Solutions for biomass fuel market barriers and raw material availability - IEE/07/777/SI2.499477

Results of enquiry to market actors on industrial wood pellet product standard – D 4.5

VTT-R-03874-1

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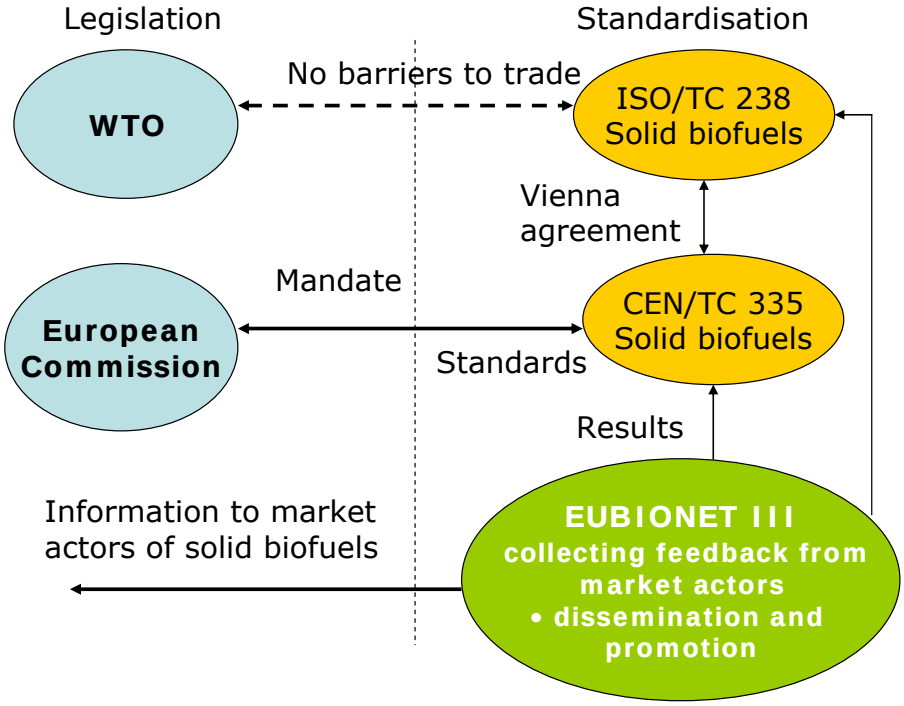
European and international framework for solid biofuel standardisation



Jyväskylä, 24 May 2011

INTELLIGENT ENERGY EUROPE

Content

Preface

This publication is part of the EUBIONET III Project (Solutions for biomass fuel market barriers and raw material availability - IEE/07/777/SI2.499477, www.eubionet.net) funded by the European Union's Intelligent Energy Programme. EUBIONETII is coordinated by VTT and other partners are Danish Technological Institute, DTI (Denmark), Energy Centre Bratislava, ECB (Slovakia), Ekodoma (Latvia), Fachagentur Nachwachsende Rohstoffe e.V., FNR (Germany), Swedish University of Agricultural Sciences, SLU (Sweden), Brno University of Technology,UPEI VUT (Czech), Norwegian University of Life Sciences, UMB (Norway), Centre wallon de Recherches agronomiques, CRA-W (Belgium), BLT-HBLuFA Francisco Josephinum, FJ-BLT (Austria), European Biomass Association, AEBIOM (Belgium), Centre for Renewable Energy Sources, CRES (Greece), Utrecht University, UU (Netherlands), University of Florence, UNIFI (Italy), Lithuanian Energy Institute, LEI (Lithuania), Imperial College of Science, Imperial (UK), Centro da Biomassa para a Energia, CBE (Portugal), Energy Restructuring Agency, ApE (Slovenia), Andalusian Energy Agency, AAE (Spain). EUBIONET III project will run 2008 – 2011.

The main objective of the project is to increase the use of biomass based fuels in the EU by finding ways to overcome the market barriers. The purpose is to promote international trade of biomass fuels to help demand and supply meet each other, while at the same time the availability of industrial raw material is to be secured at reasonable price. The EUBIONET III project will in the long run boost sustainable, transparent international biomass fuel trade, secure the most cost efficient and value-adding use of biomass for energy and industry, boost the investments on best practice technologies and new services on biomass heat sector and enhance sustainable and fair international trade of biomass fuels.

This report is a summary of the results collected by EUBIONET III partners in an enquiry about product standard of industrial wood pellets.

Eija Alakangas, VTT, May 2011

List of symbols

A	Designation for ash content (w-% of dry basis)*
ar	as received
BD	Designation for bulk density [kg/m^3]*
d	dry (dry basis)
daf	dry, ash-free
D	Designation for diameter [mm]*
DT	Deformation temperature analysed for ash melting behaviour [^{o}C]
E	Designation for energy density as received, E_{ar} [kWh/m^3 or kWh/kg, unit is to be stated in brackets]*
F	Designation for amount of fines (< 3.15 mm, w-%)
Fpr	Final draft version of standard (working group has finalised and which is under approval (voting by national standardisation committees))
L	Designation for length [mm]*
M	Designation for moisture content as received, M_{ar} [w-% on wet basic]*
pr	preliminary (standard under preparation, draft version)
$q_{p,net}$	Net calorific value at constant pressure [MJ/kg]
Q	Designation for net calorific value (at constant pressure) as received, $q_{p,net,ar}$ [MJ/kg]

* Designation symbols are used in combination with a number to specify property levels. For designation of chemical properties, chemical symbols like S (sulphur), Cl (chlorine), and N (nitrogen) are used and the value is added directly after the symbol.

1 Introduction

EUBIONET III project carried out a survey on industrial wood pellet product standard. The survey was agreed on with the EACI Agency. Many industrial pellet users have proposed similar product standard as EN 14961-2 – Wood pellets for non-industrial use. In this standard properties are bind together to form classes: A1, A2 and B. FprEN 14961-2 standard is approved and will be published soon. Because the draft standard could not be delivered to market actors, VTT made an article explaining the main parts of the standards EN 14961-1 and EN 14961-2, which was needed to carry out the survey. EUBIONET III partners have translated it to their own languages in order to carry out the interviews with market actors. EPC ENplus and DINplus certification handbook was also disseminated to partners and other target organisations.

The interviews were carried out between December 2010 and April 2011. The template for interviews is attached in App. 1 and additional information on the new pellet standards were distributed to interviewees.

The questionnaire was sent to the following organisations:

- EUBIONET III partners for interviews within pellet producers, industrial pellet users, traders (mainly power producers) and associations
- CEN/TC 335 Solid biofuels – working group 2 members (Fuel specifications and classes, quality assurance)
- ISO/TC 238 Solid biofuels – working group 2 members (Fuel specifications and classes) – with members from Europe, USA, Canada, South-Korea, Thailand and Malesia
- European Pellet Council members (pellet associations)

The aims of the questionnaire were to find out,

- if a special industrial pellet product standard is needed
- to collect proposals regarding what this standard should include
- if certification system for industrial pellets is needed and should this certification system include sustainability issues
- what are the raw material requirements e.g. can chemically treated material accepted
- if standard for thermally treated biomass e.g. torrefied pellets is needed

The whole questionnaire can be seen in App. 1.

The feedback was gathered in total from 44 responses representing different European countries and Canada. All biggest users of industrial wood pellets, which have power plants in several EU-countries, replied to the questionnaire. All actual identification data of the respondents has been removed, thus the results can not be traced back to any single country or respondent.

The first part of the questionnaire was designed to collect data about the respondents. Figure 1 presents the organisation types of the respondents. Of a total of 44 answers, there were 18 producers, 17 end-users and 13 other organisations like associations and certification bodies. It should be noted that 5 respondents had multiple roles, e.g. function both as a producer and an end-user.

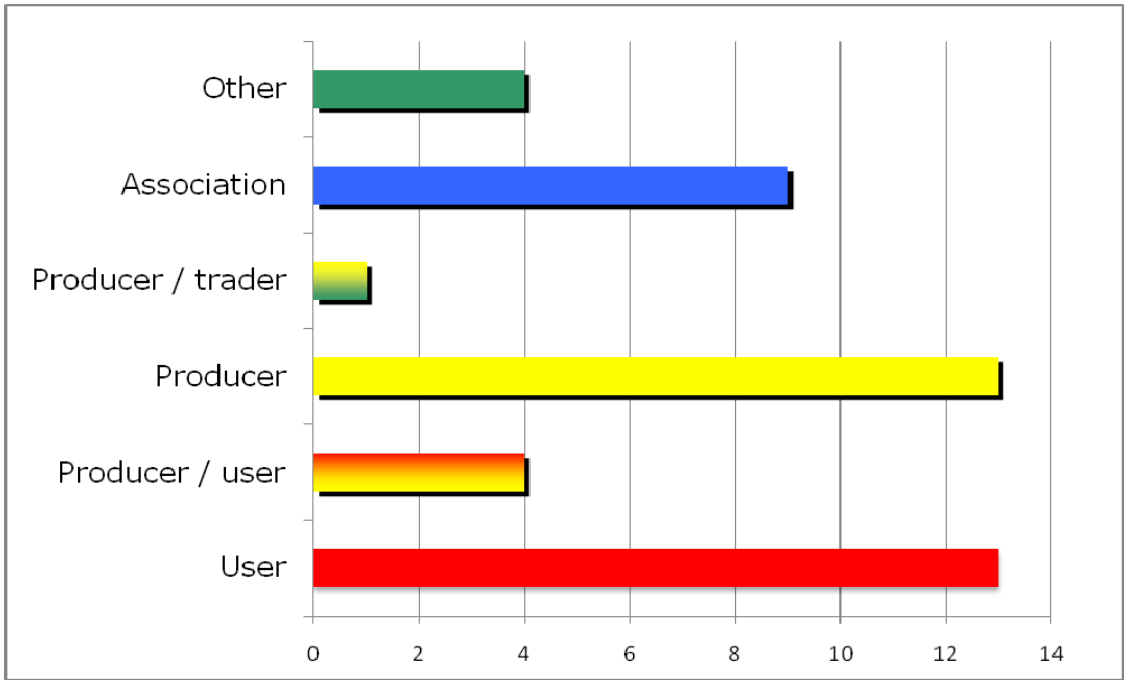


Figure 1. Type of respondent organisations.

2 Results of the survey

1. USE OF CEN PELLET STANDARDS (EN 14961-1 or EN 14961-2)

1.1 Are you going to use CEN wood pellet standards?

According to the interviews 27 replied that they will use EN 14961-1 standard and 12 that they will not use EN 14961-1. For EN 14961-2 the same figures are the following: yes 18 and 17 no. Most of the respondents stated that they will use EN 14961-1 (see Figure 3).

The respondents had a possibility to give free comments and explanations. Some of the reasons and explanations for intending (or not intending) to use the standards are collected below.

YES, because:

- Basis of validation in conjunction with DINplus certification and DIN-Geprüft "Industriepellets".
- It is well done and successful to get a European-wide standard. It is important to secure the pellets quality in each country, with a European-wide standard.
- It is important to have a European wide standard especially for internationally operating companies.
- We are partner of EPC. During 2011 we will work to introduce ENplus in our country.
- Makes trading/ asset development measurable and thus valued.
- Probably yes. If it is necessary and it makes sense.
- We will use the terminology in our specifications for power plants and contracts.
- In some cases, if applicable.
- We use and we know this CEN standard.
- Assists with sales
- A standard is necessary to ensure product quality and uniformity.
- It's the only way of competing of form balanced on the market.
- If standard will be know among the customers, as eg. DIN plus.

NO, because:

- Each contract has its own specification. The agreement with the client also sets the fuel quality requirements.
- If the client is not asking the standard, the companies are not interested to implement it.
- We think the industrial quality pellets consumers have already their own criteria and it is sufficient.

- We only produce high quality pellets and we won't produce industrial pellets in the future, therefore we could not comment about this kind of pellets, we could not give a concrete statement, because we do not have any experiences on industrial-quality.

- We used ÖNORM in the past, but then we have found that Austrian customers prefer non-certified products from Balkan countries. We don't give support to pellet standards and certification after this experience.

2. PRODUCT STANDARD FOR INDUSTRIAL WOOD PELLETS

2.1 Is an industrial wood pellets product standard needed, or is it sufficient to use EN 14961-1 as a common system of denominations to specify pellet qualities?

17 of the respondents find it sufficient to use EN 14961-1 standard, in which you can select each property class separately. Same number of respondents stated that own product standard for industrial pellets is needed.

Comments from respondents are presented below.

YES, separate standard is needed, because:

- Yes needed as well since it makes trading/ asset development measurable and thus valued.

- Yes it is needed to cover all the potential customer segments. Industrial pellets are needed to mobilise big stocks of biomass not used today.

- There is necessary a standardization of all the products that exist on the market, but due to the fact that the not industrial pellets have a characterization more demanding, only it would be necessary to relax the conditions for industrial use.

- Standardisation makes trading easier, but how much it will increase the prices? Large combustion plants have different user requirements than households, which favours own standard for industrial pellets.

- Industrial wood pellets product standard is needed. Producers must comply with technical and legal requirements of power plants.

- Yes, there should also be a product standard for industrial pellets, EN 14961-1 is not enough even when we think about torrefied pellets.

NO, separate standard is not needed, because:

- EN14961-1 should be sufficient, or should be made sufficient, for both industrial and non-industrial qualities.

- It is not absolutely necessary. It is possible to describe the requested quality according to EN14961-1, except the raw material particle size and off-gasing-behaviour.

- It is sufficient to use EN14961-1 or EN 14961-2.

- No, I don’t see any need of that. It would be too many classes to fit all the different plants’ demands, and all plants have individual requirements.

- Only use the EN14961-2 B1, 2, 3 and to add other material like: used wood, bark, straw

- While it would be good to have a single Industrial Pellet Standard we do not believe it is feasible as the term "industrial" covers very many different circumstances of use with different fuel property requirements. Existing standards provide an adequate framework for informatively describing any product properties (except sub-particle size).

- No special product standard needed for industrial wood pellets in the stage.

- The standards are defined adequate, EN 14961-1 as well as part 2.

- I think that existing standard EN 14961-2 is sufficient, because there are 3 types and they also cover industrial pellets.

2.2 It has been suggested to use the same specifications for industrial pellet as specified by EN 14961-2 and some additional parameters for industrial use. Do you consider this approach is feasible?

12 respondents find it feasible to use EN 14961-2 as a basic for industrial pellet product standard and 13 didn't find it feasible. Some of the respondents produce only wood pellets for household markets or otherwise didn't comment this question at all (in total 20 no comments).

Comments from respondents are presented below.

YES, because:

- Yes, but pellet requirements for industrial use must be more flexible because boilers' technology permit lower quality standard.

- Yes, from the point of a consumer, the parameters are relatively, because they should be coordinated between the boiler producer and the pellets producer, and public authorities should observe the compliance.

- Yes we do, because we think that in future, ordinary markets are developing in trade and small- and middle-scale industry; further if we are short of required quantity, we could use industrial quality temporary, when they are of the same specifications.

- All standards should be as simple as possible, so 1 standard, possibly a mix, and not several.

- For a pellets standard, this seems logical. Stakeholders in the industrial market, as well as stakeholders in the non-industrial market, can then formulate their own specifications.

- Yes, we think so, if the majority of the end-users are all right with the quality requested in prEN 14961-2.

- Yes, with some implementation on variables considered by 14961-2 could cover Industrial Pellets.

- NO, because:Quality performance of industrial pellets is usually part of bi- or multilateral contracts between dealers and customers. Standardized qualities are therefore not reasonable.

- No, should be separate standards, but 14961-1 may need some additional options for a wider range of raw materials.

- No, requirements are not the same.

- No, significant specificities must apply for industrial pellets.
- No, because the pellets go in a different kind of stoves and other boilers.

2.2 b) Which additional specifications should be required (Table 2, see App.1)?

In Figure 2 replies from the respondents are shown. Red colour indicates the normative (mandatory) properties and green informative (voluntary) properties. Most important properties to be stated according to the survey are:

- moisture content (M)
- net calorific value (Q)
- ash content (A)
- mechanical durability (DU)
- bulk density (BD)
- origin
- fines (F)
- dimensions (D, L), sulphur (S), additives

Similar replies were received in EUBIONET II survey for CEN/TS 14961 (Alakangas, et. al. 2007). Most of the producers stated that heavy metals should be informative. Also users didn't find all heavy metals necessary to be stated e.g. zinc, nickel, mercury, lead and copper.

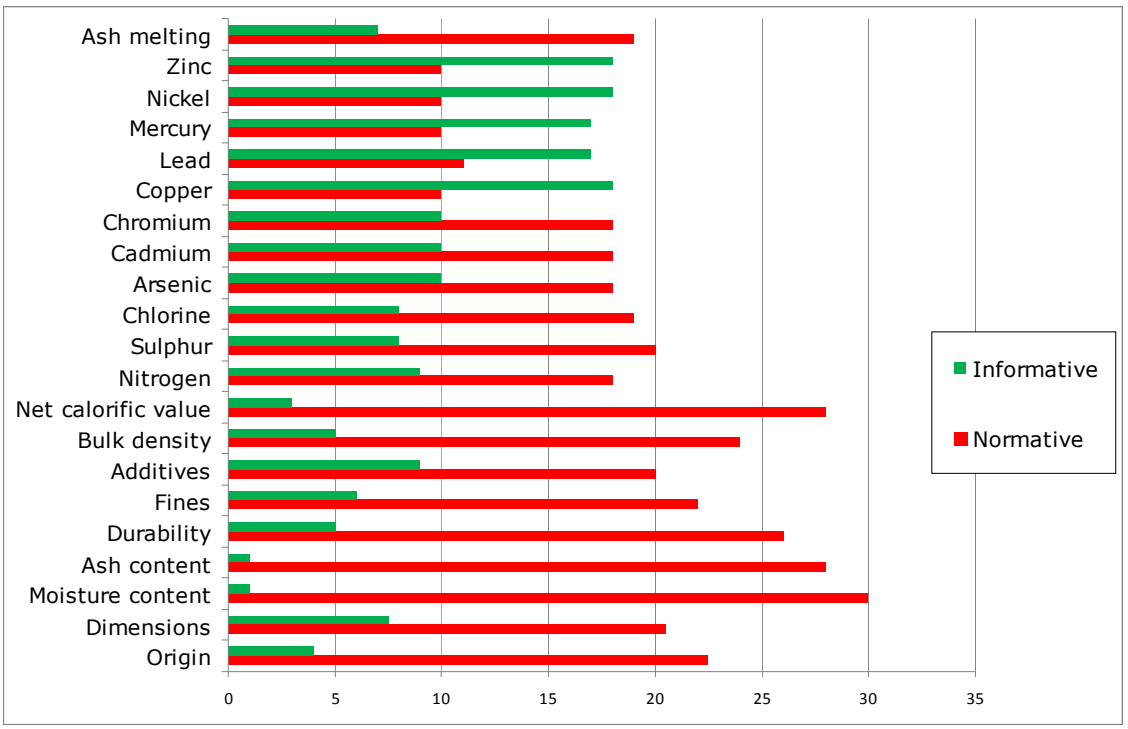


Figure 2. Properties, which are needed for specification of industrial wood pellets. Normative properties are mandatory and informative properties are voluntary.

2.2 c) Your own proposal for a specification for industrial wood pellets (Table 3 in App.1)?

Several proposals were received from respondents for threshold values for industrial wood pellets. In Table 1 proposals for high quality industrial wood pellets (class I1) are stated, in Table 2 for class I2 and in Table 3 for class I3. Table 4 includes an additional proposal for I1, which was not reported as requested in Table 3 in App.1. Columns in Tables 1 to 3 indicate the type of organisation. Many users have proposed same values, so those are under column "user (several)".

For power plants, which are applying pulverized combustion technology the particle size distribution is very important for combustion and also ash melting behaviour.

Table 1. Proposal for the specification of wood pellets for industrial use /class I1

Property class, Analysis method	**Unit**	**I1 Research org.**	**I1 User**	**I1 User (several)**	**I1 Producer**	**I1 Producer / User**	**I1 Producer**
Origin and source (see table 1 in attached article and Appendix 3) EN 14961-1				1.1 Forest, plantation and other virgin wood, 1.2 By-products and residues	1.1.3 Stemwood 1.2.1 Untreated wood residues	1.1 Forest plantation 1.3 Used wood 1.2 Residues for wood processing industry	1.1.3 Stemwood 1.2.1 Untreated wood residues
Diameter, D [a] and Length L, [b] prEN 16127	mm	D06 – D25	D010, ≤ 10 ± 1; 3,15 ≤ L ≤ 45 D0X10+, > 10 ± 1 3,15 ≤ L ≤ 45	D06 to D08 L < 40	D06, 6 ± 1; 3,15 ≤ L ≤ 40 D08, 8 ± 1; 3,15 ≤ L ≤ 40	D08, 8 ± 1; 3,15 ≤ L ≤ 40 D10, 10 ± 1; 3,15 ≤ L ≤ 40 D12, 12 ± 1; 3,15 ≤ L ≤ 40	D06, 6 ± 1; 3,15 ≤ L ≤ 40 D08, 8 ± 1; 3,15 ≤ L ≤ 40
Moisture, M EN 14774-1, EN 14774-2	as received, w-% wet basis	M10 – M20	M ≤ 12	M10 M < 10%	M 10 ≤ 10	M 10 ≤ 10	M 10 ≤ 10
Ash, A EN14775	w-% dry	A2.0	A ≤ 3	A 1.0 A < 1,0%	A 0.7 ≤ 0,7	A 1. ≤ 1	A 0.7. ≤ 0,7
Mechanical durability, DU, EN 15210-1	as received, w-%		DU ≥ 96	DU 97.5 – max. 99	DU97.5 ≥ 97,5	DU97.5 ≥ 97,5	DU97.5 ≥ 97,5
Fines at final place before delivering to plant), F, EN15210-1	w-% as received	Max. 4%	F2.0 ≤ 2,0	F4.0 F < 4,0%	F1.0 ≤ 1,0	F1.0 ≤ 1,0	F1.0 ≤ 1,0
Additives [c]	w-% dry	Type and amount to be stated	≤ 2 w-% type and amount to be stated	None	≤ 0 w-% Type and amount to be stated	≤ 0 w-% Type and amount to be stated	≤ 0 w-% Type and amount to be stated
Net calorific value, Q, EN 14918	as received, MJ/kg		Q17.0 ≥ 17.0	Q16.5 Q ≥ 16,5	Q16.5 Q≥ 16,5	Q16.5 Q≥ 16,5	Q16.5 Q≥ 16,5
Bulk density, BD, EN 15103	kg/m^3		BD ≥ 600	BD600 ≥ 600	BD650 ≥ 650	BD650 ≥ 650	BD650 ≥ 650

Property class, Analysis method	**Unit**	**I1 Research org.**	**I1 User**	**I1 User (several)**	**I1 Producer**	**I1 Producer / User**	**I1 Producer**
Nitrogen, N, FprEN 15104	w-% dry			N0.5 ≤ 0,5	N0.3 ≤ 0,3	N0.5 ≤ 0,5	N0.3 ≤ 0,3
Sulphur , S, FprEN 15289	w-% dry			S0.05 ≤ 0,05%	S0.03 ≤ 0,03	S0.05 ≤ 0,05	S0.03 ≤ 0,03
Chlorine, Cl, FprEN 15289	w-% dry			Cl0.03 ≤ 0,03%	Cl0.02 ≤ 0,02	Cl0.03 ≤ 0,03	Cl0.02 ≤ 0,02
Arsenic, As, FprEN 15297	mg/kg dry		As in 14961-2	≤ 2	≤ 1	≤ 1	≤ 1
Cadmium, Cd, FprEN 15297	mg/kg dry		As in 14961	≤ 1,0	≤ 0,5	≤ 0,5	≤ 0,5
Chromium, Cr, FprEN 15297	mg/kg dry		As in 14961	≤ 15	≤ 10	≤ 10	≤ 10
Copper, Cu, FprEN 15297	mg/kg dry		As in 14961		≤ 10	≤ 10	≤ 10
Lead, Pb, FprEN 15297	mg/kg dry		As in 14961		≤ 10	≤ 10	≤ 10
Mercury, Hg, FprEN 15297	mg/kg dry		As in 14961		≤ 0,1	≤ 0,1	≤ 0,1
Nickel, Ni, FprEN 15297	mg/kg dry		As in 14961		≤10	≤10	≤10
Zinc, Zn, FprEN 15297	mg/kg dry		As in 14961		≤100	≤100	≤100
Ash melting behaviour, [d] prEN15370	°C		DT	1200			
Particle size distribution, prEN15149 % < 4.0 mm % < 3.15 mm % < 2.0 mm % < 1.5 mm % < 1.0 mm % < 0.1 mm	w-% dry			 100% > 97% > 95% > 75% > 50% < 3%			

Table 2. Proposal for the specification of wood pellets for industrial use /class I2

Property class, Analysis method	**Unit**	**I2 Research org.**	**I2 User**	**I2 User several**	**I2 Producer**	**I2 Producer / User**	**I2 Producer**
Origin and source (see table 1 in attached article App. 3)				1.1 Forest, plantation and other virgin wood, 1.2 By-products and residues	1.1.1 Whole trees w.o.roots 1.1.3 Stemwood	1.1 Forest plantation 1.3 Used wood 1.2 Residues for wood processing industry	1.1.1 Whole trees w.o roots 1.1.3 Stemwood
Diameter, D [a] and Length L, [b] prEN 16127	mm		D010, ≤ 10 ± 1; 3,15 ≤ L ≤ 45 D0X10+, > 10 ± 1 3,15 ≤ L ≤ 45	D06 to D08 L < 40	D06, 6 ± 1; 3,15 ≤ L ≤ 40 D08, 8 ± 1; 3,15 ≤ L ≤ 40	D08, 8 ± 1; 3,15 ≤ L ≤ 40 D10, 10 ± 1; 3,15 ≤ L ≤ 40 D12, 12 ± 1; 3,15 ≤ L ≤ 40	D06, 6 ± 1; 3,15 ≤ L ≤ 40 D08, 8 ± 1; 3,15 ≤ L ≤ 40
Moisture, M EN 14774-1, EN 14774-2	as received, w-% wet basis		M ≤ 15	M10 M < 10%	M 10 ≤ 10	M 10 ≤ 10	M 10 ≤ 10
Ash, A EN14775	w-% dry		A ≤ 5	A 2.0 A < 2,0%	A 1.5 ≤ 1,5	A 2. ≤ 2	A 1.5 ≤ 1,5
Mechanical durability, DU, EN 15210-1	as received, w-%		DU ≥ 95	DU 96.5 – max. 99	DU97.5 ≥ 97,5	DU97.5 ≥ 97,5	DU97.5 ≥ 97,5
Fines at final place before delivering to plant), F, EN15210-1	w-% as received		FX ≤ 3,0	F4.0 F < 4,0%	F1.0 ≤ 1,0	F1.0 ≤ 1,0	F1.0 ≤ 1,0
Additives [c]	w-% dry		≤ 5 w-% type and amount to be stated	None	≤ 0 w-% Type and amount to be stated	≤ 0 w-% Type and amount to be stated	≤ 0 w-% Type and amount to be stated
Net calorific value, Q, EN 14918	as received, MJ/kg		Q1 ≥ 16,5	Q16.5 Q ≥ 16,5	Q16.3 Q≥ 16,3	Q16.3 Q≥ 16,3	Q16.3 Q≥ 16,3
Bulk density, BD, EN 15103	kg/m^3		BD ≥ 600	BD600 ≥ 600	BD650 ≥ 650	BD650 ≥ 650	BD650 ≥ 650

Property class, Analysis method	**Unit**	**I1 Research org.**	**I2 User**	**I2 User (several)**	**I2 Producer**	**I2 Producer / User**	**I2 Producer**
Nitrogen, N, FprEN 15104	w-% dry			N1.5 ≤ 1,5	N0.5 ≤ 0,5	N0.5 ≤ 0,5	N0.5 ≤ 0,5
Sulphur , S, FprEN 15289	w-% dry			S0.4 ≤ 0,4%	S0.05 ≤ 0,05	S0.05 ≤ 0,05	S0.05 ≤ 0,05
Chlorine, Cl, FprEN 15289	w-% dry			Cl0.1 ≤ 0,1%	Cl0.02 ≤ 0,02	Cl0.03 ≤ 0,03	Cl0.02 ≤ 0,02
Arsenic, As, FprEN 15297	mg/kg dry		As in 14961-1	≤ 6	≤ 1	≤ 1	≤ 1
Cadmium, Cd, FprEN 15297	mg/kg dry		As in 14961	≤ 10	≤ 0,5	≤ 0,5	≤ 0,5
Chromium, Cr, FprEN 15297	mg/kg dry		As in 14961	≤ 50	≤ 10	≤ 10	≤ 10
Copper, Cu, FprEN 15297	mg/kg dry		As in 14961		≤ 10	≤ 10	≤ 10
Lead, Pb, FprEN 15297	mg/kg dry		As in 14961		≤ 10	≤ 10	≤ 10
Mercury, Hg, FprEN 15297	mg/kg dry		As in 14961		≤ 0,1	≤ 0,1	≤ 0,1
Nickel, Ni, FprEN 15297	mg/kg dry		As in 14961		≤10	≤10	≤10
Zinc, Zn, FprEN 15297	mg/kg dry		As in 14961		≤100	≤100	≤100
Ash melting behaviour, [d] prEN15370	°C		DT	1 100			
Particle size distribution, prEN15149 % < 4.0 mm % < 3.15 mm % < 2.0 mm % < 1.5 mm % < 1.0 mm % < 0.1 mm	w-% dry			 100% > 97% > 90% > 50% < 5%			

Table 3. Proposal for the specification of wood pellets for industrial use /class I3

Property class, Analysis method	**Unit**	**I3 Research org.**	**I3 User**	**I3 User (several)**	**I3 Producer**	**I3 Producer / User**	**I3 Producer**
Origin and source (see table 1 in attached article App.2)					1.1 Forest plantation 1.3 Used wood 1.2 Residues for wood processing industry	1.1 Forest plantation 1.3 Used wood 1.2 Residues for wood processing industry	1.1 Forest plantation 1.3 Used wood 1.2 Residues for wood processing industry
Diameter, D [a] and Length L' [b] prEN 16127	mm		D010, ≤ 10 ± 1; 3,15 ≤ L ≤ 45 D0X10+, > 10 ± 1 3,15 ≤ L ≤ 45		D06, 6 ± 1; 3,15 ≤ L ≤ 40 D08, 8 ± 1; 3,15 ≤ L ≤ 40	D08, 8 ± 1; 3,15 ≤ L ≤ 40 D10, 10 ± 1; 3,15 ≤ L ≤ 40 D12, 12 ± 1; 3,15 ≤ L ≤ 40	D06, 6 ± 1; 3,15 ≤ L ≤ 40 D08, 8 ± 1; 3,15 ≤ L ≤ 40
Moisture, M EN 14774-1, EN 14774-2	as received, w-% wet basis		M ≤ 20		M 10 ≤ 10	M 10 ≤ 10	M 10 ≤ 10
Ash, A EN14775	w-% dry		A ≤ 10		A 3.0 ≤ 3,0	A 3.0 ≤ 3,0	A 3.0 ≤ 3,0
Mechanical durability, DU, EN 15210-1	as received, w-%		DU ≥ 90		DU97.5 ≥ 97,5	DU97.5 ≥ 97,5	DU97.5 ≥ 97,5
Fines at final place before delivering to plant), F, EN15210-1	w-% as received		FX ≤ 5,0		F1.0 ≤ 1,0	F1.0 ≤ 1,0	F1.0 ≤ 1,0
Additives [c]	w-% dry		≤ 10 w-% type and amount to be stated		≤ 0 w-% Type and amount to be stated	≤ 0 w-% Type and amount to be stated	≤ 0 w-% Type and amount to be stated
Net calorific value, Q, EN 14918	as received, MJ/kg		Q1 ≥ 16,2		Q16.0 Q≥ 16,0	Q16.0 Q≥ 16,0	Q16.0 Q≥ 16,0
Bulk density, BD, EN 15103	kg/m^3		BD ≥ 600		BD600 ≥ 600	BD600 ≥ 600	BD600 ≥ 600

Property class, Analysis method	**Unit**	**I13 Research org.**	**I3 User**	**I3 User (several)**	**I3 Producer**	**I3 Producer/User**	**I3 Producer**
Nitrogen, N, FprEN 15104	w-% dry				N0.1 ≤ 1,0	N0.1 ≤ 1,0	N0.1 ≤ 1,0
Sulphur , S, FprEN 15289	w-% dry				S0.1 ≤ 0,1	S0.1 ≤ 0,1	S0.1 ≤ 0,1
Chlorine, Cl, FprEN 15289	w-% dry				Cl0.03 ≤ 0,03	Cl0.03 ≤ 0,03	Cl0.03 ≤ 0,03
Arsenic, As, FprEN 15297	mg/kg dry		As in 14961-2		≤ 1	≤ 1	≤ 1
Cadmium, Cd, FprEN 15297	mg/kg dry		As in 14961-2		≤ 0,5	≤ 0,5	≤ 0,5
Chromium, Cr, FprEN 15297	mg/kg dry		As in 14961-2		≤ 10	≤ 10	≤ 10
Copper, Cu, FprEN 15297	mg/kg dry		As in 14961-2		≤ 10	≤ 10	≤ 10
Lead, Pb, FprEN 15297	mg/kg dry		As in 14961-2		≤ 10	≤ 10	≤ 10
Mercury, Hg, FprEN 15297	mg/kg dry		As in 14961-2		≤ 0,1	≤ 0,1	≤ 0,1
Nickel, Ni, FprEN 15297	mg/kg dry		As in 14961-2		≤10	≤10	≤10
Zinc, Zn, FprEN 15297	mg/kg dry		As in 14961-2		≤100	≤100	≤100
Ash melting behaviour, [d] prEN15370	°C		DT (deformation temperature)				
Particle size distribution, prEN15149 % < 4.0 mm % < 3.15 mm % < 2.0 mm % < 1.5 mm % < 1.0 mm % < 0.1 mm	w-% dry						

[a] Selected size of pellets to be stated.
[b] Amount of pellets longer than XX mm can be X w-%. Maximum length shall be < XX mm. (no replies for XX)
[c] Type (e.g. starch, corn flour, potato flour, vegetable oil)

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

Table 4. Additional proposal not fit to Table 3 in questionnaire (App.1)

Specification Wood Pellets						
Component	Unit	Acceptance level	Expected level	Analysis method	Principal Analysis standard	Alternative CEN standard
Physical Characteristics of the Biomass						
Temperature	ºC	< 50	30			
Moisture	% of weight	< 9	5	ISO 598-Method B	NTA8200	EN 14774
Calorific value as received, net, under constant pressure	GJ/ton	>16.50	17.5	ISO 1928	NTA 8200	EN 14918
Fractional distribution (inside the pellet)	% of weight	100 % < 4 mm >90.5 % < 2 mm >65 % < 1 mm < 3% < 0.1 mm	100 % < 4 mm >90.5 % < 2 mm >65 % < 1 mm < 3% < 0.1 mm	Disintegrated pellets: ISO 1953 (square holes)	NTA 8200	EN15149
Fines (separate of the pellet particles) Particles 0 to 4 mm Particles 0 to 1 mm	% of weight	<3,5% < 1%	<3% <0.5%	ISO 1953 (Square holes)	NTA 8200	EN 15149

Component	Unit	Acceptance level	Expected level	Analysis method	Principal Analysis standard	Alternative CEN standard
Shape (cylindrical pellet)		6 – 10 mm diameter < 30 mm long	6 – 10 mm diameter < 30 mm long			
Binding agent		None	None			
Additive agent		None	None			
Extraneous material		None	None			
Stowage Factor	cbft per MT	<58	<55	EN 15103	EN 15103	EN 15103
Mechanical Durability of pellets	% of weight		>90.0	EN 15210-1	EN 15210-1	EN 15210-1
Total Ash	% of weight	<2	1	ISO 1171 (550 °C)	NTA 8200	EN 14775
Elemental components in weight % of ash from the Biomass						
CaO	% of weight	< 45	35	ICPMS or ICPAES	NTA 8200	EN 15290
P_2O_5	% of weight	<5	3	ICPMS or ICPAES	NTA 8200	EN 15290
SiO_2	% of weight	<50	15	ICPMS or ICPAES	NTA 8200	EN 15290

Component	Unit	Acceptance level	Expected level	Analysis method	Principal Analysis standard	Alternative CEN standard
As	mg/kg	< 6	3	ICPMS or HAAS	NTA 8200	EN 15297
Ba	mg/kg	<1 040		ICPMS or ICPAES	NTA 8200	EN 15290
Cd	mg/kg	<1	0.3	ICPMS or GFAAS	NTA 8200	EN 15297
Co	mg/kg	<10	3	ICPMS or ICPAES	NTA 8200	EN 15297
Cr	mg/kg	<100	16	ICPMS or ICPAES	NTA 8200	EN 15297
Cu	mg/kg	<20	5	ICPMS or GFAAS	NTA 8200	EN 15297
Hg	mg/kg	<0.1	0.07	ICPMS or CVAAS	NTA 8200	EN 15297
Mn	mg/kg	<800	343	ICPMS or ICPAES	NTA 8200	EN 15297
Mo	mg/kg	<40	18	ICPMS or GFAAS	NTA 8200	EN 15297
Ni	mg/kg	<70	11	ICPMS or ICPAES	NTA 8200	EN 15297
Pb	mg/kg	<200	20	ICPMS or GFAAS	NTA 8200	EN 15297
Sb	mg/kg	<6	4	ICPMS or HAAS	NTA 8200	EN 15297
Se	mg/kg	<10	5	ICPMS or HAAS	NTA 8200	
Sn	mg/kg	<20	4	ICPMS or GFAAS	NTA 8200	
Te	mg/kg	<20	6	ICPMS or ICPAES	NTA 8200	
V	mg/kg	<10	4	ICPMS or ICPAES	NTA 8200	EN 15297
Zn	mg/kg	<2 543		ICPMS or ICPAES	NTA 8200	EN 15297
F	mg/kg	< 150	35	ISO/DIS 11724	NTA 8200	

Component	Unit	Acceptance level	Expected level	Analysis method	Principal Analysis standard	Alternative CEN standard
Elemental components in % of weight of Biomass (dry basis)						
S	% of weight	<0.4	<0.1	ISO 351	NTA 8200	EN 15289
Cl	% of weight	<0.1		ISO 352	NTA 8200	EN 15289
Ad Annex A						
ICP-MS = Inductively Coupled Plasma - Mass Spectrometry						
ICP-AES = Inductively Coupled Plasma - Atomic Emission Spectrometry						
HAAS = Hybrid Atomic Absorption Spectrometry						
GFAAS = Graphite Furnace Absorption Spectrometry						
CVAAS = Cold Vapour Atomic Absorption Spectrometry						
XRF = X-ray Fluorescence Emission Spectrometry						
Alternative CEN standard = an alternative standard that shall give an equal result to the Principal Analysis standard. In case of difference the Principal Analysis Standard shall prevail						
EN standards: until the relevant EN standard is printed the CEN/TS version of this standard may be used						
The stowage factor above does not include any broken stowage						

3. CERTIFICATION

3.1 The European Pellet Council is launching ENplus certification systems for non-industrial wood pellets, which is based on EN 14961-2 standard. Also DINplus has similar certification system. Is a certification system needed also for industrial wood pellets?

3.2 If a certification system is needed for industrial wood pellets, what additional requirements or different requirements should it include compared to ENplus or DINplus? Are there elements which are unnecessary and/or too expensive to measure in ENplus or DINplus.

Within the questionnaire a draft handbook of ENplus certification system and DINplus handbook was delivered to participants for interviews. There is also NF certification system in France, but EUBIONET III didn't receive any English material on this. These two handbooks were examples, which respondents could see and comment.

22 of respondents see a certification system necessary and 16 unnecessary.

Replies from respondents are collected below.

NECESSARY, because:

- Certification is probably the best instrument to guarantee appliance to certain standards or specifications. Still, this could be realised under and extended ENplus-system.

- A certification system will help to achieve a constant technical quality, to guarantee best practices are carried out and will help integrating sustainability criteria that are verified at all steps of the supply chain.

- Certification for the origin of pellets is needed.

- The buyer must know what buys. The competition of internecine of sellers must be more honest.

- Specifically different technology

- To avoid misinformation and to define correct market.

- Standards are important in all markets and for all applications.

- Yes, however system is needed to cover all quality of pellets. Currently too many initiative arise to do the same certification. Unity amongst certifying bodies is needed to make trading more effective. These growing pains are costly and in-efficient.

- The biggest problem for implementing the industrial use of biomass is the lack of uniformity of the product, with the consequential waste and efficiency changes. Product's certification allows design specific uses and technology.

- We understand that pellets as a new energy commodity, therefore need to express confidence to the final customer. Note that bigger volume of pellets will be trade within Europe for industrial purposes.

- Yes, in matters of sustainability it is necessary to have such a certifications system also for industrial pellets. From my point of view sustainability is a major point in ENplus certification, and therefore it is important to have also a certification system for industrial pellets.

- Not all utilities in Europe do feel the necessity of a certification system because their position on certification has not yet been outlined fully. But some other utilities - like those having operations in BE, NL, UK - do feel this necessity. Key elements would then be as follows:
  (1) constant wood pellets quality,
  (2) raw material,
  (3) existence of a tracking system,
  (4) make the producer responsible for sustainability,
  (5) ability to report on energy use and evaluate GHG balance.

  ENplus Green integrating those sustainability requirements would be more than welcome.

- Only if "sustainability" issues (e.g. conversion efficiency) shall be included;

- Yes, to prevent the confusion and escape way for speculators.

- If an ENplus certification system for industrial wood pellets is introduced, it must be somehow flexible, because wood pellets are often traded on industrial scale "on the spot market".

- Yes, a certification for industrial wood pellets is important to transform pellets in a "energetic commodity". Different certified types of pellets for different end user. Some elements included in ENplus are not necessary for industrial pellets because this type of pellet will be used in industrial plants.

- Yes, however one system is needed to cover all quality of pellets. Currently too many initiatives arise to do the same certification. Unity amongst certifying bodies is needed to make trading more effective. These growing pains are costly and in-efficient.

UNNECESSARY, because:

- The certification is not needed for industrial pellets, nor non-industrial.

- It is too expensive and complex

- In most cases, boilers > 500 kW run by personnel having enough knowledge of what fuels are suitable for the actual boiler.

- We think a certification system on the basis of 14961-2 B is adequate and enough.

- It requires additional costs. Each contract with the client sets its own quality requirements.

- Certification only for quality pellets.

- Large consumers have their own intake control. If the products do not match the recommendations, they will send it back to the distributor.

- The fuel purchaser didn’t see any use of that, at least not for verifying the quality of pellets. But to certify origin, traceability etc. would be valuable and motivated.

- It is not necessary, because the standard provide everything.

- Not, because as soon as the product is certified, it would have to turn out to be sufficient. The origin of the wood only should have informative character, and, in case of verifying on the part of an organ of supervision an origin

different from the informed one, it would be when it should proceed to execute a sanction.

- We did not receive inquiries in regard to certification of wood pellets for industrial use from the market so far.

4. RAW MATERIAL REQUIREMENTS

4.1 Should chemically treated material be allowed? If Yes, what would be the requirements for the material; or if No, why?

In EN 14961-1 classification of raw material (see Table 1 in EN 14961-1 chemically treated wood residues from wood processing (glued, painted, coated, lacquered or otherwise treated wood, class 1.2.1) or used wood (class 1.3.2) *is allowed as long as they do not contain heavy metals or halogenated organic compounds as a result of treatment with wood preservatives or coating*. In *EN 14961-2 chemically treated wood is allowed only in class B*, but same threshold values for heavy metals and other chemical compounds as for chemically untreated material has to be met.

In the ENplus certification no chemically treated wood is allowed, but small levels of glue, grease and other timber production additives used in saw mills during production of timber and timber products 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.

Some of the respondents understood the question that chemically treated means contaminated, pollutant material. In the standard EN 14588 contamination is described as follows: make impure by exposure to or addition of a poisonous or polluting substance to a fuel.

Most of the respondents found that small amounts of chemically treated (not contaminated) material could be used, and the threshold values should be fulfilled. In some countries e.g. in Italy and France national legislation hinder the use of chemically treated material. 14 respondents supported the use of chemically treated material in pellet production for industrial use.

Comments from respondents are presented below.

YES, because:

- But only if allowed under the EU Waste Directive, or when the End-of-Waste principle applies to a certain material quality. Still this specifically has to be specified.

- At least there should be minimum one quality class including chemically treated material since most of the large combustion facilities own comprehensive filter systems.

- Same requirement as the ones included in EN14961-2.

- Except hazardous materials. But construction residues, pallets are acceptable.

- Chemically treated material should be allowed but where appropriate exhaust gas cleaning systems are in place.

- Control of chemical elements is necessary.

- For B and C qualities and lower it could be, for example used wood, but there should be limit values, it must be divided into wood, with is little contaminated and wood with surface coating or chip boards.

- Big scale plants (< 100 MW) do have their own formulation and could handle harmful substances, there are still big-scale plants operating, which are allowed to burn contaminated materials because of specific temperature and flue gas treatment.

- Should be allowed and chemical limits should be fulfilled.

- Yes, based on calorific value and contamination contribution.

- As long as identified as safe to health, must reuse all fibre sources.

- In small amount so that it is still considered biomass.

NO, because:

- Different classification according to the origin of the wood, for being purer it extracted directly from the forest and having a major added value, for what the certification ENplus, it would not be appropriate.

- In most cases small plants have no filter for flue gas cleaning.

- No, specific combustion technology needed.

- For high quality pellets and for non-industrial pellets not (EN 14961-2, ÖNORM and DIN).

- Technically it is possible, but only for boiler houses and other plants where the flue gas cleaning system is available. It should not be allowed for households.

- The risk of manipulation is too high, the costs of testing for each delivery would make the material inefficient.

- This could make the sustainability arguable.

- Anything extra should not be allowed.

- Power plants do not use contaminated wood and are not permitted for it.

- Biomass energy must be clean. A green energy cannot proceed from pollutant material.

- No, law do not allow chemically treated wood (e.g. in Italy and France)

5. PRODUCT STANDARD FOR THERMALLY TREATED BIOMASS PELLETS

5.1 Do we need also product standard for thermally treated biomass pellets (e.g. torrefied pellets)?

The need for a product standard for torrefied pellets divided opinions evenly: 17 of the respondents considered thet standard necessary, while another 17 answered that it is not needed.

Comments from respondents are collected below.

YES, because:

- Standardisation will be needed to guide in a production environment that is going to consist of a manifold of production processes, base materials, product qualities, etc.
- Own standard would probably be needed, possibly separately for forest and agro-based biomass.
- Torrefied pellets seem to have a great future in cofiring. Since there is no possibility to describe the quality according to EN 14961-1, an additional standard should be formulated.
- Torrefied pellets should be identified with the differing weather-proofing capabilities, density and colouring.
- Threshold for critical elements are very important.
- Yes, even a specific one for torrefied or as part of an other product standard e.g. for industrial wood pellets, but EN 14961-1 is not enough, this fuel is getting more and more important for plants and from a sustainable point of view, it is important to include the whole production chain.
- We think that is necessary, because of high production costs, it is not that big topic, but it is only a question of time, when the market is ready for that technology.
- Every type of pellet needs a specific standard.
- Yes, based on calorific value and contamination contribution.
- All products should have standards to compare the norm & for producers to aim for.
- It will probably be difficult, because many different biomasses may be torrefied.
- What are definitely needed are standards for methods for determining the quality of the pellets. Most likely black pellets etc. will be used in large boilers and thus bought in large scale that would talk against need of a products standard. I think it would be enough with an own sheet in the "General requirements".

NO, because:

- General specifications are sufficient.
- Early state of the art.
- It will allow us to obtain new products in less time period.
- Will be used in large scale.
- It is not needed for pellets for industrial use.
- No, the raw material is dried in present, and the pellets are produced from the dried material.

- This is premature since the product has not been yet sufficiently tested at large scale and so specifications have not yet been designed.

- There is not enough knowledge about the product yet.

5.2 What properties should be specified for torrefied pellets?

The respondents were asked for their suggestions regarding the most important properties to be specified for torrefied pellets.

Comments from respondents:

- Take properties and specifications in existing standards. In addition I expect that it will become important to specify the torrefaction grade, the amount of tar, volatiles and acids still contained by the torrefied material, aspects on which storage environment has an impact like water absorption by the material, aspects regarding dust explosion risk, smell, etc.

- Parameters according to EN 14961-2. Additionally hydrophobic, degree of torrefaction, grindability and biodegradation.

- Ashes, heat value, moisture, additives.

- Same as in 14961-1 and particle size.

- Key parameters will (probably) be:
  (1) net calorific value,
  (2) volatiles,
  (3) ash content,
  (4) ash melting temperature;
  and in addition for fire & explosion risk: MIE and KSt.

- The whole scope of parameters should be specified.

- No difference from requirements of large scale wood pellets, apart from e.g.
  (1) grindability properties,
  (2) some property describing the "degree" of thermal treatment, I don't know if it is fixed carbon, or something else, like..?
  (3) ash melting behaviour,
  (4) odour (don't know if it can be an issue), self ignition,...;
  I suggest all of these should be informative until more knowledge is available about the fuels and methods exist, so that the demand is really known.

- Moisture and ash content.

- We need to end up with one standard per product group and separate value calculations based on calorific value and contamination contribution.

- Anything extra is not necessary.

- Fixed carbon, particle size, moisture, net calorific value, ash melting behaviour, origin and source of raw material, net calorific value, and other like 14961-2 but for the industrial use.

3 Summary and recommendations

Results of different key questions are summarised in Figure 3.

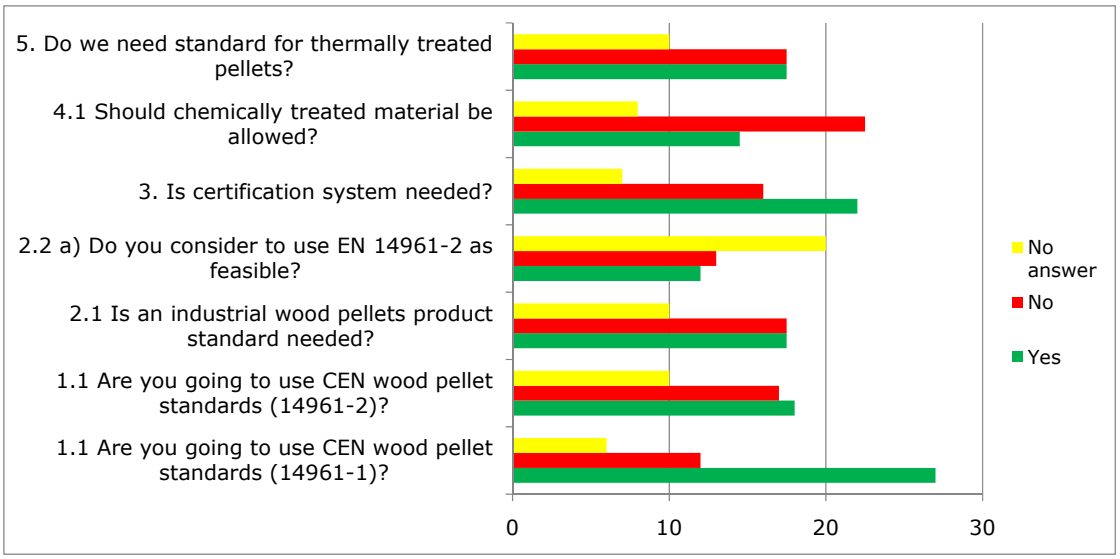


Figure 3. Summary of the replies for different questions.

Most of the respondents replied that they are going to use EN 14961 standards (60%), and 27 % is not going to use.

39% of the respondents find separate industrial pellet standard important and same amount that it is not necessary or EN 14961-1 can be used and some additional parameters could be added. It was same with standard for torrefied pellets.

49% of respondents found that certification system is needed and 36% that it is not needed. The certification was especially found important in the Netherlands, UK and Belgium. Most of the respondents from Nordic countries and some Central European countries didn't find this necessary, because raw material is from certified forests.

50% of the respondents didn't support to use chemically treated material and 32% would like to allow small amounts to be included in raw material, if the combustion technology and flue gas cleaning system is advanced. Most of the respondents wouldn't allow chemically treated raw material to be used in pellets, which are targeted for domestic consumers.

ISO/TC 238 working group 2 is preparing standards ISO 17225-1 "General requirements" and it is proposed that there will one master table for thermally treated biomass. Torrefied pellets can be classified under pellets table by adding some additional property classes for bulk density and fixed carbon and moisture content. Torrefied pellets are not yet common biocommodity, so it is too early to set many property classes and values for them. The table should be very general and flexible.

When drafting product standard EN 14961-2 for non-industrial wood pellets some of the power producers already commented that similar table should be available for industrial use, too. The ISO product standard under preparation (ISO 17225-2 "Graded wood pellets") can include also separate tables for non-industrial and industrial use. Proposals for threshold values collected by EUBIONET III will be disseminated to ISO/TC 238 working 2 for discussion. ISO/TC 238 is drafting solid biofuels standards during 2011 and 2012, so the results of this questionnaire will be discussed in the ISO meeting which will be organised in November 2011 in Thailand.

References

Alakangas, E., Wiik, C. & Lensu, T. CEN 335 – Solid biofuels, Feedback from market actors, EUBIONET report – VTT Report VTT-R-00430-07, Jyväskylä 2007. 58 p. + app. 13 p. (www.eubionet.net → EUBIONET II)

Certification of wood pellets for heating purposed, Master Handbook based on EN 14961-2– draft, 9.12.2010, 56 p.

DINplus – Certification Scheme – wood pellets for use in small furnaces in accordance with E DIN EN 14961-2. Edition July 2010, 16 p.

DINplus – IndustriePellets - Certification Scheme –industry pellets for use in small furnaces in accordance with E DIN EN 14961-2. Edition August 2010, 18 p.

Appendix 1 – EUBIONET III questionnaire

Questionnaire of wood pellets product standard for industrial use

Replies to VTT to Eija Alakangas (eija.alakangas@vtt.fi)

The aim of the questionnaire is to collect feedback from industrial pellets users (power or CHP plants), pellet producers, national pellet or bioenergy associations and the European Pellet Council. **The aim is to clarify, if a special industrial wood pellet product standard is needed**. A product standard for non-industrial use (for appliances used in households, small public and industrial buildings) will be published in spring 2011 for wood pellets (EN 14961-2). Results of the questionnaire will be used for the ISO/TC 238 standard: Graded wood pellets.

Table 1. Information about the respondent

Organisation type	Name of organisation	Country
Wood pellet producer		
Wood pellet user (power plant or CHP plant)		
Association		
Other, specify		

Replies are handled confidentially and no organisation names will be published.

1. USE OF CEN PELLET STANDARDS (EN 14961-1 or EN 14961-2)

1.1 Are you going to use CEN wood pellet standards?

CEN standard	Use of standard (Yes or No)	Please explain
EN 14961-1 General requirements (see Annex 2)		
EN 14961-2 Wood pellets for non-industrial use		

In EN 14961-1 General requirements each property class is selected separately and in EN 14961-2 Wood pellets for non-industrial use to specify pellets are to classes A1, A2 or B?

2. PRODUCT STANDARD FOR INDUSTRIAL WOOD PELLETS?

2.1 Is a industrial wood pellets product standard needed, or is it sufficient to use EN 14961-1 as a common system of denominations to specify pellet qualities?

2.2 It has been suggested to use the same specifications for industrial pellet as specified by EN 14961-2 and some additional parameters for industrial use.

a) Do you consider this approach is feasible? If so (or if not), please give reasons.
b) If feasible, which additional specifications should be required for industrial wood pellets? Please fill in the Table 2, which properties are needed for industrial wood pellets. If you consider that values can be same as in EN 14961-2, add this information in Comments column.
c) If you consider industrial wood pellet classifications <u>are needed and that they are different than specified by EN 14961-2</u>, please fill in Table 3 and make your own proposal for a specification of industrial wood pellets.

3. CERTIFICATION

3.1 The European Pellet Council is launching ENplus certification systems for non-industrial wood pellets, which is based on EN 14961-2 standard. Also DINplus has similar certification system (see attached draft handbooks). Is a certification system needed also for industrial wood pellets?

a) Yes, explanation

b) No, explanation

3.2 If a certification system is needed for industrial wood pellets, what additional requirements or different requirements should it include compared to ENplus or DINplus? Are there elements which are unnecessary and/or too expensive to measure in ENplus or DINplus. See attached draft EN handbook and DINplus handbook.

4. RAW MATERIAL REQUIREMENTS

4.1 Should chemically treated material be allowed? If Yes, what would be the requirements for the material; or if No, why?*

Answer	(mark X)	Explanation
Yes		
No		

* In EN 14961-1 classification of raw material chemically treated wood residues from wood processing (glued, painted, coated, lacquered or otherwise treated wood, 1.2.1) or used wood (1.3.2) is allowed as long as they do not contain heavy metals or halogenated organic compounds as a result of treatment with wood preservatives or coating. In *EN 14961-2 chemically treated wood allowed only in class B*, but same threshold values for heavy metals as for chemically untreated material to be met. In the ENplus certification no chemically treated wood is allowed.

5. PRODUCT STANDARD FOR THERMALLY TREATED BIOMASS PELLETS

5.1 Do we need also product standard for thermally treated biomass pellets (e.g. torrefied pellets)?

Answer	(mark X)	Explanation
Yes		
No		

5.2 What properties should be specified?

Make a list of properties (e.g. fixed carbon, particle size, moisture, net calorific value or what else), which you see most important.

Table 2. What are the most important quality requirements for industrial wood pellets? Shall they be normative (mandatory) or informative (voluntary)

Property class	**Normative*** (mark X)	**Informative*** (mark X)	Comments (e.g. values of EN 14961-2 can be used)
Origin and source (raw material basis, see table 1 in article)			
Dimensions, diameter (D) and length (L)			
Moisture content, w-% wet basis (M)			
Ash content, w-% dry basis (A)			
Mechanical durability, w-% of pellets after testing (DU)			
Amount of fines, w-% (< 3,15 mm) (F)			
Additives, w-% of pressing mass, type and amount			
Bulk density, kg/m^3 (BD)			
Net calorific value as received, MJ/kg (Q) or kWh/kg			
Nitrogen, w-% of dry basis (N)			
Sulphur, w-% of dry basis (S)			
Chlorine, w-% of dry basis (Cl)			
Arsenic, mg/kg dry basis (As)			
Cadmium, mg/kg dry basis (Cd)			
Chromium, mg/kg dry basis (Cr)			
Copper, mg/kg dry basis (Cu)			
Lead, mg/kg dry basis (Pb)			
Mercury, mg/kg dry basis (Hg)			
Nickel, mg/kg dry basis (Ni)			
Zinc, mg/kg dry basis (Zn)			
Ash melting behaviour, ^{o}C			
Other, own proposal			
Other, own proposal			
Other, own proposal			

*__Normative__=mandatory property class, __Informative__= voluntary property class

Table 3. Proposal for the specification of wood pellets for industrial use

Replace **X** by your own proposal (number, see model from Annex 3 in attached article). If you find some property class unnecessary, mark it by ~~strikethrough~~.

	Property class, Analysis method	**Unit**	**I1**	**I2**	**I3**
Normative	Origin and source (see table 1 in attached article and Annex 3)				
	Diameter, D [a] and Length L, [b] prEN 16127	mm	D0X, X ± 1; 3,15 ≤ L ≤ X D0X, X ± 1 3,15 ≤ L ≤ X	D0X, X ± 1; 3,15 ≤ L ≤ X D0X, X ± 1 3,15 ≤ L ≤ X	D0X, X ± 1; 3,15 ≤ L ≤ X D0X, X ± 1 3,15 ≤ L ≤ X
	Moisture, M EN 14774-1, EN 14774-2	as received, w-% wet basis	M XX ≤ XX	M XX ≤ XX	M XX ≤ XX
	Ash, A EN14775	w-% dry	A X.X≤ X,X	A X.X≤ X,X	A X.X≤ X,X
	Mechanical durability, DU, EN 15210-1	as received, w-%	DU9X.X ≥ 9X,X	DU9X.X ≥ 9X,X	DU9X.X ≥ 9X,X
	Fines at final place before delivering to plant), F, EN15210-1	w-% as received	FX.0 ≤ 1,0	FX.0 ≤ 1,0	FX.0 ≤ 1,0
	Additives [c]	w-% dry	≤ X w-% Type and amount to be stated	≤ X w-% Type and amount to be stated	≤ X w-% Type and amount to be stated
	Net calorific value, Q, EN 14918	as received, MJ/kg	Q1X,X Q≥1X,X	Q1X,X Q≥1X,X	Q1X,X Q≥1X,X
	Bulk density, BD, EN 15103	kg/m^3	BDXXX ≥ XXX	BDXXX ≥ XXX	BDXXX ≥ XXX
	Nitrogen, N, FprEN 15104	w-% dry	N0.X ≤ 0,X	N0.X ≤ 0,X	N0.X ≤ 0,X
	Sulphur , S, FprEN 15289	w-% dry	S0.0X ≤ 0,0X	S0.0X ≤ 0,0X	S0.0X ≤ 0,0X
	Chlorine, Cl, FprEN 15289	w-% dry	Cl0.0X ≤ 0,0X	S0.0X ≤ 0,0X	S0.0X ≤ 0,0X
	Arsenic, As, FprEN 15297	mg/kg dry	≤ X	≤ X	≤ X
	Cadmium, Cd, FprEN 15297	mg/kg dry	≤ 0,X	≤ 0,X	≤ 0,X
	Chromium, Cr, FprEN 15297	mg/kg dry	≤ XX	≤ XX	≤ XX
	Copper, Cu, FprEN 15297	mg/kg dry	≤ XX	≤ XX	≤ XX
	Lead, Pb, FprEN 15297	mg/kg dry	≤ XX	≤ XX	≤ XX
	Mercury, Hg, FprEN 15297	mg/kg dry	≤ 0,X	≤ 0,X	≤ 0,X
	Nickel, Ni, FprEN 15297	mg/kg dry	≤ XX	≤ XX	≤ XX
	Zinc, Zn, FprEN 15297	mg/kg dry	≤ XXX	≤ XXX	≤ XXX
	Ash melting behaviour, [d] prEN15370	°C	all temperatures	all temperatures	all temperatures

[a] Selected size of pellets to be stated.
[b] Amount of pellets longer than XX mm can be X w-%. Maximum length shall be < XX mm.
[c] Type (e.g. starch, corn flour, potato flour, vegetable oil)
[d] All characteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT) and flow temperature (FT) in oxidizing conditions should be stated.

Note: for raw material specification use Table 1 in EN 14961-1. If you do not allow chemically treated material select classes from 1.2.1 and 1.3.1.