



SLOVENSKI STANDARD
kSIST-TP FprCEN ISO/TR 20736:2023
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Predelava, recikliranje, obdelava in odlaganje blata - Navodilo za toplotno obdelavo blata (ISO/TR 20736:2021)

Sludge recovery, recycling, treatment and disposal - Guidance on thermal treatment of sludge (ISO/TR 20736:2021)

Schlammgewinnung, -verwertung, -behandlung und -beseitigung - Leitfaden für die thermische Behandlung von Schlamm (ISO/TR 20736:2021)

Valorisation, recyclage, traitement et élimination des boues - Lignes directrices pour le traitement thermique des boues (ISO/TR 20736:2021)

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**Sludge recovery, recycling, treatment
and disposal — Guidance on thermal
treatment of sludge**

*Valorisation, recyclage, traitement et élimination des boues — Lignes
directrices pour le traitement thermique des boues*

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword	vi
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviated terms	3
5 Sludge properties	4
5.1 General.....	4
5.2 Physico-chemical characteristics.....	4
5.2.1 General.....	4
5.2.2 Dry matter.....	4
5.2.3 Loss on ignition.....	4
5.2.4 Calorific value.....	5
5.2.5 Grease, scum and screening.....	5
5.2.6 Physical consistency and others.....	6
5.3 Chemical and microbiological characteristics.....	6
5.3.1 General.....	6
5.3.2 Sulfur.....	6
5.3.3 Phosphorus.....	7
5.3.4 Nitrogen.....	7
5.3.5 Chlorine and other halogens.....	7
5.3.6 Organic micro pollutants.....	7
5.3.7 Trace elements.....	8
5.3.8 Pathogens.....	8
6 Thermal processes fundamentals	8
6.1 General.....	8
6.2 Drying.....	9
6.3 Hydrolysis.....	10
6.4 Incineration.....	11
6.5 Pyrolysis.....	12
6.6 Gasification.....	13
6.7 Thermolysis.....	14
6.8 Carbonization.....	14
6.9 Wet oxidation.....	14
6.10 Melting.....	15
6.11 Pasteurization.....	15
7 Technologies	16
7.1 General.....	16
7.2 Drying.....	16
7.2.1 Direct dryers.....	16
7.2.2 Indirect dryers.....	20
7.2.3 Solar dryers.....	22
7.3 Hydrolysis.....	23
7.4 Incineration.....	24
7.4.1 Fluidized bed furnace.....	24
7.4.2 Multiple hearth furnace (MHF).....	28
7.4.3 Hybrid furnace.....	31
7.4.4 Others.....	32
7.5 Pyrolysis.....	33
7.6 Gasification.....	33
7.7 Thermolysis.....	35
7.8 Carbonization.....	36

ISO/TR 20736:2021(E)

7.9	Wet oxidation	36
7.10	Melting	37
7.11	Pasteurization	39
7.12	Emerging technologies	40
	7.12.1 General	40
	7.12.2 Oxidation technologies	40
	7.12.3 Enzymatic sludge hydrolysis	41
	7.12.4 Plasma gasification	41
	7.12.5 Ultrasound pretreatment	41
	7.12.6 Microwave irradiation	41
	7.12.7 Infrared radiation	42
7.13	Design aspects	42
7.14	Auxiliary equipment	42
	7.14.1 General	42
	7.14.2 Transport, receiving area, storage and feeding systems	43
	7.14.3 Heat supply and recovery	43
	7.14.4 Gas cleaning	44
	7.14.5 Ash and other residues handling	44
	7.14.6 Wastewater treatment	44
	7.14.7 Process monitoring	44
	7.14.8 Safety systems	45
8	Operational aspects	45
8.1	General	45
8.2	Drying	46
8.3	Hydrolysis	46
8.4	Incineration	46
	8.4.1 General	46
	8.4.2 Fluidized bed furnace	47
	8.4.3 Multiple hearth furnace	48
8.5	Pyrolysis	49
8.6	Gasification	49
8.7	Thermolysis	49
8.8	Carbonization	49
8.9	Wet oxidation	49
8.10	Melting	50
8.11	Pasteurization	50
8.12	Hazards	50
9	Management of energy and secondary resources	50
9.1	General	50
9.2	Drying	51
9.3	Hydrolysis	51
9.4	Incineration	51
9.5	Pyrolysis	52
9.6	Gasification	53
9.7	Thermolysis	54
9.8	Carbonization	54
9.9	Wet oxidation	54
9.10	Melting	54
9.11	Pasteurization	54
9.12	Thermal treatments and circular economy	55
10	Management of residues	55
10.1	General	55
10.2	Flue gas	55
	10.2.1 Characteristics and parameters	55
	10.2.2 Equipment	57
10.3	Ashes	59
	10.3.1 Composition/parameters	59

10.3.2	Processes and equipment	60
10.4	Wastewater	61
11	Decommissioning of installations	61
11.1	General	61
11.2	Specific considerations	61
12	Co-management with other organic wastes	62
12.1	General	62
12.2	Specific considerations	63
12.3	Additional storage and transport aspects	65
12.3.1	General	65
12.3.2	Storage	65
12.3.3	Transport	66
13	Assessment of sustainability	66
13.1	General	66
13.2	Environmental aspects	67
13.3	Economical aspects	67
13.4	Social aspects	67
Annex A (informative)	Calorific values calculations	69
Annex B (informative)	Various systems to input sludge into a household waste incineration plant	70
Annex C (informative)	Case studies	72
Annex D (informative)	Regulatory aspects	86
Bibliography		89

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ISO/TR 20736:2021(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 275, *Sludge recovery, recycling, treatment and disposal*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

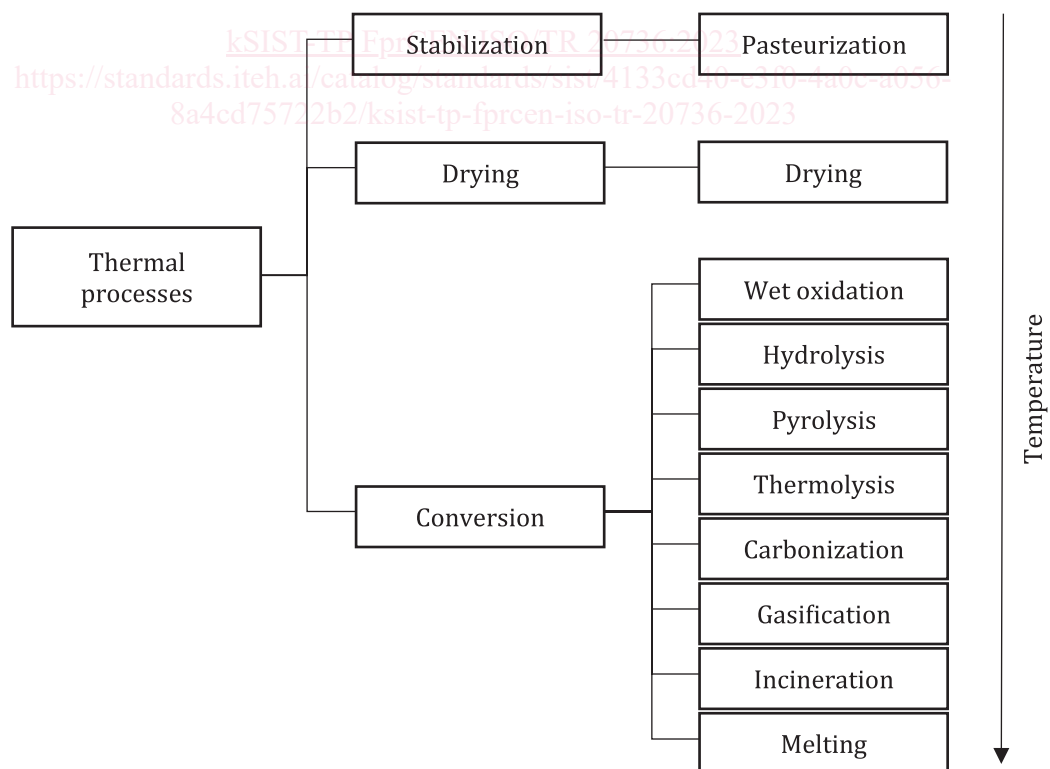
Sludge treatment and management is globally a growing challenge for most countries:

- sludge is a by-product of water treatment process produced in large quantities as new wastewater treatment facilities are built and the existing ones are upgraded to keep up with the population growth;
- sludge treatment and disposal constitutes one of the most significant costs associated with water and wastewater treatment;
- stricter regulations on conventional outlets such as beneficial agricultural land, composting, landfilling require more treatment due to concerns about the long-term impacts on public health and environment;
- sludge is now being considered as a source of renewable energy, and also a source of valuable components such as carbon and nutrients.

The growing trend to recover energy and resources from waste sludge and stricter regulations on outlets have created interest in a number of thermal treatments and may meet, under certain conditions, the circular economy principles.

The objective of this document is to pragmatically present the methods for thermal treatment of sludge by covering the different process fundamentals, the associated technologies and operational aspects, the management of energy, valuables and residues, the aspects related to impacts and integration of installations referring to them.

[Figure 1](#) highlights the thermal processes covered according to their main function and operating temperature.



NOTE The processes listed in the right column and connected to conversion and drying as main functions also achieve the sludge stabilization.

Figure 1 — Thermal processes covered by this document

Sludge recovery, recycling, treatment and disposal — Guidance on thermal treatment of sludge

1 Scope

This document describes good practices for the incineration and other organic matter treatment by thermal processes of sludges.

Thermal conditioning is excluded.

This document applies to sludges specifically derived from:

- storm water handling;
- night soil;
- urban wastewater collecting systems;
- urban wastewater treatment plants;
- treating industrial wastewater similar to urban wastewater.

It includes all sludge that may have similar environmental and/or health impacts but excludes hazardous sludge from industry and dredged sludge.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

melting

thermal treatment which makes sludge or ash temperature raising over melting point of sludge inorganic substances

3.2

drying

thermal treatment for evaporating water from dewatered sludge to control water content by heating

3.3

carbonization

part of *pyrolysis* (3.4), focusing on production of a solid secondary resource so-called bio-charcoal

ISO/TR 20736:2021(E)**3.4****pyrolysis**

thermal treatment without supply of oxygen

[SOURCE: CEN/TR 16788, 3.4]

3.5**gasification**

thermal treatment with less than the stoichiometric supply of oxygen or air (partial combustion)

3.6**char**

combination of non-combustible materials and carbon produced from devolatilization, *gasification* (3.5), *pyrolysis* (3.4) or *carbonization* (3.3) process

3.7**bio-charcoal****biochar**

solid secondary resource, generated from carbonization (or pyrolysis) process

3.8**thermal treatment**

treatment in which heat is applied to remove moisture, microbial content and organic compounds

3.9**thermal process**

technique for the application of *thermal treatment* (3.8)

3.10**combined treatment**

treatment of sludge and other waste in the same device

3.11**furnace**

enclosed chamber where combustion of organic matter takes place

3.12**boiler**

specific part of the thermal treatment plant where heat exchange takes place in view of recovering heat and energy

3.13**flue gas treatment**

any physical or chemical process aimed at cleaning the gas emission resulting from the *thermal treatment* (3.8) with regard to their discharge into the atmosphere

3.14**bottom ash**

combustion residue collected at the bottom of a combustion furnace

3.15**fly ash**

solid material that is entrained in a flue gas stream

3.16**energy recovery**

use of combustible waste as a means to generate energy through thermal treatment with recovery of heat

3.17**recycling**

activity in a production process to process waste materials for the original purpose or for other purposes, excluding *energy recovery* (3.16)

3.18**slag**

partially glassy by-product obtained by cooling a mineral liquid phase

3.19**energy efficiency**

amount of energy and/or heat recovery in relation to the energy content of input material

3.20**wet oxidation****wet air oxidation**

aqueous-phase oxidation of organics under pressure, using either air or oxygen as the oxidant

3.21**syngas**

mixture of gases (including carbon monoxide, hydrogen, methane, etc.) produced from *gasification* (3.5) or *pyrolysis* (3.4) process

3.22**combustion**

chemical and exothermic reaction with full oxidation of combustible materials

3.23**autothermal conditions**

conditions that keep combustion without auxiliary fuel and/or other external energy

3.24**paste-like sludge**

sludge capable of continuous flow under the effect of pressure above a certain threshold and having a shear resistance below a certain threshold

[SOURCE: CEN/TR 15463, 1.2.b]

3.25**solid sludge**

sludge having a shear resistance above a certain threshold

[SOURCE: CEN/TR 15463, 1.2.c]

4 Abbreviated terms

BAT	Best available technology
CFBF	Circulating fluidized bed furnace
DM	Dry matter
FBF	Fluidized bed furnace
GCV	Greater (or gross) calorific value
LCV	Lower (or net) calorific value
LOI	Loss on ignition

ISO/TR 20736:2021(E)

MHF	Multiple hearth furnace
MSW	Municipal solid waste
PFBF	Pressurized fluidized-bed furnace
SCR	Selective catalytic reduction
SNCR	Selective not catalytic reduction
3T	Temperature, turbulence and (residence) time

5 Sludge properties**5.1 General**

Sludge characterization for the assessment of thermal processes involves the evaluation of both technical and economic parameters. The main technical characteristics to evaluate the suitability of thermal process are DM or moisture content, calorific value, ash content. The main economic parameters are cost of processing, collection and transport, and the characteristics of the recovered materials and by-products.

5.2 Physico-chemical characteristics**5.2.1 General**

The main physico-chemical characteristics to be taken into account are:

- DM (or moisture content);
- loss on ignition;
- calorific value;
- amount of grease, scum and screenings.

Physical consistency, together with rheological properties, also play an important role, especially as far as the design of feeding system is concerned.

5.2.2 Dry matter

The DM, or moisture content, is of primary importance for thermal processes because it strongly affects the LCV of organic material which decreases when the moisture content increases.

In thermal processing of sewage sludge DM is a parameter affecting both fuel requirement and exhaust gas production. Generally, any increase in DM is believed to be beneficial in the combustion for the reduction in fuel requirement. When the condition for autothermal combustion, at a given temperature, is reached the increase in DM corresponds also to a decrease in combustion gases production. Any further increase of DM beyond the limit of autothermal combustion involves a more abundant gas production, due to dilution air or water needed for the control of the combustion chamber temperature depending on design of incineration plant. However, the use of water, reduces the quantity of recoverable heat in the boiler.

5.2.3 Loss on ignition

The loss on ignition represents the portion mass escaping as gas as a result of the ignition of the dry mass of sludge.

The loss of ignition is generally used as a measure of the volatile matter content but it should be noted that inorganic substances or decomposition products (e.g. H₂O, CO₂, SO₂, O₂) are released or absorbed and some inorganic substances are volatile under the reaction conditions.

It is measured by heating sludge in a furnace at 550 °C ± 25 °C (see Reference [4]) or 600 °C ± 25 °C (see Reference [18]) and expressed as percent of the dry mass. The loss on ignition can be used as an assessment of the organic part of the sludge, and is therefore related to its heat value.

The presence in the sludge of iron with oxidation during ignition from iron (II) to iron (III), and of calcium hydroxide or calcium oxide, when sludge is conditioned with lime, can involve decreasing of the loss on ignition value (see EN 15935).

5.2.4 Calorific value

Calorific value of sludge is a very important parameter for the evaluation of thermal processes, as it represents the heat quantity developed in the combustion process by the unit mass of material in standard conditions.

The calorific value can be expressed as (see EN 15170):

- GCV at constant volume which is absolute value of the specific energy of combustion, in Joules, for unit mass of a solid sludge burned in oxygen in a calorimetric bomb under the conditions specified. The products of combustion are assumed to consist of gaseous oxygen, nitrogen, carbon dioxide and sulfur dioxide, of liquid water (in equilibrium with its vapour) saturated with carbon dioxide under the conditions of the bomb reaction, and of solid ash, all at the reference temperature;
- LCV obtained by calculation from the gross calorific value provided that either the hydrogen content of the sludge or the amount of water found in the combustion test can be determined.

Sludge usually contains much water, combustible and incombustible solids. Therefore, their calorific value, especially on the “as received” basis is quite low.

The calculation of calorific value of sludge can be expressed per LOI (loss on ignition) or DM.

Typical calorific values of municipal wastewater sludge range from 22,1 MJ/kg LOI to 24,4 MJ/kg LOI (anaerobically digested primary) to 23,3 MJ/kg LOI to 27,9 MJ/kg LOI (raw primary). Secondary sludge displays values between 20,7 MJ/kg LOI and 24,4 MJ/kg LOI.

Given typical values of organic matter content (LOI), the calorific value of sludge would generally be in the range of 12 MJ/kg to 17 MJ/kg DM for non-digested sludge, 10 MJ/kg to 12 MJ/kg DM for digested sludge.

GCV and LCV values can be calculated according to the standard method EN 15170, while the procedures for the theoretical calculation of GCV and LCV are reported in [Annex A](#).

5.2.5 Grease, scum and screenings

Grease, scum and screenings can be thermally treated together with sludge but generally they pose several problems.

Screenings clog feed mechanisms for certain types of furnace and therefore grinding or shredding is advisable before feeding. Screenings also contain bulky and incombustible materials, which create problems in the ash disposal system.

Skimmed material generally contains more than 95 % moisture and therefore should be dewatered to at least 25 % solids before treatment. Skimming is difficult to handle in the dewatered state due to its viscosity and a heating process to 70 °C to 80 °C is generally requested to get skimming pumpable. After dewatering, scum solids should be ground to a size not exceeding 6 mm. GCV of skimming and screenings are in the range 37 000 to 44 000 kJ/kg DM and 23 000 to 25 600 kJ/kg DM, respectively.