Discussion paper on criteria for energy recovery in waste incineration plants

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I. Introduction

The reason why discussions on distinction between recovery and disposal are so controversial is that the criteria, that have been proposed so far, such as the calorific value, are not combined with environmental, technical or scientific aspects. Indeed, they are used to steer the market.

Considering this, the discussion will be much more efficient, if it will continue in a frank way. This means with respect to energy recovery to create criteria independently, but **based on environmental aspects** and not on political ones (II.).

II. Criteria for energy recovery

Criteria for energy recovery should be based on environmental aspects considering the technical possibilities and equipment of the waste treatment plant and its possibility to deliver energy, thus replacing fossil fuels. Therefore, two criteria are decisive: the plant efficiency factor (1) and the energy utilization rate (2).

1. Plant efficiency factor

Waste incineration in waste incineration plants has to be qualified as recovery if the plant energy efficiency factor allows to deliver energy to third parties, because in this case the energy produced by incinerating the waste is higher than the plant`s own demand. Imported energy (gas, oil etc.) has to be subtracted.

To get the plant energy efficiency factor, the produced energy minus the imported energy has to be divided by the total energy demand for the waste incineration process.

The plant efficiency factor (Pl_{ef}) can be described by an easy formula (enclosed Annex I). The figures have to be expressed in equivalents to allow comparison between the different energy forms.

2. Energy utilization rate

The equivalent energy utilization rate has to be > 50 %, i.e. the actual use of the greater part of the released energy.

More than 50 % of the produced energy as steam, heat, electricity minus imported energy has to be utilized out of the released energy from the combustion chamber, all energy as equivalent.

If this results in an usable energy surplus > 50 % the operation is assumed to be energy recovery.

The energy utilization rate can be described by a formula as well (enclosed Annex II). The figures have to be expressed in equivalents to allow comparison between the different energy forms.

3. Calorific value

In the past the calorific value of the waste has been discussed as a criterion for the distinction between energy recovery and disposal.

In the TAC (Technical Adaptation Committee) the Commission and the Member States tried for many years to find the “right” calorific value as a distinction criterion, however they failed to find an agreement.

The reason is that this criterion is always arbitrary (“political”) and the measurement of the calorific value before being burned is not as easy as it seems to be.

It also has to be considered that a plant with a good energy efficiency rate, i.e. the appropriate technical equipment, can produce more energy from the waste than a plant with a bad energy efficiency rate. Therefore, only the plant`s technique has to be the decisive criterion.

This approach is tied to *environmental* requirements due to the replacement of fossil fuels by energy delivery. It has the advantage that it is based on facts that are easily available taking into account the plant`s technical equipment and its possibility to deliver energy.

4. Conclusion

There is no “right” calorific value based on technical or scientific criteria. This criterion will always be arbitrary. This is why we don’t` consider this criterion as suitable.

The plant efficiency factor and the energy utilization rate out of the energy input by waste are much more suitable as criteria as they are based on facts, considering technical possibilities and environmental contributions (replacing fossil fuels). Therefore, we propose the following as the decisive criteria for energy recovery in waste incineration plants:

1. **Plant efficiency factor > 1**
2. **Energy utilization rate > 50 %**

III. General criteria on co-incineration

We assume that other sectors that may be concerned, such as the co-incineration industry, will make their own proposals on criteria of energy recovery in their plants.

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Annex I

Plant efficiency factor (Pl ef)

Formula:

$$Pl_{ef} = (O_{prod} - (E_f + I_{imp})) / (E_f + I_{imp} + I_{circ})$$

all figures as equivalents *

E_f = *annual energy input to the system by fuels with steam production (GJ/y)*
I_{imp} = *annual imported energy (Note: energy from the treated waste (E_w) is not included)*
I_{circ} = *annual energy circulated*
$O_{prod.}$ = *annual produced energy (combined total of heat plus electricity as equivalents)*

*** Equivalents:**
Taking account of the energy form this requires the comparison of different units of measurement, i.e. MWh, MWh_e, MWh_{th}. Therefore conversion factors as equivalents are needed (for externally generated sources) assuming an overall European average of 38 % conversions efficiency (i.e. 1 MWh = 0.38 MWh_e or 1 MWh_e = 2.6136 MWh) for electrical energy generation, and 91 % for heat generation (i.e. 1 MWh = 0.91 MW_{th} or 1 MWh_{th} = 1.0989 MWh) in external power plants. For the use of energy, e.g. in a fuel or in steam with 100 % conversion efficiency 1 MWh remains 1 MWh. Only by this way different kind of energy can be evaluated and summarized to a comparable energy mix.

This means: Electricity, because of its high energy quality, will be valued at 2.6 times other energy forms. Saving a kWh of electricity is worth more than saving the equivalent amount of gas, etc. at the final point of consumption.

If the resulting figure is < 1:

This could be because no energy is recovered or because the energy that is recovered is consumed by the waste incineration process itself and not available for export and further more some imported energy is necessary.

If the result is > 1:

This shows that the plant minus imported energy with steam production is producing more energy than that which is required to operate the total waste incineration process.

This calculation does not require knowledge of the energy content of the waste. However, the result will be mainly influenced by the waste energy content, and it can be expected that wastes with a higher energy content can result in greater energy production, and hence higher values of $Pl_{ef.}$

Annex II

Energy utilization rate

Formula:

$$\eta = ((O_{prod} -(E_f + I_{imp})) / 0.97 \times (E_w + E_f)) \times 100$$

all figures as equivalents *

E_f = annual energy input to the system by fuels with steam production (GJ/y)
I_{imp} = annual imported energy (Note: energy from the treated waste (E_w) is not included)
E_w = annual energy input to the system by waste (GJ/y)
$O_{prod.}$ = annual produced energy (combined total of heat plus electricity as equivalents)
0.97 = factor for in general not usable energy losses in the incinerator by bottom ash and radiation

*** Equivalents:**
Taking account of the energy form this requires the comparison of different units of measurement, i.e. MWh, MWh_e, MWh_{th}. Therefore conversion factors as equivalents are needed (for externally generated sources) assuming an overall European average of 38 % conversions efficiency (i.e. 1 MWh = 0.38 MWh_e or 1 MWh_e = 2.6136 MWh) for electrical energy generation, and 91 % for heat generation (i.e. 1 MWh = 0.91 MW_{th} or 1 MWh_{th} = 1.0989 MWh) in external power plants. For the use of energy, e.g. in a fuel or in steam with 100 % conversion efficiency 1 MWh remains 1 MWh. Only by this way different kind of energy can be evaluated and summarized to a comparable energy mix.

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