GA no 282826

# Production of Solid Sustainable Energy Carriers from Biomass by Means of Torrefaction

## Deliverable No. D8.3

## Graded thermally and densified biomass fuels
## Development of the ISO 17225-8 standard

| Dissemination Level | | |
|---|---|---|
| **PU** | Public | X |
| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the consortium (including the Commission Services) | |
| **CO** | Confidential, only for members of the consortium (including the Commission Services) | |

| Nature | | |
|---|---|---|
| **R** | Report | |
| **O** | Other | X |

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# Symbols and abbreviations

The symbols and abbreviations used in this International Standard comply with the SI system of units as far as possible.

*d* dry (dry basis)

*ar* as received

w-% weight-percentage

A Designation for ash content on dry basis, $A_d$ [w-%] [1]

BD Designation for bulk density as received [kg/m$^3$] [1]

D Designation for diameter as received, $D$ [mm] [1]

DE Particle density as received, [g/cm$^3$] [1]

DU Designation for mechanical durability as received [w-%] [1]

F Designation for amount of fines as received [w-%, particles less than 3,15 mm] [1]

L Designation for length as received, $L$ [mm] [1]

M Designation for moisture content as received on wet basis, $M_{\mathrm{ar}}$ [w-%] [1]

Q Designation for net calorific value as received, $q_{p,\mathrm{net,ar}}$ [MJ/kg or kWh/kg or MWh/t] at constant pressure[1]

VM Designation for content of volatile mater on dry basis [w-%] [1]

NOTE 1 MJ/kg equals 0.2778 kWh/kg (1 kWh/kg equals 1 MWh/t and 1 MWh/t is 3,6 MJ/kg). 1 g/cm$^3$ equals 1 kg/dm$^3$. 1 mg/kg equals to 1 ppm or 0,0001 % on dry basis

[1] Designation symbols are used in combination with a number to specify property levels in the Tables 1, 2, 3 and 4. For designation of chemical properties chemical symbols like S (sulfur), Cl (chlorine), N (nitrogen) are used and the value is added at the end of the symbol.

# 1 Summary

To support the use of torrefied biomass (pellets), a proposal for a new product standard in Europe and a worldwide standard was planned to draft in the SECTOR project.

International Organisation for Standardisation (ISO) Technical committee 238 (ISO/TC 238) has started to draft an international product standard for thermally treated pellets and briquettes made from woody and non-woody (herbaceous, fruit and aquatic biomass) in February 2013. First ISO draft (a working document, WD) was discussed in a working group 2 (WG2) meeting on 12 June 2014 in Stockholm, Sweden. The first SECTOR D8.3 report was prepared in June 2014 according to the SECTOR work plan. Second SECTOR D8.3 report was published in September 2014 including the proposal for committee draft (CD). This CD draft was discussed in York in June 2015 and the draft international standard (DIS) will be sent for ISO and CEN ballot in end of year 2015. The European and International Standard will be developed in parallel, and the standard will be published in Europe as EN ISO 17225-8 “Graded thermally treated and densified biomass fuels”.

Thermal treatment includes processes such as torrefaction, steam treatment (explosion pulping), hydrothermal carbonization and charing, all of which represent different exposure to heat, oxygen, steam and water. This product standard will include industrial and non-industrial use. Highest quality classes (TW1 classes) for thermally treated woody pellets and briquettes are recommended for non-industrial use (residential and other small-scale applications). It was also agreed to have two alternatives for TW classes based on the net calorific value on dry basis. Limit value was agreed to be 21 MJ/kg. Class “a” will include TW classes where calorific value on dry basis is $\geq$ 21 MJ/kg and in “b” class < 21 MJ/kg.

This document includes quality tables, which will be presented as a draft international standard (DIS) for next ISO and CEN balloting in the end of the year 2015. This final report D8.3 is based on the decisions of the WG2 meeting in York, UK.

Because there was not enough property data from different kinds of thermally treated pellets and briquettes, it was agreed that VTT sent a questionnaire to collect more data from SECTOR partners and ISO/TC WG2 members by end of March 2015. Also the SECTOR second round-robin test results for grindability and hygroscobicity was planned to use later, when writing the draft of the international standard (DIS version). VTT has got property data (more than 100 samples) for torrefied, steam exploded and HTC pellets and briquettes. Most of the data is for torrefied material. Results of all data and also results of grindability and hygroscobicity tests of the SECTOR project were presented in York meeting. The method used for grindability was not found to be the suitable one and it was decided to develop a new method based on a hammer mill. This means that there will not be any threshold value for grindability and hygroscopicity, because method development will take 2 to 3 years time.

# 2 Introduction

To support the use of torrefied biomass (pellets), a proposal for a new product standard in Europe and a worldwide standard was planned to draft in the SECTOR project.

Ofi in cooperation with the International Biomass Torrefaction Council (IBTC) has sent a new work item proposal (NWIP) for the International Organisation for Standardisation (ISO) Technical committee 238 (ISO/TC 238) through the Austrian national standardization body to start drafting international standards for torrefied pellets and briquettes made from woody and non-woody (herbaceous, fruit and aquatic biomass) in February 2013. NWIP included also a working document (WD) for discussion.

Working group 2 (WG2) lead by Finland, discussed about NWIP and the attached WD document on 18 March 2013 in Bangkok, Thailand and recommended that ISO/TC 238 would start preparing a product standard, but covering all kind of thermally treated densified biomass fuels. It was also agreed to make only one product standard, which includes both pellets and briquettes.

NWIP proposal was accepted in balloting 10 January 2014 attached with 122 comments for proposed classification tables. These comments were discussed on 10 June 2014 in Stockholm and at the same time the schedule for drafting standard was agreed. Table A summarizes the plan for the development phases of the international and European standard. Because ISO/TC 238 is applying the Vienna agreement[2], the European and International Standard will be developed in parallel, and the standard will be published in Europe as EN ISO 17225-8 “Graded thermally treated and densified biomass fuels”, if accepted in the DIS balloting. Thermal treatment includes processes such as torrefaction, steam treatment (explosion pulping), hydrothermal carbonization and charing, all of which represent different exposure to heat, oxygen, steam and water.

Thermally treated biomass is defined in ISO 16559:2014 (term 4.204) standard as follows:

> Thermally treated biomass whose chemical composition has been changed by heat (usually by temperatures of 200 to 300°C and above)
>
> EXAMPLE torrefied biomass, charcoal
>
> Note 1 to entry: Drying is not considered thermal treatment in this definition.

VTT has also participated in two meetings of the IBTC to discuss about the standardization of thermally treated biomass fuels with the torrefaction industry.

During the ISO meetings on 10 June 2014 and 9 June 2015 main results of the SECTOR project (Work Package 4 and Work Package 8) on measured properties of torrefied biomass fuels were presented and discussed.

[2] Vienna agreement signed in 1991 was drawn up with the aim of preventing duplication of effort and reducing time when preparing standards. As a result, new standards projects are jointly planned between CEN and ISO. ISO standards will be published in Europe as EN ISO standards and voting of different phase will carried out parallel. (http://boss.cen.eu/ref/Vienna_Agreement.pdf)

In the Tables 1 to 4 a proposal for draft document (DIS) is presented. This draft if based on the decisions made in the meeting in York, UK.

Because there was not enough property data of different kinds of thermally treated pellets and briquettes, it was agreed that VTT will collect property data from WG2 members and SECTOR partners. Also the SECTOR second round-robin test results for grindability and hygroscopicity was presented in the meeting in York in June 2015.

Health, safety and environmental issues for solid biofuels are important and need special attention; however they are outside the scope of ISO 17225-8 standard. ISO/TC 238 decided to establish a new working group (WG7) for safety issues on 12 June 2014. Standards will include safety issues for pellets (e.g. for safe handling and storage of pellets both in small and large scale, off-gassing and prevention, detection, suppression and management of fires and explosions).

EN ISO 17225-1:2014 has also property classes for thermally treated pellets and briquettes, charcoal and thermally treated biomass (undensified). This standard can be used before a product standard.

ISO/CD 17225-8 "Graded thermally treated and densified biomass fuels" has been approved to DIS (Draft International Standard) stage by 75% (15 P-members voting approval, 5 voting against (Canada, France, Germany, the Netherlands and United States) and 3 abstaining). The main reason for disapproval was about the publication form. Disapproval countries want to produce technical specification (TS) and not official ISO standards, because technologies (torrefaction, steam treatment (explosion pulping), hydrothermal carbonization and charring) are still under developing and test methods are missing for e.g. grindability and hydrophobicity (water absorption). Some countries also wanted separate specifications for different technologies, which was not possible according the ISO rules.

Secretary of ISO/TC 238 (Per Forsberg, SIS) explained the situation of ISO/CD 17225-8. Situation of ISO/CD 17225-8 is clear according to ISO Central Secretariat (CS) and ISO/TC 238 secretariat:

- Work item of ISO 17225-8 has been approved at the ISO/NP ballot on 2014-01-10. Task is to write an ISO standard to determine the fuel quality classes and specifications of graded pellets and briquettes made from thermally treated biomass for non-industrial and industrial use. So the task is not to write separate fuel quality classes and specification based on different technologies and not to write a technical specification.
- ISO/CD 17225-8 was agreed to the circulation as a DIS at the CD ballot on 2014-11-05 with 75% approval. Next stage is DIS ballot according to the ballot result.
- If the DIS fails (do not reach 2/3 approval), next step is after improve the draft either second DIS or downgrade document to Technical Specification (TS) or delete whole work item. Choosing technical specification, it is likely that there are coming only ISO technical specification and not EN ISO specification.

**Table A. Schedule for drafting European and international standard for Graded thermally treated biomass fuels – EN ISO 17225-8**

| Action | Who | When |
|---|---|---|
| **New work item proposal** sent for ISO/TC 238 | Austrian NSB | February 2013 |
| Discussion in WG2 meeting | WG2 | 18 March 2013 |
| **NWIP** approved | ISO/TC 238 | 10 January 2014 |
| **WG2 meeting in Stockholm** | WG2 | 10 June 2014 |
| **CD document** to SIS | WG2 secretariat | Mid September 2014 |
| CD ballot (2 months)<br>(technical comments accepted) | SIS | Until mid November 2014 |
| Webinar | WG 2 group | End November 2014<br>(agreed to post-pone discussion until June 2015 |
| **DIS document** to SIS | WG2 secretariat | Autumn 2015 |
| DIS ballot (2 months for translations and 3 months for balloting) (technical comments accepted) | SIS | Planned December 2015<br>(balloting until end of February 2016) |
| WG2 meeting connected to ISO/TC 238 meeting, discussion of DIS comments | WG2 members | April 2016 |
| **FDIS document** | WG2 secretariat (Finland) | Early autumn 2016 |
| FDIS ballot (only editorial comments are allowed) | SIS | Autumn 2016 |
| **International standard** published<br>(ISO 17225-8 and EN ISO 17225-8) | ISO and CEN | December 2016 (planned)<br>If failed new DIS phase or TS version (only ISO/TS) and more time is needed. |

NWIP= new work item proposal

WD = working draft, usually submitted when NWIP is made,

CD = committee draft (technical comments accepted);

DIS = Draft International standard (technical comments accepted), if ballot approve standard, then it will be published.

FDIS ballot = Final approval and only editorial comments accepted. To be published as an ISO standard and in Europe as EN ISO standard

# 3 Fuel specification of graded thermally treated and densified biomass fuels

## 3.1 Specification of raw material and property classes for thermally treated biomass

TW[3] classes are used for specification of pellets and briquettes produced from woody biomass. TW1a[4], TW1b, TW2a, TW2b, TW3a and TW3b represent virgin woods and chemically untreated wood residues. In Table 1 and Table 3 TW1a and TW1b represent fuels which are low in ash and nitrogen content, while class TW2a and TW2b have slightly higher ash and TW3a and TW3b higher ash and nitrogen contents. TW1a or TW1b are recommended to be used in residential and other small-scale appliances that have the similar fuel requirements as residential appliances. TA property classes are recommended to be used in industrial applications.

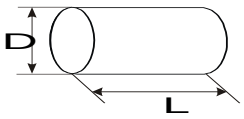
Chemically treated residues from processing industries are included in classes TW2a or TW2b or TW3a or TW3b as long as they do not contain heavy metals or halogenated organic compounds more than typical virgin material values or typical values of country of origin, unless specified in Annex B in ISO 17225-1. Chemically treated used wood (1.3.2) is not included. In case of raw materials belonging to 1.2.2 (chemically treated wood according to EN ISO 17225-1 Table 1) the actual origin of the raw material shall be closer described, e.g. 1.2.2, Residues from laminated wood production.

EXAMPLE: 99 w-% sawdust from spruce 1.2.1.2, 1 w-% glued wood from wood beam production (amount of glue < 0.1 %).

TA[5] classes are used for specification of pellets and briquettes from non-woody biomass. TA1, TA2 and TA3 represent non-woody, chemically untreated herbaceous, fruit and aquatic biomass in Table 2 and in Table 4. TA1, TA2 and TA3 differ in ash, nitrogen and chlorine contents.

## 3.2 Specification of thermally treated pellets

The specification of thermally treated pellets is stated in accordance with Tables 1 and 2. The sampling and analysis of the properties shall be carried out in accordance with the methods listed in Appendix 1.




*D* Diameter *L* Length

**Figure 1 — Dimension of pellets**

[3] TW = property class for thermally treated woody biomass
[4] „a" net calorific value on dry basis is ≥ 21 MJ/kg and "b" net calorific value on dry basis is < 21 MJ/kg
[5] TA = property class for thermally treated non-woody biomass (e.g. agrobiomass).

Specifications for grindability, interaction with water with respect to hygroscopic properties and adsorption shall be added, when methods are developed.

It was also agreed to have a total carbon as a normative property without any threshold values.

The quality shall be given either in the product declaration (see model in Table B based on ISO 17225-1:2014 standard) or by a corresponding label on the package, if traded for household sector.

**Table B. Example of a product declaration on thermally treated pellets produced from woody biomass based on ISO 17225-1 standard**

| Thermally treated pellets – ISO 17225-1 | | | |
|---|---|---|---|
| **Normative** | Property | Unit | Value |
| | Origin and source | | 1.2.1 Chemically untreated by-products and residues from wood processing industry |
| | Traded form | | Pellets, torrefied |
| | Dimensions (D) | mm | D06 |
| | Moisture, M | w-% | 8 |
| | Ash content, A | w-% dry | 1.2 |
| | Mechanical durability, DU | w-% | 96.5 |
| | Amount of fines, F | w-% | 2 |
| | Additives | w-% | none |
| | Bulk density, BD | $kg/m^3$ | 650 |
| | Net calorific value, Q | MJ/kg as received | 20.0 |
| | Fixed carbon, C | w-% dry | 16.0 |
| | Volatile matter, VM | w-% dry | 75.0 |

**Table 1 — Specification of graded thermally treated pellets produced from woody biomass (proposal DIS)**

| | Property class, **Analysis method** | Unit | TW1a | TW1b | TW2a | TW2b | TW3a | TW3b |
|---|---|---|---|---|---|---|---|---|
| Normative | **Origin and source**, ISO 17225-1 | | 1.1.1 Whole trees without roots<br>1.1.3 Stemwood<br>1.1.4 Logging residues<br>1.2.1 Chemically untreated wood residues [a] | | 1.1 Forest, plantation and other virgin wood<br>1.2 By-products and residues from wood processing industry<br>1.3.1 Chemically untreated used wood | | **1.1 Forest, plantation and other virgin wood**<br>**1.2 By-products and residues from wood processing industry**<br>**1.3.1 Chemically untreated used wood** | |
| | **Diameter, D** [b] and **Length L** [c] ISO 17829<br>According Figure 1 | mm | D06, 6 ± 1;<br>3,15 ≤ L ≤ 40<br>D08, 8 ± 1;<br>3,15 ≤ L ≤ 40 | | D06 to D25, D ± 1;<br>3,15 ≤ L ≤ 40<br>(from D06 to D10)<br>3,15 ≤ L ≤ 50<br>(from D12 to D25) | | **D06 to D25, D ± 1;**<br>**3,15 ≤ L ≤ 40**<br>**(from D06 to D10)**<br>**3,15 ≤ L ≤ 50**<br>**(from D12 to D25)** | |
| | **Moisture, M** [d], ISO 18134-1, ISO 18134-2 | as received, w-% wet basis | M08 ≤ 8 | M10 ≤ 10 | M08 ≤ 8<br>TW2a | M10 ≤ 10 | **M10 ≤ 10** | |
| | **Ash, A**, ISO 18122 | w-% dry | A1.2 ≤ 1,2[6] | | A3.0 ≤ 3,0 | | **A5.0 ≤ 5,0** | |
| | **Mechanical durability, DU**, ISO 17831-1 | as received, w-% | DU97.5 ≥ 97,5 | | DU96.0 ≥ 96,0 | | **DU95.0 ≥ 95,0** | |
| | **Fines, F** [e], ISO 18846 (hand sieving) | w-% as received | F1.0 ≤ 1,0 | | F4.0 ≤ 4,0 | F2.0 ≤ 2,0 | F6.0 ≤ 6,0 | **F3.0 ≤ 3,0** |
| | **Additives** [f] | w-% dry | ≤ 4, Type and amount to be stated | | Type and amount to be stated | | **Type and amount to be stated** | |
| | **Net calorific value, Q,** ISO 18125 | dry, MJ/kg or kWh/kg | Q21, Q ≥ 21<br>Q5.8,Q ≥ 5,8<br>Value to be stated | Q16,9 Q ≥ 16,9<br>Q4.7,Q ≥ 4,7<br>Value to be stated | Q20,2 Q ≥ 20,2<br>Q5.6,Q ≥ 5,6<br>Value to be stated | Q16,9 Q ≥ 16,9<br>Q4.7,Q ≥ 4,7<br>Value to be stated | Q18,7 Q ≥ 18,7<br>Q5.2,Q ≥ 5,2<br>Value to be stated | **Q16,0 Q ≥ 16,0**<br>**Q4.4,Q ≥ 4,4**<br>**Value to be stated** |
| | **Bulk density, BD** , ISO 17828 | kg/m³as received | BD700 ≥ 700<br>Value to be stated | | BD650 ≥ 650<br>Value to be stated | | BD550 ≥ 550<br>Value to be stated | **BD650 ≥ 650**<br>**Value to be stated** |
| | **Carbon, C,** ISO 16948 | w-% dry | Value to be stated | | Value to be stated | | **Value to be stated** | |
| | **Nitrogen, N**, ISO 16948 | w-% dry | N0.5 ≤ 0,5 | | N0.5 ≤ 0,5 | | **N1.0 ≤ 1,0** | |
| | **Sulphur , S**, ISO 16994 | w-% dry | S0.04 ≤ 0,04 | | S0.05 ≤ 0,05 | | **S0.1 ≤ 0,1** | |
| | **Chlorine, Cl**, ISO 16994 | w-% dry | Cl0.03 ≤ 0,03 | | Cl0.05 ≤ 0,05 | | **Cl0.1 ≤ 0,1** | |
| | **Arsenic, As**, ISO 16968 | mg/kg dry | ≤ 1 | | ≤ 2 | | **≤ 2** | |
| | **Cadmium, Cd**, ISO 16968 | mg/kg dry | ≤ 0,5 | | ≤ 1 | | **≤ 2** | |
| | **Chromium, Cr**, ISO 16968 | mg/kg dry | ≤ 10 | | ≤ 15 | | **≤ 15** | |
| | **Copper, Cu**, ISO 16968 | mg/kg dry | ≤ 10 | | ≤ 20 | | **≤ 20** | |
| | **Lead, Pb**, ISO 16968 | mg/kg dry | ≤ 10 | | ≤ 10 | | **≤ 10** | |
| | **Nickel, Ni**, ISO 16968 | mg/kg dry | ≤ 10 | | ≤ 10 | | **≤ 10** | |
| | **Zinc, Zn**, ISO 16968 | mg/kg dry | ≤ 100 | | ≤ 100 | | **≤ 100** | |
| | **Volatile matter, VM,** ISO 18123 | w-% dry | Value to be stated | | Value to be stated | | **Value to be stated** | |

[6] Note: In standards a comma (,) is used for a decimal point.

| | Property class, **Analysis method** | **Unit** | **TW1a** | **TW1b** | **TW2a** | **TW2b** | **TW3a** | **TW3b** |
|---|---|---|---|---|---|---|---|---|
| Informative | **Ash melting behaviour** [g], CEN/TS 15370-1 [4] | °C | To be stated | | To be stated | | **To be stated** | |

[a] **Negligible levels of glue, grease and other timber production additives (< 1 w-%) used in sawmills during production of timber and timber product from virgin wood are acceptable if all chemical parameters of the pellets are clearly within the limits and concentrations are too small to be concerned with.**

[b] **Selected size D06 or D08 of pellets to be stated.**

[c] **Amount of pellets longer than 40 mm can be 1 w-%. Maximum length shall be < 45 mm.**

[d] **At point of delivery.**

[e] **At point of delivery. Fines less than 3,15 mm are screened by hand according to standard ISO 18846.**

[f] **Type of additives to aid production, delivery or combustion (e.g. pressing aids, slagging inhibitors or any other additives like starch, corn flour, potato flour, vegetable oil, lignin …).**

[g] **All characteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT) and flow temperature (FT) in oxidized conditions should be stated.**

**Table 2 — Specification of graded thermally treated pellets produced of non-woody biomass (proposal)**

| | Property class, **Analysis method** | Unit | TA1 | TA2 | TA3 |
|---|---|---|---|---|---|
| Normative | **Origin and source**, ISO 17225-1 | | 2. 1 Herbaceous biomass from agriculture and horticulture<br>2.2.1 By-products and residues from food and herbaceous processing industry, chemically untreated herbaceous residues<br>3.1 Orchard and horticulture fruit<br>3.2.1 By-products and residues from food and fruit processing industry, chemically untreated fruit residues<br>4.Aquatic biomass | 2. Herbaceous biomass<br>3. Fruit biomass<br>4. Aquatic biomass | **2. Herbaceous biomass**<br>**3. Fruit biomass**<br>**4. Aquatic biomass** |
| | **Diameter, D** [a] and **Length L** [b], ISO 17829 According Figure 1 | mm | D06 to D25, D ± 1;<br>3,15 ≤ L ≤ 40<br>(from D06 to D10)<br>3,15 ≤ L ≤ 50<br>(from D12 to D25) | D06 to D25, D ± 1;<br>3,15 ≤ L ≤ 40<br>(from D06 to D10)<br>3,15 ≤ L ≤ 50<br>(from D12 to D25) | **D06 to D25, D ± 1;**<br>**3,15 ≤ L ≤ 40**<br>**(from D06 to D10)**<br>**3,15 ≤ L ≤ 50**<br>**(from D12 to D25)** |
| | **Moisture, M**[c], ISO 18134-1, ISO 18134-2 | as received, w-% wet basis | M10 ≤ 10 | M10 ≤ 10 | **M10 ≤ 10** |
| | **Ash, A**, ISO 18122 | w-% dry | A5.0 ≤ 5,0 | A10.0 ≤ 10,0 | **Value to be stated** |
| | **Mechanical durability, DU**, ISO 17831-1 | as received, w-% | DU97.5 ≥ 97,5 | DU96.5 ≥ 96,5 | **DU95.0 ≥ 95,0** |
| | **Fines, F**[d], ISO 18846 | w-% as received | F2.0 ≤ 2,0 | F2.0 ≤ 2,0 | **F3.0 ≤ 3,0** |
| | **Additives**[e] | w-% dry | Type and amount to be stated | Type and amount to be stated | **Type and amount to be stated** |
| | **Net calorific value, Q**, ISO 18125 | as received, MJ/kg or kWh/kg | Q18, Q ≥ 18<br>Q5.0,Q ≥ 5,0<br>Value to be stated | Q17, Q ≥ 17<br>Q4.7,Q ≥ 4,7<br>Value to be stated | **Value to be stated** |
| | **Bulk density, BD**, ISO 17828 | kg/m$^3$ | BD600 ≥ 600 | BD600 ≥ 600 | **BD600 ≥ 600** |
| | **Carbon, C,** ISO 16948 | w-% dry | Value to be stated | Value to be stated | **Value to be stated** |
| | **Nitrogen, N**, ISO 16948 | w-% dry | N1.5 ≤ 1,5 | N2.0 ≤ 2.0 | **N2.0 ≤ 2,0** |
| | **Sulphur , S**, ISO 16994 | w-% dry | S0.05 ≤ 0,05 | S0.05 ≤ 0,05 | **S0.05 ≤ 0,05** |
| | **Chlorine, Cl**, ISO 16994 | w-% dry | Cl0.2 ≤ 0,2 | Cl0.3 ≤ 0,3 | **Cl0.3 ≤ 0,3** |
| | **Arsenic, As**, ISO 16968 | mg/kg dry | ≤ 2 | ≤ 2 | **≤ 2** |
| | **Cadmium, Cd**, ISO 16968 | mg/kg dry | ≤ 1 | ≤ 1 | **≤ 1** |
| | **Chromium, Cr**, ISO 16968 | mg/kg dry | ≤ 50 | ≤ 50 | **≤ 50** |
| | **Copper, Cu**, ISO 16968 | mg/kg dry | ≤ 20 | ≤ 20 | **≤ 20** |
| | **Lead, Pb**, ISO 16968 | mg/kg dry | ≤ 10 | ≤ 10 | **≤ 10** |
| | **Nickel, Ni**, ISO 16968 | mg/kg dry | ≤ 10 | ≤ 10 | **≤ 10** |
| | **Zinc, Zn**, ISO 16968 | mg/kg dry | ≤ 200 | ≤ 200 | **≤ 200** |
| | **Volatile matter, VM,** ISO 18123 | w-% dry | Value to be stated | Value to be stated | **Value to be stated** |

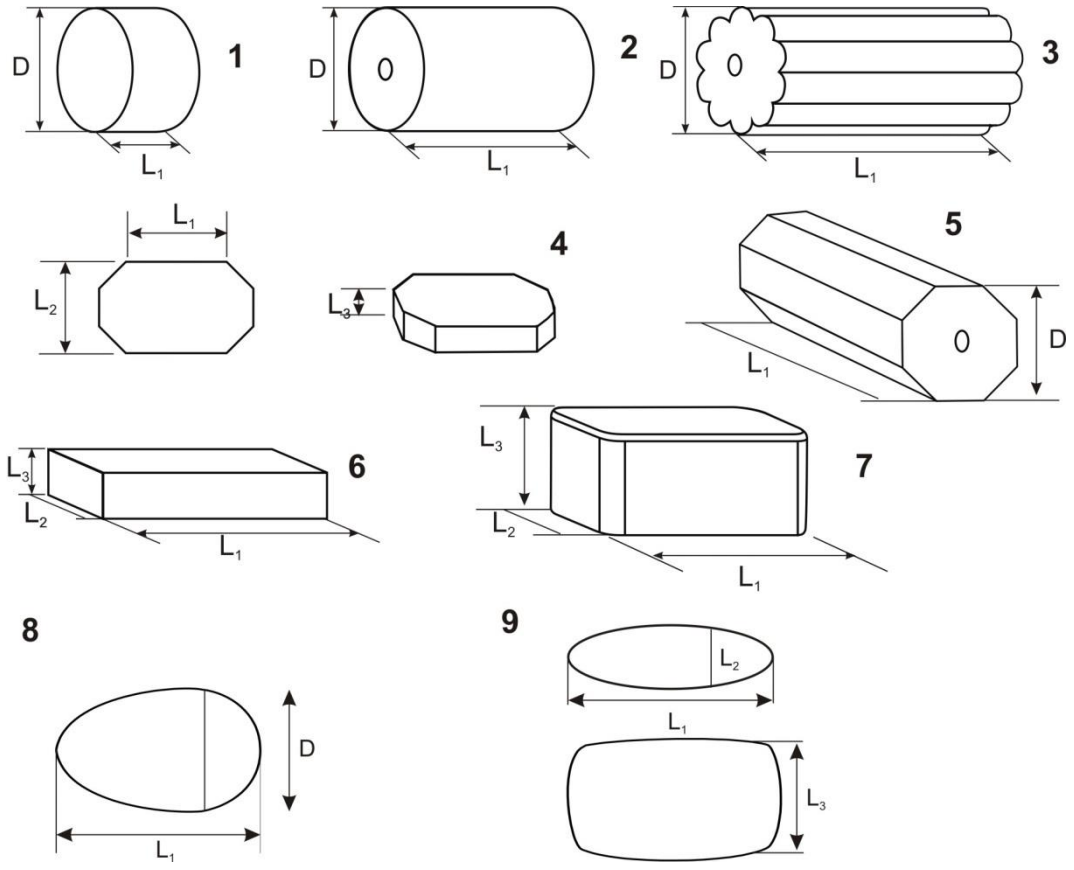
| | | | | | |
|---|---|---|---|---|---|
| Informative | **Ash melting behaviour** [f], CEN/TS 15370-1 | °C | Should be stated | Should be stated | **Should be stated** |

**[a] Selected size D06 or D08 of pellets to be stated.**
**[b] Amount of pellets longer than 40 mm can be 1 w-%. Maximum length shall be < 45 mm.**
**[c] At point of delivery.**
**[d] At point of delivery. Fines less than 3,15 mm are screened by hand according to standard ISO 18846.**
**[e] Type of additives to aid production, delivery or combustion (e.g. pressing aids, slagging inhibitors or any other additives like starch, corn flour, potato flour, vegetable oil, lignin …).**
**[f] All characteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT) and flow temperature (FT) in oxidized conditions should be stated.**

## 3.3 Specification of thermally treated briquettes

The specification of thermally treated briquettes is stated in accordance with Tables 3 (woody) and 4 (non-woody). The sampling and analysis of the properties shall be carried out in accordance with the methods mentioned in the references.

Same specification of raw material is applied for TWa and TWb briquettes as for pellets.




**Key**

*D* Diameter *L* Length

**Figure 2 — Dimension of briquettes**

Specifications for grindability, interaction with water with respect to hygroscopic properties and adsorption shall be added, when methods are developed.

If data of chemical or physical properties are available, further analysis may not be required.

The quality shall be given either in the product declaration or by a corresponding label on the package.

**Table 3 — Specification of graded thermally treated briquettes produced from woody biomass (proposal)**

| | Property class, **Analysis method** | Unit | TW1a | TW1b | TW2a | TW2b | TW3a | TW3b |
|---|---|---|---|---|---|---|---|---|
| Normative | **Origin and source**, ISO 17225-1 | | 1.1.1 Whole trees without roots<br>1.1.3 Stemwood<br>1.1.4 Logging residues<br>1.2.1 Chemically untreated wood residues [a] | | 1.1 Forest, plantation and other virgin wood<br>1.2 By-products and residues from wood processing industry | | **1.1 Forest, plantation and other virgin wood**<br>**1.2 By-products and residues from wood processing industry** | |
| | **Diameter, D** and **Length L**<br>According Figure 2 | mm | Diameter and length to be stated | | Diameter and length to be stated | | **Diameter and length to be stated** | |
| | **Moisture, M** [b], ISO 18134-2 | as received, w-% wet basis | M10 ≤ 10 | | M10 ≤ 10 | | **M10 ≤ 10** | |
| | **Ash, A**, ISO 18122 | w-% dry | A1.2 ≤ 1,2 | | A3.0 ≤ 3,0 | | **A5.0 ≤ 5,0** | |
| | **Additives** [b] | w-% dry | ≤ 4, Type and amount to be stated | | Type and amount to be stated | | **Type and amount to be stated** | |
| | **Net calorific value, Q,** ISO 18125 | dry, MJ/kg or kWh/kg | Q21, Q ≥ 21<br>Q5.8,Q ≥ 5,8<br>Value to be stated | Q16,9 Q ≥ 16,9<br>Q4.7,Q ≥ 4,7<br>Value to be stated | Q20,2 Q ≥ 20,2<br>Q5.6,Q ≥ 5,6<br>Value to be stated | Q16,9 Q ≥ 16,9<br>Q4.7,Q ≥ 4,7<br>Value to be stated | Q18,7 Q ≥ 18,7<br>Q5.2,Q ≥ 5,2<br>Value to be stated | **Q16,0 Q ≥ 16,0**<br>**Q4.4,Q ≥ 4,4**<br>**Value to be stated** |
| | **Particle density, DE,** ISO 18847 | g/m³ as received | DE 1.0 ≥ 1.0 | | not applicable | | **not applicable** | |
| | **Carbon, C,** ISO 16948 | w-% dry | Value to be stated | | Value to be stated | | **Value to be stated** | |
| | **Nitrogen, N**, ISO 16948 | w-% dry | N0.5 ≤ 0,5 | | N0.5 ≤ 0,5 | | **N1.0 ≤ 1,0** | |
| | **Sulphur , S**, ISO 16994 | w-% dry | S0.04 ≤ 0,04 | | S0.05 ≤ 0,05 | | **S0.1 ≤ 0,1** | |
| | **Chlorine, Cl**, ISO 16994 | w-% dry | Cl0.03 ≤ 0,03 | | Cl0.05 ≤ 0,05 | | **Cl0.1 ≤ 0,1** | |
| | **Arsenic, As**, ISO 16968 | mg/kg dry | ≤ 1 | | ≤ 2 | | **≤ 2** | |
| | **Cadmium, Cd**, ISO 16968 | mg/kg dry | ≤ 0,5 | | ≤ 1 | | **≤ 2** | |
| | **Chromium, Cr**, ISO 16968 | mg/kg dry | ≤ 10 | | ≤ 15 | | **≤ 15** | |
| | **Copper, Cu**, ISO 16968 | mg/kg dry | ≤ 10 | | ≤ 20 | | **≤ 20** | |
| | **Lead, Pb**, ISO 16968 | mg/kg dry | ≤ 10 | | ≤ 10 | | **≤ 10** | |
| | **Nickel, Ni**, ISO 16968 | mg/kg dry | ≤ 10 | | ≤ 10 | | **≤ 10** | |
| | **Zinc, Zn**, ISO 16968 | mg/kg dry | ≤ 100 | | ≤ 100 | | **≤ 100** | |
| | **Volatile matter, VM,** ISO 18123 | w-% dry | Value to be stated | | Value to be stated | | **Value to be stated** | |

| | Property class, Analysis method | Unit | TW1a | TW1b | TW2a | TW2b | TW3a | TW3b |
|---|---|---|---|---|---|---|---|---|
| Informative | **Bulk density, BD**, ISO 17828 | kg/m$^3$ | BD650 ≥ 650<br>Value to be stated | | BD650 ≥ 650<br>Value to be stated | | **BD650 ≥ 650**<br>**Value to be stated** | |
| | **Ash melting behaviour**[d], CEN/TS 15370-1 | °C | Value to be stated | | Value to be stated | | **Value to be stated** | |

**[a] Negligible levels of glue, grease and other timber production additives (< 1 w-%) used in sawmills during production of timber and timber product from virgin wood are acceptable if all chemical parameters of the briquettes are clearly within the limits and concentrations are too small to be concerned with.**

**[b] At point of delivery.**

**[c] Type of additives to aid production, delivery or combustion (e.g. pressing aids, slagging inhibitors or any othercadditives like starch, corn flour, potato flour, vegetable oil, lignin…).**

**[d] All characteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT) and flow temperature (FT) in oxidized conditions should be stated.**

**Table 4—Specification of graded thermally treated briquettes produced of non-woody biomass (proposal)**

| | Property class, **Analysis method** | Unit | TA1 | TA2 | TA3 |
|---|---|---|---|---|---|
| Normative | **Origin and source**, ISO 17225-1 | | 2. 1 Herbaceous biomass from agriculture and horticulture<br>2.2.1 By-products and residues from food and herbaceous processing industry, chemically untreated herbaceous residues<br>3.1 Orchard and horticulture fruit<br>3.2.1 By-products and residues from food and fruit processing industry, chemically untreated fruit residues<br>4. Aquatic biomass | 2. Herbaceous biomass<br>3. Fruit biomass<br>4. Aquatic biomass | 2. Herbaceous biomass<br>3. Fruit biomass<br>4. Aquatic biomass |
| | **Diameter, D** and **Length L** , ISO 17829 According Figure 2 | mm | Diameter and length to be stated | Diameter and length to be stated | Diameter and length to be stated |
| | **Moisture, M** [a], ISO 18134-1, ISO 18134-2 | as received, w-% wet basis | M10 ≤ 10 | M10 ≤ 10 | M10 ≤ 10 |
| | **Ash, A**, ISO 18122 | w-% dry | A5.0 ≤ 5,0 | A10.0 ≤ 10,0 | Value to be stated |
| | **Fines, F** [b], ISO 18846 (hand sieving) | w-% as received | F1.0 ≤ 1,0 | F2.0 ≤ 1,0 | F2.0 ≤ 2,0 |
| | **Additives** [c] | w-% dry | Type and amount to be stated | Type and amount to be stated | Type and amount to be stated |
| | **Net calorific value, Q**, ISO 18125 | as received, MJ/kg or kWh/kg | Q18, Q ≥ 18<br>Q5.0,Q ≥ 5,0<br>Value to be stated | Q17, Q ≥ 17<br>Q4.7,Q ≥ 4,7<br>Value to be stated | Value to be stated |
| | **Particle density, DE,** ISO 18847 | g/m$^3$ | ≥ 1 | not applicable | not applicable |
| | **Carbon, C,** ISO 16948 | w-% dry | Value to be stated | Value to be stated | Value to be stated |
| | **Nitrogen, N**, ISO 16948 | w-% dry | N1.5 ≤ 1,5 | N2.0 ≤ 2.0 | N2.0 ≤ 2,0 |
| | **Sulphur , S**, ISO 16994 | w-% dry | S0.05 ≤ 0,05 | S0.05 ≤ 0,05 | S0.05 ≤ 0,05 |
| | **Chlorine, Cl**, ISO 16994 | w-% dry | Cl0.2 ≤ 0,2 | Cl0.3 ≤ 0,3 | Cl0.3 ≤ 0,3 |
| | **Arsenic, As**, ISO 16968 | mg/kg dry | ≤ 2 | ≤ 2 | ≤ 2 |
| | **Cadmium, Cd**, ISO 16968 | mg/kg dry | ≤ 1 | ≤ 1 | ≤ 1 |
| | **Chromium, Cr**, ISO 16968 | mg/kg dry | ≤ 50 | ≤ 50 | ≤ 50 |
| | **Copper, Cu**, ISO 16968 | mg/kg dry | ≤ 20 | ≤ 20 | ≤ 20 |
| | **Lead, Pb**, ISO 16968 | mg/kg dry | ≤ 10 | ≤ 10 | ≤ 10 |
| | **Nickel, Ni**, ISO 16968 | mg/kg dry | ≤ 10 | ≤ 10 | ≤ 10 |
| | **Zinc, Zn**, ISO 16968 | mg/kg dry | ≤ 200 | ≤ 200 | ≤ 200 |
| | **Volatile matter, VM,** ISO 18123 | w-% dry | Value to be stated | Value to be stated | Value to be stated |

| | Property class, **Analysis method** | Unit | TA1 | TA2 | TA3 |
|---|---|---|---|---|---|
| Informative | **Bulk density, BD**, ISO 17828 | kg/m$^3$ | BD600 ≥ 600 | BD600 ≥ 600 | BD600 ≥ 600 |
| | **Ash melting behaviour** [d], CEN/TS 15370-1 | °C | Value to be stated | Value to be stated | Value to be stated |

[a] At factory gate in bulk transport (at the time of loading) and in small (up to 20 kg) and large sacks (at time of packing or when delivering to end-user). Fines less than 3,15 mm are screened by hand according standard ISO 18846.

[b] Type of additives to aid production, delivery or combustion (e.g. pressing aids, slagging inhibitors or any other additives like starch, corn flour, potato flour, vegetable oil, lignin from …).

[c] All characteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT) and flow temperature (FT) in oxidized conditions should be stated.

# 4 Conclusions

The next DIS balloting will show if the product standard ISO 17225-8 will be published as international and European standard or only as an ISO technical specification. DIS balloting will also allow to make technical comments, which probably will change Tables 1–4 in this document. Especially according to the SECTOR results and data collection net calorific values as received for TW1a class is quite high. It is also difficult to receive a high net calorific value as received at the same time with a high mechanical durability. The idea, when setting the threshold values for TW1a and TW1b, was that they should be as near to wood pellets values (ISO 17225-2:2014) as possible.

# 5 References

CEN/TS 15370-1:2006, Solid Biofuels — Method for the determination of ash melting behaviour – Part 1: Characteristic temperatures method.

ISO 14780, Solid biofuels — Sample preparation

ISO 16559:2015, Solid biofuels — Terminology, definition and description[7]

ISO 16948:2015, Solid biofuels — Determination of total content of carbon, hydrogen and nitrogen[6]

ISO 16968:2015, Solid biofuels — Determination of content of minor elements[6]

ISO 16994:2015, Solid biofuels — Determination of total content of sulfur and chlorine[6]

ISO 17225-1:2015, Solid biofuels — Fuel specification and classes — Part 1: General requirements[6]

ISO 17828:2015, Solid biofuels — Determination of bulk density[6]

[7] published, other standards are under preparation

ISO 17829:2015, Solid biofuels — Determination of length and diameter of pellets[8]

ISO 17831-1:2015, Solid biofuels — Determination of mechanical durability of pellets and briquettes — Part 1: Pellets[7]

ISO 18122:2015, Solid biofuels — Determination of ash content[6]

ISO 18123:2015, Solid biofuels — Determination of the content of volatile matter[7]

ISO 18125, Solid biofuels — Determination of calorific value

ISO 18134-1:2015, Solid biofuels — Determination of moisture content — Oven dry method — Part 1: Total moisture — Reference method[6]

ISO 18134-2:2015, Solid biofuels — Determination of moisture content — Oven dry method — Part 2: Total moisture — Simplified procedure[6]

ISO 18135, Solid biofuels — Sampling

ISO 18846, Solid biofuels — Determination of fines content in quantities of pellets

ISO 18847, Solid biofuels — Determination of particle density of pellets and briquettes

[8] published, other standards under preparation