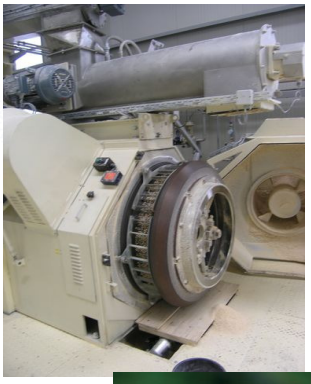

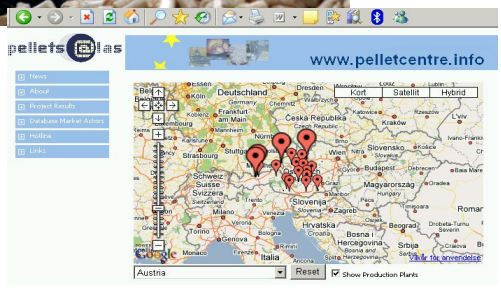

Development and promotion of a transparent European Pellets Market

Creation of a European real-time Pellets Atlas

Advancement of pellets-related European standards

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This report is available at the pellets@las website at www.pelletsatlas.info

The pellets@las project is supported by the European Commission under the EIE programme (EIE/06/020/SI2.448557). The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.

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1. Introduction

Standardisation aims at removing trade and application barriers by establishing unification (of concepts, procedures and products) within a national or international community of concerned stakeholders. Standards increase economization, compatibility, user-friendliness and security in the application and exchange of products and services.

Quality is a central issue for the further development of pellet markets. Especially the residential heating sector depends on reliable fuel quality since it is crucial for a reliable and economic use of small-scale pellet heating systems.

The importance of quality standards and assurance became obvious in the last years in Germany and Austria where the early introduction of pellet-related standards and certification systems certainly was a stimulating factor for the dynamic development of residential pellet heating markets.

Now, a set of European standards related to solid biofuels is under preparation. This is a positive step towards the unification of the European pellet market and will contribute to enhancing market development all over Europe.

However, standards alone are not sufficient. Certification and the control of products and of the whole supply chain are desirable. Existing national and international certification systems such as DINplus contributed a lot to quality assurance and to gaining consumers´ confidence. However, they all have certain drawbacks and none of them covers the whole supply chain within one system.

Based upon the new European standards, the German Pellet Association (DEPV), together with other partners, is currently developing a new certification system with a European scope and a more holistic approach. The system claims the potential to replace the other existing certificates that are partly well accepted by stakeholders such as boiler manufacturers and end-consumers.

The original scope of this report, according to the pellets@las work programme, was to provide recommendations to the European standardisation process. However, this was and still is done in a direct way by pellets@las partner HFA (*Holzforschung Austria*) being an official member of the responsible European Standardisation Committee CEN TC 335 and pellets@las partner FORCE Technology being a member of the Danish mirror group. This way, pellets@las results and findings were directly incorporated in the process. By now, the development of standards is close to completion.

This document now aims at informing a broader target group about the current situation and future developments of pellet standardisation and certification. This information is mainly relevant for two major stakeholder groups. End-consumers should be clear about the background and meaning of pellet quality and quality certificates when buying pellets and pellet producers will have to prepare for the requirements of upcoming standards and certification schemes and they also have to decide upon strategies how the use of standards and the participation in certification schemes can enable the access to certain pellet markets.

2. Quality requirements on pellets

Chemical and physical properties of solid biofuels have manifold effects on their thermal utilization. Besides the energy content, end-consumers are mainly concerned with two problem areas: Emissions and boiler/stove function.

Emissions relevant for small-scale wood combustion are mainly NO_x, SO_x, HCl, PCCD (polychlorinated dibenzo-p-dioxins) and fly ash. The amount of NO_x and SO_x emissions correlates directly with N and S contents in the fuel. Fuels with N contents below 0.6 % and S contents below 0.2 % usually do not cause emission problems and problematic HCl (and PCCD) emissions are characteristic for biofuels with chlorine contents above 0.1 %.[1] However, much lower thresholds are recommended. In countries with demanding NO_x emission thresholds, N contents below 0.3 % are preferable. Newer findings also show that corrosion problems in chimneys can already occur with chlorine contents as low as 0.01 %. Therefore, this is the recommended threshold. The formation of inorganic fly ash increases with higher contents of elements such as K, S and Cl while the formation of organic fly ash usually only occurs independently from fuel quality when old combustion technology is used or when pellet appliances are poorly installed or controlled.[2]

The combustion of clean wood fuels generally does not produce problematic emissions of any kind since contents of critical elements are very low. Raw materials containing larger amounts of bark or herbaceous raw materials on the other hand have higher ash contents and therefore cause higher emissions.

Besides problematic emissions, low-quality biofuels can also cause harmful effects on combustion equipment such as slagging, corrosion and interference with process control.

The ash that is not emitted as fly ash (see above) deposits in the combustion chamber. The melting point of this deposited ash is an important fuel characteristic. Ca and Mg usually increase the melting point, while K and Na decrease it.[2] During the combustion of fuels with unfavorable ash composition (such as straw) and therefore low ash melting temperature, high temperatures in the combustion chambers can lead to melting and sintering of deposited ashes. Corrosion of metal parts of the boiler/stove is usually caused by chloride salts and HCl derived from high Cl contents in the fuel.

Finally, the content of fine particles in the fuel can disturb the regulation of highly automated heating systems or interrupt automated fuel feeding. In addition, fine particles burn quicker and the resulting higher temperatures can favor ash melting. The content of fine particles depends on the mechanical durability and on logistics and storage issues.

As already said, clean wood (and especially soft wood) pellets contain very low amounts of the problematic elements mentioned above, so that most of the problems described above (except problems related to fine contents) are not relevant for high quality wood pellets. However, with increasing use of bark, forest residues, SRC wood or herbaceous biomass, the described problems gain relevance.

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[1] Obernberger et al., Chemical properties of solid biofuels – significance and impact, Graz University.

[2] Obernberger et al., Aktuelle Erkenntnisse im Bereich der Feinstaubemissionen bei Pelletsfeuerungen, Graz University.

3. Pellet quality: Standards and certification

Several European countries such as Austria (ÖNORM M 7315), Sweden (SS 187120) and Germany (DIN 51731) have introduced pellet-related standards in the past, but experiences in these countries showed that standards need to be accompanied by a control system that certifies pellet production and minimum pellet quality. In Austria, for example, the pellet standard is connected to a certification label ("ÖNORM tested") that certifies pellet producers and guarantees unproblematic pellet usage for the end-consumer.

This did not work in Germany where production in agreement with DIN standards is usually certified by the "DIN tested" label. However, this label is granted without external controls at the production site. Furthermore, the minimum requirements of DIN 51731 are not always strict enough for unproblematic pellet combustion in small-scale applications. This standard also lacks a threshold for mechanical durability.

This led to the development of the standard-independent certification scheme DINplus for wood pellets by DIN CERTCO which combines features of the German and the Austrian standard, including external controls and strict quality requirements. Today, it is the best known certification label for wood pellets in Europe and worldwide.

The situation will change largely after the introduction of European standards for solid biofuels (EN 14961). National standards have to be adapted or taken back. Therefore, they will loose their relevance soon and will not be addressed in detail in this report.

Existing certification schemes do not have to comply with the new standards but the certification bodies acting in a unified European framework will still face the necessity to adapt their requirements. Both end-consumers and appliance manufacturers will look for a certification system that ensures the compliance of pellet quality with European standards.

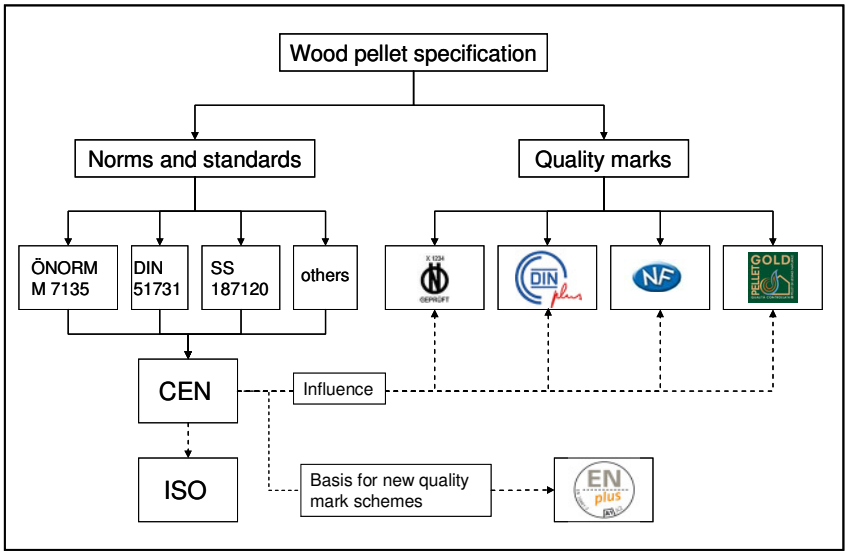


Figure 1: Overview on existing and future systems for wood pellet quality specification[3]

[3] Figure modified; Original from: Englisch, M. (ofi, Austria); Europäische Normen für Biomassebrennstoffe;

4. Existing national certification schemes

DINplus (Germany)

In 1996, the DIN 51731 on compressed wood was introduced in Germany. As already said, the usability of this standard for the small-scale pellet heating sector is limited. Main reasons for this are high maximum ash contents (1.5 % ash might already cause combustion problems) and the absence of a maximum for abrasion (Figure 2). Furthermore, the certificate that attests production according to this standard is awarded without external control. That means that end-consumers cannot always be sure that certified pellets actually comply with the requirements of DIN 51731. This system is still in use today (October 2009). However, it is mainly used for briquette production rather than pellet production.

				
				
	Unit	**DIN plus[4]**	**DIN 51731[5]**	**Ö NORM M 7135[6]**
Diameter	mm	4 - 10	4 - 10	4 - 10
Length		< 5 x D	< 50 mm	< 5 x D
Density	Kg / dm^3	> 1.12	1.0 - 1.4	> 1.12
Water content	%	< 10	< 12	< 10
Abrasion	%	< 2.3	--	< 2.3
Ash content	%	< 0.5	< 1.5	< 0.5
Energy content	MJ / kg	> 18	17.5 – 19.5	> 18
Sulphur content	%	< 0.04	< 0.08	< 0.04
Chlorine content	%	< 0.02	< 0.03	< 0.02
Nitrogen content	%	< 0.3	< 0.3	< 0.3
Heavy metals	%	regulated	regulated	not regulated

Figure 2: Comparison of selected German and Austrian requirements on wood pellets

[4] DINplus Zertifizierungsprogramm – Holzpellets zur Verwendung in Kleinfeuerungsstätten, DIN CERTCO, 2007, available at www.dincertco.de

[5] DIN 51731 „Presslinge aus naturbelassenem Holz – HP 5“; available at www.beuth.de

[6] ÖNORM M 7135 „Presslinge aus naturbelassenem Holz oder naturbelassener Rinde, Pellets und Briketts – HP 1“, available at www.as-plus.at

As the DIN standard did not show to be useful, DIN CERTCO developed the DINplus certification scheme for high quality wood pellets in 2002. It combines characteristics of both the German DIN 51731 (e.g. testing of heavy metal contents) and the Austrian ÖNORM M 7135 (e.g. high quality requirements in general) (Figure 2). This scheme includes the establishment of internal quality management and annual, external controls without announcement.

DINplus contributed a lot to the promotion of the residential pellet market in Germany and today, it is the most important quality label for high quality wood pellets worldwide.

In total, 102 pellet producers are DINplus certified (October 2009) and 61 of these are based in Germany. Figure 3 shows the countries, where DINplus is used (Certificates in Germany are not shown).

The DINplus certified producers with known production capacity represent a total capacity of around 3.5 million tons. Considering the other 40 small and medium scale producers with unknown capacity, the total production capacity for DINplus pellets certainly exceeds 4 million tons.

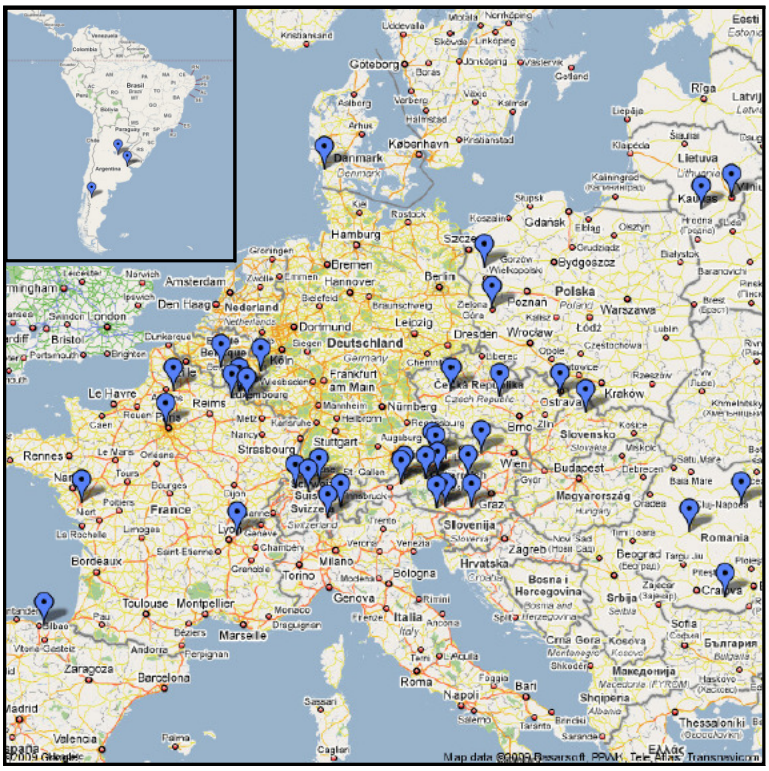


Figure 3: DINplus certified pellet producers outside of Germany

Most of the producers in Figure 3 use DINplus certification only. However, most DINplus certified producers in Austria have obtained DINplus certification following a successful ÖNORM certification. This possibility is also often used in the Czech Republic.

The German DINplus producers with known production capacity represent a total capacity of at least 2.2 million tons. In addition, 25 producers with unknown capacity

are certified. This means that the largest part of the German production capacity (in total: 2.4 million tons in 2008[7]) is DINplus certified.

For producers e.g. in France, Belgium and Switzerland, the DINplus certificate certainly is a marketing instrument for selling pellets in their own home countries, while it provides access to Central European residential pellet heating markets to export-oriented producers in e.g. Poland, the Czech Republic, Romania and Argentina (So far, DINplus pellet exports from Argentina to Europe are rather rare).

Additional information

In addition to pellet quality certification, DIN CERTCO offers DINplus certification for wood briquettes and pellet stoves.

Furthermore, producers, traders and retailers with their own pellet distribution can get certificates for their pellet logistics (complementary to ÖNORM M 7136). However, only 8 companies are certified (all of them based in Germany) and this certification does not seem to be well accepted by relevant market stakeholders.

[7] www.depv.de

ÖNORM M 7135 (Austria)

Pellet standardization and certification started in 1990 in Austria. The standard ÖNORM M 7135 was modified twice in the meantime and became the model for other standards / certification systems in Europe (incl. DINplus). The current requirements on pellets are shown in Figure 2.

As in Germany, the compliance with standards can be certified. In Austria this is done by "Austrian Standards plus" who can award the "ÖNORM tested" label. In contrast to Germany, this system worked and no additional certification scheme had to be established. The Austrian certification system also includes both internal and external (annual and unannounced) control mechanisms.

In Austria, 18 pellet producers (October 2009) are ÖNORM certified. 11 of them are additionally DINplus certified. The ÖNORM certified producers represent the largest part of the pellet production capacity installed in Austria.

Furthermore, 7 German producers have ÖNORM certificates in addition to their DINplus certification (If compliance with DINplus is certified by an Austrian testing institute, the testing report is also valid for ÖNORM certification). The ÖNORM pellet certification is particularly popular in the Czech Republic, but also producers in Romania, Ukraine, Italy and Switzerland are certified (Figure 4).

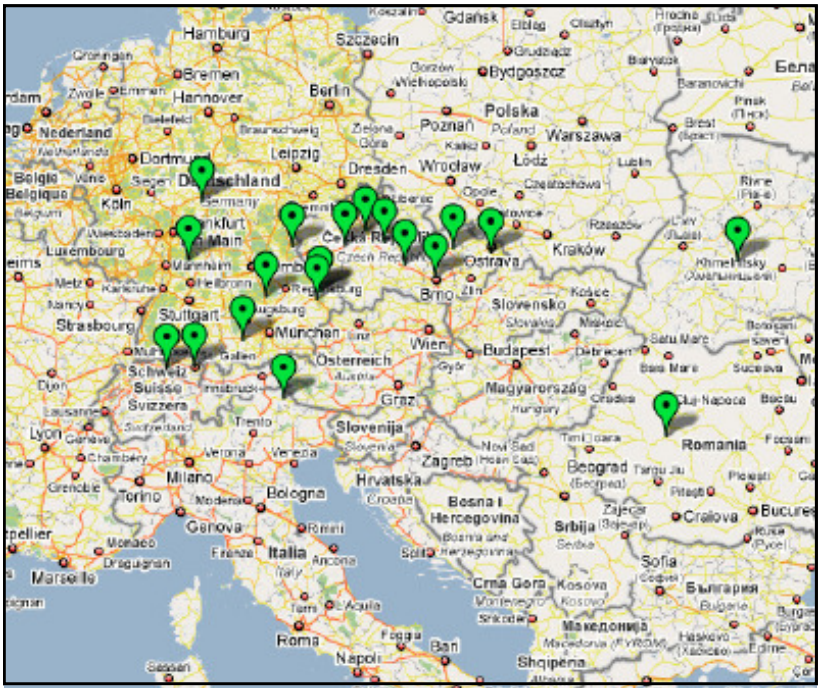


Figure 4: ÖNORM certified producers outside Austria

Additional information

Other pellet-related standards in Austria are concerned with pellet logistics (M 7136) and pellet storage tanks (M 7137). Furthermore, standards for non-wood biomass pellets were or are being developed: M 7139 on energy grains, C 4000 on Miscanthus pellets and C 4002 on straw pellets.

NF Granules Biocombustibles (France)

In France, the Technology Institute FCBA, together with ITEBE, developed a new quality label for fuel pellets which was introduced in 2009. AFNOR is the managing organization that awards the NF quality label (*Norme Francaise*).

The scheme includes the establishment of internal quality management by the producer and annual, external controls of production sites.[8] The development of this system was supported by ADEME and the newly founded SNPGB (*Syndicat National des Producteurs de Granulés de Bois*). The aim is to overcome existing problems with pellet quality in France. Although the German DINplus system has been used in France for some time, acceptance problems with the rather unknown DIN label occurred. The NF label as a general product quality label is well known in France and it is expected that its impact on French pellet quality might be higher.

The quality requirements of this system are based on CEN/TS 14961, as far as values were available. Figure 5 summarizes quality requirements for 5 defined pellet quality categories. In addition to requirements shown here, maximum values for heavy metal contents are set. For agropellets there is also a threshold for ash melting temperature.

Three quality categories for wood pellets are described: High, standard and industrial, following the European categories of prEN 14961-2 (A1, A2 and B; see chapter 6).

The high quality standard resembles EU quality A1, except for values of e.g. ash and chlorine contents. However, there are many differences between standard quality and prEN 14961-2 A2 and between industrial quality and prEN 14961-2 B. The reason for this is that prEN 14961-2 is still under discussion and has undergone many changes during 2009.

With two categories on non-wood pellets, the French system is ahead of the development of the European CEN/TS 14961-6 on “non-woody pellets for non-industrial use”. With these standards, the French NF system currently is the only existing quality certification for non-wood biomass pellets. Taking into consideration the chemical properties of herbaceous biomass, these categories allow for very high ash, chlorine, nitrogen and sulphur contents. However, the usability of these categories is questionable since at the moment, these values are certainly too high for unproblematic combustion in small-scale pellet appliances.

Consequently, no company uses these agropellet categories for certification of their pellets until now while the wood pellet certification already started. In October 2009, 5 French pellet producers use the quality label for high quality wood pellets (*Bois Qualité Haute Performance*) and one uses the standard quality label (*Bois Qualité Standard*).

These certified companies do not use the DINplus label at the same time. In the future, there might be several competing quality labels in France.

[8] NF Granules Biocombustibles, Référentiel de certification, AFNOR/FCBA, 2009.

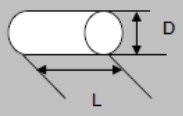
Caractéristiques	Bois Qualité Haute Performance	Bois Qualité Standard	Bois Qualité Industrielle	Agro Qualité Haute Performance	Agro Qualité Industrielle
Origine matière première	ligneuse	ligneuse	ligneuse	Herbacée et/ou fruitière	Herbacée et/ou fruitière
Dimensions (mm) 	D=6mm ± 1mm L de 3,15mm á 5xD	D=6 á 9mm ± 1mm L de 3,15mm á 5xD	D=6 á 16mm L de 3,15mm á 5xD	D=6 á 8mm ± 1mm L de 3,15mm á 5xD	D=6 á 16mm ± 1mm L de 3,15mm á 5xD
Taux d´humidité sur brut (%)	≤10%	≤10%	≤15%	≤11%	≤15%
Pouvoir Calorifique Inférieur sur brut, PCI (MJ/kg)	≥16,5	≥16,5	≥15,4	≥15,8	≥14,9
(Pour information) PCI en kWh/kg	≥4,6	≥4,6	≥4,3	≥4,4	≥4,1
Masse volumique apparente (kg/m^3)	≥650	≥650	≥650	≥650	≥650
Durabilité mécanique (% en masse des granulés après essai)	≥97,5%	≥95%	≥95%	≥95%	≥92%
Quantité de fines (% en masse, <3,15mm) Après production á la sortie de l´usine	≤1%	≤2%	≤3%	≤2%	≤3%
Taux de cendres (% en masse sur produit sec)	≤0,7%	≤1,5%	≤3%	≤5%	≤7%
Chlore, Cl (% en masse sur produit sec)	≤0,03%	≤0,05%	≤0,05%	≤0,2%	≤0,3%
Azote, N (% en masse sur produit sec)	≤0,3%	≤0,3%	≤0,5%	≤1,5%	≤2%
Soufre, S (% en masse sur produit sec)	≤0,05%	≤0,08%	≤0,08%	≤0,2%	≤0,2%

Figure 5: Quality requirements on fuel pellets, according to NF Granules Biocombustibles; Table taken from ([8]).

Pellet Gold (Italy)

Already in 2006, AIEL[9] introduced the Pellet Gold quality label in order to promote pellet quality in the Italian market and to increase consumer confidence. The scheme is called an “attestation system” since there is no official certifying body involved. AIEL states that the requirements of the label are based on CEN/TS 14961, DINplus, ÖNORM M 7135 and limits introduced by PFI (American Pellet Fuels Institute).

Parametro	U.M.	LIMITI AIEL	Grado di tolleranza
Contenuto idrico (tal quale)	% su	<10	--
Ceneri	% ss	≤1	+0,05
PCI	MJ/kg	≥16,9	-0,2
Azoto - (N)	% ss	≤0,3	--
Cloro – (Cl)	% ss	<0,03	--
Zolfo – (S)	% ss	<0,05	--
Massa sterica	Kg/m^3	>600	--
Durabilità meccanica	%	≥97,7	--
Formaldeide (HCOH)	Mg/100g	≤1,5	+0,5
Radioattività	Bq/kg	<6	--
Agenti leganti	<2%	Indicare valore	--

Figure 6: Quality requirements on fuel pellets, according to Pellet Gold (Italy); Table taken from ([10])

Figure 6 shows part of the parameters controlled by Pellet Gold. Besides the common parameters, formaldehyde contents are measured. More recently, following an incident with possibly radioactive pellets, AIEL also introduced a maximum value for radioactivity. The requirements of Pellet Gold take into consideration the raw material situation in Italy. The widely available wood materials are characterized by higher ash and slightly higher chlorine content. Therefore, the threshold values are higher than foreseen by the European standard for A1 quality.

In October 2009, 11 Italian wood pellet producers are certified. Certification might not appear to be feasible for the numerous small-scale producers in Italy. However, despite the small number of certificates, Pellet Gold still is the most successful quality label in Italy since there is no DINplus certified and only one ÖNORM certified producer.

[9] Associazione Italiana Energie Agroforestali, www.aiel.it.

[10] Allegato 3 – Pellet Gold; AIEL.

5. Pellet quality issues in selected countries

In this chapter, some essential information on pellet quality shall be presented for selected European countries. For more information on these and other countries, please consult the pellets@las country reports which are available at www.pelletsatlas.info.

In Germany and Austria wood pellets are used for heating purposes only. Therefore, the majority of consumed pellets has to be of high quality. The largest part of pellet production capacities in these countries is DINplus and/or ÖNORM certified.

Switzerland is also a residential pellet heating market. Previous efforts by Holzenergie Schweiz to establish their own quality label (Swisspellet) failed. Today, the two most important producers (AEK and Tschopp) are DINplus certified.

With four important producers in Belgium being DINplus certified, the DINplus pellet production capacity amounts to around 265.000 tons. This is enough to cover a large part of pellets used in the heating market in Belgium.

Only 11 producers are certified within the national Italian certification scheme Pellet Gold and neither ÖNORM (only 1 certificate in Italy) nor DINplus (no certificate) managed to establish in this important market. However, DINplus and ÖNORM certainly play a certain role in the country through certified pellets imported by DINplus and ÖNORM certified producers in Germany, Austria and Eastern Europe. In addition to the Pellet Gold attestation scheme, there is UNI/TS 11263 as a technical specification for the characterization of pellets for energy pellets.[11]

There is no official national standard and no national certification scheme in the UK. No producer is DINplus or ÖNORM certified. British BioGen (now merged with the Renewable Energy Association[12]) developed a Code of good practice for biofuel pellets and pellet combustion appliances[13] in 2000. The Code includes minimum requirements on “domestic” pellets (untreated raw materials only) and “commercial” pellets (requirements less strict). According to ash contents, pellets are termed “premium” (<1%), “standard” (<3%) or “high ash” (<6%). It is unknown if this Code is still used by producers today who are rather using their own trade labels as a quality guarantee and/or refer to CEN/TS 14961.

Quality issues hindered market development in France for a long time. Today, 5 French producers use the DINplus certification as a marketing instrument. 5 additional producers use the newly introduced NF quality label.

Sweden was one of the first countries to introduce pellet quality standards (SS 187120). The three quality categories of this standard were well established in Sweden. They will have to be adapted to new European standards. The Swedish standard is also used in Norway (NS 3165).

Even though Denmark is a large consumer, proprietary standards have been prevailing. Limitations to types of biomass feedstock allowed in pellets and efficient information channels promoting good pellet quality have helped keeping the quality

[11] www.uni.com

[12] www.r-e-a.net

[13] The British BioGen Code of Good Practice for Biofuel pellets and pellet burning appliances <25kW; April 2000.

high. Proper standards are slowly gaining market shares and the large consumers have defined their own quality requirements.

The Czech Republic is a pellet exporting country with a small domestic demand. Pellet producers aiming at residential heating markets in Germany and Austria therefore have to be certified. With 3 DINplus and 7 ÖNORM certificates (3 companies have both), high quality pellets are produced at a significant scale in the Czech Republic.

The situation is similar in Poland. There are two large producers (Barlinek and Stelmet) with DINplus certificates. Both companies are based close to the German border. DINplus and/or ÖNORM certified producers are also found in other export-oriented countries such as Romania, Slovakia, Latvia, Ukraine, Spain and Argentina.

6. Development of European pellet-related standards

Introduction

Against the background of strong pellet market growth in Europe with a rapidly increasing number of market participants, international standardisation activities aim at supporting further market growth. The large number of producers using a variety of raw materials and the use of pellets in a variety of applications, from highly automated small-scale boilers to large scale industrial co-firing, cause the development of separated markets for pellets according to usage and pellet quality.[14]

Furthermore, European and international pellet trade is an important factor for securing pellet supply in pellet importing countries in Europe. In order to further develop the European and the international pellet market, the interaction between market actors along supply chains needs to be facilitated. Pellet standardisation (and certification) proofed to be suitable instruments for defining markets, facilitating trade and thus promoting market development in countries such as Germany or Austria.

In order to provide this support for the whole European pellet market the European Commission mandated the Standardisation Committee CEN TC 335 “Solid Biofuels” to develop a set of standards for the definition of fuel classes, test and sampling methods and quality assurance schemes for supply chains.

The main outcome of these efforts will be two multipart standards that will be explained below.

[14] Mohrig V. et al. (DBFZ); Pre-normative research on solid biofuels for improved European standards; 17th European Biomass Conference and Exhibition; 29 June – 3 July 2009, hamburg, Germany.

Fuel specification and classes – prEN 14961

This standard will consist of 6 parts. The first part provides the framework for a common and clear classification method for solid biofuels. The aim is to create a common language for biomass suppliers, processers, customers and also e.g. equipment manufacturers. The other 5 parts are product standards for commonly traded forms of biofuels such as wood pellets, agropellets, briquettes and chips (Figure 7).

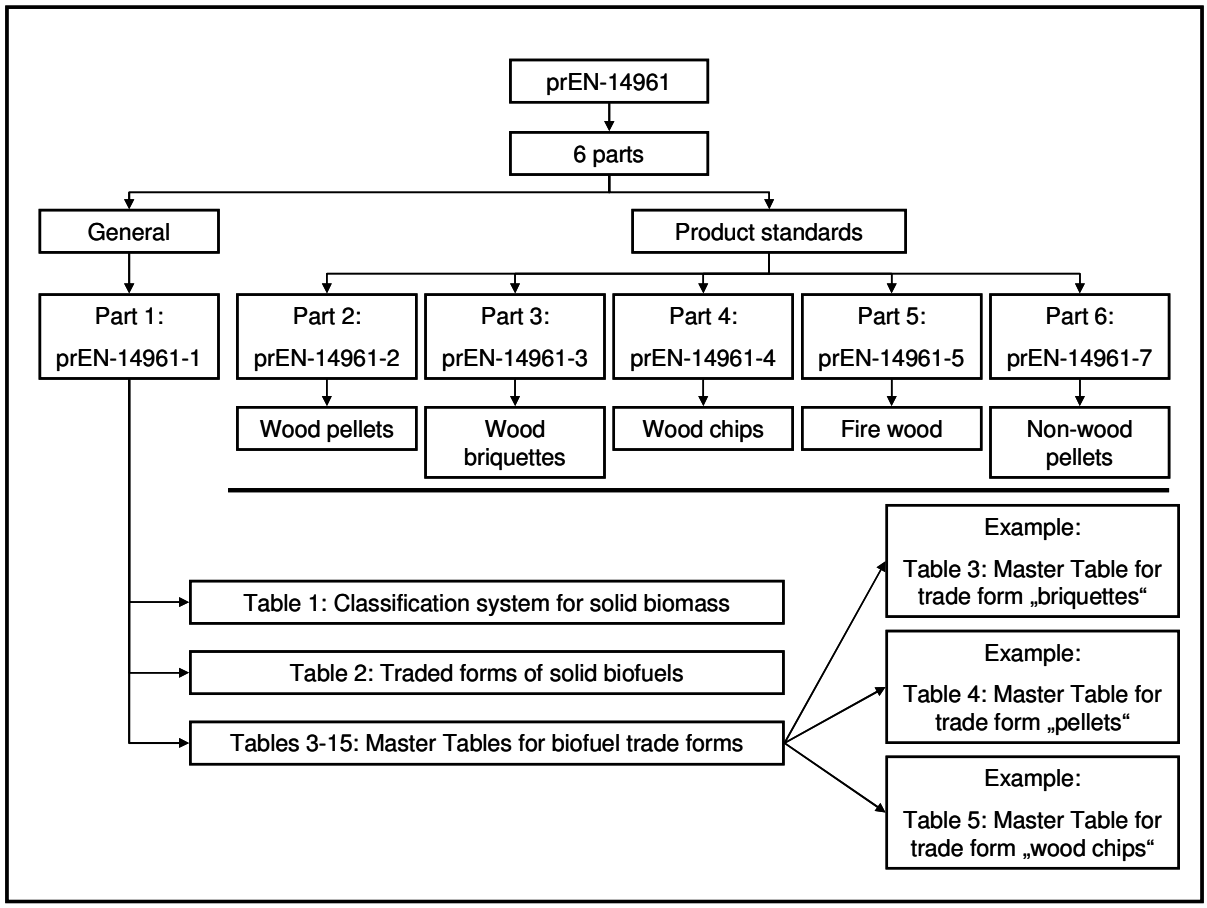


Figure 7: Structure of prEN 14961

Part 1 (General requirements), part 2 (Product standard for wood pellets) and part 6 (Product standard for non-wood pellets) are briefly described below.

Part 1: General requirements (prEN 14961-1)

To accomplish this, prEn 14961-1 contains 15 tables (2 general tables and 13 “Master Tables” for different biomass trade forms).

prEN 14961-1-Table 1 provides a hierarchical classification system for the origins and sources of biomass, distinguishing four basic types of biomass: woody biomass, herbaceous biomass, fruit biomass as well as blends and mixtures thereof. With this system, the origin and source of biomass can be described with a four-digit number. Figure 8 only shows the part dealing with woody biomass.

1. Woody biomass	1.1 Forest, plantation and other virgin wood	1.1.1 Whole trees without roots	1.1.1.1 Deciduous
			1.1.1.2 Coniferous
			1.1.1.3 Short rotation coppice
			1.1.1.4 Bushes
			1.1.1.5 Blends and mixtures
		1.1.2 Whole trees with roots	1.1.2.1 Deciduous
			1.1.2.2 Coniferous
			1.1.2.3 Short rotation coppice
			1.1.2.4 Bushes
			1.1.2.5 Blends and mixtures
		1.1.3 Stemwood	1.1.3.1 Deciduous
			1.1.3.2 Coniferous
			1.1.3.3 Blends and mixtures
		1.1.4 Logging residues	1.1.4.1 Fresh/Green, Deciduous (incl. leaves)
			1.1.4.2 Fresh/Green, Coniferous (incl. leaves)
			1.1.4.3 Stored, Deciduous
			1.1.4.4 Stored, Coniferous
			1.1.4.5 Blends and mixtures
		1.1.5 Stumps/roots	1.1.5.1 Deciduous
			1.1.5.2 Coniferous
			1.1.5.3 Short rotation coppice
			1.1.5.4 Bushes
			1.1.5.5 Blends and mixtures
		1.1.6 Bark (from forestry operations)	
		1.1.7 Segregated wood from gardens, parks, roadside maintenance, vineyards and fruit orchards	
		1.1.8 Blends and mixtures	
	1.2 By-products and residues from wood processing industry	1.2.1 Chemically untreated wood residues	1.2.1.1 Without bark, Deciduous
			1.2.1.2 Without bark, Coniferous
			1.2.1.3 With bark, Deciduous
			1.2.1.4 With bark, Coniferous
			1.2.1.5 Bark (from industry operations)
		1.2.2 Chemically treated wood residues, fibres and wood constituents	1.2.2.1 Without bark
			1.2.2.2 With bark
			1.2.2.3 Bark (from industry operations)
			1.2.2.4 Fibres and wood constituents
		1.2.3 Blends and mixtures	
	1.3 Used wood	1.3.1 Chemically untreated wood	1.3.1.1 Without bark
			1.3.1.2 With bark
			1.3.1.3 Bark
		1.3.2 Chemically treated wood	1.3.2.1 Without bark
			1.3.2.1 With bark
			1.3.2.3 Bark
		1.3.3 Blends and mixtures	
	1.4 Blends and mixtures		

Figure 8: Classification of origin and sources of solid biomass;

From: CEN/TC 335–prEN 14961-1 (Table 1)

prEN 14961-1-Table 2 (see Figure 9) defines a number of commonly used trade forms of solid biofuels (briquettes, chips, bales, etc) and refers to the respective Master Tables that specifically address one trade form and define normative (mandatory) and informative (voluntary) fuel properties that have to be or can be stated by the fuel supplier.

Fuel name	Typical particle size	Common preparation method
Whole tree (Table 15)	> 500 mm	No preparation or delimbed
Wood chips (Table 5)	5 mm to 100 mm	Cutting with sharp tools
Hog fuel (Table 6)	Varying	Crushing with blunt tools
Log wood/firewood (Table 7)	100 mm to 1000 mm	Cutting with sharp tools
Bark (Table 10)	Varying	Debarking residue from trees; Can be shredded or unshredded
Bundle (Table 15)	Varying	Lengthways oriented & bound
Fuel powder (Table 15)	< 1 mm	Milling
Sawdust (Table 8)	1 mm to 5 mm	Cutting with sharp tools
Shavings (Table 9)	1 mm to 30 mm	Planing with sharp tools
Briquettes (Table 3)	D ≥ 25 mm	Mechanical compression
Pellets (Table 4)	D < 25 mm	Mechanical compression
Bales (Table 11) Small square bales Big square bales Round bales	 0,1 m^3 3.7 m^3 2.1 m^3	 Compressed and bound to squares Compressed and bound to squares Compressed and bound to cylinders
Chopped straw or energy grass (Table 15)	10 mm to 200 mm	Chopped during harvesting or before combustion
Grain (Table 12, Table 13) or seed (Table 13, Table 14)	Varying	No preparation or drying except for process operations necessary for storage for cereal grain
Fruit stones or kernel (Table 13)	5 mm to 15 mm	No preparation or pressing and extraction by chemicals
Fibre cake (Table 15)	Varying	Prepared from fibrous waste by dewatering

Figure 9: Major traded forms of solid biofuels;

From: CEN/TC 335–prEN 14961-1 (Table 2)

prEN 14961-1-Table 4 (see Figure 10 on next page) is the Master Table for pellets (wood and other). The Master Tables define a number of classes for each parameter across a wide range. Again, this shall provide a common language to European market participants who can arrange flexible agreements on biofuel properties with these definitions.

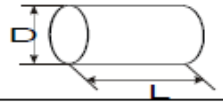
	Master table		
	Origin: According to 6.1 and Table 1		Woody biomass (1), Herbaceous biomass (2), Fruit biomass (3), Blends and mixtures (4)
	Traded Form (see Table 2)		Pellets
Normative	**Dimensions** (mm)		
	Diameter (D) and Length (L) [a]		
	D06	6 mm ± 1,0 mm and 3,15 ≤ L ≤ 40 mm	
	D08	8 mm ± 1,0 mm, and 3,15 ≤ L ≤ 40 mm	
	D10	10 mm ± 1,0 mm, and 3,15 ≤ L ≤ 40 mm	
	D12	12 mm ± 1,0 mm, and 3,15 ≤ L ≤ 50 mm	
	D25	25 mm ± 1,0 mm, and 10 ≤ L ≤ 50 mm	
	Moisture, M (w-% as received)		
	M10	≤ 10 %	
	M15	≤ 15 %	
	Ash, A (w-% of dry basis)		
	A0.5	≤ 0,5%	
	A0.7	≤ 0,7%	
	A1.0	≤ 1,0%	
	A1.5	≤ 1,5 %	
	A2.0	≤ 2,0 %	
	A3.0	≤ 3,0 %	
	A5.0	≤ 5,0 %	
	A7.0	≤ 7,0 %	
	A10.0	≤ 10,0 %	
	A10.0+	> 10,0 %	
	Mechanical durability, DU (w-% of pellets after testing)		
	DU97.5	≥ 97,5 %	
	DU96.5	≥ 96,5 %	
	DU95.0	≥ 95,0 %	
	DU95.0-	< 95,0 % (minimum value to be stated)	
	Amount of fines, F (w-%, < 3,15 mm [b]) after production when loaded or packed		
	F1.0	≤ 1,0 %	
	F2.0	≤ 2,0 %	
	F3.0	≤ 3,0 %	
	F5.0	≤ 5,0 %	
	F5.0+	> 5,0 % (maximum value to be stated)	
	Additives (w-% of pressing mass) [c]		Type and content of pressing aids, slagging inhibitors or any other additives have to be stated
	Bulk density (BD) as received (kg/m³)		
	BD550	≥ 550 kg/m³	
	BD600	≥ 600 kg/m³	
	BD650	≥ 650 kg/m³	
	BD700	≥ 700 kg/m³	
	BD700+	> 700 kg/m³ (minimum value to be stated)	
	Net calorific value as received, Q (MJ/kg or kWh/kg)		Minimum value to be stated
Normative / informative	**Sulphur, S** (w-% of dry basis)		
	S0.02	≤ 0,02 %	Normative: Chemically treated biomass (1.2.2; 1.3.2; 2.2.2; 3.2.2) or if sulphur containing additives have been used. Informative: All fuels that are not chemically treated (see the exceptions above)
	S0.05	≤ 0,05 %	
	S0.08	≤ 0,08 %	
	S0.10	≤ 0,10 %	
	S0.20	≤ 0,20 %	
	S0.20+	> 0,20 % (maximum value to be stated)	
	Nitrogen, N (w-% of dry basis)		
	N0.3	≤ 0,3 %	Normative: Chemically treated biomass (1.2.2; 1.3.2; 2.2.2; 3.2.2) Informative: All fuels that are not chemically treated (see the exceptions above)
	N0.5	≤ 0,5 %	
	N1.0	≤ 1,0 %	
	N2.0	≤ 2,0 %	
	N3.0	≤ 3,0 %	
	N3.0+	> 3,0 % (maximum value to be stated)	
	Chlorine, Cl (w-% of dry basis)		
	Cl0.02	≤ 0,02 %	Normative: Chemically treated biomass (1.2.2; 1.3.2; 2.2.2; 3.2.2) Informative: All fuels that are not chemically treated (see the exceptions above)
	Cl0.03	≤ 0,03 %	
	Cl0.07	≤ 0,07 %	
	Cl0.10	≤ 0,10 %	
	Cl0.10+	> 0,10 % (maximum value to be stated)	
Informative: Ash melting behaviour (°C)			Deformation temperature, DT should be stated

Figure 10: Master table – Specification of properties for pellets;

From: CEN/TC 335–prEN 14961-1 (Table 4)

Part 2: Product standard for wood pellets (prEN 14961-2)

As already said, the standard prEN 14961 is planned to consist of 6 parts. The general part 1 was described above.

Parts 2-6 are product standards similar to e.g. ÖNORM standards, defining product quality requirements by means of minimum/maximum thresholds for certain parameters. The trade forms addressed are wood pellets (Part 2, see Figure 11), wood briquettes (Part 3), wood chips (Part 4), firewood (Part 5) and non-wood pellets (Part 6). Figure 11 shows the latest draft (July 2009) of Table 1 in Part 2 (prEN 14961-2). Please note that the details are still under discussion.

Property class	Unit	A1	A2	B
Origin and source [a]		1.1.3 Stemwood 1.2.1 Chemically untreated wood residues	1.1.1 Whole trees without roots 1.1.3 Stemwood 1.1.4 Logging residues 1.1.6 Bark 1.2.1 Chemically untreated wood residues	1.1. Forest, plantation and other virgin wood 1.2. By-products and residues from wood processing industry 1.3 Used wood
Diameter, D and Length L	mm	D06 6 ± 1; [a] 3,15 ≤ L ≤40 [b] D08 8 ± 1; [a] 3,15 ≤ L ≤40 [b]	D06 6 ± 1; [a] 3,15 ≤ L ≤40 D08 8 ± 1; [a] 3,15 ≤ L ≤40 [b]	D06 6 ± 1; [a] 3,15 ≤ L ≤40 [b] D08 8 ± 1; [a] 3,15 ≤ L ≤40 [b]
Moisture, M	as received, w-%	M10 ≤ 10	M10 ≤ 10	M10 ≤ 10
Ash, A	w-% dry	A0.5 ≤ 0,5; [a] A0.7 ≤ 0,7; [a]	A1.0≤ 1,0	A3.0≤ 3,0
Mechanical durability, DU	as received, w-%	DU97.5 ≥ 97,5	DU97.5 ≥ 97,5	DU97.5 ≥ 97,5
Fines at factory gate in bulk transport (at the time of loading) and in large sacks (at time of packing), F Fines in small bags at factory gate (at the time of packing), F Fines in small bags, up to 20 kg, when delivered to end-user, F	w-%	F1.0 ≤ 1,0 F0.5 ≤ 0,5 F1.0 ≤ 1,0	F1.0 ≤ 1,0 F0.5 ≤ 0,5 F1.0 ≤ 1,0	F1.0 ≤ 1,0 F0.5 ≤ 0,5 F1.0 ≤ 1,0
Additives [c]	w-%	Type and amount to be stated	Type and amount to be stated	Type and amount to be stated
Net calorific value, Q	as received, MJ/kg or kWh/kg	Q16.5 ≥ 16,5 or Q4.6 ≥ 4,6	Q16.5 ≥ 16,5 or Q4.6 ≥ 4,6	Q16.0 ≥ 16,0 or Q4.4 ≥ 4,4
Bulk density, BD	kg/m^3	BD600 ≥ 600	BD600 ≥ 600	BD600 ≥ 600
Nitrogen, N	w-% dry	N0.3 ≤ 0,3	N0.5 ≤ 0,5	N1.0 ≤ 1,0
Sulphur, S	w-% dry	S0.05 ≤ 0,05	S0.05 ≤ 0,05	S0.05 ≤ 0,05
Chlorine, Cl	w-% dry	Cl0.02 ≤ 0,02	Cl0.03 ≤ 0,03	Cl0.03 ≤ 0,03
Arsenic, As	mg/kg dry	≤ 1	≤ 1	≤ 1
Cadmium, Cd	mg/kg dry	≤ 0,5	≤ 0,5	≤ 0,5
Chromium, Cr	mg/kg dry	≤ 10	≤ 10	≤ 10
Copper, Cu	mg/kg dry	≤ 10	≤ 10	≤ 10
Lead, Pb	mg/kg dry	≤ 10	≤ 10	≤ 10
Mercury, Hg	mg/kg dry	≤ 0,1	≤ 0,1	≤ 0,1
Nickel, Ni	mg/kg dry	≤ 10	≤ 10	≤ 10
Zinc, Zn	mg/kg dry	≤ 100	≤ 100	≤ 100
Ash melting behaviour, DT [d]	°C	DT1200 ≥ 1200	DT1100 ≥ 1100	DT1100 ≥ 1100

[a] Select appropriate size and ash content of pellets.
[b] Amount of pellets longer than 40 mm can be 5 w-%. Maximum length shall be < 45 mm. It is recommended that pellets used in stoves and small household appliances should have maximum length of 30 mm.
[c] The maximum amount of additive is 2 w-% of pressing mass. Type (e.g. starch, corn flour, potato flour, vegetable oil) and the amount of additives shall be stated.
[d] If appropriate, all characteristic temperatures can be stated.

Figure 11: Specifications of wood pellets for non-industrial use (prEN 14961-2 status July 2009)

The product standard for wood pellets consists of three quality classes. For class A1-pellets only stemwood and untreated by-products can be used as raw materials. For class A2 also materials with higher bark contents (e.g. residual wood) can be used. Class B allows for a broad range of raw materials including chemically treated wood by-products and used wood. The major differences between the three classes (ash, nitrogen and chlorine contents) are mainly a result of the broader raw material spectrum.

Compared to existing standards and certification schemes, the new European standard in general does not demand a higher pellet quality. However, some changes (compared to ÖNORM and DINplus) have to be considered:

- Requirements on pellet dimensions are now better defined.
- Instead of abrasion (in %), the European standard asks for the measurement of durability and introduces the fine content as an additional criterion.
- The abrasion threshold of 2.3 % is now changed to a durability of at least 97.5 %.
- Maximum sulphur contents are increased.
- The ash content is measured at 550°C according to EN 14775 instead of 815°C (ÖNORM and DINplus). At 550°C, higher ash contents are measured. However, a maximum ash content of 0.5 % is demanded in both cases. This means that the European norm is stricter here. It is possible that there will be another change in the European norm.
- Thresholds for fines, ash melting behaviour and bulk density are newly introduced.

Part 6: Product standard for non-woody pellets (prEN 14961-6)

By now, there is a first draft for this standard. It includes two tables, each similar to the table in prEN 14961-2 (wood pellets; Figure 11). The tables describe quality classes for:

a) pellets produced from herbaceous biomass and

b) pellets from fruit biomass and blends and mixtures.

Each table contains specifications for three quality categories (A1, A2, B). The major differences are related to different raw material characteristics that make higher thresholds for ash (3-7 %), nitrogen (0.5-2 %), sulphur (0.1-0.3 %) and chlorine (0.1-0.4 %) necessary.

Next steps

The general part 1 of prEN 14961 was approved in September 2009 and will come into effect with the beginning of 2010. The product standards (incl. prEN 14961-2 for wood pellets) have been under internal commenting. Comments were discussed at the last meeting in Leipzig, Germany, in November 2009. Details on prEN 14961-2 on wood pellets will be further discussed and shall come into effect by the end of 2010. The product standard for non-wood pellets needs further coordination and will be published later.

Fuel quality assurance – prEN 15234

This multipart standard defines the basis of a quality assurance system for the whole biofuel supply chain. It includes general definitions of specifications necessary for agreements between actors along the supply chain, needs for documentation and traceability and critical control points.

In addition to general guidance, specific parts corresponding to prEN 14961 are being developed. Part 2 for example will give an overview on critical quality issues specifically for the wood pellets supply chain.

Next steps

The general part of this standard (prEN 15234-1) is already well developed and might come into effect in 2010 while work on specific parts (incl. prEN 15234-2 on wood pellets) just started. It is planned to finalize them for 2011.

International standardisation (ISO/TC 238)

In addition to the European standardization initiative, the International Organization for Standardization established the ISO/TC 238 Solid Biofuels in 2007. The first meeting of the committee was in May 2008 where six working groups were set up. Afterwards a work programme for TC 238 was elaborated.

The second meeting was in October 2009, where, based on CEN Technicals Specifications, the working groups were supposed to present first drafts of new ISO standards.

Working Group 2 (Solid biofuels – Fuel specifications and classes) discussed the status of CEN standards (prEN 14961). It was decided to use these standards as a basis for ISO standards. In addition there shall be one ISO product standard for non-woody briquettes for non-industrial use. Also the scope of new ISO standards was discussed. It was decided that ISO standards (in contrast to CEN standards) will also cover aquatic biomass as a raw material for fuels.

Next steps in the work of ISO/TC 238 are the preparation of draft standards by the end of 2009, the acceptance until mid 2010 and the publication of standards in 2011. In WG 2, members will comment on European documents until February 2010. Based upon this, first ISO working drafts for all 7 standards shall be prepared until May 2010 which will be discussed in the next meeting in June 2010.

By now, only 6 countries are represented in WG 2. The members now seek the participation of experts worldwide who can be nominated by National Standardisation Bodies to the ISO Global Directory.

7. New pellet certification (ENplus)

As already discussed above, the effectiveness of a pellet standard in the market is largely increased by an accompanying certification and quality control scheme. An example is the Austrian ÖNORM M 7135 in combination with the "ÖNORM tested" label.

Following the development of new European standards for solid biofuels (and pellets), existing quality labels can be upgraded and adapted in order to control and certify the compliance of pellets with the European standard. However, new European standards suggest the introduction of a European certification system not only targeting national markets but all 30 CEN member states. The new standards imply also to set up a certification system with a wider scope, i.e. addressing the whole pellet supply chain instead of pellet production only.

Against the background that the German pellet industry never was completely satisfied with existing certification schemes, the German Pellet Industry Association (DEPV), together with the German Biomass Research Centre (DBFZ), proPellets Austria and other European partners are developing a new certification system based on prEN 14961-2 (Product standard for wood pellets) and prEN 15234-1 (Quality assurance). "ENplus" is designed as a European certification system to be supported and distributed by all European pellet associations. The certification process will be carried out by national certification bodies together with national accredited laboratories. Similar to other international quality labels, like FSC or PEFC, the certification system is developed and supervised by an international supervision committee.

"ENplus" is intended to be a quality label for the whole pellet supply chain. Pellets can only be sold as ENplus pellets when every actor in the supply chain (pellet producer, traders, and retailers) is individually certified. Additionally, ENplus covers not only quality issues but also criteria for sustainability and supply security – which are crucial for the future development of the pellet market.

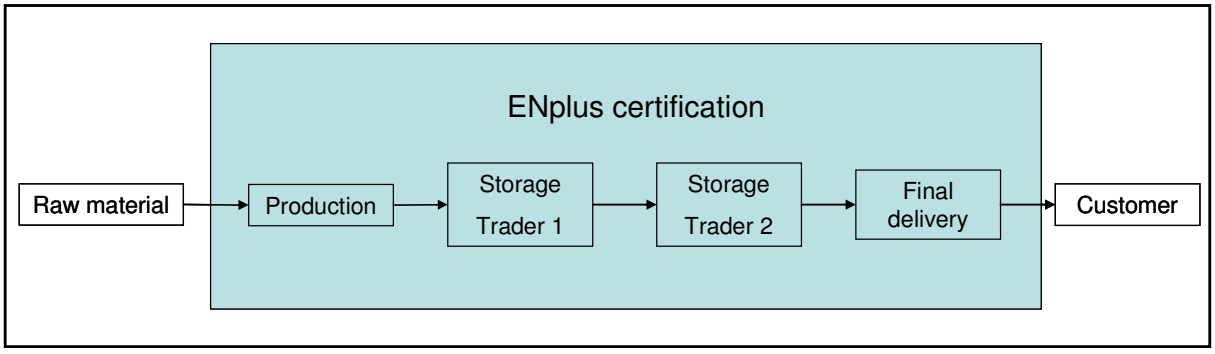


Figure 12: Scope of ENplus certification

Details on the certification procedure, internal/external control and documentation modalities, costs and sanctions will be presented in a handbook. So far, the following features became apparent:[15]

- As already mentioned, every actor along the supply chain has to be certified.
- The scheme is an international European certification system.
- Similar to prEN 14961-2, there are three quality classes: ENplus-A1, ENplus-A2 and EN-B; Pellet quality requirements are based on prEN 14961-2 with only one difference: Chemically treated material is not allowed in any quality class;
- Sustainability of pellet use shall be guaranteed by an obligatory minimum share of certified wood (PEFC or FSC) in pellet production.
- Quality management (at production plants, storage sites, and logistics providers) is important. The system foresees the setup of internal quality management with a quality representative, documentation and control.
- An identification system shall facilitate the traceability of pellet sources.
- Certified actors are obliged to document (see QM) and report on produced/marketed volumes on a monthly basis. The aim is to improve the monitoring of available volumes in the market and thus increase supply security.
- It is also discussed to include a minimum storage space as a precondition for certification. This might further increase supply security.
- External controls of production sites are performed once per year by testing institutes accredited according to ISO 17020 and ISO 17025. Additional controls are foreseen if necessary.

The system was presented to European pellet actors at the pellet industry forum in Stuttgart, October 2009. Until November 2009, details are discussed with European stakeholders. The certification process shall start in 2010.

[15] Behr, H.M. (DEPV); Umsetzung der europäischen Norm für Holzpellets in Deutschland; 9. Industrieforum Pellets; October 2009, Stuttgart, Germany.

8. Summary

Pellets@las data collections showed how inadequate the current status of pellet standardization and certification is in Europe. The existing national standards with individual quality requirements were not accepted by all stakeholders and did not spread within Europe. In most European countries, pellet quality standards are not used at all. Thus, national standards may have contributed to the development of single national pellet markets but the absence of common European standardisation was an important barrier to further development of the European pellet market in general and to increased international pellet trade in particular.

It can be expected that this situation will improve greatly with the implementation of new European standards for solid biofuels, including pellets. The pellets@las consortium follows and supports the European standardisation process and directly contributes to the process: Pellets@las partner *Holzforschung Austria* is a member of CEN/TC 335 and pellets@las partner FORCE Technology is a member of the Danish mirror group.

One experience gained during the pellets@las project was that standards alone are not sufficient to promote European pellet markets. The diversity of raw materials, the rapidly increasing number of producers and the critical importance of pellet quality for consumer satisfaction and therefore for market growth in general make the reinforcement and communication of compliance with standards necessary. In order to reinforce the compliance with quality standards, internal quality management needs to be accompanied by regular, external and unannounced controls at the production sites. Concerning communication, the end-consumer needs a reliable and recognisable quality label facilitating buying decisions. Quality labels also are an important marketing instrument for pellet producers. Finally, quality labels are used by pellet appliance manufacturers in warranty conditions that exclude the use of pellets without quality label.

All this can be delivered by quality certification schemes that award a reliable and recognizable quality label following regular external controls. Therefore, already in 2007, pellets@las partners recommended to use prEN 14961 and prEN 15234 as a basis for a pan-European certification system that could be used across Europe and facilitate international pellet trade and market development.

This recommendation will be followed by national certification bodies who decided to adapt their systems to the framework set by European standards. Two of these certification systems (ÖNORM and DINplus) have reached a certain level of international acceptance in the past but none can be characterized as a European quality label. One barrier to the European usage of these national systems is that quality labels which are well known in their country of origin (DIN in Germany; ÖNORM in Austria) may not be recognized and accepted in other countries. This led, for example, to efforts for replacing DINplus with the French NF label in France. Besides this, also language barriers and deficiencies in the certification process hinder the expansion of national certification systems. For DINplus this means that there is only one certification body (DIN CERTCO in Germany) without a representation or a sufficient number of control and testing organizations in other countries.

Finally, existing certification systems are lacking close cooperation between certification bodies and the pellet industry. AIEL may manage its own system and ITEBE and SNPGB may have contributed to the setup of the French system but the

risk of certification systems developing against markets´ needs remains as long as the pellet industry is not directly involved in the management of certification systems. Besides this, the pellet industry does not necessarily have to accept that profits with certification are made only outside the industry.

Based upon these arguments the pellets@las consortium recommended developing a new European certification system, based upon new European standards and with the following characteristics:

- The system should have a clear European focus from the beginning. This means involving experts and associations from all European countries (or as many as possible).
- The involved national associations should serve as the managing authorities of the certification system in their countries.
- In addition, a European pellet association should be established, not only to serve as the managing authority on the European level, but also as a platform for the discussion of pan-European issues such as policy development, R&D strategies, trade facilitation, market monitoring, supply security and sustainability.
- A new pellet certification system should include sustainability criteria.
- A new system could also be used for market monitoring and securing supply security.

With ENplus, the German Pellet Industry Association (DEPV), together with the German Biomass Research Centre (DBFZ) and the pellets@las member proPellets Austria developed a new certification system that aims at combining the recommended features mentioned above.

In October 2009, the system was presented to European actors at the pellet industry forum in Stuttgart and discussed with a number of other national pellet associations. In addition, first steps towards the formation of a European pellet industry association were taken.

These measures will be followed and fully supported by the pellets@las consortium.

Outlook

The development of a new French certification system will certainly cause some competition for pellet producers with DINplus, which has already been used by French producers for some time. In the same way, ENplus will have to face the competition of all the existing certification schemes. Certification bodies such as DIN CERTCO (Germany) and FCBA/AFNOR (France) may not be willing to abandon already established or recently developed quality labels and to integrate in the new system.

On the one hand, competition may be good for the certification business in general. On the other hand, it is also thinkable that there is only the need for one European quality label since pellet producers may have to decide between a trade mark that grants access to the pan-European market and trade marks that confine their activities to the respective national markets.

Within this process, the European boiler/stove manufacturers play an important role. By recommending a certain quality label in their equipment quality conditions, they substantially influence consumers´ buying decisions and directly influence the pellet producers´ decision for a certain quality label.