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Solid biofuels — Safe handling and storage of solid biofuel pellets in commercial and industrial applications

Biocombustibles solides — Manutention et stockage en toute sécurité des granulés de biocombustibles solides dans des applications commerciales et industrielles

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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 238, *Solid biofuels*.

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

There is a continuous global growth in production, storage, handling, bulk transport and use of solid biofuels especially in the form of pelletized biofuels.

The handling and storage of solid biofuels and their physical characteristics can lead to a risk for fire and/or explosion, but also health risks, for example intoxication due to exposure to carbon monoxide (CO), asphyxiation due to oxygen depletion, and allergic reactions.

There is a risk of injury or fatality associated with pellet storage so the implementation of safety measures is important. The possibility of fire and explosion incidents is a clear indicator that safety is to be prioritized, first of all for human safety but also because interruptions in energy supply will have significant consequences. The market confidence in solid biofuels as a reliable energy source will be jeopardized, and financial losses due to business interruptions could occur. Difficulty to obtain insurance coverage will also increase.

This document provides support, advice and guidance to facility owners, logistics providers, equipment suppliers/manufacturers, consultants, authorities and insurance providers to assess and mitigate risk when handling and storing solid biofuel pellets. General guidance is provided for personnel safety protection and personal precautions in accordance with generally accepted work safety requirements. As part of the determination and assessment of risks for solid biofuels, applicable quality standards and related test methods are discussed and recommendations for additional methodologies are indicated. As made of living materials, solid biofuels are subject to degradation such as ageing and moisture contamination causing variability in reactivity which requires margins in risks assessments. One shipment of solid biofuels may have substantially different physical and chemical characteristics in terms of self-heating and off-gassing than another, and therefore diligent monitoring, frequent testing and house-keeping are recommended.

Solid biofuels — Safe handling and storage of solid biofuel pellets in commercial and industrial applications

1 Scope

This document provides principles and requirements for safe handling and storage of solid biofuels pellets in commercial and industrial applications. This document is using a risk-based approach to determine what safety measures should be considered.

Facilities with a storage capacity <100 t are covered by ISO 20023. Generally, for end-user facilities with a storage capacity of <1 000 t, ISO 20023 could also be applicable if storage principle and facility complexity is in-line with the objectives of ISO 20023.

This document covers the handling and storage process of pellets in the following applications:

— at a pellet production plant from the outlet of the cooler unit until loaded for transportation;

— at a commercial distributor from the receiving station until loaded for transportation; and

— at an industrial end-user from the receiving station until fed into the fuel preparation or combustion process.

Although unloading and loading of e.g. vessels, trains or trucks are included in the operational envelops defined above, the safety aspect of the transportation itself is beyond the scope of this document.

This document also gives specific guidance on detection and suppression systems and preparatory measures to enable safe and efficient firefighting operations. Guidance on the management of fire and explosion incidents is also specified.

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 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

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 General terms

3.1.1
biofuel pellet
biofuel made with or without additives in the form of cubiform, polyhedral, polyhydric or cylindrical units with a diameter up to 25 mm, produced by compressing biomass

Note 1 to entry: Usually the biomass has been milled before densification.

Note 2 to entry: See also non-woody pellet and wood pellet.

[SOURCE: ISO 16559:2014, 4.31]

3.1.2
combustible dust
finely divided solid particles, 500 µm or less in nominal size, which may form explosive mixtures with air at standard atmospheric pressure and temperatures

Note 1 to entry: This includes dust and grit as defined in ISO 4225.

Note 2 to entry: The term 'solid particles' is intended to address particles in the solid phase but does not preclude a hollow particle.

[SOURCE: ISO/IEC 80079-20-2:2016, 3.1]

3.1.3
combustible flyings
solid particles, including fibres, where one dimension is greater than 500 µm in nominal size, which may form an explosive mixture with air at standard atmospheric pressure and temperature

Note 1 to entry: The ratio of length to width is 3 or more.

[SOURCE: ISO/IEC 80079-20-2:2016, 3.2, modified — Note 2 deleted.]

3.1.4
fines
small sized particles in fuel below a certain pre-defined size, here less than 3,15 mm

[SOURCE: ISO 16559:2014, 4.90, modified — "usually" replaced by "here" to indicate exact limit.]

3.1.5
ignition source
source of energy that initiates combustion

[SOURCE: ISO 13943:2008, 4.189]

3.1.6
product safety data sheet
specification sheet defining physical aspects, characteristics and health and safety data for a product

3.1.7
self-heating
exothermic reaction within a material resulting in a rise in temperature in the material

[SOURCE: ISO 4880:1997, 55]

3.1.8
self-ignition
ignition resulting from *self-heating* (3.1.7)

[SOURCE: ISO 4880:1997, 56]

3.1.9
smouldering
slow combustion of a material without light being visible and generally evidenced by an increase in temperature and/or by smoke

[SOURCE: ISO 4880:1997, 58]

3.1.10
wood pellet
biofuel made from woody biomass with or without additives in the form of cubiform, polyhedral, polyhydric or cylindrical units, random length and typically 3,15 mm to 40 mm, a diameter up to 25 mm and with broken ends

Note 1 to entry: The raw material for wood pellets is woody biomass in accordance with Table 1 of ISO 17225-1. Pellets are usually manufactured in a die, with total moisture content usually less than 10 % of their mass wet basis.

Note 2 to entry: The woody biomass used as feedstock for pellet making is milled to size in accordance with customer specification. Determination of the particle size distribution of the constituent of pellets is done by ISO 17830.

[SOURCE: ISO 16559:2014, 4.228]

3.2 Risk management

3.2.1
accident
incident resulting in fatality, disease, injury or other damage

[SOURCE: ISO 21101:2014, 3.25]

3.2.2
emergency
serious situation requiring immediate action

[SOURCE: ISO/TR 21102:2013, 2.8]

3.2.3
fail-safe
term applied to equipment or a system so designed that, in the event of failure or malfunction of any part of the system, devices are automatically activated to stabilize or secure the safety of the operation

[SOURCE: ISO 13628-7:2005, 3.1.49]

3.2.4
failure mode and effect analysis
FMEA
analytically derived identification of the conceivable equipment failure modes and the potential adverse effects of those modes on the system and mission

Note 1 to entry: It is primarily used as a design tool for review of critical components.

[SOURCE: ISO/TS 16901:2015, 3.11]

3.2.5
harm
injury or damage to the health of people or animals or damage to property or the environment

[SOURCE: ISO/IEC Guide 51:2014, 3.1, modified — "or animals" added.]

3.2.6
hazard
potential source of *harm* (3.2.5)

[SOURCE: ISO/IEC Guide 51:2014, 3.2]

3.2.7
hazardous event
event that can cause *harm* (3.2.5)

[SOURCE: ISO/IEC Guide 51:2014, 3.3]

3.2.8
hazardous situation
circumstance in which people or animals, property or the environment is/are exposed to one or more *hazards* (3.2.6)

[SOURCE: ISO/IEC Guide 51:2014, 3.4, modified — "or animals" added.]

3.2.9
hazard and operability study
HAZOP
systematic approach by an interdisciplinary team to identify *hazards* (3.2.6) and operability problems occurring as a result of deviations from the intended range of process conditions

Note 1 to entry: All four steps are in place and recorded to manage a hazard completely.

[SOURCE: ISO/TS 16901:2015, 3.16]

3.2.10
incident
event or occurrence, which can, but does not necessarily, create a *risk* (3.2.14) of *harm* (3.2.5), including possible risks due to shearing, crushing, falling, impact, trapping, fire, electric shock, exposure to weather etc.

[SOURCE: ISO/TS 25740-1:2011, 3.13]

3.2.11
inherently safe design
measures taken to eliminate *hazards* (3.2.6) and/or to reduce *risks* (3.2.14) by changing the design or operating characteristics of the product or system

[SOURCE: ISO/IEC Guide 51:2014, 3.5]

3.2.12
intended use
use in accordance with information provided with a product or system, or, in the absence of such information, by generally understood patterns of usage

[SOURCE: ISO/IEC Guide 51:2014, 3.6]

3.2.13
reasonably foreseeable misuse
use of a product or system in a way not intended by the supplier, but which can result from readily predictable human behaviour

[SOURCE: ISO/IEC Guide 51:2014, 3.7, modified — Note 1 to entry and Note 2 to entry has been deleted.]

3.2.14
risk
combination of the probability of occurrence of *harm* (3.2.5) and the severity of that harm

Note 1 to entry: The probability of occurrence includes the exposure to a hazardous situation, the occurrence of a hazardous event and the possibility to avoid or limit the harm.

[SOURCE: ISO/IEC Guide 51:2014, 3.9]

3.2.15
risk analysis
systematic use of available information to identify *hazards* (3.2.6) and to estimate the *risk* (3.2.14)

[SOURCE: ISO/IEC Guide 51:2014, 3.10]

3.2.16
risk assessment
overall process comprising a *risk analysis* (3.2.15) and a *risk evaluation* (3.2.20)

[SOURCE: ISO/IEC Guide 51:2014, 3.11]

3.2.17
risk control
process of decision-making for managing and/or reducing *risk* (3.2.14); its implementation, enforcement and re-evaluation from time to time, using the results of *risk assessment* (3.2.16) as one input

3.2.18
risk criteria
terms of reference against which the significance of a *risk* (3.2.14) is evaluated

Note 1 to entry: Risk criteria are based on organizational objectives, and external and internal context.

Note 2 to entry: Risk criteria can be derived from standards, laws, policies and other requirements.

[SOURCE: ISO/IEC Guide 73:2009, 3.3.1.3]

3.2.19
risk estimation
process of assigning values to the probability of occurrence of events and their consequences

[SOURCE: ISO 13824:2009, 3.15]

3.2.20
risk evaluation
procedure based on the *risk analysis* (3.2.15) to determine whether tolerable *risk* (3.2.14) has been exceeded

[SOURCE: ISO/IEC Guide 51:2014, 3.12]

3.2.21
risk management
coordinated activities to direct and control an organization with regard to *risk* (3.2.14)

[SOURCE: ISO/IEC Guide 73:2009, 2.1]

3.2.22
risk reduction measure
protective measure
action or means to eliminate *hazards* (3.2.6) or reduce *risks* (3.2.14)

[SOURCE: ISO/IEC Guide 51:2014, 3.13, modified — Example has been removed.]

3.2.23
residual risk
risks (3.2.14) remaining after *risk reduction measures* (3.2.22) have been implemented

[SOURCE: ISO/IEC Guide 51:2014, 3.8]

3.2.24
safety
freedom from *risk* (3.2.14) which is not tolerable

[SOURCE: ISO/IEC Guide 51:2014, 3.14]

3.2.25
significant hazard
hazard (3.2.6) which has been identified and which requires specific action to eliminate or to reduce *risk* (3.2.14) according to the *risk management* (3.2.21)

3.2.26
tolerable risk
level of *risk* (3.2.14) that is accepted in a given context based on the current values of society

Note 1 to entry: For the purposes of this document, the terms "acceptable risk" and "tolerable risk" are considered to be synonymous.

[SOURCE: ISO/IEC Guide 51:2014, 3.15]

3.3 Storage, handling and operation

3.3.1
mechanical bridging
process of forming stable bridges in a bulk storage of solids where large particles mechanically interlock and form an obstruction, preventing the discharging of the material

Note 1 to entry: Bridging is also called arching.

3.3.2
cohesive bridging
process of forming stable bridges in a bulk storage of solids when particles bond together due to effects of moisture, fines concentration, particle shape, temperature, etc. and form an obstruction, preventing the discharging of the material

Note 1 to entry: Bridging is also called arching.

3.3.3
bulk material
amount of material within which component parts are not initially distinguishable on the macroscopic level

[SOURCE: ISO 11648-1:2003, 3.1.1]

3.3.4
bunker
vessel for the storage of materials, with the main section having vertical walls and the lowermost portion usually constructed in the form of a hopper

Note 1 to entry: Large bunkers are often used at power plants for short term fuel storage before the combustion furnace.

[SOURCE: ISO 1213-1:1993, 9.1.6, modified — “bin” deleted, Note 1 to entry added.]

3.3.5
bunker floor
steel construction above the *bunker* (3.3.4) to support the conveyor system and a steel grating to allow entrance for maintenance

3.3.6
bunker covering
construction covering the *bunker floor* (3.3.5) to aid the *bunker* (3.3.4) ventilation system to create an airflow from the *bunker house* (3.3.7) into the bunker

Note 1 to entry: The bunker covering will reduce dust dispersion into the bunker house and the environment during filling but also reduce the risk of foreign objects falling into the bunker during e.g. maintenance work inside the bunker house.

3.3.7
bunker house
building construction covering the *bunker* (3.3.4), the bunker floor *bunker floor* (3.3.5) and the conveyor system, protecting it against precipitation and preventing dispersion of dust to the environment

3.3.8
core flow
material flow that is confined to a column immediately surrounding the vertical axis through the outlet and in which the material on the surface slides in towards the downward-moving column

[SOURCE: ISO 1213-1:1993, 10.1.15]

3.3.9
funnel flow
flow that occurs during gravity storage when bulk material sloughs off the surface of the material and discharges through a vertical channel which forms within the material in the bin whenever material is drawn from the outlet

Note 1 to entry: Material adjacent to the bin walls remains stationary.

Note 2 to entry: Core flow is sometimes used instead of funnel flow.

[SOURCE: ISO 15117-1:2004, 3.15, modified — Note 2 to entry included.]

3.3.10
hopper
container for a loose bulk material such as grain, rock, or rubbish, typically one that tapers downward and is able to discharge its contents at the bottom

3.3.11
maintenance manual
document detailing the disciplines and procedures to be followed to maintain an item of equipment, complete machine or system in good working order

Note 1 to entry: A maintenance manual will detail periodic checks and replacement of parts, type of lubricant and protective processes and the period of time between each check. It will include instructions on how to locate faults, carry out repairs and the replacement of components. It may also include a detailed list of the components which go together to make the complete unit, and their reference numbers and quantity required to assist purchase of replacements as required.

[SOURCE: ISO/TR 11065:1992, 385, modified — Part of definition moved as Note 1 to entry.]

3.3.12
mass flow
flow in which all the contents of a bin, silo or bunker are in motion, so that there is substantially uniform velocity of flow across the whole cross-section of the material

[SOURCE: ISO 1213-1:1993, 10.1.14, modified — "(in bunkers)" deleted in heading; bin, silo or added.]

3.3.13
operation manual
collection of documents that provide the information necessary to familiarize the personnel with the operation and maintenance of a facility, system or item of equipment

[SOURCE: ISO 26870:2009, 3.11, modified — and maintenance deleted in heading.]

3.3.14
personal protection equipment
PPE
equipment that can include, but is not limited to, clothing, gloves, helmets, footwear and face protection

[SOURCE: ISO/TR 21808:2009, 2.1]

3.3.15
powered mobile handling equipment
equipment provided with some form of self-propulsion ordinarily under the direct control of an operator

Note 1 to entry: Powered mobile handling equipment includes, earthmoving machinery (e.g. rollers, graders, scrapers, skid steer loader), wheel loaders and wheel loader equipment, trucks, excavators, mobile cranes, hoists, elevating work platforms, concrete placement booms, reach stackers and forklifts, and trains and wagons.

3.3.16
ratholing
discharging of material taking place only in a flow channel formed above the outlet of a silo, *bunker* (3.3.4) or *hopper* (3.3.10)

Note 1 to entry: The reason for ratholing is the material being cohesive leading to the material outside the formed channel will not flow into it, stopping the outflow once the central flow channel is emptied.

Note 2 to entry: Ratholing is also called piping.

Note 3 to entry: See also definition on funnel flow, 3.3.9.

3.3.17
SCBA
self contained breathing apparatus
generic term for respiratory protective devices, designed for the wearer to carry a source of supplying air, oxygen or breathable gas to be consumed in breathing

[SOURCE: ISO 16972:2010, A.267]

3.3.18
screw conveyor
auger conveyor
mechanism that uses a rotating helical screw blade, usually within a tube, to move liquid or granular materials

3.3.19
silo
structure for the storage of a volume of *bulk material* (3.3.3)

[SOURCE: ISO 6707-1:2014, 3.2.20, modified — "loose" material has been replaced by "bulk" material, "large" has been deleted.]

3.3.20
warehouse
flat storage
A-frame storage
building or structure for storage, such as garages, storage buildings and freight depots