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Solid recovered fuels — Methods for sampling

Combustibles solides de récupération — Méthodes d'échantillonnage

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Contents

Page

Foreword

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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).

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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 300, *Solid recovered fuels*.

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

The testing of solid recovered fuels (SRF) 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 SRF itself can be implemented.

This document is largely based on the work already done by CEN/TC 292 "*Characterization of waste*" (now integrated in CEN/TC 444 "Environmental characterization of solid matrices"), in particular EN 14899:2005[1] and CEN/TR 15310-1:2006[2].

The main characteristic that makes SRF samples significantly different from other kinds of waste is that SRFs are very often solid, but neither "granular" nor monolithic; it often happens that SRF samples are fibrous-like materials. This typical characteristic of SRF implies that the statistical formula for sampling of EN 14899:2005 and CEN/TR 15310-1:2006, Annex D are not applicable without amendment. The "shape factor" (f) is additionally needed in the statistical formula.

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

Sampling of solid biofuels is described in ISO 18135[3].

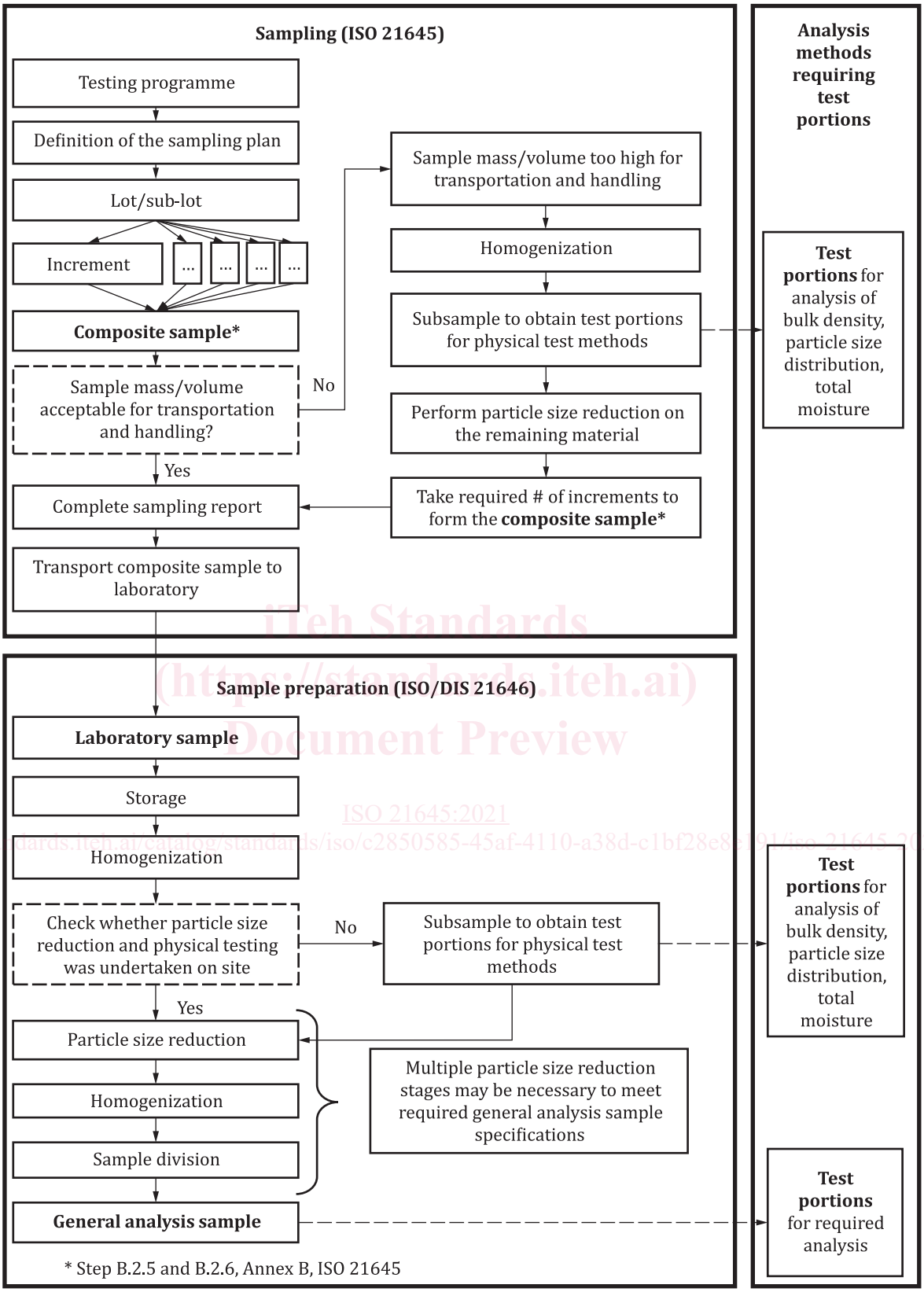

Figure 1 — Links between the essential elements of a testing program

Solid recovered fuels — Methods for sampling

1 Scope

This document specifies 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 documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 21637, *Solid recovered fuels — Terminology, definitions and descriptions*

ISO 21640:—[1)], *Solid recovered fuels — Specifications and classes*

ISO 21644, *Solid recovered fuels — Methods for the determination of biomass content*

ISO 21654, *Solid recovered fuels — Determination of calorific value*

ISO 21656, *Solid recovered fuels — Determination of ash content*

ISO 21660-3, *Solid recovered fuels — Determination of moisture content using the oven dry method — Part 3: Moisture in general analysis sample*

ISO 21663, *Solid recovered fuels — Methods for the determination of carbon (C), hydrogen (H) and nitrogen (N) content*

ISO 22167, *Solid recovered fuels — Determination of the content of volatile matter*

EN 15408, *Solid recovered fuels — Method for the determination of sulphur (S), chlorine (Cl), fluorine (F) and bromine (Br) content*

EN 15410, *Solid recovered fuels — Method for the determination of the content of major elements (Al, Ca, Fe, K, Mg, Na, P, Si, Ti)*

EN 15411, *Solid recovered fuels — Methods for the determination of the content of trace elements (As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mo, Mn, Ni, Pb, Sb, Se, Tl, V and Zn)*

EN 15415-1, *Solid recovered fuels — Determination of particle size distribution — Part 1: Screen method for small dimension particles*

EN 15415-2, *Solid recovered fuels — Determination of particle size distribution — Part 2: Maximum projected length method (manual) for large dimension particles*

EN 15415-3, *Solid recovered fuels — Determination of particle size distribution — Part 3: Method by image analysis for large dimension particles*

CEN/TS 15401, *Solid recovered fuels — Determination of bulk density*

CEN/TR 15404, *Solid recovered fuels — Methods for the determination of ash melting behaviour by using characteristic temperatures*

1) Under preparation. Stage at the time of publication ISO/FDIS 21640.

CEN/TS 15405, *Solid recovered fuels —Determination of density of pellets and briquettes*

CEN/TS 15406, *Solid recovered fuels —Determination of bridging properties of bulk material*

CEN/TS 15412, *Solid recovered fuels — Methods for the determination of metallic aluminum*

CEN/TS 15414-1, *Solid recovered fuels — Determination of moisture content using the oven dry method — Part 1: Determination of total moisture by a reference method*

CEN/TS 15414-2, *Solid recovered fuels — Determination of moisture content using the oven dry method — Part 2: Determination of total moisture by a simplified method*

CEN/TS 15639, *Solid recovered fuels — Determination of mechanical durability of pellets*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21637 and the following 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
coefficient of variation
estimate of the standard deviation of a population from a *sample* (3.28) of n results divided by the mean of that sample

Note 1 to entry: The coefficient of variation is frequently stated as a percentage.

Note 2 to entry: Adapted from Eurachem/Citac Guide CG 4[4].

3.2
composite sample mass
amount of *sample* (3.28) taken from a *lot* (3.11) or a *sub-lot* (3.40) consisting of all the *increments* (3.9)

3.3
distribution factor
correction factor for the *particle size distribution* (3.20) of the material to be sampled

[SOURCE: ISO 21637:2020, 3.17]

3.4
drop flow
material flow falling over an overflow point or a drop point in a transport system

[SOURCE: ISO 21637:2020, 3.18]

3.5
duplicate sample
two *samples* (3.28) taken under comparable conditions

Note 1 to entry: This selection may be accomplished by taking units adjacent in time or space.

Note 2 to entry: The replicate sample is usually used to estimate sample variability.

[SOURCE: ISO 21637:2020, 3.23, modified – Note 2 to entry has been added.]

3.6
general analysis sample
sub-sample (3.41) of a *laboratory sample* (3.10) having a nominal top size of 1 mm or less and used for a number of chemical and physical analyses

3.7
heterogeneity
degree to which a property or type of particle of a *solid recovered fuel* (3.34) is not uniformly distributed throughout a quantity of material

[SOURCE: ISO 21637:2020, 3.36]

3.8
homogeneity
degree to which a property or type of particle of a *solid recovered fuel* (3.34) is uniformly distributed throughout a quantity of material

[SOURCE: ISO 21637:2020, 3.37]

3.9
increment
portion of *solid recovered fuel* (3.34) extracted from a *lot* (3.11) or *sub-lot* (3.40) in a single operation of the *sampling* (3.30) device

[SOURCE: ISO 21637:2020, 3.39]

3.10
laboratory sample
composite *sample* (3.28) received by the laboratory on which *sample preparation* (3.29) procedures for analysis are undertaken

Note 1 to entry: When the laboratory sample is further prepared by mixing, subdividing, particle size reduction or by combinations of these operations, the result is the general analysis sample. A test portion is removed from the general analysis sample for the performance of the test or for analysis. When no preparation of the laboratory sample is required, the test portion may be taken directly from the laboratory sample.

3.11
lot
defined quantity of fuel for which the quality is to be determined

Note 1 to entry: A lot may be divided into sub-lots.

[SOURCE: ISO 13909-1:2016, 3.16[5]]

3.12
mechanical durability
ability of densified fuels to remain intact during handling and transportation

Note 1 to entry: Typical measures of resistance are shock and/or abrasion as a consequence of handling and transportation processes, characterized by disintegration and fines formulation.

Note 2 to entry: Examples are briquettes and pellets.

[SOURCE: ISO 21637:2020, 3.41]

3.13
minimum increment mass
minimum dimension or mass of the increment that is taken from a *lot* (3.11) in a single operation of the *sampling* (3.29) device from the point of view of preserving its representativeness

3.14
minimum sample mass
minimum amount or dimension of the sample required during *sampling* (3.30) and *sample preparation* (3.29) from the point of view of preserving its representativeness

Note 1 to entry: The minimum sample mass is at least equal to the increment mass multiplied by the number of increments, and is linked directly to the nominal top size.

3.15
moisture
water removable under specific conditions

Note 1 to entry: See also *total moisture* (3.43).

[SOURCE: ISO 21637:2020, 3.46, modified – Note 1 to entry has been added.]

3.16
nominal minimum size
d_{05}
smallest aperture size of the sieve used for determining the *particle size distribution* (3.20) of solid fuels through which at least 5 % by mass of the material passes

3.17
nominal top size
d_{95}
smallest aperture size of the sieve used for determining the *particle size distribution* (3.20) of *solid recovered fuels* (3.34) through which at least 95 % by mass of the total material passes through the sieve

[SOURCE: ISO 21637:2020, 3.48]

3.18
particle density
density of a single particle

Note 1 to entry: Pores within the particle are included.

[SOURCE: ISO 21637:2020, 3.52]

3.19
particle size
size of the fuel particles as determined in a solid fuel

Note 1 to entry: Different methods of determination can give different results.

Note 2 to entry: See also *particle size distribution* (3.20).

3.20
particle size distribution
proportions of various *particle sizes* (3.19) in a solid fuel

3.21
particle size reduction
reduction of the *nominal top size* (3.17) of a *sample* (3.28) or *sub-sample* (3.41)

3.22
planned increment mass
planned dimension or mass of the *increment* (3.9) that is taken from a *lot* (3.11) in a single operation of the *sampling* (3.30) device

3.23
planned sample mass
sample (3.28) amount or dimension that is planned to be taken during *sampling* (3.29)

Note 1 to entry: The planned sample mass is derived from the minimum sample mass and includes additional considerations regarding the sampling procedure, practical handling and storage and the required sample amounts for analysis.

Note 2 to entry: The planned sample mass can be equal to the minimum sample mass.

3.24
precision
closeness of agreement between independent test/measurement results obtained under stipulated conditions

Note 1 to entry: Precision depends only on the distribution of random errors and does not relate to the true value or the specified value.

Note 2 to entry: The measure of precision is usually expressed in terms of imprecision and computed as a standard deviation of the test results or measurement results. Less precision is reflected by a larger standard deviation.

Note 3 to entry: Quantitative measures of precision depend critically on the stipulated conditions.

[SOURCE: ISO 3534-2:2006, 3.3.4[6], modified – Second sentence of Note 3 to entry has been removed.]

3.25
producer
organization or unit responsible for the production of *solid recovered fuel* (3.34)

Note 1 to entry: The producer can also be the supplier of the fuel.

Note 2 to entry: The producer may not directly produce or process non-hazardous waste into solid recovered fuel but may receive material appropriate to its requirements and already meeting the minimum criteria of ISO 21640:—.

[SOURCE: ISO 21637:2020, 3.60]

3.26
random sampling
taking a *sample* (3.28) at a random location within a specified range or from a specified *lot* (3.11) such that every portion of the *solid recovered fuel* (3.34) would have the same chance of being part of the sample

Note 1 to entry: A random location is determined by lot.

3.27
replicate sampling
taking of *increments* (3.9) at intervals, which are combined in rotation into different containers to give two or more *samples* (3.28) of approximately equal mass

Note 1 to entry: The replicate sampling is usually used to estimate sample variability.

3.28
sample
quantity of material, from a larger amount for which the quality is to be determined

Note 1 to entry: See also *increment* (3.9).

[SOURCE: ISO 21637:2020, 3.63, modified – Note 2 and 3 to entry have been removed.]

3.29
sample preparation
actions taken to obtain representative *laboratory sample* (3.10) or *test portions* (3.42) from the original sample as received

[SOURCE: ISO 21637:2020, 3.66]

3.30
sampling
process of drawing or constituting a *sample* (3.28)

[SOURCE: ISO 21637:2020, 3.68]

3.31
sampling plan
predetermined procedure for the selection, withdrawal, preservation, transportation and preparation of the portions to be removed from a population as a *sample* (3.28)

[SOURCE: ISO 21637:2020, 3.70]

3.32
sampling record
report which serves as a check list and provides the investigator with all necessary information about the *sampling* (3.30) techniques applied at the site and any additional important information

[SOURCE: ISO 11074:2015, 4.4.26[7], modified – Part of definition has been removed as irrelevant to the context of this document.]

3.33
shape factor
factor that corrects the *minimum sample mass* (3.14) if the particles in a lot have not a regular shape (e.g. spherical or cubic)

[SOURCE: ISO 21637:2020, 3.72]

3.34
solid recovered fuel
solid fuel for energy purposes according to ISO 21640:— derived from non-hazardous waste

Note 1 to entry: A number of terms can be used to describe fuels from waste that might (but not always) qualify as solid recovered fuels. For example, refuse derived fuel, refuse derived paper and plastics densified fuel, waste derived fuel, shredded light fraction, sewage sludge, end of life wood, fuel composed of either municipal solid waste, industrial waste, commercial waste, construction and demolition waste, animal waste (e.g. meat and bone meal).

Note 2 to entry: This definition does not consider the value of the waste.

Note 3 to entry: Whether the input material is hazardous or non-hazardous is determined through national laws and directives or by categorization of the fuel through the annexes in the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal.

[SOURCE: ISO 21637:2020, 3.75]

3.35
specification
document stating requirements

Note 1 to entry: See also *specification of solid recovered fuels* (3.36).

[SOURCE: ISO 9000:2015, 3.8.7[8], modified - Example and notes to entry have been removed/replaced.]

3.36
specification of solid recovered fuels
list of properties that characterize *solid recovered fuel* (3.34)

Note 1 to entry: A template for such specification is given in ISO 21640:—.

[SOURCE: ISO 21637:2020, 3.76, modified – Note 1 to entry has been added.]

3.37
static lot
lot (3.11) that is not in motion during the *sampling* (3.30), or transported by a conveyor or alternative transport system

[SOURCE: ISO 21637:2020, 3.77]

