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Characterisation of sludges — Good practice for combined incineration of sludges and household wastes

ICS 13.030.20; 13.030.40

British Standards

National foreword

This Published Document is the official English language version of CEN/TR 13768:2004. It supersedes PD CR 13768:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EH/5, Sludge characterisation, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

Summary of pages

This document comprises a front cover, an inside front cover, the CEN/TR title page, pages 2 to 22, an inside back cover and a back cover.

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English version

Characterisation of sludges - Good practice for combined incineration of sludges and household wastes

Caractérisation des boues - Bonne pratique pour incinération combinée des boues et des déchets ménagers

Charakterisierung von Schlämmen - Anleitung für die gute fachliche Praxis bei der gemeinsamen Verbrennung von Schlämmen und Haushaltsabfällen

This Technical Report was approved by CEN on 26 February 2004. It has been drawn up by the Technical Committee CEN/TC 308.

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Contents

Foreword

This document (CEN/TR 13768:2004) has been prepared by Technical Committee CEN /TC 308, "Characterization of sludges", the secretariat of which is held by AFNOR.

This document supersedes CR 13768:2001.

Significant technical differences between this edition and CR 13768:2001 is taking account of the new Directive 2000/76/EC (incineration of waste).

The status of this document as CEN Technical Report has been chosen because the most of its content is not completely in line with practice and regulation in each member state. This document gives recommendations for a good practice concerning the combined incineration of sludges and household wastes but existing national regulations remain in force.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Report: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

All of the recommendations of this document constitute a framework within which the combined incineration process can be proposed in addition to and/or as a substitution for field spreading, waste site disposal (landfilling), specific incineration (see TR 13767), or any other process.

Combined incineration should abide by the European Directive 2000/76/EC (Incineration of waste) and should comply with the relevant regulations and recommendations in force within each member state to reduce as far as possible negative effects on the environment such as pollution of the air, ground, surface and underground water, and on human and animal health. This concern therefore relates to: the pre-treatment of the sludge in plants, the transfer of the material to the treatment centre, the actual destruction process, the treatment of gaseous discharge into the atmosphere, the future of the different by-products stemming from combustion and the treatment of the liquid effluents possibly resulting from the process.

Anyway, priority should be given to reduction of pollutants at the origin and or to recovery of valuable substances (phosphorus, potassium…) in sludge and derived products if technically and economically feasible.

As part of a process and company quality approach, the relevant issues are therefore :

- exploiting the operating data and the statutory inspections carried out ;
- rendering the process reliable, optimising and of perpetuating it, as well as guaranteeing a permanent development ;
- maintaining a climate of confidence between the authorities, the sludge producers, the transporters, the incineration plant and waste disposal site operators and to allow the services to be provided on a contractual basis.

When necessary, a distinction can be made between existing facilities and new incineration plants.

1 Scope

This document gives indication for dealing of the combined incineration treatment of sludge and household waste.

This document is applicable to sludges described in the scope of CEN/TC 308 i.e. specifically derived from :

- storm water handling ;
- night soil ;
- urban wastewater collecting systems ;
- urban wastewater treatment plants ;
- treating industrial wastewater similar to urban wastewater (as defined in Directive 91/271/EEC) ;

but excluding hazardous sludges from industry.

Annex A gives information on various systems to input sludge into a household waste incineration plant.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1085, *Wastewater treatment – Vocabulary.*

EN 12832, *Characterization of sludges. – Utilization and disposal of sludges – Vocabulary*

EN 13965-1, *Characterization of waste – Terminology – Part 1 : Materials related terms and definitions.*

EN 13965-2:2004, *Characterization of waste – Terminology – Part 2 : Management related terms and definitions.*

3 Terms and definitions

For the purposes of this document, the following terms and definitions given in EN 12832 and EN 1085 and the following in accordance with EN 13965-1 and 2 except for the definition of combined incineration apply :

3.1
household waste
waste arising in households

[see EN 13965-1]

3.2
incineration
treatment by combustion

NOTE In contrast to pyrolysis, incineration is carried out with full supply of oxygen

[see EN 13965-2]

3.3
household waste incineration plant
all of the equipment required for the thermal conversion by incineration of household waste with or without energy recovery

3.4
combined incineration of sludge and household waste
incineration of sludge and household waste in a same combustion chamber

3.5
pyrolysis
thermal treatment with limited supply of oxygen

[3.40 of EN 13965-2:2004]

3.6
thermolysis
one of the methods of application of pyrolysis

3.7
charge preparation
the operation of preparing sludge that can be necessary prior to entering the furnace

3.8
incinerator furnace
specific part of the incineration plant where the combustion reactions that destroy the organic matter take place, generating gaseous effluent and solid residues

3.9
boiler (heat exchanger)
specific part of the incineration plant where heat exchange takes place in view of recovering energy and of cooling down the fumes

3.10
waste gas treatment
any physical or chemical process aimed at cleaning the flue gas resulting from the thermal treatment with the regard to their discharge into the atmosphere

3.11
bottom ash
combustion residue arising at the bottom of combustion furnaces

[see EN 13965-1]

3.12
fly ash
solid material that is entrained in a flue gas stream

[see EN 13965-1]

NOTE See waste Directive 91/156/EEC.

3.13
energy recovery
activity to use combustible waste as a means to generate energy through direct incineration with recovery of heat

[see EN 13965-2]

NOTE See packaging Directive (94/62/EEC).

3.14
storage center (landfill)
waste disposal site for the deposit of the waste onto or into land

3.15
leachate

liquid percolating through the deposited waste and emitted from or contained within a landfill

3.16
recycling

activity in a production process to process waste materials for the original purpose or for other purposes, excluding energy recovery

NOTE See packaging Directive 94/62/EEC

[see EN 13965-2]

4 Requirements

4.1 General

As a general rule, the criteria, which lead the decision-makers to choose combined incineration, are similar to those which lead them to construct or to extend incineration plants for household waste only.

The local recommendations take into account :

— impossibility to introduce or pursue any other process or to have at one's disposal an alternative to existing solutions, throughout whole or part of the year, in particular in the case of technical shutdown and particularly if the incineration plant only has one treatment unit ;

— geographical context, the client population and therefore the potential input material (waste + sludge) as well as the expected developments ;

— proximity of the sewage treatment plant/incineration plant and the local road network ;

— extent to which the incineration plants are used (dimensioning of furnaces, charge levels, filling) ;

— variations due to seasonal activity and production peaks both in sludge and household waste.

4.2 Origin and knowledge of the materials intended for combined incineration

4.2.1 General aspects

Considering, in the spirit of this guide, combined incineration as one of the channels for sludge treatment, two approaches are possible :

the treatment site accepts over the course of time materials of different origin, type, behaviour and quantity and it should be readily adaptable in order to always guarantee optimum destruction ;

the treatment site (due to its design, for example) cannot offer any flexibility. Two cases then present themselves :

— a quantitative or qualitative limitation will be demanded on the site ;

- a reflection, taking into account the technical and economic constraints, should be conducted in order to examine the influence of any modification in sludge production, so as to achieve a perfect material/process match.

There should be the opportunity for process evolution to comply with new constraints, particularly arising from changes in legislation. Finally, it is worthwhile specifying that incineration plants are installations which, for reasons of technical availability and maintenance, operate between 7000 h and 8000 h per year. It will therefore be advisable to provide for a selective and appropriate organisation (alternative elimination or storage channel) with the water treatment site administrator during the furnace shutdown periods, whether of short duration (minor maintenance operations, incident) or of long duration (programmed stoppage for major yearly overhauling). This latter comment is particularly important in the case of a plant equipped with one incineration line only. Under these conditions, it is then a question of specifying certain physico-chemical properties of the "sludge material" which can influence the combined incineration process with a view to making provision for the necessary installations, the behaviour and flexibility of the equipment to be implemented as well as the possible additional maintenance and wear. The methods for sampling and controlling the follow-ups as well as their validity will conform to the requirements suggested by all of the players of the process, from the producer up to the final disposer.

Prior knowledge of the parameters given below will greatly help determine what equipment has to be considered both for adapting the new combined incineration activity at existing plants not planned for this purpose and for designing new incineration plants.

The operational departments of the incineration plants reserve the right to refuse a sludge, which can present one or more "abnormal" parameters, e.g. a particularly high content of one or more trace elements and for which the unit's equipment :

- will not allow to respect prescriptions of the directive 2000/76/EC
- will not allow to guarantee compliance with current emission thresholds ;
- will generate bottom ash and fly ash whose deterioration of the quality will no longer allow a disposal in conformity to the provisions in force (regulation and/or current technical-economic conditions). We will point out that too high contents of phosphorous pentoxide (P_2O_5) in the bottom ash and ash cause a drop in their melting point.

4.2.2 Parameters relating to transport. storage and transfer

It is a question of :

- origin of sludge ;
- type of sludge ;
- dry substance content ;
- viscosity and rheological behaviour on delivery and on recovery ;
- stability when piled, heap angle ;
- risks of the material and its parameters changing with time, during transport and storage (varying stability, rheological change, fermentation, smells) ;
- pH value.

4.2.3 Parameters relating to combustion conditions and to gaseous and solid discharges

These elements permits to anticipate the consequences on the combustion chamber functioning and on discharges :

- dry matter content ;

- organic matter content, organic micropollutants or volatile matter index ;
- higher or lower calorific value ;
- content of :
  - carbon ;
  - hydrogen ;
  - oxygen ;
  - nitrogen ;
  - sulfur ;
  - chlorine ;
- phosphorous :
  - as far as the nature of the gaseous discharge into the atmosphere is concerned, particular attention will be paid to compliance with national regulatory provisions and with Directive 2000/76/EC requirements. A periodic monitoring of toxic metals of sludges should be carried out to ascertain the standards of incineration plants are respected.

4.2.4 Case of sludge with additives

Lime-treated sludge.

In order to slow down fermentation, lime is frequently added to the sludge. The limed sludge may have a positive impact on transport and storage, however, on the other hand, combustion can be affected by it: the life cycle of the refractories can be reduced due to alkaline degradation at these temperature levels, and additional clogging occur in the furnace's boiler unit. Furthermore, the resulting quantities of bottom ash and ash are increased in the proportions considered.

- Other important types of additives : $FeCl_3$, polymers, organic flocculants, phosphate removal products, etc.

To date, the impact of these additives has not been sufficiently quantified to enable recommendations to be made.

For all of these three categories of parameters, a distinction will be made between those parameters which are worthwhile knowing for satisfactory combined incineration on a routine basis and the additional parameters which, although having little or no influence, can prove useful for optimising the process.

It will be particularly important to determine the ranges within which change is acceptable and/or unacceptable. Among all of these parameters, a selection of those, which should be regularly monitored and/or inspected, should be proposed.

4.3 Requirements concerning transport, storage and transfer

4.3.1 General provisions concerning transport

The "transport" system should be designed so as to guarantee maximum containment and limited nuisance due to smells. The transport vehicle driver should have in his possession the consignment note stating the origin, quality, quantity and destination of the sludge being transported.

Transport should not give rise to any accidental spillage of sludge onto the roadways and the various manoeuvring areas. In the event of the travelling distances being long, modification of the sludge should be taken into consideration.

The vehicles used should be suited to the different categories of roads. National and/or local regulatory provisions should be imperatively observed.

4.3.2 Recommendations specific to transport

Transport consists in conveying the sludge from the sewage treatment plant to the incineration plant, if possible in a single stage. It includes the sludge loading and unloading operations.

In the majority of cases, transport will be carried out using an appropriate vehicle for which loading and unloading means adapted to the volume and condition of the sludge should exist. Unloading generally takes place by gravity, occasionally by pumping.

Transport can be carried out via pipeline where the plant and incineration plants are close enough to one another for this to be technically and economically feasible. The pumping conditions and the outputs to be applied will then be particularly examined. In particular, the use of polymers can be used for facilitating transport in the case of very long pipes.

4.3.3 General provisions concerning storage

4.3.3.1 Storage with household waste

Sludge can be stored with household waste either directly by tipping into the pit, or by using spray, or any other method in order to spread it right through the pit. The operator will have to accept and master the constraints involved in the choice of storage method.

4.3.3.2 Recommendations

Two elements are essential in the quality of the sludge to be tipped: dryness and consistency. In the case of liquid or semi-paste-like sludge, there is a risk of the household waste becoming wet and water accumulating by gravity at the bottom of the pit. An identical gravity phenomenon can occur with solid sludge of low particle size, difficult to remove with a grapple.

In all cases, tipping sludge into a pit creates an additional work for the crane operator so that the mixture will be as homogeneous as possible. This work should be carried out in parallel with the management of household waste in pits and therefore requires a dual function for the crane driver.

In fact, this is a possible solution where sludge quantity is low compared to the household waste and/or on a selective basis. According to how dry the sludge can be and the proportions anticipated, a study should be envisaged, even prior tests.

We would draw attention to the risks related to handling dried sludge: (explosive and burning risk depends on solid state).

On the other hand, the odour problems are directly linked to the quality of the sludge (e.g. raw sludge) stored in pits, which will lead to the calculations of the unloading hall system being revised: additional deodorization can prove necessary.

4.3.3.3 Specific storage

It is advantageous to store sludge on the incineration plant site, because it provides a buffer between the sludge production and its incineration, which can sometimes be discontinuous.

If the storage facility area is close to the incineration plant, the sludge can possibly be stored directly in this area and to feed the incineration plant by pipeline.

The storage facility area will regroup sludge of different origins, irrespective of its condition. It can therefore take the form of a pit, a tank or silo. It is located within the incineration plant site perimeter in a separate properly identified area, different from the storage area where other wastes treated on the site are stored. Input to the storage facility should be either by pipeline (for liquid or paste-like sludge) or by skips (for paste-like or solid sludge).

NOTE Mention should be made of the particular case of solid sludge arriving at the site for incineration, for which a possibility of direct tipping into the waste pit can be examined.

The storage container should be leak tight with respect to sludge, preferably covered, enclosed and ventilated in order to limit any nuisance and possibly to collect the odours given off with a view to treatment.

All of the equipment should be accessible to all vehicles and should have adequately dimensioned and easy to maintain working areas.

The sludge container should be equipped with a level measurement system or (except when it is merely a pit for which a simple visual inspection by the operators should prove sufficient) a filling system and a draining-off connection device.

Provision should be made for sludge recovery from the bottom of pits, tanks or silos. Likewise, consideration should be given to recovering water used for cleaning working areas and the containers themselves.

4.3.3.4 Recommendations

Because a sludge is an "evolutive" substance due to its organic matter and to its water content, fermentation and transport can influence its physical conditions. Most of the time, it is not economically worthwhile pretreating the sludge in order to prevent this phenomenon. It is prudent to recommend the shortest possible time interval between sludge production at the sewage plant and its actual incineration in order to avoid a change in the latter's mechanical stability.

The storage containers should be adequately dimensioned. It is wise to have at least one storage volume equivalent to the quantities of sludge, which will be treated by combined incineration over a 72 h period. This volume should be calculated on the basis of incineration furnace operation at the constructor's rated capacity and confirmed by the operator, taking into account a nature of waste which is always highly variable and on the basis of a ratio of incinerated sludge to domestic refuse which is dependent on the size of the furnaces and on the principle adopted for combined incineration. The hazards relating to the supply of sludge will also be taken into consideration.

From an environmental standpoint, the working and storage areas should be integrated at best into the landscape and into the plant, this being generally easier to achieve for a new incineration plant.

Local conditions can influence the transport/storage arrangements, and increasing the size of the latter can result in reducing sludge delivery frequencies.

NOTE Sludge mixing can also be taken into consideration, as the combined incineration plant should be capable of treating all the sludge brought to the site, i.e. from different origins and sewage plants.

The relevant national and/or local regulations in force should be observed.

Generally, the sludge handling operations will be limited to the greatest possible extent and will be carried out so as to ensure the safety of both the equipment and men involved.

The constituent materials of the equipment should be insensitive to the products being stocked in order to avoid any premature ageing.

Prior to installation, particular attention should be paid to the maintenance of the equipment.

4.3.4 General provisions concerning transfer

It is the operation, which consists in taking the sludge from the storage area and transferring it to the place of incineration plant.

The stored sludge will be reclaimed by all means appropriate to its condition (either by direct pumping or mechanically by means of a screw system plus pumping for example or by travelling crane for solid sludges).

All equipment should be accessible in order to permit interventions with the use of vehicles.

The course followed by the piping up to the point of introduction into the furnace should be designed in order to minimise pressure drops and to integrate at best into the incineration plant.

The technical means for introduction into the furnace will be designed so as to mix in the most appropriate manner possible the sludge with the household waste and to avoid all concentration points and all risks of clogging on the refractoried surfaces of the furnace.

4.4 Suitability of the incineration equipment

4.4.1 Incineration equipment

a) differing exclusively in terms of dryness, three main sludge types can be envisaged :

- mechanically dewatered sludge, usually by belt and filter/press or centrifuge ;
- partially heat-dried sludge using thermal dryers ;
- total heat-dried sludge using thermal dryers ;

b) four main furnace types can be used for sludge-waste combined incineration. These are :

- furnaces containing mechanical components (bars or grates) driven by a translation motion (linear movement). The grate is either inclined or horizontal (see Figure B.1) ;
- roller furnaces comprising stepwise arranged rotating cylinders (circular movement) (see Figure B.2) ;
- reciprocating or rotary kilns. The axis is slightly inclined to the horizontal (see Figure B.3) ;
- fluidised bed furnaces, which can comprise two types: bubbling fluidised beds and fluidised beds with re-circulation (see Figure B.4) ;

c) whatever the furnace type involved, two essential functions should be combined :

- incineration of waste either alone or in mixed form, in order to convert it into ash with the lowest possible percentage of Total Organic Carbon (slag and bottom ashes: Total Organic Carbon content has to be less than 3% or their loss of ignition has to be less than 5%), while avoiding the formation of more or less melted blocks of bottom ash (caking) ;
- distribution of the air used for combustion and cooling down of the mechanical components or of the sole plate according to two types of air versus current or combined air-current designs.

Besides the sludge characteristics, the possible different waste-sludge combined incinerations depend on the constraints resulting from the complete incineration line, taking into account the design and flexibility of the furnace-boiler-waste gas treatment facility.

4.4.2 General considerations relating to the incineration

Incineration is a treatment process, which makes it possible to reduce both the mass and volume of the materials being treated by reducing them to ash, while taking advantage of their inherent energy potential.

The contained water, converted into vapour, and the organic matter converted into combustion gases are discharged into the atmosphere.

The inorganic material and incombustible substances form the ash, this residue having to be evacuated to be valorised or disposed of according to national regulations :

a) incineration comprises three principal phases corresponding to three conversion zones :

- the first step of combustion is the drying of the waste through contact with hot gases and decomposition into volatile materials which rapidly reach their ignition temperature ;
- continuation of combustion as the waste moves or is moved through the furnace ;
- gradual conversion into bottom ash which is then extracted and cooled down ;

b) complete combustion requires compliance with three basic parameters (the "3T" rule) :

- a sufficient dwell time ;
- a controlled and sufficiently high temperature ;
- a degree of turbulence.

To avoid consuming make-up energy from fossil sources, it is desirable to achieve a thermal balance, i.e. so that the heat supplied by the combustion of the organic matter is sufficient to evaporate the water, to heat the combustion air and to raise all the combustion gases to a minimal temperature of 850°C. Combustion in the system is then said to be self-sustaining.

According to the Directive 2000/76/EC, each line of the incineration plant is equipped with at least one auxiliary burner which is switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below 850°C. Sludge feed is interrupted when these improper conditions occur.

It is the case of the incineration of household waste the calorific value of which is usually situated between 7 000 and 11 000 kJ/kg. A lower calorific value (LCV) caused by the sludge/household waste mixture less than 7 000 kJ/kg should be avoided, because of the problem of complex mixing of the two wastes.

The two principal parameters taken into consideration in the dimensioning of a furnace are :

- calorific value of the waste (with or without sludge) ;
- required incineration capacity (hourly flow of waste).

These two parameters allow the determination of a nominal operating point expressed as the thermal capacity of the furnace and with respect to which various operating zones are determined. These different zones are represented in an operating diagram called a combustion chart. These charts vary according to the furnace constructors and the different furnace types. They show on a plot of mass capacity against heat capacity the zones of optimum combustion and the permissible overloads. The different calorific values (single substance or mixture) are expressed according to a group of linear straight lines.

For a given furnace, it is around the rated conditions of the waste's calorific value that it will present the greatest operating flexibility.

It is strongly recommended to use this type of chart prior to carrying out any sludge/household waste combined incineration, irrespective of the envisaged furnace type, the composition of the sludge and waste to be supplied and this for an existing installation or one at the design stage.

NOTE Concerning the combustion air: the stoichiometric combustion air is that which should be injected into the furnace in order to provide the amount of oxygen essential for achieving the combustion reactions. Since some of the air can not in fact be used for oxidising the hydrocarbon compounds, an additional volume of air should be injected. This excess volume makes it possible to reduce the unburned residues, to limit the natural flame temperature and to ensure combustion at a temperature of 850 °C, compatible with the nature of the materials being used and conforming to the Directive 2000/76/EC requirements.

The overall excess air represents between 1,3 and 2,5 times of the stoichiometric air. Grate type furnaces generally operate with a much higher quantity of excess air. 1,6 to 1,9 than fluidised bed type furnaces with 1,3 to 1,6.

The different zones for introduction and distribution of the combustion air are particularly important (primary air underneath the grate, secondary and possibly tertiary air higher up in the furnace).

4.4.3 Particular recommendations for combined incineration

An incineration line allocated to household waste imposes two essential constraints for the acceptance of sludge in view of a combined incineration.

4.4.3.1 Mass loading of the grate and thermal loading of the furnace

The introduction of an additional waste material into the combustion system should not interfere in any significant manner with the initial performance of the furnace. In general, the combustion chamber-heat recovery boiler unit is designed to withstand occasional overloads in the region of 10 %.

In order to maintain satisfactory combustion and to avoid any adverse effects on the resistance of the refractory materials, it is desirable not to exceed a thermal overload and therefore an increase in waste gas enthalpy in the region of 5 %, this figure being dependent on the lower calorific value (LCV) of the sludge.

It is very difficult by referring only to a mass loading to bracket the combined incineration rates.

Each case is in fact a specific case, whether it is a question of existing or new installations, defined by :

- combustion chart ;
- furnace type ;
- possible location of the introduction system (s) ;
- compliance with the "3T rule" ;
- combustion gas treatment capacity ;
- dividing up of the sludge mineral ashes into bottom ash and fly ash ;
- observance of the regulations (0_2 > 6 %; T > 850 °C/2s).

A distinction will also be made between the introduction of a paste-like sludge and that of a solid sludge.

In the case of a paste-like sludge (up to 35 % of dry matter) the quantity of sludge which can be incinerated depends mainly on the quantity of excess air available if it is wished to maintain the furnace's thermal capacity. The quite rapid vaporisation of the large quantity of water contained in the sludge will increase the volume of the gas in the furnace and thus contribute to "locally cooling down" the temperature of the gases. Taking these elements into account, it appears wise to limit the raw sludge household waste weight ratio between 10 % and 20 % for grate, roller or reciprocating type furnaces and around 30 % of fluidised bed type furnaces.

In the case of a pre-dried sludge (around 60 % for example, an interesting case for which the calorific value of the sludge is close to that of household waste), the quantity of sludge which can be incinerated depends on the available thermal capacity, the furnace type and its mechanical functioning. At nominal operation, all additions of sludge will be made to the detriment of the household waste.

In the case of sludge dried to around 90 %, the calorific value of the resultant mixture will be considerably increased and only the combustion chart will allow a reasonable ratio to be defined. This type of combined incineration will only be used insofar as the quantity of household waste treated is less than the furnace's nominal capacity.

Particularly for this latter case, the distribution of the sludge over the bed of household waste should be well carried out in order to avoid the emergence of oxygen starved zones which can give rise to an increase in the quantity of unburned residues in the bottom ash and in the CO content in the combustion gases and a possible not homogeneous temperature in the furnace. This remark is not valid in the case of fluidised beds, taking into account the levels of natural internal swirling of the waste (turbulence).

4.4.3.2 Volume loading on the waste gas treatment system

The introduction of sludge into a household waste furnace results in an increase in the volume of the combustion gases, in their humidity and in their SO_2 content essentially.

Just like the furnace, the waste gas treatment system can withstand temporary overloads in the region of 10 %.

New installations will be dimensioned so as to take into account a total volume of waste gas greater than the volume given off by the combustion of household waste alone. Finally, the proportions of the various basic materials and additives will be studied, taking into account all of the pollutants stemming from the sludge and the household waste.

Concerning all the pollutants to be treated, each installation has its own limitation thresholds (or maximum pollutant load values at the entry of the purification system). It will be advisable to verify the compatibility of the treatment process with the addition of sludge. Likewise, if the combined incineration is not continuous (e.g. only operates on one or two units, namely 8 h to 16 h a day) particular attention should be paid to the relevant local regulations in force for pollutant emissions - continuous, average rate per hour, per day,...and to the European regulation (Directive 2000/76/EC).

In this latter case, care will be taken to see that the furnace's regulation system manages these periods, with our without sludge, so as not to disrupt combustion and the resulting elements (gaseous, liquid and solid effluent).

Annex A

Various systems to input sludge into a household waste incineration plant

A.1 General

In order to complement this practical document, it is worthwhile pointing out some input systems. The list is not exhaustive and can be complemented at any time.

It can be divided into two major parts :

— input of sludge whose dry matter content < 35 % ;

— input of sludge whose dry matter content > 65 %.

A.2 Sludge whose dry matter content < 35 %

There is a lot of feeding systems :

— through a crane (mixed waste) ;

— through a hopper ;

— into the furnace, at various points :

  — pipe ;

  — side wall or ceiling ;

  — output of post combustion ;

  — post combustion.

According to the systems, the sludge will be :

— injected in form of "cakes" ;

— pulverised in form of drops ;

— cut into slices.

A.3 Sludge whose dryness is > 65 %

There are several methods to input sludge into a furnace :

— sludge can be directly discharged from the pit into the drop chute through an air conveyor, a screw or bucket conveyor. The hopper will be fed as regularly as possible in order to mix small quantities of household waste with sludge ;

— sludge can be directly discharged into the furnace ;

— sludge can be directly dumped into the household waste pit.

A.4 Sludge whose dry matter content between 35 % to 65 %

No recommendation can be made in this document since storage and transfer technologies are not yet mastered for this kind of sludge.

A.5 Drying the sludge in the household waste incineration plant

Drying the sludge in the plant changes the sludge whose dryness is about 20 % into sludge of 60 % to 90 % dryness by using the energy recovered from household wastes. In this way, solid and incinerated sludge generate power.

Depending on the drying method, the sludge drying can generate a polluted liquid effluent that has been treated. Some problems can occur if drying is carried out an incineration plant limited in its liquid discharges.

Annex B

Different furnace types

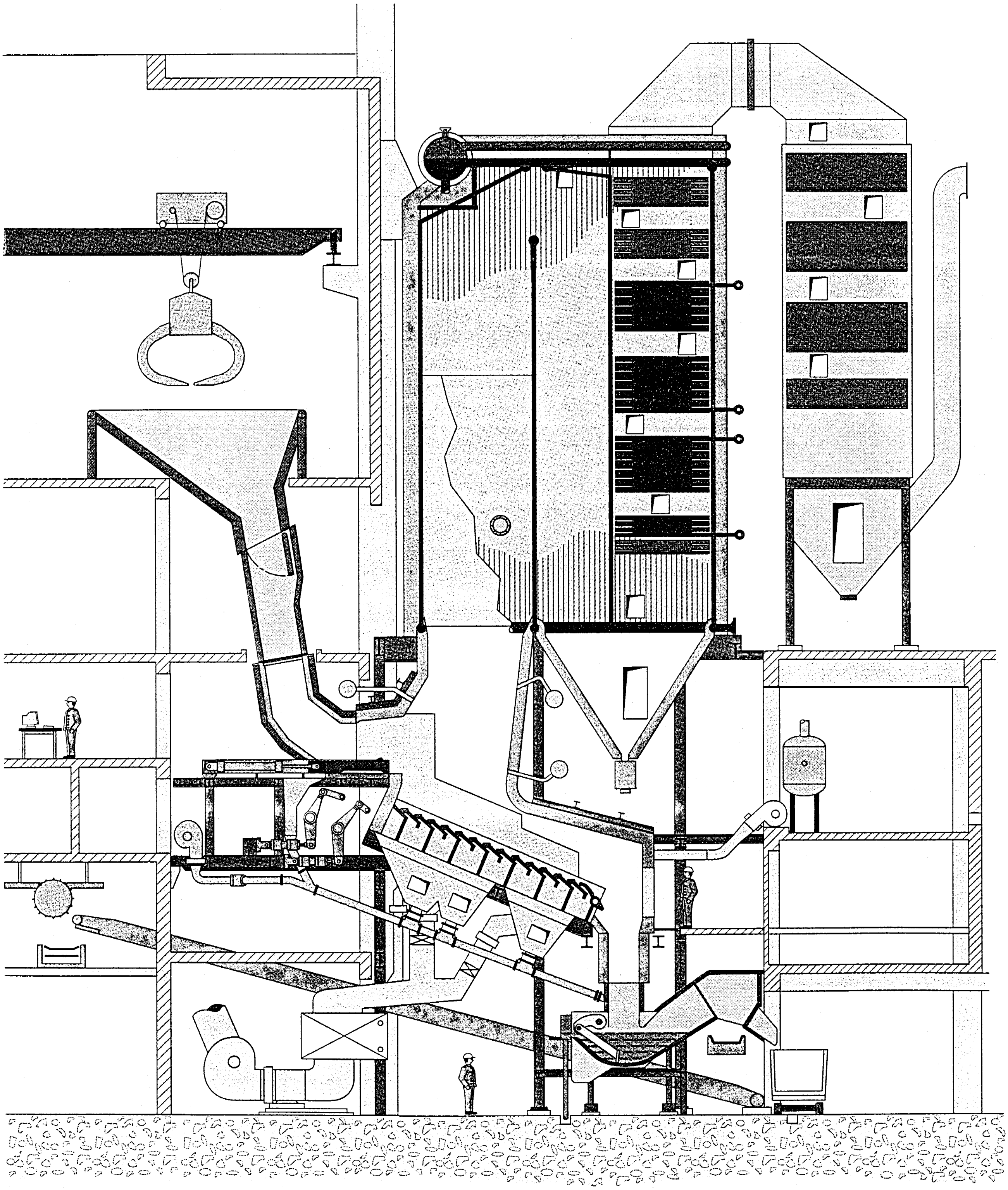
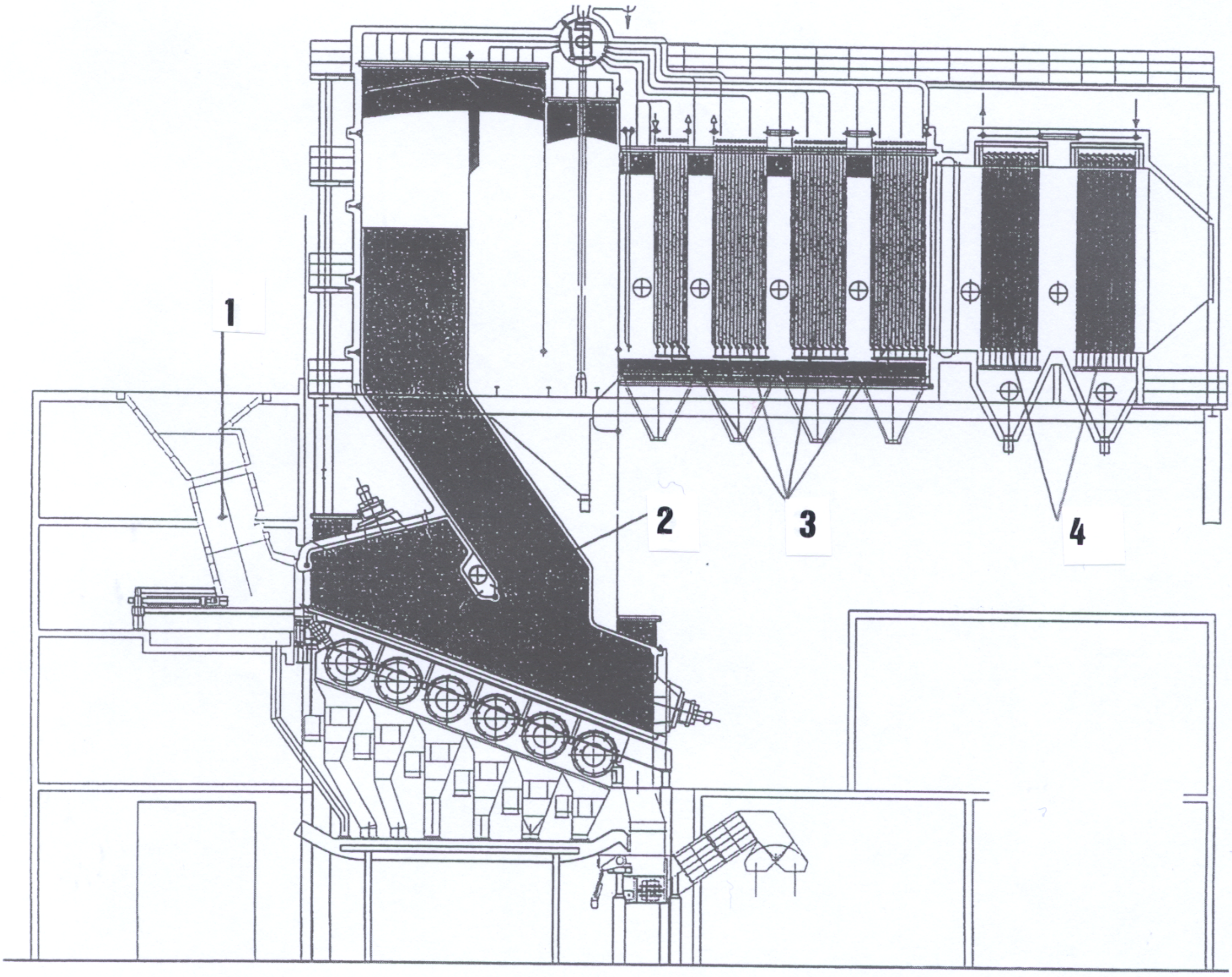


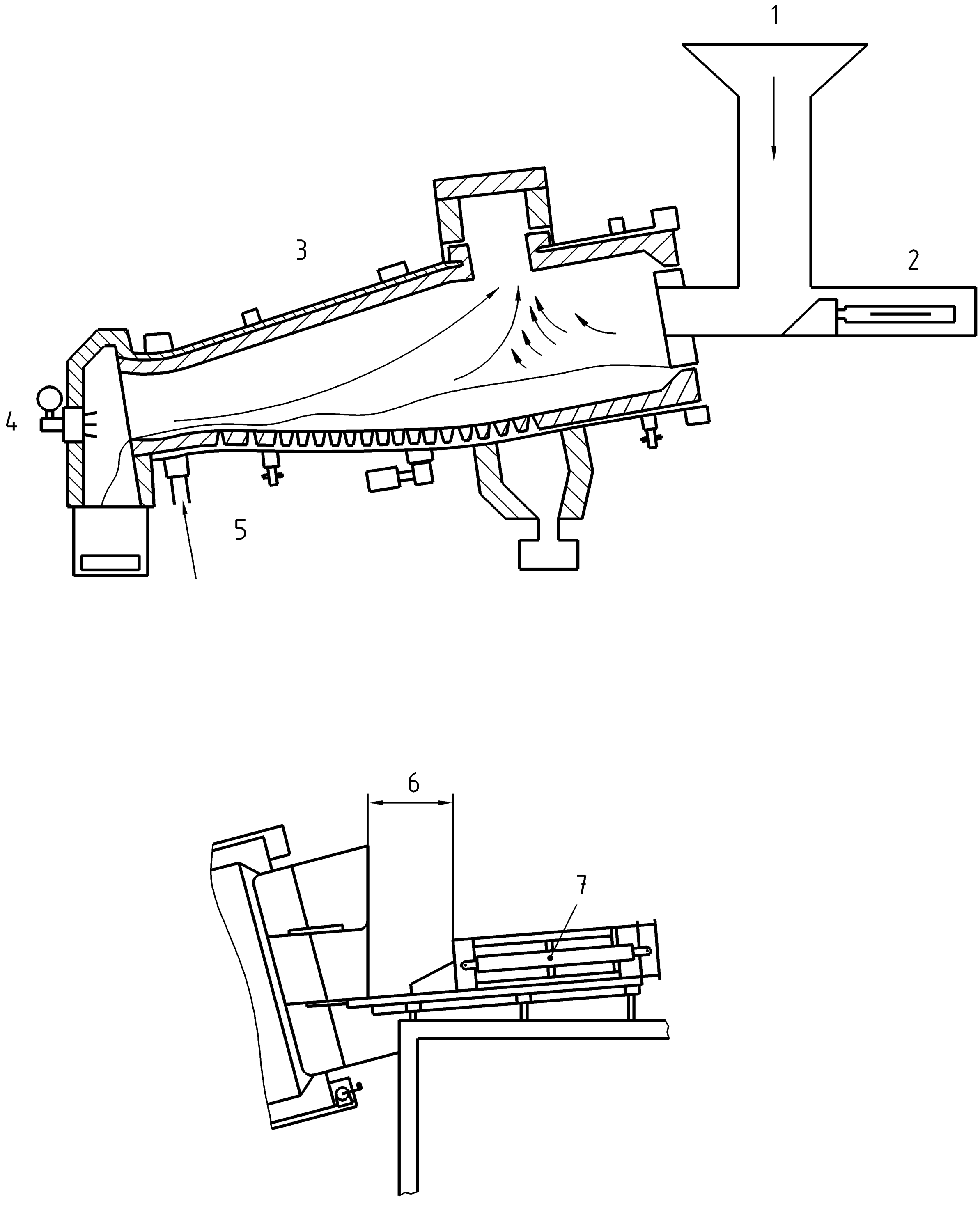
Figure B.1 — Grate furnace



Key

1 Spout
2 Grate/evaporator
3 Overheater
4 Fuel-saving device

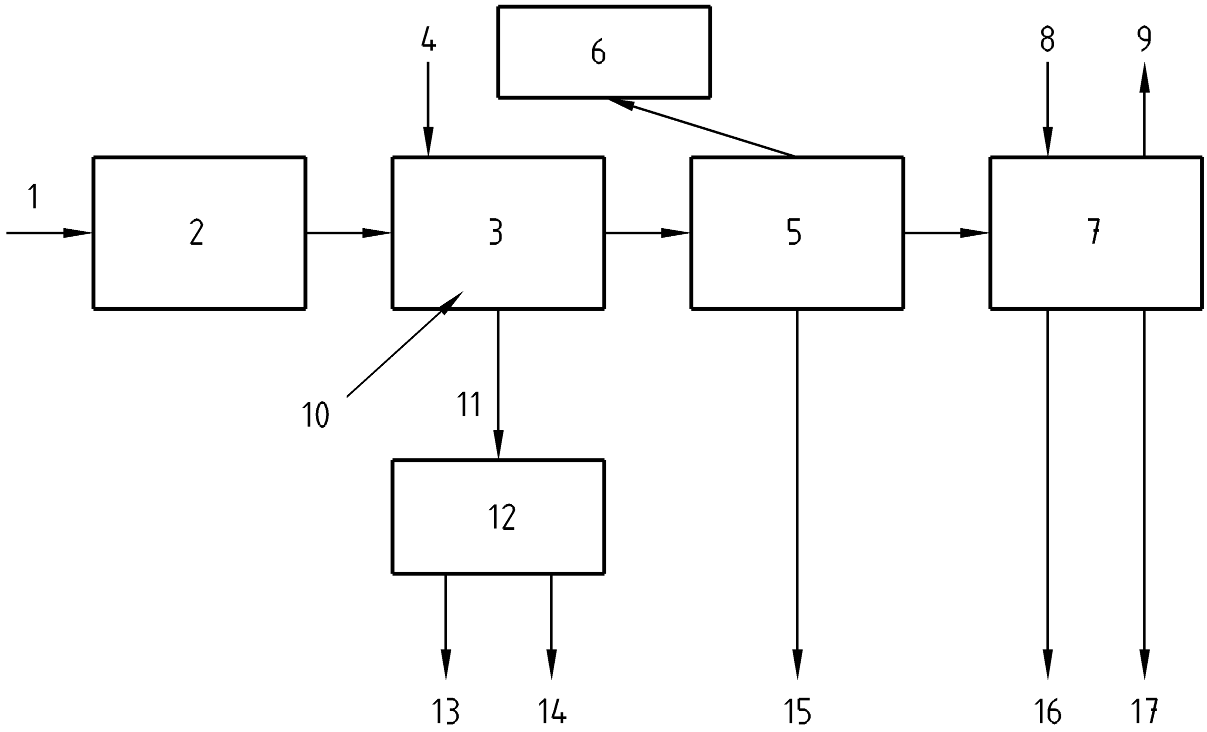
Figure B.2 — Roller furnace



Key

1 Introduction of wastes
2 Push rod
3 Oscillating chamber
4 Ignition burner
5 Air
6 Putting hopper
7 Push rod

Figure B.3 — Reciprocating kiln



Key

1 MSW(Mixing sludge and household wastes)
2 Pre-sorting and size reduction
3 Fluidised bed combustion
4 Sand
5 Steam production
6 Power generation
7 Flue gas cleaning
8 Additives
9 Cleaned stack gases
10 Air
11 Bed ash
12 Recovery
13 Recyclables (Fe/Al)
14 Bed ash
15 Boiler ash
16 Fly ash
17 Scrubber residue

Figure B.4 — Scheme of fluidised bed furnace

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CEN/TR 13767, *Characterization of sludges – Good practice for sludge incineration with and without grease and screenings*

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