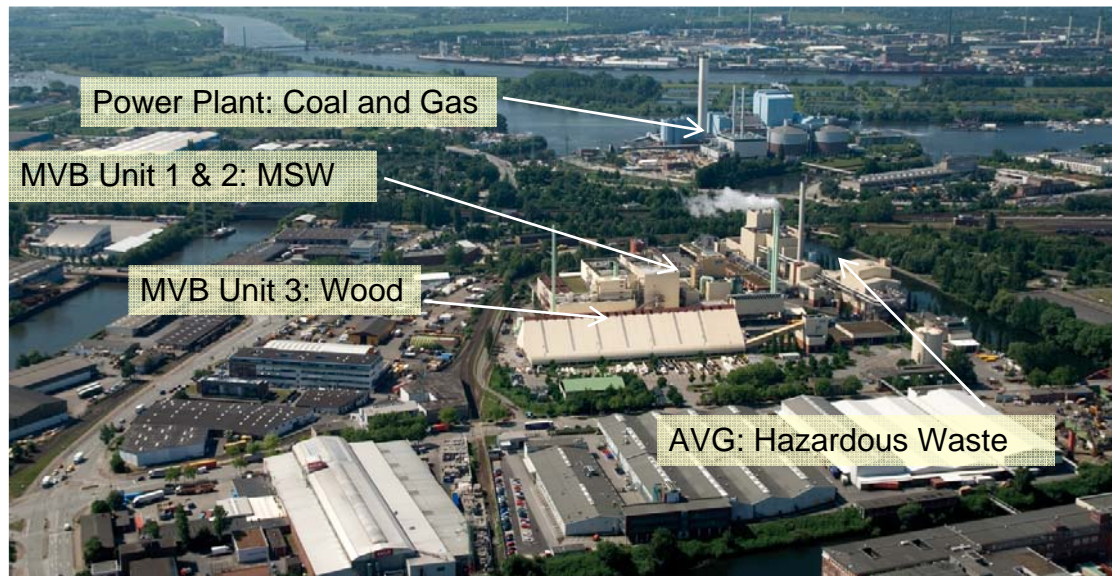


Technical Report for the MVB (MSW & Biomass) Waste to Energy Plants and the AVG Hazardous WTE Plant in Hamburg, Germany

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1. MVB Waste to Energy (WtE) Plant (Unit 1&2)

Main Technical Details:

- The WTE plant was commissioned on 1994 and acquired an investment cost of 186 million €
- There are 2 incineration lines, treating an overall waste capacity of 325,000 tpa (LHV 9 Mj/kg), from which 92% is MSW, 4% is commercial waste and 4% is bulky refuse
- The shareholders are per 85.5% the Vattenfall Europe New Energy GmbH and per 14.5% the E.ON Energy from Waste AG
- The flowrate of the produced steam is 70 tph per line, at 19 bar and 380° C
- The main energy product is heat, which is supplied to the municipal district system of Hamburg
- On 2009 the plant functioned for 315 days and delivered 736,340 MWh of steam energy
- The plant is also equipped with a small steam-turbine producing 3 MW for the plant's internal needs
- The filtration part of the plant is equipped with SNCR technology, baghouse filters, HCl & SO₂ scrubbers

- The plant's residuals are 61,721 tpa bottom ash (19% of the initial feed), 8,177 tpa fly ash (2.5% of the initial feed) and 9,117 tpa scrap metals (2.8 % of the initial feed)
- The plant's emissions are showed to the following tables:

| <u>Continuously Measured Emissions</u> | NO_x | CO | Dust | Cges | HCl | SO₂ | Hg |
|--|-----------------------|-----------|-------------|-------------|------------|-----------------------|-----------|
| Average 2009 (mg/m3) | 98.3 | 7.4 | 0.3 | 0.2 | 0.2 | 5.5 | 0.0038 |
| Legal Limits (mg/m3) | 200 | 50 | 10 | 10 | 10 | 50 | 0.03 |

| <u>Discontinuously Measured Emissions</u> | HF | Cd+TI | Sb-Sn | As-BaP | PCDD/F |
|---|-----------|--------------|--------------|---------------|---------------|
| Average 2009 (mg/m3) | 0.045 | 0.0006 | 0.0066 | 0.0017 | 0.0085 |
| Legal Limits (mg/m3) | 4 | 0.05 | 0.5 | 0.05 | 0.1 |

2. MVB Wood Residuals & Waste Wood (Biomass) Energy Recovery Plant (Unit3)

- The Biomass energy recovery plant was commissioned on 2005 and acquired an investment cost of 42 million €
- The overall biomass capacity of 158,000 tpa (LHV 13 Mj/kg) is treated in one incineration line, from which 65% is A1 - A3 waste wood category and the rest 35% is A4 category, according to the following table:

| | |
|-------------|---|
| Category A1 | natural or only mechanically treated waste wood (not more than insignificantly contaminated with foreign substances) |
| Category A2 | glued, varnished, coated, painted or otherwise treated waste wood without organic halogen compound and without wood protection agents |
| Category A3 | waste wood coating with organic halogen compound, without wood protection agents |
| Category A4 | waste wood treated with wood protection agents such as railway sleepers, line poles, hop poles, vine stakes and other types of waste wood |

- The shareholders are per 85.5% the Vattenfall Europe New Energy GmbH and per 14.5% the E.ON Energy from Waste AG
- The applied boiler technology is circulating fluidised bed having an efficiency rate of 92.24 %
- The flowrate of the produced steam is 90 tph per line, at 90 bar and 500° C
- The plant is equipped with a steam turbine of 20 MWe
- On 2009 the plant functioned for 330 days and delivered 159,420 MWh of electrical energy

- The filtration part of the plant is equipped with cyclones, calcium hydroxide activated carbon and baghouse filters.
- The plant's residuals are 6,417 tpa fine combusted bed ash (4% of the initial feed), 4,967 tpa rough combusted bed ash (3.15% of the initial feed) and 6,978 tpa flue dust (4.4 % of the initial feed)
- The plant's emissions are showed to the following tables:

| <u>Continuously Measured Emissions</u> | NO_x | CO | Dust | Cges | HCl | SO₂ | Hg | HF |
|--|-----------------------|-----------|-------------|-------------|------------|-----------------------|-----------|-----------|
| Average 2009 (mg/m3) | 86 | 13 | 0.6 | 0.8 | 2.0 | 2.7 | 0.1 | 0.1 |
| Legal Limits (mg/m3) | 200 | 50 | 10 | 10 | 10 | 50 | 0.03 | 4 |

| <u>Discontinuously Measured Emissions</u> | Cd+TI | Sb-Sn | As-BaP | PCDD/F |
|---|--------------|--------------|---------------|---------------|
| Average 2009 (mg/m3) | 0.0008 | 0.011 | 0.0023 | 0.0012 |
| Legal Limits (mg/m3) | 0.05 | 0.5 | 0.05 | 0.1 |

3. AVG Hazardous Waste To Energy Recovery Plant

- The AVG plant was established on 1971 and between 1994 - 1997 were spent 200 million € for reconstruction
- There are 2 incineration lines feeded with an overall annual waste capacity of 159.000 tons (HWI), from which the 40% is international waste (out of Germany boundaries)
- The 2 incineration lines are equipped with rotary kilns, in which hazardous wastes remain for 2 sec at a temperature greater than 1,100 ° C (up to 1250 ° C)
- The high temperature incineration plant is equipped with storage units according to the kind of waste, chemical-physical treatment units, separation units and temporary storage of waste
- Between 750 and 840 kinds of different hazardous waste are acceptable (according to EWC) to be treated in the AVG plant. Mainly the following categories:
 1. Residues from production and off-spec-products from pharmaceutical, chemical industry and others
 2. Organic and inorganic laboratory wastes
 3. Hospital wastes
 4. Pesticides
 5. Paints, varnishes, resins
 6. PCB-oils
 7. Wastes containing dioxin
 8. Wastes containing halogen
 9. Contaminated filter materials and absorbent materials

10. Soil from contaminated sites

- The flowrate of the produced steam is 34 tph per line, at 20 bar and 380° C
- The main energy product is heat, from which the 70% is supplied to the municipal district system of Hamburg and the rest 30% covers internal needs
- The filtration part of the plant is equipped with electrostatic precipitator, HCl & SO₂ scrubbers and activated carbon filters
- The plant's emissions are showed to the following tables:

| Measured Emissions | NO_x | CO | Dust | HCl | SO₂ |
|----------------------|-----------------------|-----------|-------------|------------|-----------------------|
| Average 2009 (mg/m3) | < 95 | < 45 | < 8 | < 5 | < 30 |
| Legal Limits (mg/m3) | 200 | 50 | 10 | 10 | 50 |

| Measured Emissions | Cd+Tl | Sb-Sn | PCDD/F | Hg | HF |
|----------------------|--------------|--------------|---------------|-----------|-----------|
| Average 2009 (mg/m3) | < 0.01 | < 0.2 | < 0.05 | < 0.02 | < 0.1 |
| Legal Limits (mg/m3) | 0.05 | 0.5 | 0.1 | 0.03 | 4 |