**P. JEVIČ, DSc.**
Research Institute of Agricultural Engineering (VÚZT), Kiev (Ukraine)
**J. MALAŤÁK, DSc.**
Czech University of Agriculture (ČZU), Praha (Czech Republic)
**V.O. DUBROVIN, DSc.**
National Agricultural University of Ukraine (NAUU), Kiev (Ukraine)

# QUALITY AND SPECIFICATION OF SOLID BIOFUELS IN EUROPE

*Summary*

*Ukraine has rather big potential of biomass available for energy production. Biomass (excluding the share that is used by other sectors of economy) can cover up to 9% of the total primary energy demand. Technologies of biomass utilization are mostly at the beginning of their development in Ukraine, but they have good prospects for commercialization in the near future.*

*The quality classification is interesting for both small and big consumers. The quality classification is focused to the most important commercial biofuels as briquettes, pellets, wood chips, crushed wooden fuel, wooden logs, sawdust, bark, straw bales. That classification is flexible and thus manufacturer or customer can choose any properties class corresponding with produced or required fuel quality. That free classification does not bind mutually different properties of individual fuels. Its advantage is in fact that manufacturer and customer can agree with a certain characteristics for each simple case. In the paper are presented European examples of specification of properties for briquettes, pellets, straw bales and for classes of high-quality solid biofuels for household. Development of bioenergy technologies would reduce Ukraine dependence on imported energy carriers, enhance its energy security at the expense of organizing energy supply based on local renewable sources, create a lot of new jobs (mostly in rural area), contribute greatly to the improvement of ecological situation.*

## Introduction

Total energy potential of biomass in Ukraine is estimated as 9% of the total primary energy consumption. The most promising technologies are direct combustion of biomass for heat production, production of biogas from manure on large farms, extraction and utilization of landfill gas, co-combustion of biomass and fossil fuel for power production. Technologies of direct combustion of wood, first of all for heat and process steam production, require prior development in Ukraine. It is due to rather low electricity price existing in Ukraine (0.03 $/kWh) and the same time quite high heat and fuel price. Implementation of small-scale power plants and CHP plants operating on solid biomass (wood, straw and husk) will be profitable if electricity price rises significantly or in the case of subsidies. Heat production from biomass is profitable now even with the use of foreign equipment. Besides, Ukraine has opportunity to launch its own production of wood and straw fired boilers.

Technologies of straw combustion are very promising for Ukraine as well. To implement them widely it is necessary to solve a number of problems connected with arrangements on collection, baling, transportation and storage of straw. First of all 0.1-1 MW farm and neighbor heating boilers for implementation at agricultural enterprises has the best prospects. After demonstration of their advantages large-scale district heating plants also have good opportunities for commercialization. As for 1-10 $MW_e$ biomass-based CHP plants, we restrict their position in the conception of bioenergy development in Ukraine only by two demonstrational plants (one wood-based and one straw-based) until electricity price rises greatly.

The basic aim of specification of solid biofuels classification is to promote the trade of biofuels, so that the customer and the seller can unanimously define the quality [1, 2, 3]. Solid biofuels are fuel produced directly or indirectly from biomass. Among basic biomass resources which are defined as a material of biological origin excluding material embedded in geological formations and transformed to fossil belong:

- products from agriculture and forestry,
- vegetable waste from agriculture and forestry,
- vegetable waste from the food processing industry,
- wood waste, with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coating, and which includes in particular such wood waste from construction- and demolition waste,
- cork waste,
- fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and heat generated is recovered.

## Classification of origin and sources of solid biofuels

The classification is based on the biofuel origin and source. In the hierarchical classification system (Table 1) the main origin-based solid biofuel groups are [5]:

- woody biomass;
- herbaceous biomass;
- fruit biomass;
- blends and mixtures.

Woody biomass is biomass from trees, bushes and shrubs. Herbaceous biomass is from plants that have a non-woody stem and which die back at the end of the growing season. Fruit biomass is the biomass from the parts of a plant which hold seeds. The term “Blends and mixtures” in Table 1 refers to material of various origin within the given box in the classification table and appears on four levels. Blends are intentionally mixed biofuels, whereas mixtures are unintentionally mixed biofuels. The origin of the mixture or blend has to be described using Table 1. If solid biofuel blend or mixture may contain chemically treated material it has to be stated. A blend or a mixture of e.g. chemically treated wood and chemically untreated wood has to be

classified as chemically treated wood.

The second level of classification in Table 1 describes fuels from different sources within the main groups, primarily stating whether the biomass is a by-product or a residue from the industry or if it is virgin material.

Groups in Table 1 are further divided into third and fourth level sub-groups.

The purpose of Table 1 is to allow the possibility to differentiate and specify biofuel material based on origin with as much detail as needed.

Table 1. Classification of origin and sources of solid biofuels [5]

| | | | |
|---|---|---|---|
| 1. Woody biomass | 1.1 Forest and plantation wood | 1.1.1 Whole trees | 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 Stemwood | 1.1.2.1 Deciduous |
| | | | 1.1.2.2 Coniferous |
| | | | 1.1.2.3 Blends and mixtures |
| | | 1.1.3 Logging residues | 1.1.3.1 Fresh/Green (including leaves/needles) |
| | | | 1.1.3.2 Stored |
| | | | 1.1.3.3 Blends and mixtures |
| | | 1.1.4 Stumps | 1.1.4.1 Deciduous |
| | | | 1.1.4.2 Coniferous |
| | | | 1.1.4.3 Short rotation coppice |
| | | | 1.1.4.4 Bushes |
| | | | 1.1.4.5 Blends and mixtures |
| | | 1.1.5 Bark (from forestry operations) | |
| | | 1.1.6 Landscape management woody biomass | |
| | 1.2 Wood processing industry, by-products and residues | 1.2.1 Chemically untreated wood residues | 1.2.1.1 Without bark |
| | | | 1.2.1.2 With bark |
| | | | 1.2.1.3 Bark (from industry operations) |
| | | | 1.2.1.4 Blends and mixtures |
| | | 1.2.2 Chemically treated wood residues | 1.2.2.1 Without bark |
| | | | 1.2.2.2 With bark |
| | | | 1.2.2.3 Bark (from industry operations) |
| | | | 1.2.2.4 Blends and mixtures |
| | | 1.2.3 Fibrous waste from the pulp and paper industry | 1.2.3.1 Chemically untreated fibrous waste |
| | | | 1.2.3.2 Chemically treated fibrous waste |
| | 1.3 Used wood | 1.3.1 Chemically untreated wood | 1.3.1.1 Without bark |
| | | | 1.3.1.2 Bark |
| | | | 1.3.1.3 Blends and mixtures |
| | | 1.3.2 Chemically treated wood | 1.3.2.1 Without bark |
| | | | 1.3.2.2 Bark |
| | | | 1.3.2.3 Blends and mixtures |
| | 1.4 Blends and mixtures | | |
| 2. Herbaceous biomass | 2.1 Agriculture and Horticulture herb | 2.1.1 Cereal crops | 2.1.1.1 Whole plant |
| | | | 2.1.1.2 Straw parts |
| | | | 2.1.1.3 Grains or seeds |
| | | | 2.1.1.4 Husks or shells |
| | | | 2.1.1.5 Blends and mixtures |
| | | 2.1.2 Grasses | 2.1.2.1 Whole plant |
| | | | 2.1.2.2 Straw parts |
| | | | 2.1.2.3 Seeds |
| | | | 2.1.2.4 Shells |
| | | | 2.1.2.5 Blends and mixtures |
| | | 2.1.3 Oil seed crops | 2.1.3.1 Whole plant |
| | | | 2.1.3.2 Stalks and leaves |
| | | | 2.1.3.3 Seeds |

Table 1 (*continued*)

| | | | |
|---|---|---|---|
| | | | 2.1.3.4 Husks or shells |
| | | | 2.1.3.5 Blends and mixtures |
| | | 2.1.4 Root crops | 2.1.4.1 Whole plant |
| | | | 2.1.4.2 Stalks and leaves |
| | | | 2.1.4.3 Root |
| | | | 2.1.4.4 Blends and mixtures |
| | | 2.1.5 Legume crops | 2.1.5.1 Whole plant |
| | | | 2.1.5.2 Stalks and leaves |
| | | | 2.1.5.3 Fruit |
| | | | 2.1.5.4 Pods |
| | | | 2.1.5.5 Blends and mixtures |
| | | 2.1.6 Flowers | 2.1.6.1 Whole plant |
| | | | 2.1.6.2 Stalks and leaves |
| | | | 2.1.6.3 Seeds |
| | | | 2.1.6.4 Blends and mixtures |
| | | 2.1.7 Landscape management herbaceous biomass | |
| | 2.2 Herb processing industry, by-products and residues | 2.2.1 Chemically untreated herb residues | 2.2.1.1 Cereal crops and grasses |
| | | | 2.2.1.2 Oil seed crops |
| | | | 2.2.1.3 Root crops |
| | | | 2.2.1.4 Legume crops and flowers |
| | | | 2.2.1.5 Blends and mixtures |
| | | 2.2.2 Chemically treated herb residues | 2.2.2.1 Cereal crops and grasses |
| | | | 2.2.2.2 Oil seed crops |
| | | | 2.2.2.3 Root crops |
| | | | 2.2.2.4 Legume crops and flowers |
| | | | 2.2.2.5 Blends and mixtures |
| | 2.3 Blends and mixtures | | |

**Specification of solid biofuels based on traded forms and properties**

Solid biofuels are traded in many different sizes and shapes. The size and shape influence the handling of the fuel as well as its combustion properties. Biofuels may be delivered for example in the forms shown in Table 2.

At the standardized symbols:
d dry (dry basis),
daf dry, ash-free,
ar as received,
A designation for ash content (w-%, dry basis),
$\rho$ density [kg/m$^3$],
BD designation for bulk density,
DE designation for particle density as received [kg/dm$^3$],
D designation for diameter,
DU designation for mechanical durability,
$E_{ar}$ energy density as received [MWh/m$^3$ loose, solid or stacked volume (amount of energy/volume unit)],
E designation for energy density as received [kWh/m$^3$ or kWh/kg, unit is to be stated in brackets],
F designation for amount of fines (< 3,15 mm, w-%),
L designation for length,
$M_{ar}$ total moisture content as received [w-%] on wet basis,
M designation for moisture content as received,
P designation for particle size distribution,
$q_{V,gr}$ gross calorific value [MJ/kg] at constant volume,
$q_{p,net}$ net calorific value [MJ/kg] at constant pressure.

Examples of various forms and differences of solid biofuels present Fig. 1 and 2.

Fig. 1. Examples of various forms of solid biofuels

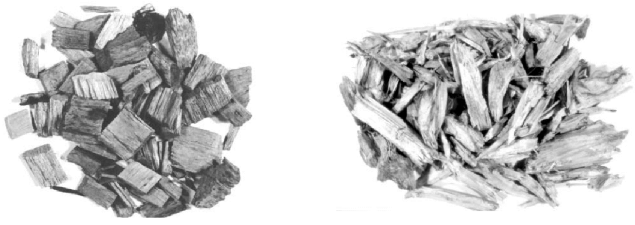


Fig. 2. Difference between wood chips (left) and crushed wood fuel (right) [5]

Table 2. Major traded forms of solid biofuels [5]

| Fuel name | Typical particle size | Common preparation method |
|---|---|---|
| Briquettes | Ø > 25 mm | Mechanical compression |
| Pellets | Ø < 25 mm | Mechanical compression |
| Fuel powder | < 1 mm | Milling |
| Sawdust | 1 mm to 5 mm | Cutting with sharp tools |
| Wood chips | 5 mm to 100 mm | Cutting with sharp tools |
| Hog fuel | Varying | Crushing with blunt tools |
| Logs | 100 mm to 1000 mm | Cutting with sharp tools |
| Whole wood | > 500 mm | Cutting with sharp tools |
| Small straw bales<br>Big straw bales<br>Round straw bales | 0,1 $m^3$<br>3,7 $m^3$<br>2,1 $m^3$ | Compressed and bound to squares<br>Compressed and bound to squares<br>Compressed and bound to cylinders |
| Bundle | Varying | Lengthways oriented & bound |
| Bark | Varying | Debarking residue from trees Can be shredded or un-shredded |
| Chopped straw | 10 mm to 200 mm | Chopped during harvesting |
| Grain or seed | Varying | No preparation or drying |
| Shells and fruit stones | 5 mm to 15 mm | No preparation |
| Fibre cake | Varying | Prepared from fibrous waste by dewatering |

NOTE: Also other forms may be used.

Presents on example of the specification of properties for briquettes Table 3, pellets Table 4, straw bales Table 5.

Table 3. Specification of properties for briquettes [5]

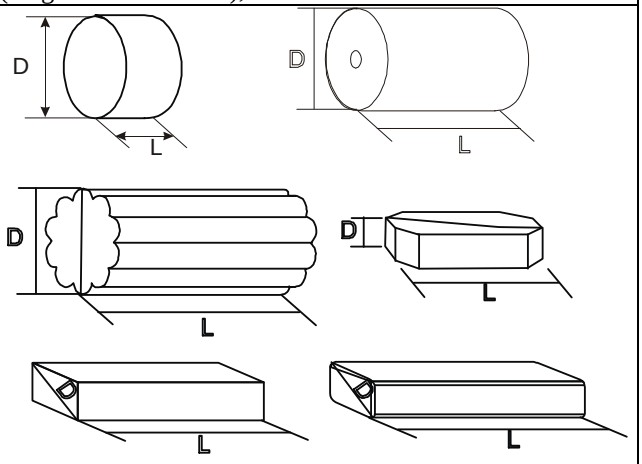
| | | | |
|---|---|---|---|
| | Master table | | |
| | Origin:<br>According to Table 1 | | Woody biomass (1)<br>Herbaceous biomass (2)<br>Blends and mixtures (4) |
| | Traded Form (see Table 2) | | Briquette |
| Normative | Dimensions (mm) Diameter (D) or equivalent (diagonal or cross cut), mm | | |
| | D40 | 25 ≤ D ≤ 40 |  Examples of briquettes |
| | D50 | ≤ 50 | |
| | D60 | ≤ 60 | |
| | D80 | ≤ 80 | |
| | D100 | ≤ 100 | |
| | D125 | ≤ 125 | |
| | D125+ | ≥ 125 actual value to be stated | |
| | | Length (L) | |
| | L50 | ≤ 50 | |
| | L100 | ≤ 100 | |
| | L200 | ≤ 200 | |
| | L300 | ≤ 300 | |
| | L400 | ≤ 400 | |
| | L400+ | ≥ 400 actual value to be stated | |
| | Moisture (w-% as received) | | |
| | M10 | ≤ 10 % | |
| | M15 | ≤ 15 % | |
| | M20 | ≤ 20 % | |
| | Ash (w-% of dry basis) | | |
| | A0.7 | ≤ 0,7 % | |
| | A1.5 | ≤ 1,5 % | |
| | A3.0 | ≤ 3,0 % | |
| | A6.0 | ≤ 6,0 % | |
| | A10.0 | ≤10,0 % | |

Table 3 (*continued*)

| | | | |
|---|---|---|---|
| | Sulphur (w-% of dry basis) | | |
| | S0.05 | ≤ 0,05 % | Sulphur is normative only for chemically treated biomass or if sulphur containing additives have been used |
| | S0.08 | ≤ 0,08 % | |
| | S0.10 | ≤ 0,10 % | |
| | S0.20 | ≤ 0,20 % | |
| | S0.20+ | > 0,20 % (actual value to be stated) | |
| | Particle density (kg/dm$^3$) | | |
| | DE0.8 | 0,80 to 0,99 | |
| | DE1.0 | 1,00 to 1,09 | |
| | DE1.1 | 1,10 to 1,19 | |
| | DE1.2 | ≥ 1,20 | |
| | Additives (w-% of pressing mass) | | |
| | Type and content of pressing aids, slagging inhibitors or any other additives have to be stated | | |
| | Nitrogen, N (w-% of dry basis) | | |
| | N0.3 | ≤ 0,3 % | Nitrogen is normative only for chemically treated biomass |
| | N0.5 | ≤ 0,5 % | |
| | N1.0 | ≤ 1,0 % | |
| | N3.0 | ≤ 3,0 % | |
| | N3.0+ | >3,0 % (actual value to be stated) | |
| Informative | Net calorific value, $q_{p,net,ar}$ (MJ/kg as received) or energy density, $E_{ar}$ (kWh/m$^3$ loose) | | Recommended to be stated at the retail level |
| | Bulk density as received (kg/m$^3$ loose) | | Recommended to be stated if traded by volume basis |
| | Chlorine, Cl (w-% of dry basis, %) | | Recommended categories<br>Cl 0.03, Cl 0.07, Cl 0.10 and Cl 0.10+ (if Cl > 0,10 % the actual value to be stated) |

Table 4. Specification of properties for pellets [5]

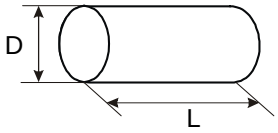
| | | | |
|---|---|---|---|
| | Master table | | |
| | Origin:<br>According to Table 1 | | Woody biomass (1),<br>Herbaceous biomass (2),<br>Fruit biomass (3),<br>Blends and mixtures (4) |
| | Traded Form (see Table 2) | | Pellets |
| Normative | Dimensions (mm) | |  |
| | Diameter (D) and Length (L) [a] | | |
| | D06 | ≤ 6 mm ± 0,5 mm and L ≤ 5 x Diameter | |
| | D08 | ≤ 8 mm ± 0,5 mm, and L ≤ 4 x Diameter | |
| | D10 | ≤ 10 mm ± 0,5 mm, and L ≤ 4 x Diameter | |
| | D12 | ≤ 12 mm ± 1,0 mm, and L ≤ 4 x Diameter | |
| | D25 | ≤ 25 mm ± 1,0 mm, and L ≤ 4 x Diameter | |
| | Moisture (w-% as received) | | |
| | M10 | ≤ 10 % | |
| | M15 | ≤ 15 % | |
| | M20 | ≤ 20 % | |
| | Ash (w-% of dry basis) | | |
| | A0.7 | ≤ 0,7% | |
| | A1.5 | ≤ 1,5 % | |
| | A3.0 | ≤ 3,0 % | |
| | A6.0 | ≤ 6,0 % | |
| | A6.0+ | > 6,0 % (actual value to be stated) | |

Table 4 (*continued*)

| | | | |
|---|---|---|---|
| | Sulphur (w-% of dry basis) | | |
| | S0.05 | ≤ 0,05 % | Sulphur is normative only for chemically treated biomass and if sulphur containing additives has been used |
| | S0.08 | ≤ 0,08 % | |
| | S0.10 | ≤ 0,10 % | |
| | S0.20+ | > 0,20 % (actual value to be stated) | |
| | Mechanical durability [a] (w-% of pellets after testing ) | | |
| | DU97.5 | ≥ 97,5 % | |
| | DU95.0 | ≥ 95,0 % | |
| | DU90.0 | ≥ 90,0 % | |
| | Amount of fines (w-%, < 3,15 mm) after production at factory gate | | |
| | F1.0 | ≤ 1,0 % | [a] At the last possible place in the production site |
| | F2.0 | ≤ 2,0 % | |
| | F2.0+ | > 2,0 % (actual value to be stated) | |
| | Additives (w-% of pressing mass) | | |
| | Type and content of pressing aids, slagging inhibitors or any other additives have to be stated | | |
| | Nitrogen, N (w-% of dry basis) | | |
| | N0.3 | ≤ 0,3 % | Nitrogen is normative only for chemically treated biomass |
| | N0.5 | ≤ 0,5 % | |
| | N1.0 | ≤ 1,0 % | |
| | N3.0 | ≤ 3,0 % | |
| | N3.0+ | > 3,0 % (actual value to be stated) | |
| Informative | Net calorific value, $q_{p,net,ar}$ (MJ/kg as received) or energy density, $E_{ar}$ (kWh/ m$^3$ loose) | | Recommended to be informed by retailer. |
| | Bulk density as received (kg/m$^3$ loose) | | Recommended to be stated if traded by volume basis |
| | Chlorine, Cl (weight of dry basis, w-%) | | Recommended to be stated as a category Cl 0.03, Cl 0.07, Cl 0.10 and Cl 0.10+ (if Cl > 0,10 % the actual value to be stated) |
| [a] Maximum 20 w-% of the pellets may have a length of 7,5 x Diameter. | | | |

Table 5. Specification of properties for straw bales [5]

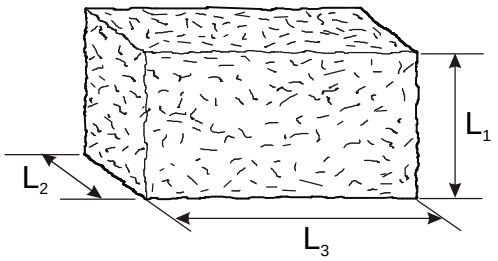
| | | | | |
|---|---|---|---|---|
| | Master table | | | |
| | Origin:<br>According to Table 1. | | 2.1.1.2 Cereal crop straw<br>2.1.2.2 Grass straw<br>2.1.3.2 Oil seed crops stalks and leaves | |
| | Traded Form | | Big Bale | |
| Normative | Dimensions (mm), height ($L_1$), width ($L_2$) and length ($L_3$)<br>  <br> | | | |
| | | Height ($L_1$) | Width ($L_2$) | Length ($L_3$) |
| | P1 | 1 300 | 1 200 | 2 200 |
| | P2 | 1 300 | 1 200 | 2 400 |
| | P3 | 600 to 900 | 1 200 | 2 400 |
| | P4 | 1 300 | 1 200 | 1 100 to 2 750 |
| | Bale density (kg/m$^3$) | | | |
| | BD130 | ≤ 135 | | |
| | BD150 | ≤ 150 | | |
| | BD165 | ≤ 165 | | |
| | BD165+ | > 165 | | |

Table 5 (*continued*)

| | | | |
|---|---|---|---|
| | Moisture (w-% as received) | | |
| | M16 | ≤ 16 % | No part over 23 % |
| | M16+ | ≤ 16 % | Parts over 23 % acceptable |
| | M23 | ≤ 23 % | no part over 30 % |
| | M23+ | ≤ 23 % | one or more parts over 30 % |
| | M30 | ≤ 30 % | no part over 35 % |
| | M30+ | ≤ 30 % | one or more parts over 35 % |
| | Ash (w-% of dry basis) | | |
| | A05 | ≤ 5 % | |
| | A10 | ≤ 10 % | |
| | A10+ | > 10 % | |
| | Species of biomass | | |
| | Has to be stated | | |
| Informative | Net calorific value, $q_{p,net,ar}$ (MJ/kg as received or energy density, $E_{ar}$ (kWh/m$^3$ loose) | | Recommended to be specified. |
| | Particle size distribution or structure | | It is recommended to declare production methods that influence the size of the straw particles. That is for instance whether the crop has been trashed by rotation or oscillation or whether it has been chopped. |

The following European examples are specifications for high quality classes of solid biofuels recommended for household usage. Household usage needs special considerations for the following reasons:
- Small-scale equipment does not usually have advanced control and gas cleaning
- Unprofessional management
- Often located in living and populated districts.

**A.1 Wood briquettes**

Origin: 1.2.1.1 Chemically untreated wood without bark (Table 1)
Moisture content: M10 (moisture ≤ 10 w-% as received)
Basic density: DE1.0 (particle density min. 1 to 1,09 kg/dm$^3$)
Dimensions: to be selected from Table 3
Ash content: A0.7 (≤ 0,7 w-% of dry basis)
Additives: < 2 w-% of dry basis. Only products from the primarily agricultural and forest biomass that are not chemically modified are approved to be added as a pressing aids. Type and amount of additive has to be stated.
Net calorific value: E4.7 [kWh/kg] ($q_{p,net,ar}$ ≥ 4,7 kWh/kg = 16,9 MJ/kg)

**A.2 Wood pellets**

Origin: 1.2.1.1 Chemically untreated wood without bark
Moisture content: M10 (moisture ≤ 10 w-% as received)
Mechanical durability: DU97.5 (97,5 w-% of a pellet batch of 100 g shall be uncrushed after testing)
Amount of fines: F1.0 or F2.0 (percentage of fines among pellets sieved through > 3.15 mm sieve shall not exceed 1 or 2 w-% at factory gate)
Dimensions: D06 or D08 (pellet diameter 6 mm ± 0.5 mm and length <5 x diameter or diameter 8 ± 0.5 mm, and length <4 x diameter, max. 20% of the pellets may have a length of 7.5 x diameter)
Ash content: A0.7 (< 0.7 w-% of dry matter)
Sulphur content: S0.05 (<0,05 w-% of dry matter)
Additives: < 2 w-% of pressing mass. Only products from the primarily agricultural and forest biomass that are not chemically modified are approved to be added as a pressing aids. Type and amount of additive has to be stated.
Energy density: E4.7 [kWh/kg] ($q_{p,net,ar}$ ≥ 4,7 kWh/kg = 16,9 MJ/kg)

**A.3 Wood chips**

Origin: 1.1.2 Stem wood (Table 1)
Moisture content: M20 or M30
Dimensions: P16, P45 or P63
Energy density: E0.9 [kWh/loose m$^3$] ($E_{ar}$ ≥ 900 kWh/loose m$^3$)

**A.4 Log wood** (oven-ready) [5]

Origin: 1.1.2 Stem wood (Table 1)
Moisture content: M20 (moisture ≤ 20 w-% as received)

| | |
|---|---|
| Dimensions: | P200, P250, P500 or P1000 (length [L] and thickness [D] (maximum diameter of a single chop: L < 200 mm and D < 20 ignition wood, L = 250 mm ± 20 mm and 40 mm ≤ D ≤ 150 mm, L = 500 mm ± 40 mm and 60 mm ≤ D ≤ 250 mm, L = 1 000 mm ± 50 mm and 60 mm ≤ D ≤ 350 mm) |
| Wood: | To be stated if coniferous or deciduous wood is used |
| Classification: | No significant amount of mould or decay seen, the cut-off surface of the logs are even and smooth. |
| Energy density: | For deciduous wood E1700 [kWh/stacked $m^3$] ($E_{ar} \geq 1\,700$ kWh/stacked $m^3$) or for coniferous or for mixture of deciduous and coniferous wood E1300 ($E_{ar} \geq 1\,300$ kWh/stacked $m^3$) |

Technologies of biomass utilization are mostly at the beginning of their development in Ukraine, but they have good prospects for commercialization in the near future [6].

## Conclusion

- The purpose of quality classification and specification of solid biofuels is to determinate their quality within whole supply chain from origin until the certificated solid biofuel delivery and to assure corresponding confidence to the qualitative requirements. This is a basis for market preparation and development with solid biofuels. Requirements for production will be met through assurance of quality and its control. Principle of the solid fuel quality assurance is based on its clearly defined determination and limited demands for product.

- Development of bioenergy technologies would reduce Ukraine dependence on imported energy carriers, enhance its energy security at the expense of organizing energy supply based on local renewable sources, create a lot of new jobs (mostly in rural area), contribute greatly to the improvement of ecological situation.

## References

[1] Alakangas, E.: The European pellets standardization. In. European pellets Conference 2004, O. Ö. Energiesparverband 2004, s. 47-54

[2] Hartmann, H.: Normen für Biomasse-Festbrennstoffe. Energie Pflanzen – Das Fachmagazin für nachwachsende Rohstoffe und erneuerbare Energien, 3/2005, s. 6-9

[3] Jevič, P.: Importance of biofuels standardization and present state in the Czech Republic. In. Situation and Trends in Agricultural Engineering – Renewable Energy in Agriculture. Institut für Agrartechnik Potsdam-Bornim, 1999, s. 119-124

[4] ČSN P CEN/TS 14588: Solid biofuels – Terminology, definitions and descriptions, 2005, s. 63

[5] ČSN CEN/TS 14961: Solid biofuels – Fuel specifications and classes, 2005, s. 48

[6] Дубровін В.О., Корчемний М.О., Масло І.П. та інші. „Біопалива". - Київ: ЦТІ „Енергетика і електрифікація", 2004-256с.