Solid Biofuel Classification Guidelines

Bioenergy Association Technical Guide 01

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About this Guide:

1. The compilation of this Technical Guide has been facilitated by contributions and oversight of the relevant expert members of the Bioenergy Association.
2. The aim of the Association's Technical Guides is to encourage delivery of high quality and consistent best practice bioenergy solutions. These Guidelines are voluntary but essentially provide a regulatory framework for the New Zealand bioenergy and biofuels sector.
3. The Guide is an outcome of industry discussion and collaboration. It captures the collective technical knowledge of a range of relevant leading bioenergy sector personnel. In addition, it benefits from the collective review and use by relevant asset owners, guide users, policy makers and regulators.
4. This guide is provided in good faith as an addition to the ongoing body of knowledge relating to the bioenergy and biofuels sector in New Zealand and Australia. However, as the guide is general and not specific to any application the Association and none of those involved with its preparation accept any liability either for the information contained herein, or its application.
5. As with all Bioenergy Association technical guidance documents, this guide is a 'living document' and will be revised from time to time and reissued, as new information comes to our attention. If you have suggested additions to this guide please contact admin@bioenergy.org.nz.
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CAVEAT

Bioenergy Association recommends that any party undertaking a project to upgrade or replace a bioenergy facility should undertake a full evaluation of all possible options prior to fixing on a specific new project solution.

As a decision maker, it's important to understand the pro's and cons of each option and have them set out by an appropriate expert in a way that ensures they are easily comparable. Too often a client rushes into a solution without properly evaluating all the options.

These Technical Guides are only a guide and users should ensure that they have engaged appropriate expert to consider their specific application.

EXECUTIVE SUMMARY

This document is a revision of the Wood Fuel Classification Guidelines published by the Bioenergy Association[1] (BANZ) and the Energy Efficiency and Conservation Authority (EECA) in July 2010. This revision has updated the various specifications of fuels so that these align with EN 14961. The main revisions in this document have included the following:

- Broadening these guidelines so that they are applicable to all solid biofuels rather than just "Wood Fuel";
- The terminology for some of the fuel property descriptions have been updated for example "S" for particle size is now "P" through where "S" has been used previously for the contracted specification, then this can continue to be used as the fuel property description. This change is to bring the terminology into alignment with EN 14961.
- Construction and demolition waste timber has been replaced by Urban Solid Biofuels and there are two separate grades for this material.
- Herbaceous wood fuels and torrefied wood and chip were added to this updated version.
- The verification methods were removed from this document and replaced by a new separate guide "Standard Methods for Verifying the Quality of Solid Biofuel for the New Zealand Energy Market: BANZ Technical Guide 5.
- This version incorporated terminology that also makes it suitable for the Australian solid biofuels market.

This document should be read in conjunction with EN 14961, however if this is not available, then there should be sufficient information in this report to effectively define the characteristics of a solid biofuel.

This document will be revised when new solid biofuels are identified and become traded fuels.

[1] Bioenergy Association of New Zealand

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1. INTRODUCTION

The wood fuel supply market is transforming and developing from an emphasis on the disposal of wood wastes to an emerging sector that supplies quality solid biofuel as an alternative to coal and gas for the production of heat. Increasingly, wood fuels and other solid biofuels are being recognized as a mainstream energy source and a number of fuel supply operators are either in the market or considering entering. In this revision of the Wood Fuel Classification Guidelines the use of the term wood fuels has been replaced by Solid Biofuels to broaden the overall range of fuels considered by this document. However because the term 'wood fuel' is often used in the market, and wood fuel is the dominant solid biofuel, the term 'wood fuel' should be considered synonymous with the term 'solid biofuel.'

As this market emerges there is a need for sellers and buyers of solid biofuels to be confident with respect to the description and quality of the fuel sought or supplied. Confidence in terms of the fuel characteristics will increase the value to both buyers and sellers.

Increasingly, it is important that standard forms of solid biofuels are available that can be used in appropriately designed boilers and heat plant. Having defined, consistent fuel classifications will assist to de-risk projects and provide the limits for specifying boiler fuel.

These guidelines for classification of solid biofuel s were prepared to provide a common terminology and methodology for classifying, specifying and declaring the quality and properties of traded solid biofuel in New Zealand. In most cases it is expected that the traded fuel will be a wood fuel.

Additional benefits of the standardised terminology and classification of these fuels include:

- An increase in use of wood energy;
- Improving consumer and user confidence in the availability and use of solid biofuel;
- Building the confidence within Regional Councils in the use of wood fuels with regard to emissions to air;
- Provide fuel quality assurance to heat plant manufacturers and wood fuel users;
- Promote wood energy as a sustainable and main-stream energy source;
- Minimise adverse environmental effects by using biofuels 'fit-for-purpose' and ensuring that any air emissions are minimal.

These Classification Guidelines were produced as a voluntary industry regulatory tool and have been prepared to meet specific New Zealand and Australian requirements, but most importantly they provide an effective tool to facilitate solid biofuel trading. The parameters set out are based on formal international standards but these have been simplified to meet New Zealand and Australian needs. The guidelines are not a replacement for the formal technical standards but provide a guide to the appropriate standards, or parts of a standard, to use in the context of New Zealand and Australia. For more information on the details of the formal technical standards fuel suppliers or buyers should refer to the full standard – a list of these is provided in section 16.

The Guidelines have been prepared on the basis of having a working document that the wood energy sector can use to develop a trade in solid biofuel. The Guidelines are intended to be flexible and allow a framework for defining the different kinds of solid fuels. As experience with the Guidelines is developed they will be reviewed and edited from time to time to best meet market requirements.

Additional categories of wood fuel will be added as appropriate.

Additional information on the Guidelines and their application is available on www.usewoodfuel.org.nz and set out in *"BANZ Technical Guide 6 – "Contracting To Deliver Quality Solid Biofuels To Customers."*

The Guidelines were developed jointly by the Bioenergy Association (BANZ) and The Energy Efficiency and Conservation Authority (EECA). Comments on the current version of the Guidelines are welcome and should be provided to the:

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2. OVERVIEW OF SOLID BIOFUEL CLASSIFICATIONS

Solid biofuel can be classified by major types or sources of materials for example wood chips, hog fuel, densified wood fuels, urban derived wood fuels, or firewood and by their specific characteristics such as particle size, moisture content, ash content, and energy content.

Furthermore, solid biofuels can come from a range of sources, the ones relevant to this classification guideline are:

- Products from forestry and agriculture;
- Wastes from forestry and agriculture;
- Vegetable waste from food processing industries;
- Wood waste;
- Fibrous vegetable waste from pulp and paper operations;
- Other woody related materials;
- Selected processed wood fuels (e.g. torrefied wood, wood pellets and briquettes).

These classification guidelines do not include materials from aquatic plants or municipal solid wastes.
For the purposes of this Classification Guideline the main principal is that fuels can be classified by:

- The main type and tradable form (chips, hog fuel etc);
- Specific descriptions that are based on the properties of the solid biofuels.

The main types of fuel included in these classification guidelines are summarised below.

Table 1: Types of solid biofuel.

Fuel Type	Features	Example
Wood Chips	Chipped woody biomass in the form of pieces, with a defined particle size produced by mechanical treatment with sharp tools such as knives.	
Hog Fuel	Fuel wood in pieces of varying size and shape produced by crushing with blunt tools such as rollers, hammers or flails. These fuels are typically of a lower quality compared to wood chip.	
Wood Pellets	Wood that has been pulverised and pelletised under heat and high pressure to produce a cylindrical wood derived fuel of consistent size.	
Urban Wood Fuels	Wood residues derived from the urban activities including packaging materials, off-cuts from manufacturing, construction and demolition wood residues, yard trimmings, urban tree residues and from land clearing	
Compressed Firelogs and Briquettes	A briquette or fire log is a block of flammable matter used as fuel to start and sustain a fire. Common types of briquettes are fuel logs, charcoal briquettes and biomass briquettes.	
Torrefied Wood	"Torrefied wood is thermally modified wood and completely desiccated, with devolatilised hemicellulose, which has not yet reached the point of “char”. These fuels may be compressed, fine or chunky.	
Herbaceous Wood Fuels	These are woody derived fuels sourced from Miscanthus, Switchgrass, other grasses and straw and may be in the form of chip, hogged, pelletised, or baled fuels.	
Firewood	Larger piece sizes of wood used for kindling or for sustaining combustion in domestic solid wood fire appliances.	

3. DESCRIPTION PROPERTIES

Solid biofuels are typically described by size, moisture content, ash, bulk density and energy density.

The classification of wood fuels is based on the following properties:

- **Size (P)**[2] – Particle size is an important parameter for many boilers and stove heaters as their fuel feed and distribution systems are typically designed to suite specific fuel sizes. Size distribution also has an effect on the boiler/stove performance. Too many fine particles or too long a piece size will reduce the boiler/stove performance considerably. It is desirable to have as consistent fuel size as possible. This may be influenced by the use of different size reduction technologies such as chippers, hoggers, hammer mills and grinders.
- **Moisture (M)** – Boilers and stoves are generally specified to be used with wood of certain moisture content. Furthermore, in some regions of New Zealand only dry wood is permitted to be used in wood fired heat plant.
- **Ash** (**A**) – Some boilers and stoves specify certain ash level limits in the fuel. Some Regional Plans also specify ash content limits on solid fuels. Excessive ash reduces fuel heating value and increases maintenance and ash disposal costs.
- **Bulk density (BD)** – By combining moisture content figures with those stated for bulk density, wood fuels can be sold on an energy basis by simply measuring a certain volume of wood chips. This has cost advantages as in many applications it is more practical to measure a volume of wood fuel for sale rather than by weight.
- **Energy density (ED)** – It is important for consumer confidence that fuels being sold with a specific classification has consistent energy content rather than one that varies by weight or volume due to high moisture or ash contents.

4. SOLID BIOFUEL PROPERTY DESCRIPTIONS

Wood fuel will be described by its grouped properties e.g. Wood Chip will be described as a Woodchip P16 M35 A1 BD200 ED15.

Example – Wood chip for small wood chip boilers would allow chip measured as P16 M35 A1 BD200 ED15 .
This would be a 16 mm sized chip (3.15≤P16≤16mm) with a moisture content of 35% (M35≤ 35%), ash content of 1% (A1≤ 1%), bulk density of 200 kg/m^3 (BD 200+/-10%), and an energy density of 15 MJ/kg (ED15+/-10%).

In a contract the fuel to be delivered will normally be specified as above with parameter ranges as set out in the relevant table or be specified by P15-18 M≤35 A≤1 BD180-220 ED14-16.

[2] Note: previously the size property was denoted by a "S".

5. VERIFICATION METHODS

The standard methods for verifying wood fuels are provided in a separate technical guide "*Bioenergy Association Technical Guide 5 - Standard Methods for Verifying the Quality of Solid Biofuels*". The guide for the verified methods was updated at the same time as this guide.

6. BLENDS AND MIXTURES

In some circumstances solid biofuels may be supplied as either blends or mixtures. Blends are intentionally mixed biofuels whereas mixtures are unintentionally mixed biofuels. The origin of a blend or mixture should be described.

A solid biofuel sold ungraded would be sold with no size or quality description.

7. MOST COMMON FORMS OF TRADED SOLID BIOFUELS

Solid biofuels are traded in many different forms, sizes and shapes often referred to as grades. The size and shape (grade) influence the handling of the fuel as well as its combustion properties. Biofuels may be delivered in the following forms:

Table 2. Most common forms of traded solid biofuel.

Fuel Type	Delivered Form	Typical Particle size	Preparation Method
Wood chips		5 mm to 100 mm	Cut with sharp tools
Hog fuels		Varying	Crushed with blunt tools
Pellets		< 25 mm	Mechanical compression
Urban solid fuels		10mm – 200mm	Chopped during collection
Firelogs and briquettes		25mm	Mechanical compression
Torrefied wood		<100 mm	Heat treatment
Herbaceous biofuels		10 mm to 200 mm	Chopped
	Small square bales	0.1m^3	Compressed and bound to squares
	Big square bales	3.7m^3	Compressed and bound to squares
	Round bales	2.1 m^3	Compressed and bound to squares
Firewood	Trailer or truck load	100 mm to1000mm	Cutting to size with sharp tools

8. WOOD CHIPS

Wood chips are a common form of solid biofuel used for small and larger scale heat plant and are produced from stem wood, process residues, billet or binwood (collected forest derived residues). Chips are produced by sharp cutting tools to which mostly give a consistent particle size.

Wood may be chipped either wet or dry. Key aspects of wood chip quality are:

- Moisture content;
- Particle size distribution; and
- Ash

The description of particle size has been changed in this guideline compared to the earlier version to become consistent with the EN Standard 14961-1. In the previous version of the Wood Fuel Classification Guidelines, particle size was referred to an "S" (i.e. S30, S50, S100). These particle descriptions had different cut-off size limits for fine and coarse particles and different allowable percentages.

The level of contamination is also important as this will affect the ash content and potential impact on deposition on boiler surfaces.

Contamination

- All wood chip classes must be free of treated wood.
- Classified wood fuels must be free from non wood contaminants.

Table 3 – Specification of properties for wood chips.

Size specification	Previous size classification[3]	Main fraction (minimum, 75 w-%mm)[4] P = particle size W= weight	Fines fraction w-% (< the specified minimum mm)	Coarse fraction, (w-%), max length of particle, mm
P16A[5]	S30	3.15≤P≤16mm	≤12%	≤3%.>16mm and all ,< 31.5mm
P16B		3.15≤P≤16mm	≤12	≤3%.>45mm and all ,< 120mm
P45A	S50	8≤P≤45mm	≤8	≤6% >63mm and maximum 3.5%>100mm, all < 120mm
P45B		8≤P≤45mm	≤8	≤6% >63mm and maximum 3.5%>100mm, all < 350mm
P63	S100	8≤P≤63mm	≤6	≤6% > 100mm,all <350mm
P100		16≤P≤100mm	≤4	≤6% >200mm,all < 350mm

Moisture properties % by weight (wet basis)	
M20	≤ 20%
M30	≤ 30%
M35	≤ 35%
M40	≤ 40%
M55	≤ 55%
M55+	≤ 55+%

[3] Previous property description from Wood Fuel Classification Guidelines, July 2010.

[4] The particle size is based on particles passing through specific screen diameters. For instance, to remove over-sized particles, P63 fuel should be passed through a screen with holes with a diameter of 63mm, the P45 screen should have holes with a diameter of 45mm etc. A separate screen should be used to ensure fines are removed to comply with the maximum fines percentage. The main fraction of the wood chips is to have a minimum of 75% of the weight is to within the specified particle size range.

[5] Refer to BANZ Technical Guide 5. Standard Methods for Verifying the Quality of Solid BioFuels for a description on measuring particle size and the other parameters.

Ash properties % by weight (dry basis)	
A.5	≤ 0.5%
A1	≤ 1%
A3	≤ 3%
A5	≤ 5%
A6+	> 6% - Actual Value Stated
Bulk Density	
Kg/m^3	Actual value stated
Energy Density	
MJ/kg	Actual Value Stated – If sold by weight

9. HOG FUEL[6]

Hog fuel is solid biofuel in the form of pieces of varying size and shape produced by crushing or shredding with blunt tools such as rollers, hammers, or flails and can be sourced from a wide range of woody feedstocks such as wood processing residues, urban clean woody waste or other forest or woodlot derived materials. Hog fuel is often a mixture of different sources and materials.

Table 4 – Specification of properties for hog fuel (These specifications are based on EN 14961).

Size Specification	Previous specification[7]	Main fraction (minimum, 75 w-%mm)[8]	Fines fraction w-%, ≤3.15mm	Coarse fraction, (w-%, max length of particle, mm
P16	S63	3.15≤P≤16mm	≤10%	≤6%.>45 mm and all < 120 mm
P45		3.15≤P≤45mm	≤10%	≤10%.>63 mm and all < 350 mm
P63		3.15≤P≤63mm	≤10%	≤10% > 100 and all <350mm
P100	S100	3.15≤P≤100mm	≤10%	≤10% > 125 and all <350mm
P125		3.15≤P≤125mm	≤15%	≤10% > 150 and all <350mm
P200	S300	3.15≤P≤200mm	≤15%	To be specified
P300		3.15≤P≤300mm	≤25%	To be specified

Moisture descriptors % by weight (moist basis)	
M20	≤ 20%
M35	≤ 35%
M55	≤ 55%
M65	≤ 65%
M65+	>65%

[6] Standard adapted from EN 14961:2010
[7] From Wood Fuel Classification Guidelines, 2010.
[8] The particle size is based on particles passing through specific screen diameters. For instance, to remove over-sized particles, P63 fuel should be passed through a screen with holes with a diameter of 63mm, the P45 screen should have holes with a diameter of 45mm etc. A separate screen should be used to ensure fines are removed to comply with the maximum fines percentage.

Ash descriptors% by weight (dry basis)	
A.5	≤ .5%
A1	≤ 1%
A3	≤ 3%
A6	≤ 6%
A6+	> 6% - Actual Value Stated
Bulk Density	
Kg/m^3	Actual Value Stated
Energy Density	
MJ/Kg	Actual Value Stated – If sold by weight

Contamination

- All hog fuel categories must be made from untreated timber.
- Wood Fuels must be free from non wood contaminants. Where contaminants may arise such as silica for wood fuels derived from the Central North Island then these will need to be considered separately and specified so that the fuel is appropriate of the selected heat plant or application.

10. WOOD PELLETS[9]

Wood pellets are produced from high quality wood residues and their production is standardised to specific standards according to the wood feedstock used.

Pellets are typically used in three different scales of heat plant, namely:

- Small – generally for domestic home heating;
- Medium – generally for small to medium sized commercial/industrial boiler plant; and
- Large – generally for large industrial process heat boilers and for substitution for coal or for electricity generation.

In small scale heating applications such as for domestic home heating the control on the quality of the wood pellet provides a means of control of the emissions from combustion. This avoids the need for monitoring emission outputs as they are controlled by the fuel inputs. In larger heat plant where air emission resource consents may be required the analysis of air emission outputs will be based on the quality of the fuel input. Control of the quality of fuel ensures that combustion plants will operate within the consent conditions.

In addition different standards of pellet may be used according to whether or not the heater or boiler is in a controlled air emission zone.

Three categories of pellet standard are defined as follows:

- Grade 1 - premium pellets - for use in any residential heater or commercial boiler;
- Grade 2 – large premium pellets - for use in selected boilers;
- Grade 3 – industrial grade pellets for use in selected boilers subject to resource and boiler manufacturer consents.

[9] Standard adapted from EN 14961:2010 and NZS 4014.6:2007

*** Consent process** – When a resource consent is applied for, the boiler supplier must clearly state what category of pellets are to be used in the appliance. This must also be stated in the warranty conditions of the boiler. This requirement will give confidence to the consent issuer that the appropriate technology and fuel are being used. Testing of both the fuel and boiler technology in advance is likely to lead to a more efficient consenting process.

Grade 1 - Premium pellets

Application – for use in any residential heater or commercial boiler.
This grade represents the highest level of quality. 'Grade 1' pellets can be used in any wood boiler. Grade 1 pellets are only manufactured from virgin wood fibre, untreated and free from contamination. Their ash levels are extremely low as are the subsequent levels of emissions. The fuel and the resulting ash should be able to be certified as organic under 'BioGro' (which is driven by both the feedstock and the operating practices in the manufacturing process). This fuel is suited to small and for boilers that require high quality fuels. 'Grade 1' pellets are suitable also for use in controlled air sheds.

Grade 1 Premium wood pellets align with the European wood pellet standard EN 14961:2010.

Table 5- Specification Parameters for Grade 1 Premium wood pellets.

Specification	Measurement	Comment
Diameter	6mm	Smallest diameter
Length	<6 x dia mm	
Ash	<1%	Note – all EU standards list <1% ash
Additives	<1%	Starch binding agent only
Moisture	<10% (<8%)	By weight (Note - <8% limit used for test fuels when testing appliances)
Bulk density	>650kg/m^3	
Energy content	>17MJ/kg	As received basis
Mechanical Durability	97.7 % (proposed)[10]	Tumbler 2000 test or equivalent test suggested;
Particle size	<3.0mm	
Fines	<1.0%	By weight, ex gate
Chlorine	<20ppm	
Sulphur	<0.05%	

Grade 2 – Large premium pellets

Application – for use in selected boilers

This grade also represents high quality pellets but is for larger scale applications, such as for school boilers. This grade can also be used in controlled air shed areas. Grade 2 pellets are suited to use in large boilers (depending on design). Grade 2 pellets differ from Grade 1 pellets only in terms of their physical qualities (likely to be larger diameter compared to Grade 1 pellets); the pellet quality remains largely unchanged compared to Grade 1 pellets.

[10] 97.7% limit is consistent with EN 14961 and DIN 51731 (briquettes and pellets)

Table 6 - Specification Parameters for Grade 2 wood pellets

Specification	Measurement	Comment
Diameter	<10mm	Largest diameter
Length	<6 x diameter mm	
Ash	<1%	
Additives	<1%	Starch binding agent only
Moisture	<10%	By weight
Bulk density	>600kg/m^3	
Energy content	>17MJ/kg	
Mechanical Durability	97.7 % (proposed)[11]	Tumbler 2000 test or equivalent test suggested;
Particle size	<3.0mm	
Fines	<4.0%	By weight, ex gate[12].
Chlorine	<50ppm	
Sulphur	<0.1%	

Grade 3 – Industrial grade pellets

Application – for use in selected boilers (subject to resource consents and boiler manufacturer approval)

This grade of wood pellets is for larger scale applications which are installed outside controlled air shed areas or where air emission consents are required. Large boilers (dependent on design) can utilise a variety of wood fuels. Grade 3 pellets offer the benefits of a pelletised fuel (easy handling) but does not necessarily offer the advantages associated with Grade 1 and 2 pellets (i.e., low ash and low emission levels). Where this grade of pellets is to be used, it would be necessary to confirm that the fuel is compatible with the boiler and any consent conditions. Furthermore, it may be necessary to add further specifications to those outlined below to adequately define the fuel for a proposed industrial application.

Table 7 - Specification Parameters for Grade 3 wood pellets.

Specification	Measurement	Comment
Diameter	<10mm	
Length	<6 x dia mm	
Ash	<5%	
Additives	<10%	Either added or already in the pellet production material. Must be stated.
Moisture	<15%	By weight (wet basis)
Bulk density	>550kg/m^3	
Energy content	>10MJ/kg	
Mechanical Durability	90 % (proposed)	Tumbler 2000 test or equivalent test suggested;
Particle size	<6.0mm	Must be stated.
Fines	<10.0%	By weight, ex gate
Chlorine		Must be stated
Sulphur		Must be stated
Pellet ingredients	Listed separately	Must be stated (including material source).

[11] ibid
[12] Note – Large boilers may be able to handle more fines.

In Europe, the two main certifications of quality for pellets in the European market are DIN 51731 (German) or Ö-Norm M-7135 (Austrian). Pellets conforming to these standards commonly used have less than 10% water content, are uniform in density (density in excess of 1 ton / cubic meter, so they do not float if placed in water), have good structural strength, and low dust and ash content. Details as follows:

Table 8. Specifications used in different standards.

	Ö-Norm	DIN-Norm	DINplus
Thermal Value	18 MJ/kg	18 MJ/kg	18 MJ/kg
Density	1.12 kg/dm3	1.0 - 1.4 kg/dm3	1.12 kg/dm3
Water content	Max. 10.0%	Max. 12.0%	Max. 10.0%
Ash content	Max. 0.5%	Max. 1.5%	Max. 0.5%
Length	Max. 5 x diameter	Max 50mm	Max. 5 x diameter
Diameter	4 - 10mm	4 - 10mm	4 - 10mm
Abrasion	Max. 2.3%		Max. 2.3%
Composition	natural wood	natural wood	natural wood

Standards work at DIN results in the publication of either a national standard, or a European Standard or an International Standard adopted at national level.Further details on DIN CERTO are to be found at http://www.dincertco.de/en/wood_pellets_for_central_heating_boilers.html.

11. URBAN SOLID BIOFUELS

The term 'urban' is used to describe solid biofuels which are derived from largely urban sources as outlined below:

- Logistics and freight forwarding companies;
- Storage, warehousing and distribution centres;
- Manufacturing including furniture, home wear, pallets and board producers;
- Construction which covers new builds, residential, industrial and commercial properties;
- Demolition works, mainly residential and commercial units;
- Building refurbishments ;
- Household Waste Recycling Centres where local residents dispose of unwanted wood and timber products;
- Commercial activities, for instance companies who receive significant quantities of palletised products or packaging cases.

Although these sources are not mutually exclusive to urban areas, the volumes necessary to make processing economically viable usually means that this type of solid fuel production is situated close to urban areas.

In developing the urban solid biofuel market, two main grades are considered, which not only simplify processing, but make it easier for potential urban fuel users to decide what type of fuel is best suited to them.

Urban Clean Biofuel

General chip dimensions and specification fall within European 'G120' W30 (EN 14961 equivalent P100 M30) specification.

Urban clean solid biofuel is untreated wood usually sourced from packaging material, pallets and wood processing off-cuts. This type of material is ideal for home and commercial boilers and heaters. Moisture content can typically be around 14% and because this fuel has relatively low moisture content it has a high (as supplied) calorific value.

Provided the material is appropriately monitored to ensure that it is not contaminated with treatment chemicals, then there is unlikely to be any constraints on its use.

Given the boiler and burner technology that is prevalent across New Zealand, then untreated wood chip can be used in a wide variety of systems without particular regulatory considerations.

Mixed Grade Urban Chip

Urban wood waste can come contaminated with wood preservatives, binders, paints, glues, chlorine bleach, plastic laminating materials, chlorinated adhesives, phenol and urea formaldehyde resins, nails/staples, or other non-wood materials. It may be mixed with other types of demolition waste, such as rubble, reinforcing bars, tiling or dry wall plasterboard.

Contaminated demolition wood should only be used in high temperature combustion facilities that are specifically designed to effectively combust such materials and which account for any potential hazardous emissions. Any such installations are likely to require specific resource consents which will allow the use of treated wood.

General chip dimensions and specification fall within European 'G120' W30 (EN 14961 equivalent P100 M30) specification.

Shavings and wood dust can also be included in the mixture and would be typically less than 10% of the total mix. This grade can include a small percentage of treated timber.

The moisture content is slightly higher than the Urban Clean Biofuel as some of the materials for this grade have greater capacities to absorb moisture, such as hogged MDF. Typically the moisture content is between 18-25%. The chip is also less dense compared to Urban Clean Biofuel and therefore has lower energy density.

Although this type of fuel can be derived from any of the sources detailed in the introduction to this section, there are four main sources:

- **Manufacturing** – treated and untreated wood consisting of off cuts from furniture making, homeware items, board making, MDF & plywood manufacturing.

- ***Construction*** – off cuts from structural timbers, timber packaging, scaffolding, wooden hoardings, concrete form work and building refurbishments.
- ***Demolition*** – used structural timbers, e.g. floorboards, joists, beams staircases and doors.
- ***Building refurbishments*** – this will be a mixture of construction and demolition materials.
- **Treated and contaminated wood**

A large proportion of the waste wood arising in each of the waste streams is treated in some form to increase its durability. Treatments commonly used now or in the recent past include surface coatings such as paints, varnishes and impregnated preservatives such as chromate copper arsenate (CCA), ammoniacal copper quat (ACQ), creosote, boric and pentachlorophenol. Treatments with lesser environmental impacts have been, and are being, developed and are likely to lead to more acceptable use of the 'end of life' wood as fuel. Different preservatives require different considerations when they are reprocessed, recovered or disposed of.

The handling of any treated or coated material as a solid biofuel should be undertaken in a safe manner and be approved by the Regional Council. Further expert technical advice may be required to process or use this fuel type.

Verification methods for these solid biofuels are the same as those described in the Verification Technical Guide (refer section 5).

12. COMPRESSED FIRELOGS AND BRIQUETTES

Biofuel firelogs and briquettes are densified biofuel made either with or without additives in a range of different shapes and are produced by compressing pulverized biomass. The raw material for briquettes can be woody biomass, herbaceous feedstocks, fruit derived material or blends and mixtures. Biomass briquettes are typically made in a piston press. The total moisture of briquettes is usually less than 15%.

The properties used to describe these fuels are summarised in Table 9.

Table 9 – Specification of the properties for firelogs and briquettes[13].

Diameter (mm) (Firelogs)	
D40	≤ 40mm
D50	≤ 50mm
D60	≤ 60mm
D80	≤ 80mm
D100	≤ 100mm
D125	≤ 125mm
D125+	> 125+
Length (mm)	
L50	≤ 50mm
L100	≤ 100mm
L200	≤ 200mm
L300	≤ 300mm
L400	≤ 400mm
L400+	> 400mm

[13] Briquettes have a range of dimensions. Diameters above should be approximated for briquettes.

Moisture (by weight, wet basis)	
M10 M15 M20	≤ 10% Moisture ≤ 15% Moisture ≤ 20% Moisture
Ash (by weight, dry basis)	
A0.5 A1 A3 A6 A10	≤0.5% ≤ 1% ≤ 3% ≤ 6% ≤ 10%
Energy Density	
MJ/Kg	Actual Value Stated – If sold by weight
MJ/m^3	Actual Value Stated – If sold by volume

Contamination

- All firelogs and briquettes must be made from untreated timber;
- Wood fuels must be free from non wood contaminants.

The description of these fuels is based on the same properties as used for other solid biofuels considered in this guide (refer section 3).

Verification methods for these solid biofuels are the same as those described in the Verification Technical Guide (refer section 5).

13. TORREFIED WOOD AND CHIP

Torrefied wood is relatively new type of upgraded wood fuel produced by heating wood to 240 -320 °C in a low oxygen atmosphere.

The advantages of torrefaction are:

- Torrefaction (+ densification) enables energy-efficient (>90%) upgrading of biomass into commodity solid biofuels with favourable properties in view of logistics and end-use;
- Favourable properties include high energy density, better water resistance, slower biodegradation, good grindability, good “flowability”, homogenised material properties;
- These characteristics give cost savings in handling and transport, advanced trading schemes (futures) possible, capex savings at end-user (e.g. outside storage, direct co-milling and co-feeding), higher co-firing percentages and enabling technology for gasification based biofuels and biochemicals production; and
- Applicable to a wide range of lignocellulosic biomass feedstock, even mixed waste streams.

Table 10.Typical characteristics of torrefied wood:

Characteristic	
Moisture content (%wt)	1-5
Calorific value (LHV MJ/kg)	18-24
Volatile matter (wt dry basis)	55-65
Fixed carbon (wt dry basis)	22-35
Bulk density (kg/L)	0.65-0.8
Energy density (GJ/m^3)	12-19
Hydroscopic properties	Moderately hydrophobic
Biological degradation	low
Milling requirement	Standard
Product consistency	High

A new project has recently been established by the EU to develop standard specifications and verification methods for torrefied solid biofuels (EU-FP7 project SECTOR). Work on the development of these standards is in progress and is still to be finalized.

The description of these fuels is based on the same properties as used for other solid biofuels considered in this guide (refer Section 3).

Verification methods for these solid biofuels are the same as those described in the Verification Technical Guide (refer section 5).

14. HERBACEOUS WOOD FUELS

Herbaceous biofuels are typically sourced from agricultural activities and will include grasses, cereal crops, root and legume crops and flowers. For each of these sources, materials may consist of whole plants, straws, grains or seeds, husks and roots.

The use of herbaceous fuels in heat plant must take into account the chemical composition of the material as typically these types of solid biofuels will have high concentrations of inorganic constituents which can contribute to fouling of boiler surfaces and corrosion issues. It is important to have good knowledge of the chemical composition of these materials before using them in heat plants. Herbaceous fuel sources such as straws, cereals and grasses can have low concentrations of calcium and high concentrations of potassium which contributes to lower sintering temperature compared to other wood fuels. The use of these types of fuel requires consideration of appropriate technology to control combustion conditions and the use of effective air emission control equipment.

The description of these fuels is based on the same properties as used for other solid biofuels considered in this guide (refer section 3).

Verification methods for these solid biofuels are the same as those described in the Verification Technical Guide (refer section 5).

15. FIREWOOD

Firewood is generally large piece sizes of wood used for domestic fire appliances. These fuels may be supplied as either kindling or larger pieces to sustain a fire.

These fuels are typically supplied by a firewood supplier.

Many jurisdictions specify moisture content for these types of fuel to minimize emissions.

Table 11 – Specification of the properties for Firewood

Diameter (mm)	
D40 kindling D100 D100+	≤ 40mm 80mm≤ D100≤ 120mm 100mm≤D100+≤200mm
Length (mm)	
L300 L350 L400+	300mm≤ L300≤ 350mm 350mm≤ L350≤ 400mm 400mm≤ L400+
Moisture (by weight, wet basis)	
M15K (Kiln dried) M20S (Seasoned) MG (Green)	≤ 15% Moisture 15%≤M20≤ 25% Moisture Greater than25% Moisture
Ash (by weight, dry basis)	
A1 A2	≤ 1% 1% ≤
Energy Density	
MJ/Kg	Actual Value Stated – If sold by weight
MJ/m^3	Actual Value Stated – If sold by volume

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