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Pre-normative research on solid biofuels for improved European standards

SPECIFIC TARGETED RESEARCH OR INNOVATION PROJECT

PRIORITY [6-1] – Sustainable energy systems

Task IV – Supply chain based properties



Used wood in the EU – Part 2

A catalogue of used wood examples

DIV.6 – Part 3, Responsible leader: VTT, Technical Research Centre of Finland

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Preface

The BioNorm II project consortium is a team of 25 experienced partners from 11 European countries (many partners are also active members of TC 335) and the Institute for Energy and Environment (IE) is the coordinator of this project that runs 3 years (2007 – 2009). Within the project framework 4 work packages (WP I - IV) exist in which fuel characteristics of solid biofuels and methods to test and verify them are developed:

- WP I: Sampling, sample reduction and planning
- WP II: Chemical and physical testing procedures
- WP III: Quality measures
- WP IV: Specifications of solid biofuels

The WP IV is co-ordinated by VTT and other partners are FJ-BLT, RTU, USTUTT and CERT/ISFTA.

In WP IV the total work is concentrated on the support of the European standardisation Committee by defining fuel specifications and classes of the most traded solid biofuels. Thus supply chain related fuel properties as well as combustion and fuel handling related fuel properties have to be analysed and determined for each specific biofuel (e. g. wood chips, pellets, briquettes etc.). This pre-normative work is continuation of the results of the first BioNorm project.

The prEN14961 – Part 1 includes also wood waste, if it not containing halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coating. One aim of the project was clarify which fractions of wood waste can be defined as solid biofuel.

This report is summary of the case studies of used wood carried out during 2007 and 2008.

Jyväskylä, August 2008

Eija Alakangas, Task IV leader

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List of Abbreviations

A	ash content, dry basis
ar	as received
BD	bulk density, kg/m ³
D	diameter, mm
d	dry
DU	mechanical durability, w-%
E	E_{ar} = energy density as received, kWh/m ³
F	finer (< 3,15 mm)
L	length, mm
M	moisture content as received, w-%
Q	$q_{net, ar}$ = net calorific value, as received, MJ/kg or kWh/kg (1 kWh/kg = 3.6 MJ/kg)
$q_{net, d}$	net calorific value, dry basis
As	arsenic
Cl	chlorine
Cr	chromium
Cu	copper
F	fluorine
Hg	mercury
I	iodine
N	nitrogen
S	sulphur, dry basis
Zn	zinc
CCA	(impregnation with) copper, chromium and arsenic
CC	(impregnation with) copper and chromium
PVC	polyvinyl chloride
LDF	low density fibreboard
MDF	medium density fibreboard
HDF	high density fibreboard

1 Introduction

Solid biofuels are classified according to the European Committee of Standardisation (CEN) technical specification CEN/TS 14961 – Solid biofuels: Fuel specification and classes (2005). This standard is under upgrading to a full EN-standard.

This report includes examples of used wood streams in a form of catalogue.

2 Classification of used wood

The classification presented here is based on EN 14961-1 draft standard and the origin of the material. Used wood is classified into the following classes: A, B, C and D. Used wood in classes A and B are solid biofuel as defined, with given restrictions (do not contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coating). Used wood in class C falls under the Waste Incineration Directive (WID) 2000/76/EC, and is solid recovered fuel. Wood waste in class D includes preservatives and shall be disposed according to the Hazardous Waste Incineration Directive (94/67/EC).

Used wood under solid biomass fuels (prEN 14961-Part 1):

Class A (natural wood, only mechanically treated)

- Chemically untreated by-products or residues from forest and wood processing industry (1.2.1)
- Chemically untreated used wood (1.3.1)

Class B (Coated, lacquered or otherwise chemically treated and coating does not contain halogenated organic compounds (for example PVC) and preservatives, no demolition wood)


- Chemically treated by-products and residues from forest and wood processing industry (1.2.2)
- Chemically treated used wood (1.3.2)


Class C is excluded from prEN 14961-1; belonging to CEN/TS 15359 and is solid recovered fuel. Class C wood includes


- halogenated organic compounds (for example PVC) in the coating
- difficult to verify the origin of the material e.g. demolition wood
- does not contain preservatives


Class D used is excluded from prEN 14961-1 and solid recovered fuel (SRF) and includes preservative-treated wood. Class D wood is hazardous wood.


The following pages present examples how to use this classification system.


CLASS A	Example
A1	Unpainted construction wood without nails
	
Detailed description	Source-separated unpainted wood. Wood is crushed at power plant.
Classification	Class A – Biofuel
Chemical treatment	Chemically untreated wood
Impurities	No impurities, if stored dry place
Traded form	Hog fuel or wood chips
Origin according to EN 14961 - 1	1.3.1.1 – Chemically untreated used wood without bark
Normative properties	EN 14961-1, the following classes should be stated: particle size (P), moisture (M), ash (A). Typically P45, M30, A1.0
Informative and other properties	EN 14961 -1: Net calorific value as received (Q), Nitrogen (N), Chlorine (Cl), bulk density (BD)
Similar raw material	Unpainted wood used in furniture industry


CLASS A	Example
A2	Ply residues from plywood mill
	
Detailed description	Plywood residues from plywood mill. Ply can be chipped and used also in pulp industry
Classification	Class A – Biofuel
Chemical treatment	Chemically untreated wood
Impurities	No impurities
Traded form	Wood chips
Origin according to EN 14961 - 1	1.2.1.1 (deciduous tree) tai 1.2.1.2 (coniferous) – Chemically untreated wood processing industry by-products and residues without bark
Normative properties	EN 14961-1, particle size, P16, moisture (M10), Ash (A1.0)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), Nitrogen (N), Chlorine (Cl), bulk density (BD)
Similar raw material	Chemically untreated residues from particle and fibre board industry


CLASS A	Example
A3	Garden wood waste
	
Detailed description	Garden wood waste at recycling centre
Classification	Class A – Biofuel
Chemical treatment	Chemically untreated wood
Impurities	Can include soil and sand
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.1.7 – Wood from gardens, parks, roadside maintenance, vineyards and fruit orchards
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), Nitrogen (N), Chlorine (Cl), bulk density (BD)
Similar raw material	Wood from parks, roadside maintenance, fruit orchards, vineyards


CLASS A	Example
A4	Landscape maintenance wood residues
	
Detailed description	Bushes and trees harvested from road side
Classification	Luokka B – Biofuel
Chemical treatment	Chemically untreated wood
Impurities	Can include soil and sand
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.1.7 – Wood from gardens, parks, roadside maintenance, vineyards and fruit orchards
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), Nitrogen (N), Chlorine (Cl), bulk density (BD)
Similar raw material	Garden waste, wood from parks, vineyards and fruit orchards


CLASS A	Example	
A5	Unpainted and chemically untreated used wood from building and timber industry	
	 <p>Pallets and construction wood before chipping; photo: BMLFUW/UBA/Gröger</p>	
Detailed description	Source separated, unpainted and chemically untreated used wood from building and timber industry and contains metal parts,	
Classification	Class A – Biofuel	
Chemical treatment	Chemically untreated wood	
Impurities	Metal parts	
Traded form	Sold and traded as hog fuel e.g. to district heating stations	
Origin according to prEN 14961	1.3.1.1 – Chemically untreated wood, without bark	
Normative properties, prEN 14961-1	prEN 14961-1, classes: P100 M10 A1.0	prEN 14961, table 6: Dimensions: <100 mm Moisture: ≤ 10 w-% Ash (of dry matter): ≤ 1,0 w-%
Informative and other properties	Net calorific value: Q 19,1 MJ/kg for dry matter	
Other comments		

CLASS A	Example	
A6	Packaging material, e.g. fruit boxes before chipping	
	 <p data-bbox="502 956 882 987">photo: BMLFUW/UBA/Gröger</p>	
Detailed description	Source separated, unpainted packaging material, contains metal parts	
Classification	Class A - Biofuel	
Chemical treatment	Chemically untreated wood	
Impurities	Includes metal parts	
Traded form	Sold and traded as hog fuel e.g. to district heating stations	
Origin according to prEN 14961-1	1.3.1.1 Chemically untreated used wood, without bark	
Normative properties, prEN 14961-1	prEN 14961-1, classes: P100, M10 A1,5	prEN 14961-1 Dimensions: <100 mm Moisture: ≤ 10 w-% Ash (of dry matter): ≤ 1,5 w-%
Informative and other properties	Net calorific value: Q 18,61 MJ/kg for dry matter	
Similar raw material	unpainted pallets	


CLASS B	Example
B1	Plywood residue for ply wood mill
	
Detailed description	Wood residues from ply wood industry, includes glued or coated wood, which is crushed at mill
Classification	Class B – Biofuel
Chemical treatment	Glued by urea-formaldehyde, phenol-formaldehyde- or melamine-urea-phenol-formaldehyde (not include organic halogenated compounds or heavy metals)
Impurities	Can include snow if storages outdoors, Note: Sodium (Na) and potassium (K) content can be high.
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.2.1 Chemically untreated wood residues (without bark)
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Similar raw material	Briquette from ply wood residue

CLASS B	Example
B2	Plywood briquette
	
Detailed description	Briquette produced from crushed plywood residue
Classification	Class B – Biofuel
Chemical treatment	Glued by urea-formaldehyde, phenol-formaldehyde- or melamine-urea-phenol-formaldehyde (not include organic halogenated compounds or heavy metals)
Impurities	Chemicals in glue
Traded form	Briquette (not suitable for small-scale installations)
Origin according to EN 14961 - 1	1.2.1 Chemically untreated wood residues (without bark)
Normative properties	EN 14961-1, diameter (D), length (L), moisture (M), ash (A), particle density (DE), additives, nitrogen (N), sulphur (S), Chlorined (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q),, mechanical durability (DU) Note: N and K content can be high.
Similar raw material	Hog fuel from ply wood industry


CLASS B	Example
B3	Particle board residue from furniture industry
	
Detailed description	Coated particle board industry residues
Classification	Class B – Biofuel
Chemical treatment	Glued by urea-formaldehyde, phenol-formaldehyde- or melamine-urea-phenol-formaldehyde or isocyanate (not include organic halogenated compounds or heavy metals).Melaminecoating board includes titanium dioxide. Glue, laminate and coating material include nitrogen content.
Impurities	Can include metal parts and different kind of covering material
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Other information	If coating material or glue is not know and there is a reason to suspect that wood can include e.g. chlorine or heavy metals more than virgin wood this should be reclassified under class C – solid recovered fuel and incinerated according Waste Incineration Directive.


CLASS B	Example
B4	Rejected furniture and parts of furniture
	
Detailed description	Rejected products or parts of furniture
Classification	Class B – Biofuel
Chemical treatment	Painted or covered with lacquer
Impurities	Include metal parts and paint or lacquer
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Other information	If coating material or paint is not know and there is a reason to suspect that wood can include e.g. chlorine or heavy metals more than virgin wood this should be reclassified under class C – solid recovered fuel and incinerated according Waste Incineration Directive.


CLASS B	Example
B5	Wood residues from furniture industry
	
Detailed description	Wood residues (plywood and unpainted wood) from furniture industry
Classification	Class B – Biofuel
Chemical treatment	Glue
Impurities	Resins
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Other information	Can include small amount of glue.


CLASS B	Example
B6	MDF-pellet
	
Detailed description	Pellet produced from MDF
Classification	Class B – Biofuel
Chemical treatment	Glue
Impurities	Resins like urea-formaldehyde, phenol-formaldehyde- or melamine-urea-phenol-formaldehyde or isocyanate (not include organic halogenated compounds or heavy metals). Amount of glue about 10 w-%.
Traded form	Pellet
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (D), moisture (M), ash (A), mechanical durability (DU), amount of fines (F), additives, bulk density (BD), net calorific value as received (Q), sulphur (S), nitrogen (N), chlorine (Cl)
Informative and other properties	–
Similar products	MDF-residue


CLASS B	Example
B7	MDF residue
	
Detailed description	Uncoated MDF residue e.g. from furniture industry
Classification	Class B – Biofuel
Chemical treatment	Glue (resin)
Impurities	Resins like urea-formaldehyde, phenol-formaldehyde- or melamine-urea-phenol-formaldehyde or isocyanate (not include organic halogenated compounds or heavy metals). Amount of glue about 10 w-%.
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Similar products	MDF pellet


CLASS	Example	
B8	Medium Density Fibre (MDF) powder	
		
Detailed description	Fuel powder after milling	
Classification	Class B - Biofuel	
Chemical treatment	Chemically treated wood (see also B6, B7)	
Origin according to prEN 14961-1	1.3.2.1 - Chemically treated wood without bark	
Traded form	Sold as powder	
Normative properties, prEN 14961	prEN 1496-1, classes: Table 14 M10 A0.7 N3	Dimensions: < 1 mm Moisture: 6.78 w-% Ash (of dry matter) : 0.54 w-% Nitrogen : 2.37 w-%
Informative and other properties	Q 16.95MJ/kg	The net calorific value is calculated according to CEN/TS 15234, Annex E using the typical value of 18.5 MJ/kg for dry matter and the moisture content 0.5 w-%
Similar products	MDF pellets and MDF residues	


CLASS B	Example
B9	Pallet
	
Detailed description	Pallets, which can include chemically untreated wood and/or chemically treated wood.
Classification	Class B – Biofuel
Recycling	The priority is to recycle pallets. Same pallet can be used for 10 years.
Chemical treatment	Mainly untreated wood, but include pieces of plywood, particle board or metal parts
Impurities	Include nails and can include small amounts of paints for marking purposes. Nails should be removed during crushing. Note that pallet can be unclean and contaminated by a product on it.
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Similar products	Wood packages


CLASS B	Example
B10	Pallet made from particle board
	
Detailed description	Pallet made from particle board and wood
Classification	Class B – Biofuel
Chemical treatment	Glued by urea-formaldehyde, phenol-formaldehyde- or melamine-urea-phenol-formaldehyde or isocyanate (not include organic halogenated compounds or heavy metals).
Impurities	Nails
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Similar products	Pallets made from plywood and wood. Glue in plywood includes more sodium (Na) and potassium (K) (see example B1).


CLASS B	Example
B11	Used cable reel
	
Detailed description	Cable reel, which is made from untreated wood
Classification	Class B – Biofuel
Chemical treatment	Can be treated by wood wood protective liquid, which do not include organic halogenated compounds of heavy metals
Impurities	Can include small amounts of paint for marking and nails which should be removed during crushing
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Other information	Cable reel is recycling usually for 10 years.


CLASS B	Example
B12	Cable reel made from untreated wood and paper board
	
Detailed description	Cable reel made from wood and/or plywood and paper board.
Classification	Class B – Biofuel
Chemical treatment	Glue in plywood (see example B1)
Impurities	Can include small amount of paint for marking and paper, and metal parts
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Other information	Metal parts should be removed during crushing.


CLASS B	Example
B13	Mould frame for cast concrete
	
Detailed description	Coated plywood used as cast mould in construction
Classification	Class B – Biofuel
Chemical treatment	Glue (see B1) and coating
Impurities	Can include small amount of concrete
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Other information	


CLASS B	Example
B14	Wood residue from construction
	
Detailed description	Source-separated construction wood
Classification	Class B – Biofuel
Chemical treatment	Plywood includes glue (see B1)
Impurities	Can include small amounts of concrete and nails
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Other information	

CLASS B	Example
B15	Source-separated used wood at recycling centre
	
Detailed description	Separated wood residues which consist mainly pallet and garden wood waste.
Classification	Class B – Biofuel
Chemical treatment	Mainly chemically untreated wood, but can include wood which have coating or painting or glue
Impurities	Nails, other metal parts, coating and glue
Traded form	Hog fuel
Origin according to EN 14961 - 1	1.3.2.1 – Chemically treated used wood without bark
Normative properties	EN 14961-1, particle size (P), moisture (M), Ash (A), Nitrogen (N), Chlorine (Cl)
Informative and other properties	EN 14961-1 Net calorific value as received (Q), bulk density (BD)
Other information	If coating material or paint is not know and there is reason to suspect that wood can include e.g. chlorine or heavy metals more than virgin wood this should be reclassified under class C – solid recovered fuel and incinerated according Waste Incineration Directive.

CLASS C	Example
C1	Window frames, doors and other demolition wood
	
Detailed description	Window frames, doors etc. demolition wood which is source separated
Classification	Class C – Solid recovered fuel
Chemical treatment	Painting
Impurities	Pain, coating, metal parts and glass. Can also include small amounts of plastics and demolition wood.
Traded form	Solid recovered wood (REF, SRF)
Origin according to EN 14961 - 1	Not under EN 14961
Normative properties	Use standard CEN/TS 15359 and state net calorific value as received (Q), chlorine (Cl), mercury, (Hg) according classe 1–5
Informative and other properties	see previous row
Other information	All demolition wood should be stated according this example

CLASS C	Example
C2	Demolition wood
	
Detailed description	Hog fuel made from demolition wood
Classification	Class C – Solid recovered wood
Chemical treatment	Painting, coating etc.
Impurities	Paint, coating, metal parts. Can also include plastics. Can include halogenated organic compounds. Difficult to verify the origin of the material.
Traded form	Solid recovered wood (REF, SRF)
Origin according to EN 14961 - 1	Not under EN 14961
Normative properties	Use standard CEN/TS 15359 and state net calorific value as received (Q), chlorine (Cl), mercury, (Hg) according classe 1–5
Informative and other properties	see previous row
Other information	Do not include preservatives

CLASS C	Example
C3	Refuse from a joinery after chipping and pressing
	
Detailed description	The refuse from joinery is a conglomerate of different wood source, chemically treated and untreated. They were chipped and pressed at the joinery and fired in industrial approved heating plants.
Classification	Class C – Solid recovered fuel
Suitability	Fuels in waste incineration plants or as Solid Recovered Fuel (SRF)
Chemical treatment	Chemically treated wood could contain halogenated organic compounds (for example PVC) or preservatives
Traded form	Hog fuel or pressed to briquettes
Origin according to prEN 14961-1	Not under EN 14961, use standard CEN/TS 15359 and state net calorific value as received (Q), chlorine (Cl), mercury, (Hg) according classes 1–5. Dimensions, <math>D < 100\text{ mm}</math>, moisture $\leq 10\text{ w-%}</math>, ash (of dry matter): \leq 1,5\text{ w-%}</math> and net calorific value: Q 18,6 MJ/kg for dry matter.$
Other comments	

CLASS D	Example
D1	Preservative-treated wood
	
Detailed description	Source-separated preservative treated wood
Classification	Class D – Hazardous waste
Chemical treatment	CCA preservative-treated wood includes chromium, copper and arsenic and should be incinerated as hazardous waste. Can also include chlorine, fluorine, iodine (halogens) or zinc, boron and phosphorus.
Impurities	Chemical and nails and other metal parts.
Traded form	–
Origin according to EN 14961 - 1	Out of the scope of EN 14961
Normative properties	EN 14961 can not be used
Informative and other properties	EN 14961 can not be used
Other information	All preservative-treated wood waste e.g. transmission line poles