Incineration Plant Construction and Operation Experiences

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AVG Incineration Plant
Some Impressions of the AVG Incineration Plant

Norbert Evermann
Dipl.-Ing. Dipl.-Kfm.
Project Manager

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Time Schedule and Technology
History of AVG Incineration Plant

- **1988** Cologne City Council adopts the Waste Management Concept (AWK)

- **1992** AVG Köln is established, based on City Council resolution as a Public-Private-Partnership (PPP) company so as:
  - To realise the waste management facilities per AWK
  - To operate the different waste management facilities

- **1992 – 1994** Planning and public tendering of SMW facilities by AVG

- **1994 – 1998** EPC of the WtE plant by the general contractor: Steinmüller, now Nippon Steel Engineering Group

- **1998** Start of operation of the residual waste combustion plant

- **2018** 26th February: 20 years anniversary of the WtE plant
Key Facts of our Incineration Plant

- 4 combustion roller grate lines
- Each line app. 20 Mg/h or all four lines 2,000 Mg/a solid waste
- Energy production with a combined heat & power plant
  - Steam parameter: 40 bar, 400 °C
  - Steam turbine: 56 MWel
- 5-step flue-gas washing works particularly efficiently
- Achieved plant availability over 95 % every year since starting point
- Annual incineration volumes: > 700,000 Mg solid waste
- Dual delivery concept road and rail
Annual Availability > 95 %

- Criteria to ensure optimum combustion and economy in relation to operating conditions
  - Homogeneity of the combustible (piece-size, caloric factor …)
  - The combustion should continue at the same level for a long period (Each unit should be revised, periodically (travel time) every 18 months.)

- How to reach?
  - By solid and proven technology (longstanding references of EPC)
  - By solid plant design and construction, reducing complexity
  - By well educated and trained staff
  - With a sophisticated maintenance concept and correct execution
  - With a solid long-term financing concept
## Construction, Commissioning and Test Periods (Schedule)

- Signing contract: 0 months
- Start civil works: 6 months (a.c.)
- Start erection works: 15 months (a.c.)
- First boiler pressure test: 23 months (a.c.)
- Readiness water supply (by owner): 27 months (a.c.)
- Power availability (by owner): 27 months (a.c.)
- Start commissioning: 28 months (a.c.)
- Readiness flue gas take over: 28 months (a.c.)
- Main erection finishing: 30 months (a.c.)
- End of trial run/take over: 36 months (a.c.)
Thermal Waste Treatment
Incineration Plant Construction and Operation Experiences

EU Waste Framework Directive - Waste Management Hierarchy

Prevention

Preparing for re-us

Recycling / re-use of waste as raw materials

Other recovery / e. g. WtE activities

Disposal / landfilling
Well suited types of waste for using grate firing incineration plants:

- Solid municipal Waste (net calorific value 6 – 11 MJ/kg)
- Household-type commercial and industrial waste and solid mixed waste
- Residues from recycling facilities
- Some types of medical and hospital waste
- Small amounts of sewage sludge

Less or not suited types of waste for using grate firing incineration plants:

- WEEE – Electronical Waste (pure)
- Demolition Waste
- Liquid waste
Factors in System Selection

- Types of waste to be treated
- Amount of waste
- Regulations of environmental law
- State-of-the-art technology
- Long time experiences with the technology - reliability
- Capex
- Opex
- Maintenance
- Restoration
- Availability of suitable labour and its specific qualification
Energy Generation by Waste Combustion

- Amount of energy generation depends from caloric factor, technology, steam parameter

- Energy generation by the incineration plant of AVG, 2015:

  - Input: Solid municipal and commercial waste
    - 735,000 tons
    - app. 10,000 kJ/kg (h_i)

  - Output: Net energy production (without internal energy consumption)
    - 338 Mio. kWh (total)
      - 281 Mio. kWh electricity
      - 331,000 tons district steam
Possible Faults and their Corrections
Most problems start mainly before the invitation of a tender due to:

- Inadequate technical concept by the tendering authority
- Unclear technical specifications
- Unclear and imbalanced predetermined EPC contract
- No realistic and sustainable financing concept

How to find solutions?

- Fair and appropriate consideration of the interests of each stakeholder
- Find out a competent system designer for tendering
- Find out a balance between functionality and technical specifications
- Focus on balance and harmony in EPC contract - experienced law firm
Problems which can be occur in construction period

- Most of these problems are due to:
  - Insolvency of EPC Contractor
  - Unsatisfactory and delayed performance of EPC and his sub-contractors
  - Problems with the building ground
  - Faults in the construction work of the EPC

- Recommendations for solutions:
  - Contract only with globally recognized and high-performed EPC firms
  - Focus on adequate calculated purchase price
  - Solid geotechnology and soil investigations in advance
  - Thorough supervising of planning and construction activities by orderer
Problems which can be occur in test periods

- System does not reach the performance promise by the EPC, e.g. such as:
  - No full achievement of the performance and functional parameters
  - Low availability, low capacity …
  - Defaults of the plant

- What to do?
  - Rework and correction of deficiencies
  - Financial compensation
  - Purchase price reduction
  - Refuse acceptance and amendment of the contract
    (Big disaster for all stakeholders, a lot of things must have gone wrong!)
Minimum Capacity of a WtE for a Feasible Investment
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- Maybe a plant with a capacity 35-40 t/h per unit or 300k – 400k tons per year
  - Minimum for one line app. 150k – 200k tons per year
  - For disposal safety a redundant second line is needed
- In case of high logistics costs, generally smaller plant capacity
  - Optimization of logistics costs and plant opex
- Energy utilization concept should influence the capacity
  - Several customers, several plants
- Amount of available locations for plant construction
  - Suitability for approval
  - Accepted by the policy and public
Critical Equipments that can be obtained from Turkey Market
Which critical equipments are producible in Turkey?

- Critical equipments could be produced in Turkey, such as:
  - Waste bunker
  - Boiler
  - Steam turbine
  - Spray absorber

However, there should be an option for local and foreign equipment so that the EPC contractor can obtain competitive prices to realize the incineration plant. As local equipment might not always be price efficient.

- Local equipment use should be integrated in the tender conditions, only:
  - However, it must be realistic and affordable for the EPC contractor.
  - Otherwise, it can be expensive or risky for the purchaser.
Personnel Requirements and Qualifications
Personnel Requirements and Qualifications for Operation

- Process Engineer
- Plant engineering expert
- Electrical engineer
- Plant or process control technician, power plant operator, shift supervisor
- Plant or installation mechanic
- Mechatronic technician
- Business people
- Human resources manager
- External personnel for the plant inspections and maintenance works (App. 2 weeks all 18 months for each unit)
Cost-effectiveness of WtE Plants
Comparison of Combustion Fees (Query of the Association of German Taxpayers 2016-08-17)

Source: https://politik-bei-uns.de/file/58cc77c81ae6a066c6bbcc7a0/download (access on 14th October 2017)
Cost-effectiveness of WtE Plants

- WtE is a long-term investments with a technical lifetime of approx. 50 years
  - WtE is a long-term environmental task
  - Money will be earned on a long-time period
  - Stronger focus on opex than capex

- Success factors for WtE activities
  - Suitable plant design
  - A high-quality WtE system
  - Maintainability of the plant
  - Well educated and motivated staff
Further Suggestions for the Plant Design
Further Suggestions for the Plant Design

- Have a lookout for a suitable WtE location to:
  - Balance logistic costs and energy demand/sale
  - Try and find possible uses for stream and heat

- Think about a combination of biological with thermal waste treatment for
  - Higher potential of waste recycling
  - Interesting option of mutual use of energy (heat, electricity, biogas)
  - In general less capex and opex in combination of both technologies

- Adapt future developments
  - More recycling activities according the policy, less combustion
  - Falling electricity prices on long-term perspectives (PV, Wind, PtG, PtL)
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Contact data

Norbert Evermann
AVG Ressourcen GmbH
Geestemünder Straße 20
50735 Köln

Mail: nevermann@avgkoeln.de

Web: www.avgkoeln.de
Welcome and hope to see you next time in Istanbul's twin city, Cologne.