(7) Check List – Waste Incineration

I. Design, Equipment and Operation of the Plant

- Does the installation contain more than one incineration line?
- What are the maximum design capacity and the maximum total incineration capacity of the plant (in t/h)?
- Is any hazardous wastes incinerated?
- Are the operating temperatures, after last injection of combustion air, 1,100°C for hazardous waste with greater than 1% halogenated hydrocarbons expressed as chlorine, or 850°C for all other wastes?
- In case operating temperatures are lower, derogation under Article 6(4) Waste Incineration Directive must be available?
- What is the residence time of gas at the operating temperatures given above?
- In case residence time is less than 2 sec, derogation under Article 6(4) Waste Incineration Directive must be available?
- What is the technique applied in order to verify the gas residence time and the minimum operating temperatures given, both under normal operation and under the most unfavourable operating conditions anticipated, in accordance with WID Article 6(4).
- Is the temperature in the combustion chamber measured in accordance with Article 6(1) Waste Incineration Directive?
- Is an automatic system to prevent waste feed under particular circumstances described in accordance with Article 6(3) and 6(4) Waste Incineration Directive?
- Does the plant use oxygen enrichment in the incineration combustion gas? If yes, what is the oxygen concentration in the secondary air (% oxygen)?
- Are for each line, at least one auxiliary burner installed to switch on automatically whenever the furnace temperature drops below a set value?
- Which fuel type is used during start-up/shut-down? If other fuels than natural gas, LPG of light fuel oil/gasoil is used; can it be proven that the used fuel will not give rise to higher emissions?
- Are pre-treatment methods required to ensure that the quality standards for Total Organic Carbon (TOC) content or Loss of Ignition (LOI) of the bottom ash or slag are achieved? If yes, is a description available?
- Is roofing and drainage segregation provided to minimise contamination of rainwater? And is sufficient storage capacity available for contaminated rainwater to allow sampling and testing prior to release?

II. Incoming Waste Management (general check list)

- Is for each type of waste burned the following information provided: waste description, EWC classification number, annual disposal in [t], statement whether it is hazardous waste?
- In case hazardous waste is treated, is additional information such as hazardous waste category, names and maximum concentration, waste composition, calorific value, etc. available?
- Is any fraction of the hazardous waste generated by the installation of which the incinerator is a part?
- How is it ensured that the information about the mass of waste to be delivered is available before it is received? (Article 5(2) Waste Incineration Directive)
- Are representative samples taken from the hazardous waste stream? What is the retention period of samples after incineration of the batch has been completed? Minimum is 1 month (Article 5(4) (b) Waste Incineration Directive).
- Is infectious clinical waste incinerated (as defined in Annex III WFD)? If yes, will the material go straight from storage into furnace without being mixed with other categories of waste and without direct handling during loading of the furnace as required by Article 6(7) Waste Incineration Directive?
- Is incoming waste pre-treated to the degree necessary to reduce variations in feed composition, to control emissions and to prevent unnecessary waste production?
- Are vehicles load/unload in designated areas provided with proper hard standing?
- Is uncontained or potentially odorous waste stored inside buildings with suitable odour control e.g. negative pressure created by feeding combustion air, automatic or restricted size doorways?
- Is fire fighting equipment, in accordance with the requirements of Local Fire Officers, provided (especially for Municipal Solid Waste (MSW) reception bunkers, clinical and chemical wastes storage)?
- Are fuels and treatment chemicals stored in appropriate tanks or silos (possibly with closed loop vapour systems and
III. Incoming Waste Management (Example: Municipal waste)

- Municipal Waste Incineration
  - Are all relevant legislative requirements fulfilled?
  - Is municipal waste delivered in covered vehicles or containers and unloaded into enclosed reception bunkers or sorting areas with odour control?
  - Are design and handling procedures used to avoid any dispersal of litter?
  - Are techniques applied to increase the homogeneity of waste fed to the incinerator?
  - Is it ensured (through inspection) that any waste, which would prevent the incineration from operating in compliance with the permit, is separated and placed in a designated storage area until its removal?
  - Are proper measures taken to minimise odour in any potentially odorous indoor areas (e.g. self-closing doors, ventilation, treatment of extracted air, storage times, monitoring quality of incoming waste, etc.)?

In order to develop similar specific check lists for pre-treatment, chemical waste incineration, clinical waste incineration, animal waste incineration, sewage sludge incineration, drum incineration, pyrolysis and gasification, refuse-derived fuel incineration and co-incineration please review Chapter 2.1 of the [EA UK 2009].

IV. Waste Charging (general check list)

- Is an automatic system used to prevent waste feed at start-up, whenever the required temperature is not maintained, whenever the continuous monitors show that any emission limit value is exceeded?
- Is the waste charging interlocked with furnace conditions?
- Is it ensured that the charging operation is as airtight as possible and the fan control system is capable of responding to charges in furnace pressure during charging, to avoid escape of fumes or excess air flows?
- Are mechanisms that load the chute interlocked to prevent loading under the conditions outlined by the Waste Incineration Directive? (in systems that use a waste filled charging chute or hopper to achieve an airtight seal)
- Are procedures in place to ensure that the designed charging rate is not exceeded?
- Are throughput rates not exceeded and are they recorded (as declared in the permit)?
- Are mass throughput rates adjusted in a way to ensure optimum combustion conditions, while maintaining sufficient waste residence in the chamber?

V. Waste Charging (Example: Municipal and clinical waste)

- Are sealed delivery chambers used if there is a risk of either waste or products of combustion escaping from the feed mechanism?
- Is the waste feed engineered to prevent backflow of combustion products through it? And is a low-level alarm included in the feed hopper?
- Are isolation doors that prevent the fire burning back up the chute double doors or have a cooling system?
- Do the operating procedures show how overloading of the furnace will be prevented?
- Is it ensured that clinical waste is placed straight from storage into the furnace, without first being mixed with other categories of waste and without direct handling (Waste Incineration Directive requirement)?

In order to develop similar specific check lists for chemical waste incineration, sewage sludge incineration, drum incineration, animal waste incineration, pyrolysis and gasification, refuse-derived fuel incineration and co-incineration please review Chapter 2.2 of the [EA UK 2009].
VI. Residues Management

- **General:**
  - How are the residues from the incineration plant minimised, recovered, recycled and disposed of?
  - Is a description given on how it is intended to minimise the harmfulness of residues and how they will be recycled where this is appropriate?
  - Is at least the following information available for each waste disposed of; incineration line identifier, residue type reference, source and description of residues, details of transport and intermediate storage, details of the total soluble fraction and soluble heavy metals fraction and the route by which the residues will leave the installation (e.g. recycling, recovery, disposal to landfill)?
  - Are requirements of Article 6(1) Waste Incineration Directive met (i.e. TOC content of slag and bottom ash is less than 3 %, or their LOI is less than 5 % of the dry weight of the material)?
- **Bottom ash:**
  - Is it ensured that dust does not become airborne (in case ash is handled dry)?
  - In case ash is handled wet, is it ensured that ash is fully drained before it is transferred to the skips or otherwise leaves the site?
  - Are all ash transport containers covered?
  - Is adequate cleaning equipment such as vacuum cleaner provided and maintained?
- **Fly ash and Air Pollution Control (APC) residues:**
  - Are fly ash and APC residues segregated in order to allow the individual streams to be re-used or recycled?
  - Are these streams carefully stored, handled and transported, whether alone or in combination?
  - Is fly ash stored and transported in a manner that prevents fugitive dust releases?
  - Is the displaced air, during silo and container filling, ducted to suitable dust arrestment equipment?
  - Are dry residues for disposal handled in sealed containers such as tankers for large quantities or for instance “big-bags” for smaller installations?
- **Rejected feedstock:**
  - Are techniques for the inspection of waste adopted (e.g. nature of the waste, the ability of the installation to treat the waste incl. any pre-treatment/waste mixing etc.) to decide whether to accept/reject the waste?
  - Is it ensured that the delivery of waste that cannot be processed at the facility is minimised?
  - Are provisions made for safe storage of rejected loads in a designated area with contained drainage?
  - Are procedures in place for dealing with such loads to ensure that they are safely stored and dispatched for onward disposal?
  - Is it ensured that storage times are minimised?
- **Recovered waste fractions:**
  - Are provisions made for the storage of all recovered waste fractions?
  - Are the waste disposal/recovery routes regularly audited to ensure proper waste treatment?
  - Is it justified why recovery is technically or economically not feasible (where disposal occurs)?
  - Is a detailed assessment provided, identifying the best environmental options for waste disposal?

VII. Continuous Emission Monitoring Performance

- How is it ensured that the requirements set in Article 11(11) Waste Incineration Directive are satisfied? (half-hourly/10-minute average, etc.)
- Are details on the definition when start-up ends and shut-down begins provided?
- Are all types of unavoidable stoppage, disturbance or failure of the abatement plant or continuous emission monitoring system described?
- Will the value of the 95 % confidence intervals of a single measured value of the daily emission limit value, exceed the percentages of the emission limit values required by Article 11(11) Waste Incineration Directive and Annex III Point 3?
- Is the monitoring of process variables described? (For emissions into air, at least the arrangements for monitoring oxygen content, temperature, pressure and water vapour content must be included (Article 11(7) Waste Incineration Directive). For emissions of waste water from the cleaning of exhaust gas, at least the arrangements for monitoring pH, temperature and flow rate must be included. (Article 8(6) Waste Incineration Directive)
(7) Check List – Waste Incineration

VIII. Emissions into Surface Water and Sewer

- Are details on the applied waste water treatment process available?
- Is it demonstrated that the requirements of Annex IV and Article 8(4) and 8(5) Waste Incineration Directive are fulfilled? (i.e. application of the mass balance requirements)
- What are the storage arrangements for contaminated rainwater run-off? Is the storage capacity adequate to ensure that such waters can be tested and, if necessary, treated before discharge (Article 8(7) Waste Incineration Directive)?
- Are benchmark data for the main chemical constituents for normal operating /possible emergency conditions available for each emission point?
- How are the pollutants monitored in these emissions?
- Is information on flow rate, pH and temperature available?
- Are for each monitoring parameter the emission points, the monitoring frequency, the monitoring method, whether the equipment/sampling/lab is certified, the measurement uncertainty, etc. defined?
- Are any different arrangements necessary during start-up and shut-down?
- Is any additional information provided on monitoring and reporting of emissions into water or sewer?

IX. Emissions into Air

- Are the emission limit requirements of the Waste Incineration Directive fulfilled (as a minimum)?
  - Particulate matter:
    - Are fabric filters installed, correctly operated and maintained?
    - Are bag burst detectors provided to indicate the need for maintenance when a bag fails?
    - Are fabric filters with multiple compartments used, which can be individually isolated in case of individual bag failure?
    - Where wet scrubbing is used in combination with fabric filters, are the cool and wet gases reheated to prevent dew point and other problems?
    - Is wet scrubbing used in combination with fabric filters (wet scrubbers on their own are not BAT)?
  - Primary NOx measures:
    - Is nitrogen rich waste burnt (e.g. sewage sludge)?
    - Are low NOx burners for burning liquid waste or for supplementary firing used?
    - Are starved air systems used where appropriate? (reduction of oxygen content and temperature)
    - Is all equipment sealed to prevent fugitive air ingress and is it maintained under slight negative pressure to allow control of air input and to prevent combustion gas releases?
    - Are computerised fluid dynamics (CFD) used to optimise the primary and secondary air input?
  - Secondary NOx measures:
    - Are secondary NOx measures considered after the application of primary NOx reduction measures?
    - Selective non-catalytic reduction (SNCR):
      - Are NH2 –X compounds/ammonia/urea injected into the furnace to reduce emissions of NOx and inhibit dioxin formation?
      - Is the addition of reagents controlled to minimise the possibility of ammonia slippage?
    - Selective catalytic reduction (SCR):
      - Is SCR applied? (reduction of NO, NO2 to N2 and reduction of VOCs, CO and dioxin emissions)
      - Is the use of SCR considered in the cost benefit assessment and is a justification provided if it is not employed?
(7) Check List – Waste Incineration

**Emissions to Air (continuation)**

- **Primary acid gas measures:**
  - Is it ensured that releases are influenced through waste selection (e.g. up-stream waste management to prevent the inclusion of problematic wastes, waste selection or segregation techniques)?
  - Are low sulphur fuels <0.2 % w/w used for start-up and support?

- **Secondary acid gas measures:**
  - Is the selection of the technology (i.e. wet, dry and semi-dry) and the selection of the reagents justified?

- **Alkaline reagent dosing control:**
  - Is the reagent dosing system optimised to control acid gas emissions within emission limit values, reduce consumption of reagent and reduce production of alkaline residues?

- **Other releases (CO₂, CO and VOCs):**
  - Are raw materials with low organic matter content and fuels with low ratio of carbon content to calorific value preferred?
  - Is it ensured that furnace and combustion requirements are fulfilled?
  - Are consistent waste feed characteristics (e.g. Calorific Value (CV), moisture) and feed rates secured?
  - Are partially oxidised gases burned before release?

- **Dioxins and furans**
  - Are combustion conditions carefully controlled (i.e. gas residence times, temperatures and oxygen contents at the combustion stage)?
  - Is it ensured that the conditions for de novo synthesis are avoided by ensuring that exit gas streams are quickly cooled through the de novo temperature region between 450 °C and 200 °C?
  - Is efficient particulate abatement in place, which will remove dioxins/furans from the gas phase (e.g. bag filters impregnated with catalyst specifically developed for the destruction of dioxins/furans)?

- **Metals**
  - Is up-stream waste segregation performed (e.g. Hg at chemical waste incinerators)
  - Is carbon injection carried out if Hg is a problem?
  - Is efficient particulate abatement in place (relevant for the majority of metals)?

- **Iodine and Bromine**
  - Is sodium thiosulphate added to the scrubber to reduce iodine and bromine to the respective halogen hydride? (in case wet scrubber systems are used)
  - Is the resulting effluent stream subsequently treated?

**X. Further issues to be checked**

- Accident management
- Efficient use of raw materials and water
- Energy efficiency, heat recovery
- Odour, noise and vibration
- Flue gas recirculation
- Dump stacks and bypasses
- Cooling system
- Boiler design
- ...

**Source:** [EA UK 2009a] The incineration of Waste (EPR 5.01): „How to comply with environmental permit; Additional guidance: The incineration of Waste“. March 2009