

# Thermal Recycling Facility

Tuesday, October 12, 2004

**Facility Name :** MVR (Müllverwertungsanlage Rugenberger Damm GmbH & Co. KG)

**Location:** The MVR plant is located in the South-West of City of Hamburg, Germany, in the port area known as Hamburg Altenwerder. The plant started operating in 1999 and it is bounded to the North by the Kohlbrand Bridge, to the East by the Kohlbrand Waterway, to the South by the site of the port operating company Hansaport Hafenbetriebsgesellschaft, and to the West by the embankment Rugenberger Damm. The lot size is about 15 acres and site was raised approximately 27 feet above mean sea level for flood protection.

**Conversion Technology:** Thermal: Waste to Energy (WTE), with advanced environmental controls and by-product recovery.

**Conversion Technology Supplier:** Waste Recovery Seattle, Inc. (WRSI), as agent for MVR technology. For the MVR plant, Steinmueller (now Fisia Babcock) provided the boilers, grates, and emission controls.

**Definition: Advanced Waste to Energy Facility (Thermal Recycling)** – The complete combustion (burning) of carbon-based materials in an oxygen-rich environment, with high air-to-fuel ratios, typically at temperatures of 1,400 degrees Fahrenheit (°F) to 2,500°F, producing flue gas composed primarily of carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) with inorganic materials converted to ash. Ash is typically formed below the melting point of the constituents. Some organic compounds are converted to tars and oils. The hot flue gas flow through a boiler, where steam is produced for driving a steam turbine-generator, producing electricity. The cooled flue gas flow through emission control systems, and then are exhausted through a stack to the atmosphere.



**Technical Meeting and Facility Tour With:** Philipp Schmidt-Pathmann, President, Waste Recovery Seattle, Inc. (WRSI), Doug Gilmore, VP, WRSI, Dr. Heiner Zwahn, General Manager, MVR Plant.



**Owner/Operator:** MVR, which is majority owned by Hamburg Electricity Works (HEW), which itself is majority owned by Vattenfall, a Swedish energy company. Revenues from sale of power, steam, and by-products go to Hamburg Dept. of Sanitation.

**Feedstock:** MSW from Hamburg. The city produces about 1,000,000 TPY of MSW. Only about 10% of the stream is removed by curbside recycling. About 4-5% of the MSW feed to the MVR plant is plastic. Most recycled plastic goes to steel making, as the high carbon plastics are used in lieu of coke to create the reducing environment needed for reducing iron ore to steel.

Users of recycled metals have a specified purity/cleanliness. Therefore, the mode of operation seems to be to recover as much of the metals after the WTE process, in the form of bottom ash. At that point, the metals are concentrated, and easier to separate and recover. (see section on by-products below)

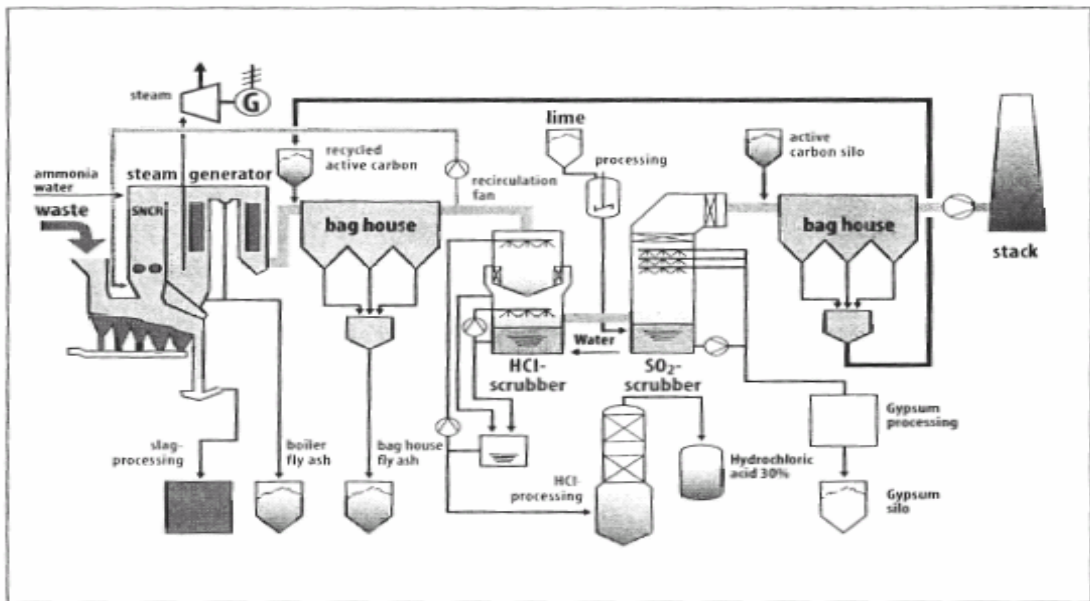
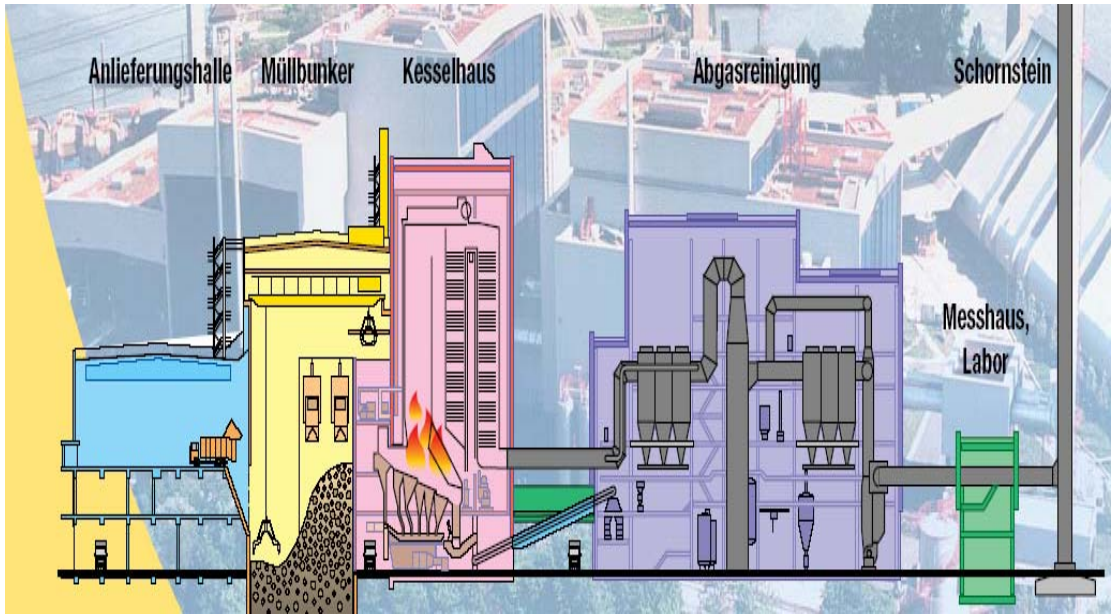
Presently, there are four WTE plants in Hamburg, which process a total of 862,000TPY (approximately 84% of the total curbside refuse collected in the City of Los Angeles):

- The MVR plant, at 350,000 TPY (visited plant)
- MVA Stelling Moor, 180,000 TPY (owned and operated by Hamburg Dept. of Sanitation)
- MVA Stapelfeld, 120,000 TPY (started up in 1979, owned and operated by Hamburg Dept. of Sanitation and 2 surrounding counties)
- MVB plant, 320,000 TPY (started up in 1994 and owned/operated by Vattenfall). Produces only steam, no electricity.

Each of these plants has an agreement to be able to take another 5% of the total feed for all four plants, in order to help them cover for supply disruptions, outages, etc.

**Throughput:** 350,000 tons/year. The plant takes delivery of about 120 trucks/day of raw MSW from the Hamburg area. Maintenance outages are 2-3 weeks/year per production line, with another 8 shorter unscheduled outages/year (usually inlet grates, PA fans, without in-place spares).

**Technology Description:** Advanced Thermal Recycling Facility with advanced emission controls.





The MSW is delivered to the facility, with no pre-processing.



MSW is dumped into the waste bunkers in the tipping hall.



From there, the MSW is picked up by a grapple hook and placed in a shredder.



The shredded material is then stored in an adjacent bunker and fed into the furnace. The MVR plant has 2 production lines, each with: A 4-draft vertical boiler with a forward feeding grate, with capacity of 24 tons/hr.



The boilers and steam turbine generator are enclosed in a building.



The furnaces operate at about 1,560 °F, with a residence time of about 2 seconds. They measure temperature with acoustic monitoring devices that determine temperature by the speed of sound in the flue gas stream.



Steam is used for district heating and for power generation in a steam turbine-generator combination (30 MW). As part of the facility, MVR constructed a 90' deep tunnel for a 1,250-foot long steam line to the steam user.



Bottom ash is about 25% of the total MSW stream. It is removed through a water bath seal/crusher. It is then dumped onto a conveyor, screened and scrubbed with Elbe River water to lower the chloride content (the scrubbing water is treated prior to disposal). Metals are removed from the bottom ash stream.



The bottom ash is sprayed with water and then stored in an enclosed facility for about 3 months. During that period of time, the wet bottom ash “cures”, forming some more acceptable metallic oxides, and also becomes harder and more stabilized.



After the 90-day period, MVR sells 90,000 TPY for road base/road construction.



About 330,000 tons of bottom ash was used as a base layer for the new Altenwerder Container Terminal near the MVR Plant.



Cleaned flue gases exit the stack, not visible except in colder weather.

The MVR cleaned flue gas exit the stack, which is not visible in colder weather. The cleaned flue gas is monitored with a real-time data link to EPA or equivalent entity, which allows continues monitoring. The air vacuum systems prevent odors from escaping and are processed by the flue gas cleaning system. For NO<sub>x</sub> control, selective non-catalytic reduction (SNCR) system using urea injection is used. The flue gases then enter a 4-stage flue gas cleaning system, including:

- Initial bag house with activated carbon injection for removal of mercury and other heavy metals.
- Acid scrubber to remove hydrochloric acid
- Lime scrubber to remove SO<sub>2</sub>
- Secondary bag house using fresh activated carbon to remove heavy metals and dioxins/furans.

Flue gas monitored pollutants include (actual measured emission values achieved are lower than the permitted values):

Particular Matter (PM)  
Hydrochloric Acid (HCl)  
Sulfur dioxide (SO<sub>2</sub>)  
NO<sub>x</sub>  
C total  
Cadmium / Thallium  
Mercury  
Dioxins / Furans

The plant emission level for mercury and dioxin are approximately four (4) percent of the allowable levels. The Plant daily emissions are equivalent to six (6) automobiles with catalytic converters. The emission control process uses about 96,000 gallons of reclaimed / circulated water/day (35 Mgal/yr), which equivalent to 0.137 percent of the wastewater treated daily (70 MGD) at the Tillman Water Reclamation Treatment Plant.



All operations are controlled from a central control room.

**Products:** Steam for district heating, electricity (30 MW where 4MW are used for internal use leaving 25 MW for feeding into the grid). Steam for district heating has more value than the electricity in this market. In the summer, they produce about 40-50 tons steam/hour. In the winter, they produce about 80 tons steam/hour. On average, the plant sells the electricity to HEW for \$0.035/kWh.

**Byproducts:**

- Bottom ash (100,000 tons/year are screened and washed, producing about 90,000 tons/year of usable/saleable bottom ash for road base/road construction)
- Hydrochloric acid (HCL) from acid scrubber (4,000 TPY sold into local market)
- Gypsum from lime scrubber (marketable for cement and wallboard – about 1,000 tons/year sold locally for about \$10/ton)
- Fly ash is about 3% of the total MSW stream. Until a market is found the fly ash, along with exhausted activated carbon, will be transported about 120 miles to a deep salt mine for disposal. MVR is working on marketing the fly ash (heavy metals and dioxins/furans concentrate in fly ash).
- Scrap iron - 9,000 TPY
- 900 TPY chrome steel and non-ferrous materials

**Plant staffing:** Total of 90, including 4 shifts of 7 operations personnel. Shifts work 37.5 hours/week. Workforce is about 20% female.

**Legislative Issue:** German legislation mandates that after 2005, no Municipal Solid Waste (MSW) can be land filled. German air emission limits are very strict on all thermal recycling facilities, which requires all air pollution control systems to remove all air pollutants. Actual measured emission values achieved are lower than the permitted values, which are more restrictive than South Coast Air Quality Management District (SCAQMD) standards.