)
- optimization of dust cleaning with modified geometry
- life time assessment of the catalyst
- industrial cost evaluation

Source: Ing. Lorenzo Zaniboni, A2A Brescia, *International Conference on Waste and Biomass Combustion*, Milano 8-10 October 2008

Bottom ash recovery

Bottom ash discharged by the combustion grate is about **20-25%** of the original weight of waste.

- **scrap-iron** separated by means of an electro-magnet ➔ to foundry
- remaining part of bottom ash: **inert** ➔ to cover waste in landfills.

Since year 2004, tests for further recovery of bottom ash:

- non-ferrous materials (e.g. **aluminium and copper**)
- residual **inert fraction to prepare cement or concrete**.

Metals collected: **8 -10%** of total bottom ash.
Inerts separated in different grain size fractions ➔ raw materials to cement or concrete factories.

Brescia WtE Plant is carrying out a feasibility study within the European project ***NextGenBioWaste***. The aim is to go deep in defining:

- chemical-physical properties of bottom ash;
- equipment necessary to separate it in several fractions which can fulfill regulations and market;
- investment cost of the plant.

Source: *Rapporto dell'Osservatorio sul funzionamento del termoutilizzatore di Brescia relativo agli anni 2006-2007*, Comune di Brescia, Settore Ambiente ed Ecologia