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Solid Biofuels Bulletin No. 6

GRADED WOOD CHIPS

This bulletin, sixth in a series of bulletins, introduces the different grades of wood chips, their appropriate use and the important parameters that can affect the fuel characteristics. It provides information on graded wood chips as specified in the CAN/CSA-ISO 17225 Solid Biofuels—Fuel specifications and classes—Part 4 Graded Wood Chips.

Wood chips have been widely used as fuel for space heating in buildings for several decades. As a locally available fuel with minimal processing, wood chips offer a less costly fuel option compared to wood briquettes or pellets.

Wood chips are typically produced by grinding or chipping operations followed by screening and air drying of the chips. Screening is necessary to produce the desired wood chip quality (particle size, ash and fines content).

Origins and Sources

The major sources for wood chips are by-products and residues from wood processing operations in the forest sector (slabs, bark or shavings). The highest quality wood chip sources tend to be from milling and manufacturing operations. According to the CAN/CSA-ISO 17225 Part 4 Standard[1], classification is based on origins and sources and provides for four different grades of wood chips. Grade A (A1 and A2) are high quality wood chips that are sourced primarily from stem wood (classification 1.1.3) and by-products and residues from milling (classification 1.2.1) and logging operations (classification 1.1.4). A1 grade wood chips are dried and contain lower ash and no or little bark. A2 grade contains slightly higher ash and/or moisture content.

Sources for Grade B1 wood chips include materials from tree trimmings, prunings and arboriculture operations in city parks (classification 1.1.7).

In addition to the sources that are used for Grades A and B1, sources for Grade B2 wood chips include chemically treated by-products and residues from wood processing facilities (classification 1.2.2) and chemically untreated used wood (classification 1.3.1). B2 grade wood chips do not contain heavy metals or halogenated organic compounds from wood preservatives or coatings. For further details on classification by the origin and sources, refer to Natural Resources Canada Solid Biofuels Bulletin No.2 – Primer for Solid Biofuels[2].

Hog fuel – coarse and varying in size wood chips

High grade wood chips (pulp chips)

Canada

Grade A classified wood chips are suitable for smaller bioenergy systems (assuming they meet the equipment's specifications) used in schools, public and commercial buildings. Larger bioenergy systems typical of industrial operations (such as sawmills, pulp mills, commercial greenhouses and large district energy systems) are able to use the lower quality Grade B1 and B2 wood chips.

Key Properties

While a number of different parameters are important for small-scale bioenergy systems, the most critical properties to consider when buying and using wood chips are moisture content (M), particle size (P), and ash content (A) (Tables 1 and 2)[2]. Bark content, extraneous material (stones, sand, and dirt) and contamination (such as glass, metal, plastics) lead to an increase in ash content causing higher equipment maintenance costs. Particle size specifies both the acceptable size range for the diameter and length of wood chips and the minimum allowable amounts of acceptable sized material (main fraction in weight %). Each grade of wood chips also defines specific limits for the amounts of both undersize (fine fraction) and oversize materials (coarse fraction). Fines are defined as particles less than 3.15 mm (less than 1/8 inch). Increased amount of fine and/or coarse fractions can have a significant impact on the fuel handling and operation (efficiency and emissions) of the bioenergy system.

It is highly recommended that the moisture, size and ash properties be tested on a regular basis to confirm contractual requirements for wood chips quality are met. This will also ensure that the biomass fuel is appropriate for efficient and economical operation of the heat or energy system.

It is possible to determine particle size using a sieve test. A hand-held moisture meter can be used to quickly measure moisture; however, an oven-dry analysis gives more accurate measurement and is preferred.

The standard test methods for determining moisture content and particle size distribution are provided in the CAN/CSA-ISO 18134-1 or -2 and CAN/CSA-ISO 17827-1, respectively. The detailed list of testing protocols is available in Natural Resources Canada Solid Biofuels No.3 – CAN/CSA-ISO Standards for Solid Biofuels.

Table 1. Key specifications of properties for graded wood chips based on CAN/CSA-ISO 17225 Part 4

Property Class	Unit	Grade A1	Grade A2	Grade B1	Grade B2
Moisture (M)	weight %	M10 ≤10 M25 ≤25	M35 ≤35	Maximum value to be stated	Maximum value to be stated
Ash (A)	weight %, dry	A1.0 ≤1.0	A1.5 ≤1.5	A3.0 ≤3.0	A3.0 ≤3.0

Table 2. Classification of particle sizes for graded wood chips based on CAN/CSA-ISO 17225 Part 4*

Particle Size (P)	Main Fraction (min. 60 % weight)	Fine Fraction weight %, (≤ 3.15 mm)	Coarse Fraction weight % (length of particle)	Max. Length of Particle
P16S	3.15 mm to 16 mm	≤ 15 %	≤ 6 % (>31.5 mm)	≤ 45 mm
P31S	3.15 mm to 31.5 mm	≤ 10 %	≤ 6 % (> 45 mm)	≤ 150 mm
P45S	3.15 mm to 45 mm	≤ 10 %	≤ 10 % (> 63 mm)	≤ 200 mm

* Test method for determining particle size is ISO 17827-1 or -2

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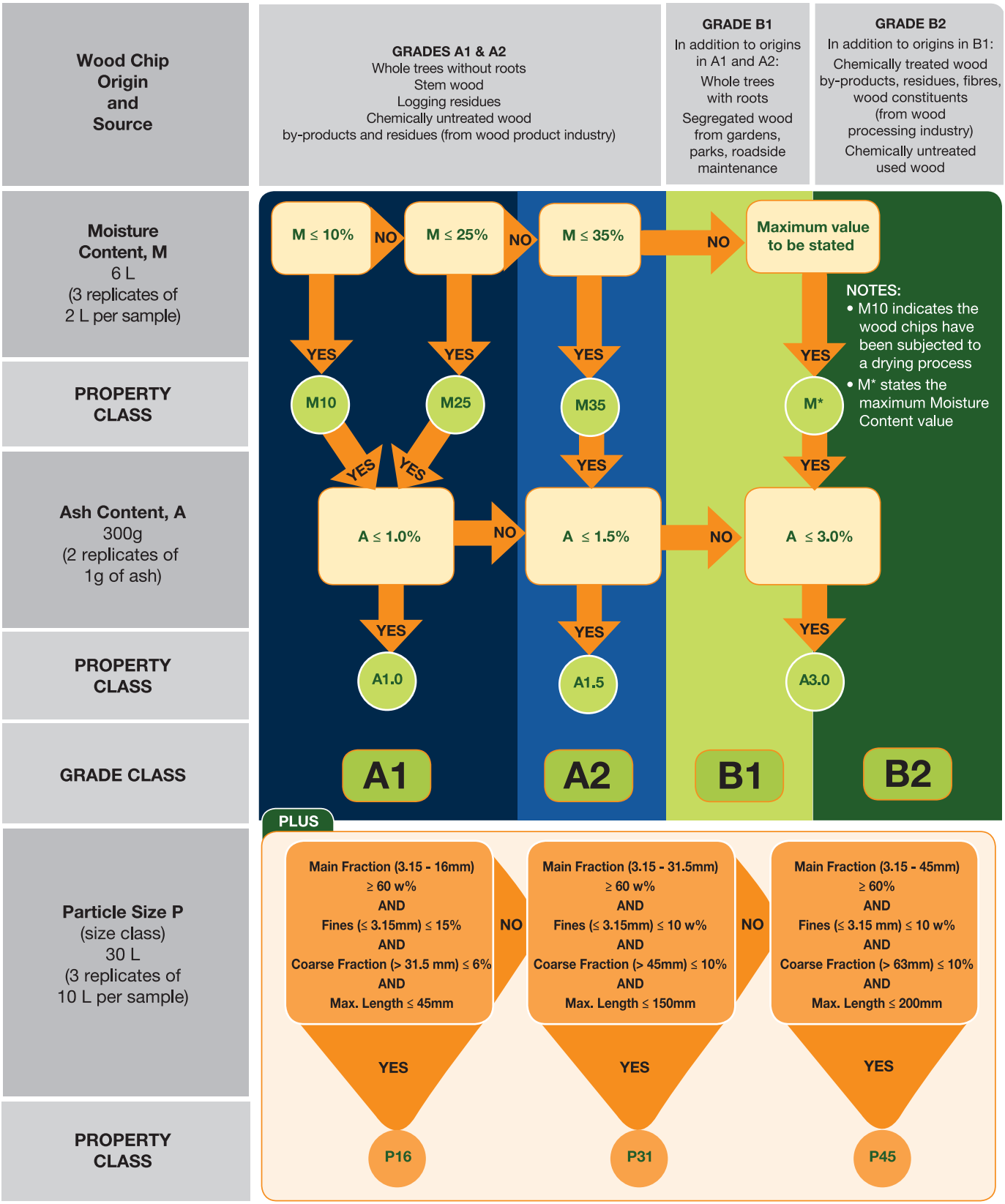

NOTES:
- This diagram highlights the most critical wood chip property classes. Other classes exists that were not included, such as: bulk density and chemical composition.
- A classification code may be generated using these classes, such as: A1-P16, B2-P31, etc.
- An appropriate wood chip sample amount should be separated from the wood chip lot (e.g., pile, chip van) for which the classification is done. The sample amount required for analysis depends on the attributes being tested, and indicated under each attribute title. For sample collection procedures, refer to ISO 17827-1 for Particle Size (P); ISO18134-1, ISO18134-2 for Moisture Content (M); and ISO 18122 for Ash Content (A).

Figure 1. Wood Chip Classification Diagram, prepared by FPInnovations based on the CAN/CSA-ISO 177225 Part 4: Graded Wood Chips.

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Figure 2. Covered storage for wood chip piles

Specifications of Properties for Graded Wood Chips

The use of common names (such as hog fuel, shavings) is neither quantitative nor sufficiently specific, and should not be used when developing biomass fuel supply agreements. CAN/CSA-ISO 17225 Part 4 provides measurable parameters for the sale of wood chips (Tables 1 and 2).[1] Current forestry by-products and residues commonly sold as wood chips may not meet grade specifications without further processing and may not be appropriate for a specific bioenergy application. Variability of wood chips should be minimized to ensure proper bioenergy system operation.

When sourcing wood chips, the nomenclature should include at minimum source class, particle size (P), moisture content (M) and ash content (A). For example, wood chips specification label would show:

Origin: Logging residues (1.1.4).

Properties: Dimensions P45S, Moisture M40, Ash A1.5.

This label states that the minimum 60% weight of the wood chips is sized between 3.15 mm and 45 mm, has moisture content of less than 40% and contains less than 1.5 % ash. Figure 1 is a schematic diagram of specifications of properties for graded wood chips.

Safe Handling and Storage of Wood Chips

Protection of the wood chips pile from rain and snow with covered storage is critical to maintain fuel quality (Figure 2).

During storage of wood chips, chemical, physical and biological processes can occur. Microbial activities might be cultivated, dry fuel mass might degrade and the pile can heat up. In the worst case this can lead to self ignition. Particle size within a pile of wood chips affects rate of moisture absorption, heat build-up and heat dissipation. Large amounts of fines in a pile causes greater amounts of water to be absorbed, leading to faster heat up and even possibly spontaneous combustion. In contrast, large wood chunks heat up more slowly due to large void volumes between particles allowing more air flow. Microbial action also takes place at lower rates. To minimize the impact of these processes on the quality of the wood chips, it is highly recommended the storage period is kept to minimum.

The Ontario Office of the Fire Marshal has a technical guideline that recommends maximum sizes for outdoor piles of wet wood chips from storm debris[4]. For wood chips to be stored for more than three months, the recommended maximum height, width, and volume are 4 meters (13 feet), 8 meters (26 feet), and 1000 cubic meters (1,300 cubic yards), respectively. For periods less than three months, the recommended maximum height is 7.5 meters (25 feet).

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Maintaining a low moisture and fines content in the wood chip pile will help minimize the risks of microbial activity, composting and self ignition. Storing low moisture pile under covered area is therefore a good practice.

To minimize the possibility of inadvertently transporting invasive species, care should also be taken when sourcing wood chips from other locations.

References & Links

1. CSA Group – www.csagroup.org for the CAN/CSA-ISO Standard 17225 Solid biofuels – Fuel specifications and classes Part 4: Graded wood chips, and, – Part 1: General requirements.
2. Natural Resources Canada – www.nrcan.gc.ca for the Solid Biofuels Bulletins Series.
3. FPInnovations, "Basic procedures for sampling and analyzing woody biomass", Advantage report Vol. 15, No.5, 2015.
4. Ontario Office of Fire Marshal Technical Guideline for wood chips storage, www.mcscs.jus.gov.on.ca/english/firemarshal/legislation/technicalguidelinesandreports/TG-1998-03.html.

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