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Trdno alternativno gorivo - Metode za vzorļ enje

Solid recovered fuels - Methods for sampling

Feste Sekundärbrennstoffe - Verfahren zur Probenahme

Combustibles solides de récupération - Méthodes d'échantillonnage

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Solid recovered fuels - Methods for sampling

Combustibles solides de récupération - Méthodes d'échantillonnage

Feste Sekundärbrennstoffe - Verfahren zur Probenahme

This Technical Specification (CEN/TS) was approved by CEN on 13 May 2006 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (CEN/TS 15442:2006) has been prepared by Technical Committee CEN/TC 343 “Solid recovered fuels”, the secretariat of which is held by SFS.

This document is one of a series of Technical Specifications dealing with solid recovered fuel.

CEN/TS 15442, *Solid recovered fuels — Methods for sampling*

CEN/TS 15443, *Solid recovered fuels — Methods for laboratory sample preparation*

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

Introduction

The testing of solid recovered fuel enables informed decisions about their subsequent handling and use. In order to carry out a test on a solid recovered fuel a sample of the material is required. Before any sampling operation is devised it is important that the objectives for sampling are clearly identified and subsequently well executed to ensure that the expectations of any involved parties are recognized and satisfied. The identification of objectives helps to define the level of testing required, e.g. thorough examination or routine testing and in addition desired reliability of testing / assessment and frequency of testing. The sampling objectives, along with the sequence of operations required to fulfil them are detailed in an overall sampling plan. After a sampling plan has been prepared the sampling of solid recovered fuel itself can be implemented.

Figure 1 shows the links between the essential elements of a testing program.

Sampling procedures are provided for a range of process streams and common storage conditions. The sampling technique adopted depends on a combination of different characteristics of the material and circumstances encountered at the sampling location. The determining factors are:

— the type of solid recovered fuel;

— the situation at the sampling location/ the way in which the material occurs (e.g. in a stockpile, on a conveyor belt, in a lorry);

— the (expected) degree of heterogeneity (e.g. monostreams, mixed fuels, blended fuels).

This Technical Specification is primarily geared toward laboratories, producers, suppliers and purchasers of solid recovered fuels, but is also useful for the authorities and inspection organizations.

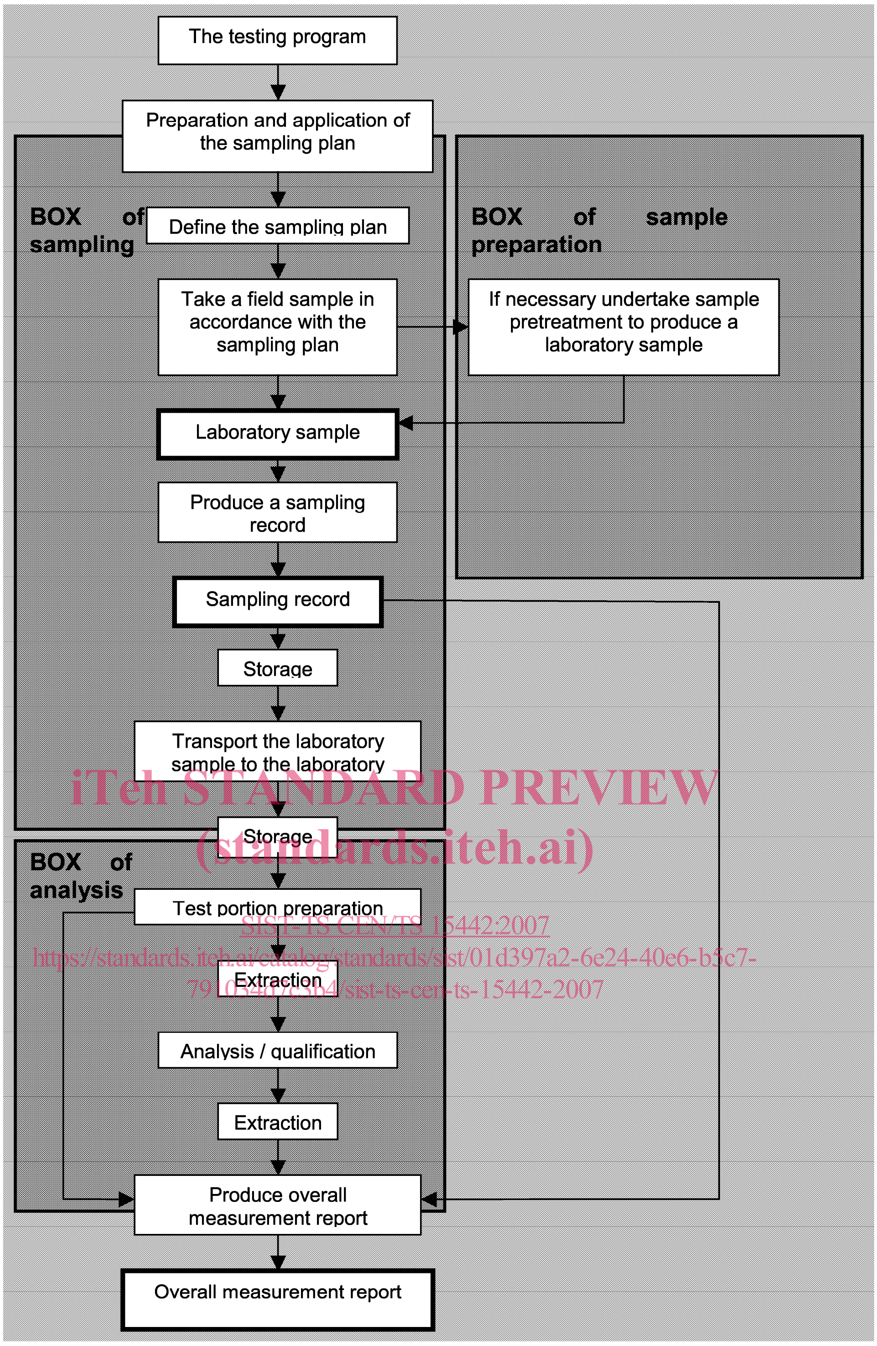

Figure 1 — Links between the essential elements of a testing program

This Technical Specification describes methods for taking samples of solid recovered fuels for example from production plants, from deliveries or from stock. It includes manual and mechanical methods.

It is not applicable to solid recovered fuels that are formed by liquid or sludge, but it includes dewatered sludge.

Technical Specifications for sampling of solid biofuels are available from Technical Committee CEN/TC 335 “Solid biofuels” (1) (2) (3). A European standard and a Technical Report for the sampling for the purpose of the characterization of waste are available from CEN/TC 292 (4) (5).

1 Scope

This Technical Specification describes methods for taking samples of solid recovered fuels for example from production plants, from deliveries or from stock. It includes manual and mechanical methods.

It is not applicable to solid recovered fuels that are formed by liquid or sludge, but it includes dewatered sludge.

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.

CEN/TS 15357:2006, *Solid recovered fuels — Terminology, definitions and descriptions*

CEN/TS 15401, *Solid recovered fuels — Methods for the determination of bulk density*

CEN/TS 15413, *Solid recovered fuels — Methods for the preparation of the test sample from the laboratory sample*

CEN/TS 15415, *Solid recovered fuels — Determination of particle size distribution by screen method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CEN/TS 15357:2006 and the following apply.

3.1
coefficient of variation
a measure of dispersion of a probability distribution, defined as the ratio of the standard deviation (this is the positive square root of the average of squared deviations from the mean) to the arithmetic mean of a set of measurements

3.2
effective increment size
minimum sample size divided by the number of increments

NOTE The effective increment size should never be smaller than the minimum increment size.

3.3
effective sample size
effective increment size multiplied by the number of increments

NOTE The effective sample size should never be smaller than the minimum sample size.

3.4
general analysis sample
sub-sample of a laboratory sample having a nominal top size of 1 mm or less and used for a number chemical and physical analysis

3.5
heterogeneity
degree to which a property or a solid recovered fuel component is not uniformly distributed throughout a quantity of material

3.6
homogeneity
degree to which a property or a solid recovered fuel component is uniformly distributed throughout a quantity of material

3.7
increment
portion of solid recovered fuel extracted in a single operation of the sampling device

3.8
lot
quantity of SRF produced during a consecutive period, provided that in this period no significant changes occur in the types of waste used in the production process

NOTE The different types of waste are identified by the number of the European Waste List (6).

3.9
minimum increment size
minimum dimensions or size of the increment that shall be taken from a lot, from the point of view of preserving its representativeness

NOTE The product of the minimum increment size and the number of increments to be taken should never be smaller than the minimum sample size.

3.10
minimum sample size
minimum sample size required during sampling and sample preparation from the point of view of preserving its representativeness

NOTE The minimum sample size is equal to the effective increment size multiplied by the number of increments, and is linked directly to the nominal top size (d_{95}).

3.11
nominal top size
d_{95}
aperture size of the sieve used in the CEN/TS 15415 through which at least 95 % by mass of the material passes

3.12
probabilistic sampling
sampling conducted according to the statistical principles of sampling

3.13
random sampling
taking a sample from a lot in such a way that all possible samples have the same probability of being taken

[ISO 3534-1:1993]

3.14
sample
quantity of material, representative of a larger quantity for which the property is to be determined

3.15
sample preparation
all the actions taken to obtain representative analysis samples or test portions from the original sample

3.16
sampling
process of drawing or constituting a sample

[ISO 3534-1:1993]

3.17
sampling plan
predetermined procedure for the selection , withdrawal, preservation, transportation and preparation of the portions to be removed from a population as a sample
[ISO 11074:2005]

3.18
sampling record
report which serves as a check list and provides the investigator with all necessary information about the sampling techniques applied at the site and any additional important information

[ISO 11074:2005]

3.19
shape factor
s
factor that corrects the dimensions of the minimum sample size in the event that the particles in a lot are not granular

3.20
static lot
lot that is not in motion during the sampling, or transported by a conveyor or alternative transport system

3.21
stratified arbitrary sampling
sample consisting of portions obtained from identified subparts (strata) of the parent population. Within each stratum, the samples are taken arbitrarily

3.22
stratified sample
sample consisting of portions obtained from identified subparts (strata) of the parent population

3.23
stratified random sample
sample consisting of portions obtained from identified subparts (strata) of the parent population. Within each stratum, the samples are taken randomly

4 Symbols and abbreviated terms

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

b is the breadth of a flowstream, in m

C_v is the coefficient of variation

d_{05} is the nominal minimum size (a mass fraction of 5 % of the particles are smaller than d_{05}), in mm

d_{95} is the nominal top size of a particle (a mass fraction of 95 % of the particles are smaller than d_{95}), in mm

g is the correction factor for distribution in the particle size

G is the conveyor load, in kg/m

λ_g is the density of the particles in the solid recovered fuel (particle density), in kg/m^3

m is mass, in kg

n is the number of increments to be taken per lot

p is the fraction of the particles with a specific characteristic (such as a specific contaminant), in g/g, and is equal to 0,1

Φ_f is the bulk density of the flow, in kg/m^3

Φ_d is the drop speed, in kg/s

s is the shape factor, in m^3/m^3

V is volume

v is conveyor speed, in m/s

5 Principle

Every particle in the lot or sub-lot to be represented by the sample should have an equal probability of being included in the sample. When this principle cannot be applied in practice, the sampler shall note the limitations in the sampling plan.

6 Development of a sampling plan

6.1 Principle

From a pre-defined lot of solid recovered fuel, samples shall be taken representatively on the basis of a sampling plan that shall be drawn up before the sampling takes place, according to Annex A. The sampling plan shall be drawn up on the basis of the objective for the sampling process, using the available data on a solid recovered fuel and the accessibility of the lot, see Annex B. The sampling plan shall be completed. If certain estimates concerning specific parameters relating to the lot cannot be determined with sufficient certainty on the basis of the information available, these shall be verified in the field. If necessary, the sampling plan shall be adjusted in the field and the deviations shall be reported in the sampling record. Figure 2 shows the actions that are necessary for the development of a sampling plan.

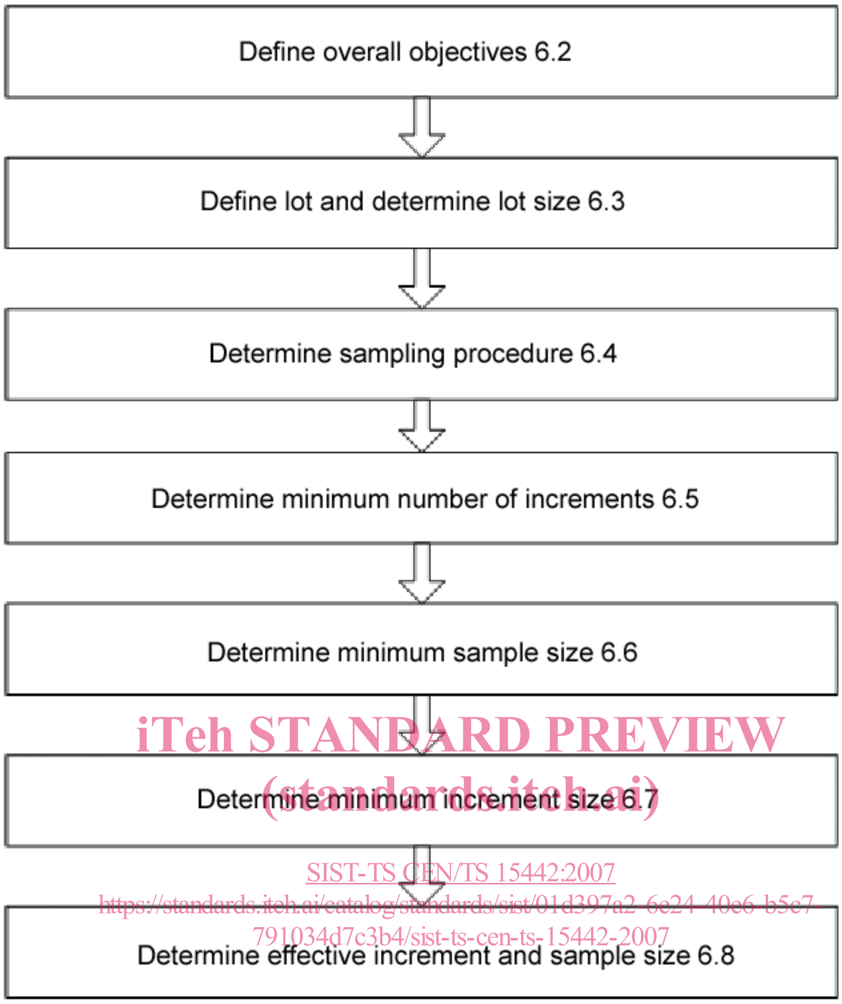

Figure 2 — Necessary elements for the development of a sampling plan

6.2 Definition of overall objectives

The sampling plan shall specify the objectives of the sampling program through consultation with all involved parties. These involved parties are e.g. the client, the producer of the solid recovered fuel, the sampler. The sampling plan shall specify the primary objectives of the sampling program. The sampling plan shall meet the requirements of objectives. If it is not possible to meet all requirements following the objectives for sampling in one single document sampling plan, two or more sampling plans shall be made in order to achieve adequate sampling plans for all objectives.

The sampling plan(s) shall identify any special precautions to be followed where the solid recovered fuel to be sampled is hazardous to human health.

6.3 Definition of a lot and determining lot size

6.3.1 General

The lot shall be defined on the basis of the way in which the material is or has been produced and/or is offered (upon delivery, upon acceptance, upon storage or in store, for instance). The lot size relates to a quantity of material delivered on the basis of one specification. This material is agreed on by contract as a unit, and is identifiable as such. The maximum weight of a lot or sub-lot, for sampling purposes, shall be no more than 1,5 kg $\times 10^6$ kg.

If the contracted lot weighs more than 1,5 kg $\times 10^6$ kg or when a year production is less than 15 kg $\times 10^6$ kg or 1/10th of a year production, the quantity of material above the maximum permitted weight of 1,5 kg $\times 10^6$ kg shall be regarded, for sampling purposes, as a new lot or sub-lot.

NOTE When selecting in a contract the size of a lot, the contractual partners should consider specific aspects e.g. the stability of the supply and the production process, the production amount of the plant etc.

The following lot definitions are possible:

6.3.2 Definition of a lot in case of transport by truck

The total lot shall compromise to the contents of the entire series of 1 or more trucks used to transport the lot.

6.3.3 Definition of a lot in case of transport by ship

The total lot shall compromise to the contents of the entire series of 1 or more ships used to transport the lot. If the ship contains more than 1,5 kg $\times 10^6$ kg the ship shall be divided in such a number of sub-lots that the size of a sub-lot is no more than 1,5 kg $\times 10^6$ kg.

If one ship contains several lots (in other words, quantities of material that differ from each other with regard to the specifications agreed on in a contract with the producer of the material beforehand), these lots shall be stored in separate compartments in the ship. In that case, a lot relates to the quantity of material that is transported and delivered by separate compartments.

6.3.4 Definition of a lot in case of transport by rail

The delivery of material by rail may be regarded in the same way as the delivery of material by truck.

6.3.5 Definition of a lot in case of sampling from a storage

If the material has been stored at the producer's or purchaser's premises in a (temporary) store, the lot relates to the quantity of material with the specifications agreed on beforehand in a contract within a demarcated area.

6.4 Determination of the sampling procedure

The sampling method that shall be used shall be representative. Therefore, the material shall preferably be sampled from a moving transport medium. Various sampling methods exist. In the list below these methods are shown in the order of preference in which the methods shall be used. The representativeness decreases as you go down the list. You shall only opt for a less representative method if a more representative one is not possible in the existing situation.

a) mechanically from a drop flow. The method specified in Annex G shall be used for this situation;

b) mechanically from a moving conveyor. The method specified in Annex G shall be used for this situation;

c) manually from a stationary conveyor. The method specified in Annex G shall be used for this situation;

d) manually from a drop flow. The method specified in Annex G shall be used for this situation;

e) manually from a vehicle. The method specified in Annex H shall be used for this situation;

f) from a (temporary) store. The method specified in Annex H shall be used for this situation.

6.5 Determination of the number of increments

The minimum number of increments shall be 24.

It is possible to take more increments. Reasons for taking more increments can be:

— if more sample material is required;

— if it is easier to stratify the lot in different number of strata e.g. 25;

— increments can be taken by splitting the lot in 5 by 5 strata.

6.6 Determination of minimum sample size

In Annex D it is specified how the minimum sample size shall be determined.

6.7 Determination of the minimum increment size

6.7.1 Determination of minimum increment size for material flows

If samples are taken from a material flow or from a conveyor, the minimum increment size shall be determined using the instructions in Annex E, in which a distinction is made between the following situations for the purposes of determining the minimum increment size:

— mechanical and manual sampling from a drop flow;

— sampling from a conveyor. Here, for the purposes of determining the minimum increment size, no distinction is made between mechanical sampling from a moving conveyor and manual sampling from a stationary conveyor.

6.7.2 Determination of the minimum increment size for static lots or vehicle

If samples are taken from static lots or vehicles (truck, ship), the minimum increment size shall be determined using the instructions in Annex F.

6.8 Determination of the effective increment and sample sizes

6.8.1 Correction for an inadequate relation between increment size and sample size

The sampling plan shall both meet minimum increment and sample size for the required number of increments. Therefore the effective increment and sample size may be larger than the minimum increment and sample size.

a) The effective increment size shall be the minimum increments unless minimum sample size divided by the number of increments exceeds the minimum increment size. In this case the effective increment size shall be equal to the minimum sample size divided by the number of increments.

b) The effective sample size shall be the minimum sample unless minimum increment size times the number of increments exceeds the minimum sample size. In this case the effective sample size shall be equal to the minimum sample size divided by the number of increments.

If the minimum sample size is lower than the minimum increment size times the number of increments then the effective sample size shall be equal to the minimum increment size times the number of increments.

6.8.2 Correction for the requirements from the laboratory

Besides the correction for the required sample size in 6.8.1 the effective sample shall also meet the minimum sample size required by the laboratory. Annex I shows the required test portion sizes per analyses. Using Annex I the minimum sample size according the laboratory shall be calculated. If this sample size is larger than the effective sample then the effective sample size shall be increased in order to meet the requirements for the test portions of the laboratory.

6.9 Selection of distribution of increments over a lot

The increments shall be taken scattered all over the lot. Each particle in the lot shall have an equal chance of ending up in the sample. The following sampling methods (arranged in decreasing order of preference) shall be used:

a) stratified random sampling;

b) stratified arbitrary sampling;

c) stratified sampling.

“Stratified” means that a quantity of material (expressed as a mass or volume) or a time block is divided into a specific number of equal strata (sections).

EXAMPLE

A quantity of solid recovered fuel weighing 1 kg $\times 10^6$ kg is transported via a conveyor at a speed of 125.000 kg/h. The prescribed number of increments is 24. The duration of the transport is 1 000/125 = 8 h (480 min), and the duration of each stratum is therefore 480/24 = 20 min. The 24 increments can then be taken within each time stratum at an arbitrary point in time, say at t = 10 min (within the stratum 0 min – 20 min), t = 25 min (within the stratum 20 min – 40 min), t = 43 min (within the stratum 40 min – 60 min), t = 75 min (within the stratum 60 min – 80 min), t = 93 min (within the stratum 80 min – 100 min), and so on.

7 Implementation of a sampling plan

7.1 Sampling from a material flow

7.1.1 General

A sampling plan shall be made for sampling from a material flow or moving transport medium. Therefore the minimum sample and increment sizes shall be determined by following the instructions in Annex E. The effective increment and sample sizes shall be determined as per 6.8. The way in which sampling from material flows shall be carried out is specified in Annex G.

7.1.2 Implementation sampling from a material flow

When sampling from a moving transport medium, the sampling time for each increment shall be determined. In 6.9 it is shown how distribution of the increments shall be selected.

Determination of stratified arbitrary points in time requires the following approach:

a) determine the time needed for the entire lot to be transported via the conveyor concerned;

b) determine the duration of a stratum by dividing the total transport time by the required number of increments. Within each time stratum, a sampling time can be chosen arbitrarily.

The sampling shall be implemented by performing the complete sampling plan.