GREENPEACE

WASTE INCINERATING PLANTS IN AUSTRIA

INCLUDING DATA ON WASTE MANAGEMENT IN VIENNA

1st edition

Herwig Schuster

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This inquiry shall give an overview about the Austrian waste incineration and waste management system. Its aim is to give figures but not a complete assessment. This inquiry was done on request from Greenpeace International to clarify the Austrian situation, because the Austrian incinerators are - especially in Southern European countries as well as in Asia – promoted as "positive examples for incinerators from Europe".

As the results show the Austrian incinerators have - compared to other industrial sources - low water and air emissions but discharge of residues is an unsolved environmental problem. Besides, the costs for waste incineration are extremely high.

1 Waste incinerating plants in Austria

In Austria there are three incinerating plants for municipal solid waste:

- Two in Vienna („Spittelau" with a capacity of about 260.000 t[1]/y and „Floetzersteig" with about 200.000 t/y)
- One in Wels (province of Upper Austria) with about 60.000 t/y

There are no other plants for municipal waste incineration but many plants burning special waste fractions (e.g. wooden or plastic waste fractions in cement industry) and industrial steam plants using internal waste. In Vienna there is also a hazardous waste incineration plant called „EbS" with a capacity of 75.000 t/y.

The technical and environmental standard of the Austrian incinerators is similar to German or Swiss or to any other plant built in the 90ies according to the state of technique. Therefore the figures given in this report give hints for incineration in other countries.

[1] metric tons

2 Air pollution

2.1 Air emissions of the Austrian incinerating plants

The following table is based on industry figures. All figures are in mg/m³ refered to 11 % oxygen. This means that the emissions of a plant are calculated due to this oxygen concentration in waste gas. This prevents a mixing of waste gas with clean gas to "reduce" emissions and it allows a comparison between different plants. The mass flow refers to the plant „Spittelau" with a waste turnover of 260.000 tons per year.

Compound	Legal framework[2]	„Floetzersteig"	„Spittelau"	Wels	Mass flow of „Spittelau"
Dust	15	2-2,9	0,8-2	1	< 2900 kg/y
Hydogen chloride HCl	10	0,5-1,9	0,5-0,7	0,1	< 950 kg/y
Hydrogen fluoride HF	0,7	0,04-0,13	0,03-0,04	0,1	< 58 kg/y
Sulphur dioxide SO_2	50	3,9-8,4	4-4,2	4	< 5800 kg/y
Carbon monoxide CO	50	13-19,6	21-22	15	< 32000 kg/y
Nitrogen oxides NO_x	100	16-18,1	21	50	< 32000 kg/y
Hydrocarbons	20	0,4	0,5-0,6	0,1	< 800 kg/y
Sum of Lead, Zinc and Chromium	2	0,06-0,07	0,08	n.n.	< 116 kg/y
Sum of Arsen, Nickel and Cobalt	0,5	0,023-0,03	0,04-0,05	n.n.	< 60 kg/y
Cadmium	0,05	0,002-0,015	0,0005-0,0020	0,0002	< 230 g/y
Mercury	0,05	0,01-0,025	0,003-0,025	0,0009	< 2,5 kg/y
Ammonia NH_3	5	0,86	n.n.	n.n.	< 1250 kg/y
Polychlorinated Dioxins and Furans in I-TEQ	0,1 ng/m³	0,03-0,04	0,03	0,009	< 43 mg/y

2.2 Analyses of air pollutants

The following parameters are continually measured: Dust, HCl, SO_2, NO_x, CO, Hydrocarbons, NH_3. All these parameters are on-line reported to the authority.

Polychlorinated Dioxins and Furans are analysed monthly.

Heavy metals and HF are analysed once a year.

Each analysis has to be made public, emissions exceeding allowed limits have to be communicated actively to the public on tables in front of the plant and of the Town Hall.

[2] The Austrian incineration plants operate under Clean Air Act emission limits. Only for „Floetzersteig" there are some parameters less restrictive due to former approval

2.3 Exceedings of emissions

During the last years exceedings were limited to carbon monoxide (one short-time[3] exceeding per plant and month, not more than 50 % over legal maximum) and nitrogen oxides (some minor short-time exceedings a year).
The carbonmonoxide-exceedings occur if waste with a too high caloric value is burned (too much plastics).

3 Scrubber water

Quantity: 440 kg/t waste

Quality: the following table gives an overview of maximum legal emissions and real emissions of „Spittelau“ (all figures in mg/l). The mass flow refers to the plant „Spittelau“ with a turnover of 260.000 tons waste per year.

parameter	legal em.	„Spittelau“ - concentration	Mass flow per year (kg/y)
filterable substances	30	20-30	3,4 t/y
Al	2	0,1-0,2	23 kg/y
As	0,1	<0,002	0,23 kg/y
Pb	1	0,01	1,1 kg/y
Cd	0,1	<0,001	0,11 kg/y
Cr	0,1	<0,05	5,5 kg/y
Co	0,5	<0,05	5,5 kg/y
Fe	2	<0,05	5,5 kg/y
Cu	1	<0,05	5,5 kg/y
Ni	2	<0,05	5,5 kg/y
Hg	0,01	<0,001	0,11 kg/y
Ag	0,1	<0,05	5,5 kg/y
Zn	3	<0,05	5,5 kg/y
Sn	0,5	<0,02	2,2 kg/y
Cl	18000	7500-11400	1.100 t/y
CN	0,1	<0,006	0,7 kg/y
F	9	5,7-7,9	800 kg/y
TOC	30	4,1-5,8	570 kg/y
Phenole-Index	0,3	0,01	1,1 kg/y
PAK	nn	<0,13 ug	15 g/y
EOX	0,1	<0,009	1 kg/y
POX	nn	<0,018	2 kg/y
Hydrocarbons	nn	<0,05	5,5 kg/y
Dioxins/Furans in I-TEQ	nn	38 pg/l	4 mg/y

4 Solid wastes from burning plants

There are three different kinds of waste: Slag, Filter ash and Filter cake

4.1 Slag

Slag: 230 kg/t waste („Spittelau“) – 278 kg/t („Floetzersteig“) - 300 kg/t (Wels)

[3] not more than 20 minutes

In Vienna, the slag gets mixed up with cement and water and is then used in landfill construction for border walls as slag-filter ash concrete.
In Wels, most of the slag and all of the filter ash are landfilled in a landfill for residual waste. A small part of the slag is mixed with cement and used as a covering of a landfill.

Analyses of slag from „Spittelau“ (in mg/kg):

Sb	As	Pb	Cd	Cl	Cr	F	Cu	Hg	Zn	Dioxins/Furans
49	15	2030	9	3000	312	300	1652	1	2000	2 ng I-TEQ/kg

4.2 Filter ash

Filter ash: 15 kg/t waste („Floetzersteig“) – 19 kg/t („Spittelau“) - 55 kg/t (Wels)

In Vienna the filter ash is mixed with the slag and used in concrete (see above). This may be critical due to high contents of heavy metals and dioxins in filter ash.

The following table gives an overview of filter ash concentrations (all figures in mg/kg):

Parameter	literature[4]	Hinwil (CH)	Vienna	Mass flow of „Spittelau“
Zinc	4700	37010	13400	67 t/y
Lead	2000	10690	4200	21 t/y
Cadmium	21	526	230	1,1 t/y
Mercury	0,7		19	0,1 t/y
Chlorid	2800	79500	71000	350 t/y
Chromium	1200		470	2,3 t/y
Copper	2100	1863	710	3,5 t/y
Antimony			310	1,5 t/y
Arsenic			14	70 kg/y
Dioxins/ Furans			2160 ng I-TEQ/kg	10,67 g/y
loss of ignition			1.4 %	

4.3 Filter cake

Filter cake from treatment of scrubber water: 1,1 kg/t waste („Spittelau“) – 1,3 kg/t (“Floetzersteig”) - 3 kg/t (Wels)

The filter cake is disposed as hazardous waste, exported to Germany and there stored in a shut down salt mine in Heilbronn.

The PCDD/PCDF concentration is 495 ng/kg in average.

[4] Thomé-Kozmiensky, Technologie der Abfallbehandlung

5 Dioxin emission factor

Example “Spittelau”:

Media	concentration (I-TEQ)	output per year
Air	0,03 ng/m³	43 mg
Water	38 pg/l	4 mg
Filter cake (water cleaning)	495 ng/kg	141 mg
Slag	2 ng/kg	115 mg
Filter ash	2160 ng/kg	10670 mg
Total dioxin production:		10973 mg = 10,973 g per year
	Dioxin emission factor	= **42,2 microgram per ton waste**

6 Treatment of slag and filter ash

In Vienna, slag and filter ash are mixed up with cement and used in landfill construction for border walls as a slag-filter ash concrete (“cementation”). There is no leaching of heavy metals nor destroying of organic pollutants.

The mixture is as follows:

slag	125.000 t
filter ash	25.000 t
cement	17.000 t

No additives are used.

This slag-filter ash concrete is used for border wall construction of Vienna´s landfill.

This kind of handling filter ashes is not state of the art. E.g. in Switzerland all filter ashes are landfilled as hazardous waste in disused salt mines. There is - also scientific - concern that heavy metals and organic pollutants (dioxins, PAHs,..) could leach from concrete. The cementation proceeding is intended only for the immobilisation of heavy metals, not for organics. In Vienna there are no analyses of leaching dioxins. Other analyses (of PAHs, phenols,...) are - in official datasheets - under detection limit but the used detection limit is very high.

According to an Austrian expert, slag-concrete will fall apart when coming into contact with sulphate-containing water (more than 300 mg/l sulphate in case of Portlandt-cement and more than 2000 mg/l in case of sulphate-resistance cement).

7 Pollution control equipment

The pollution control equipment is similar in each of the three Austrian plants:

Air cleaning:

- Electrostatic precipitator for dust reduction
- 2-stage flue gas scrubber (for reduction of SO_2, HCl, HF)
- Fine dust separator
- SCR-DeNOx-facility (based on selective catalytic reaction and ammonia)

The plant in Wels has an additionally activated carbon filter installed.

Water retreatment:

The heavy metal compounds dissolved in the scrubber water from the first scrubber are first converted into insoluble form in a precipitation reactor, by dosing lime slurry as well as special precipitation and flocculation agents (e.g. Ferrous sulphate $FeSO_4$). Then the suspension is cleared in a chamber filter press. The filter cake with a water content of about 30 % is filled into big bags, the water is passed into the public scrubber water system or into the receiving water (e.g. „Spittelau“ into the river Danube).

8 Human resources

A high level of training is essential for the well-working of the plant. More than 80 people are employed in a plant, more than 80 % of them have a special training (electrician, electronic engineer, welder, technical engineer, chemist,...).

9 Energetic output

In the plants “Floetzersteig” and in Wels there are power-heat-combinations. At “Floetzersteig” 116 kWh electricity and 1.920 kWh heat are produced per ton waste input. Thereof 78 kWh electric and 40 kWh thermic are used by the plant itself.
Referred to an average caloric value of 8.200 kJ/kg waste and an additional input of about 20 kg gas per ton waste that means a total plant efficiency of 76 %.

10 Economic parameters of waste incineration

The following figures refer to the plants in Vienna (with a capacity of 200.000-250.000 tons a year). The cost structure may be different at other smaller or larger incinerators.

Fees for waste take-over:

Waste from municipal waste disposal:	116 EUR[5]
Waste from private companies:	218 EUR

Total investment cost: 182.000.000 EUR at minimum
Two thirds are due to environmental technique (air and water cleaning, burning optimization)

Cost structure (own calculation due to plant´s figures) per year:

Output:			
Pay-back of investment (interest: 7 %, 15 years)		15.100.000 EUR	
New investments (adaptation to the level of technique)		3.600.000 EUR	
Personal costs		3.500.000 EUR	
Other fix costs (assurance, measures, maintainance,..)		2.300.000 EUR	
Variable costs		4.400.000 EUR	
thereof:	gas:		1.600.000 EUR
	disposal of slag/ash		1.500.000 EUR
	disposal of filter cake (export)		340.000 EUR
	chemicals (lime, soda lye, ammonia, precipitation agents)		440.000 EUR
	All others		520.000 EUR
Total sum of costs per year		28.900.000 EUR	
Input:			
Heat output		4.000.000 EUR	
Electricity output		300.000 EUR	
Total sum of input costs per year		4.300.000 EUR	
Money need per year		24.600.000 EUR	
Costs per ton waste		**123 EUR**	

All waste treatment plants in Vienna are owned by the City of Vienna. Thus there is a direct tax money flow to the plants to prevent losses.

[5] 1 EUR = 13,7603 ATS

11 Avoiding and recycling

Vienna´s incinerators are case study examples frequently used by technology companies to sell incineration technique to developing countries like the Philippines.

The Austrian Federal Waste Law implements the following waste strategy:

First avoid, then recycle, then dispose.

Only in the third level disposal fits in. Therefore the Vienna municipal waste management system is described in the following chapter. For many years now steps have been taken to avoid waste and to separate different types of waste (e.g. glass, paper) with quite high efficiency.

Example Vienna:

The total production of municipal solid waste in Vienna is 844.400 t, 38 % of them are collected separately.

The following fractions are collected separately: glass (white and coloured), metals, paper/cardboard, packagings plastics and organic waste. In special centers some other fractions are collected (e.g. wood, textiles). The given figures only refer to household and household-like waste, not to industrial waste.

In 1998 the following amounts were collected and recycled:

Paper and cardboard	127.000 t
Organic waste	83.000 t for composting
Metals	28.000 t
Glass	23.700 t
Plastics	6.700 t for material or “thermal” recycling
Sum of these 5 fractions	**268.400 t for material recycling**
Other fractions (wood, textiles, tyres, electronics...)	76.000 t for “energetic” use or downcycle
All together	**344.400 t are separately collected in Vienna each year**

Waste for disposal:

Municipal waste	470.000 t collected by the City of Vienna
Container waste from markets,...	30.000 t
Others	40.000 t e.g. collected by private companies
All together	**540.000 t**
	429.000 t go to „Floetzersteig“ and „Spittelau“
	3.000 t go to other burning plants (special waste)
	108.000 t go to landfill

Besides there is a well-working collection of hazardous wastes via disposal centers (batteries, mineral oils, used vegetable oils (for soap production), chemicals,..). 3.160 tons are treated separately each year.

In Vienna 38 % of all wastes are collected and recycled separately.

The following table gives mass concentrations of Vienna´s municipal solid waste (not regarding waste separation):

Organic waste	31,55 %
Paper and cardboard	23,75 %
Glass	5,87 %
Metals	4,79 %
Plastics /without compounds	5,35 %
Compounds (Paper, plastics, alu)	4,38 %
Wood, leather, rubber	5,06 %
Textiles	1,92 %
Rest all others	

The following table gives mass concentrations of Vienna´s municipal solid waste (after waste separation = input for waste incineration):

Organic waste	37,71 %
Paper and cardboard	15,92 %
Glass	4,88 %
Metals	3,00 %
Plastics /without compounds	8,16 %
Compounds (Paper, plastics, alu)	7,62 %
Wood, leather, rubber	4,29%
Textiles	3,02 %
Rest all others	

Regarding the single fractions the following percentage is recycled:

Metals	92 % (63 % directly, 29 % separating in incinerating plants)
Paper	60 %
Glass	47 %
Organic waste	29 %
Plastics	13 %

These figures are significantly higher in other parts of Austria. The smaller the town the better the recycling percentage (paper up to 85 %, glass up to 90 % and organic waste up to 50 %). Due to high contaminations with other waste and heavy metals the collection of organic waste cannot be increased in highly populated areas.

12 Summary

According to the waste management principle “avoiding-recycling-disposing” the waste separation and recycling in Austria is quite consequent. Waste separation is obligatory in Austria. Currently Vienna´s recycling rate is about 38 %, and this amount could still be higher by optimizing the collecting system especially for organic waste and plastics. A recycling rate of 50 % may be realized.
The Austrian incinerating plants have a high environmental standard as far as air and water emissions are concerned. Compared to other sources (industry, traffic,...) air and water emissions are relatively low.
Ecologically critical is the disposal of solid wastes from incinerating plants. Especially the filter ash from air cleaning is containing large amounts of dioxins and furans and toxic heavy metals. In Vienna this ash is mixed up with cement and used as slag concrete in landfill construction. As the Austrian Waste Management Act only defines leaching criteria for disposal this practice is legal but critical due to future dioxin emissions out of the concrete.

13 Sources

- Austrian Environmental Agency, www.ubavie.gv.at
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- Fernwaerme Wien, incinerator operator, companies publications and information from personal communications with „Floetzersteig“ and „Spittelau“
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Greenpeace Austria
Siebenbrunnengasse 44
A-1050 Vienna
phone: ++43/1/5454580
fax: ++43/1/5454588
http://www.greenpeace.at

AUSTRIA	
Name of hotspot:	**Dioxin contaminated landfill**
Hotspot location:	Landfill "Rautenweg", Vienna, Austria
Date of summary:	August, 1999
Hotspot category:	Landfill site with high dioxin input
Main contaminants:	Dioxin
Quantities:	More than 10g TEQ Dioxin per year
Company/body responsible:	City of Vienna (owns both the landfill and the incinerator)
Source:	2 municipal waste incineration plants
Description:	In Vienna there are two municipal waste incineration plants. Their total capacity is around 450 000 t/a. They use "state of the art" filter technology. The filter ash from air cleaning is highly contaminated with dioxins. The filter ash of the plant "Spittelau" has a dioxin concentration of 2160 ng TEQ /kg on average, which means a yearly output of more than 10 gram TEQ. This filter ash is mixed with cement to reduce dioxin leaching so it can be legally disposed of in a household landfill in Vienna. The second Viennese incineration plant "Floetzersteig" has a similar air emission control technology, it is most likely to add 8 gram TEQ annually As this practice has been going on for many years, there is a big dioxin bomb ticking on this Vienna landfill.
Action needed:	Long term: Stop waste incineration Short term: Stop disposal in normal landfill, special treatment of filter ash (e.g. glassification) and store in a storage facility for hazardous waste.
References:	Official datasheet of the plant and Greenpeace calculations.