



Safety Data Sheet

WOOD PELLETS IN BULK

SECTION 1. IDENTIFICATION

Product Identifier:	Wood Pellets
Synonyms:	Fuel pellets, whitewood pellets, softwood pellets, hardwood pellets, biopellets
Product Appearance:	Light to dark blond to light brown, glossy to semi-glossy. Cylindrical 6-12 mm (1/4-1/2 inch) in diameter and 3.15-40 mm (1/8-1 9/16 inch) long.
Other Means of Identification:	ISO 17225-2 Solid Biofuels – Part 2: Graded wood pellets (ref. 2). Product Specification with quality class, physical and chemical specifics, including any additives and/or binders and ash melting temperature, is available on request from the manufacturer (see Section 9).
Harmonized System (HS) Code:	4401-31-00-00
Chemical Abstract Service (CAS):	See Section 3.
Recommended Use:	Fuel for conversion to heat, electricity or bio-chemicals. Other uses might be absorbent and animal bedding.
Restrictions on Use:	Not for consumption by humans or animals.
Manufacturer/Supplier:	The Shaw Group Ltd 52 Hodgins Rd Belledune New Brunswick E8G 2E3 Canada switchboard tel: (001) 506-522-2839 fax: (001) 506-522-9883 www.shawresources.ca
Emergency Telephone 24/7:	First responder: Eric Cook, Plant Manager tel: (001) 506-522-9884 mob: (001) 506-544-1818 fax: (001) 506-522-9883 email: ecook@shawresources.ca Second responder: Keith Culligan, Safety & QA Coordinator tel: (001) 506-522-9881 mob: (001) 506-543-3801 fax: (001) 506-522-9883 email: kculligan@shawresources.ca

SECTION 2. HAZARD IDENTIFICATION

UN GHS Classification:	H 304 Aspiration hazard – Category 1; H 317 Skin Sensitization – Category 3; H 334 Respiratory Sensitization – Category 1.
UN GHS Label Elements:	

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UN GHS Signal Words:

Danger. Generates carbon-monoxide (CO) and causes oxygen (O₂) depletion (see Sections 4 and 7).

Warning. Dust from wood pellets may cause mild skin irritation; dust containing allergenic species may cause allergy or asthma symptoms if inhaled (see Section 11).

Hazards Statements:

Wood pellets are combustible if exposed to open fire or heat.

Dust from wood pellets when lofted in high concentrations or in layers is explosive if exposed to ignition source (see Section 9).

Inhalation of dust from wood pellets may cause respiratory reactions (see Section 4).

Inhalation of dust containing allergenic species may cause allergy or asthma symptoms (see Section 4).

Contact with skin may cause skin irritation for sensitive persons (see Section 4).

Wood pellets have propensity to self-heat. However, for purpose of the UN GHS hazard safety classification wood pellets are **not** classified as self-heating (see Section 9).

Precautionary Statements:

Prevention:

Electrical grounding of equipment shall be checked as part of maintenance to avoid ignition by electrostatic discharge and surfaces of equipment such as conveyors and hoppers in direct contact with wood pellets and related dust shall be electrically dissipative (ref. 11 and 13).

Safe handling of wood pellets requires diligent and persistent house-keeping. Cleaning of dust shall be done with an electrostatically secure vacuum system. Dust layer shall never be allowed to exceed 3 mm (1/8 inch) in thickness (see Section 7). Fire risk work permitting procedure shall be followed.

Halogen lamps or other hot surface equipment in areas where dust from wood pellets may accumulate pose a risk for fires and explosions.

If fine wood dust generation is inevitable during bulk wood pellet processing, effective engineering control measures shall be in place to prevent unsafe build-up of wood dust (see Section 7).

All personnel working in areas with dust suspended in air may wear an optional dust mask to prevent inhalation of dust if anticipated dust level is below occupational exposure guidelines. The use of properly fit-tested respirator with High-Efficiency Particulate Air (HEPA) cartridge is required if dust level is expected to exceed occupational exposure guidelines (see



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Section 8 and 11).

Before entering a storage space with wood pellets the space shall be sufficiently ventilated to make sure the conditions as specified in Section 7 are secured due to the release of carbon-monoxide (CO), oxygen (O₂) depletion by wood pellets, or possible generation of re-entrainment of settled wood dust. For confined space related entry, site-specific Confined Space Entry Work Permit procedures shall be followed.

Bulk Storage and Handling: Store in dry well ventilated space with capability to cool the wood pellets. If forced ventilation is used, do not ventilate if the ambient air temperature exceeds the temperature in the wood pellets pile or ambient relative humidity is higher than 80%.
When wood pellets reach a temperature above safe level, circulate the material outside the storage containment and cool to safe temperature (see Section 7). In all cases, ventilated air shall not be re-circulated into indoor environment without regulated regional government approval.
Do not expose to rain or high moisture conditions during handling such as loading or discharging of ocean vessels (see Section 14). Avoid prolonged storage of wood pellets in moist and warm environment to minimize possible mould growth. Consult with qualified professional if mould remediation is required (see Section 8) regarding mould exposure control measure).

Do not use water as extinguishing media when stored in contained space since wood pellets may swell 3-4 times in volume (see Section 5).

Disposal: Do not store wood pellets and related dust in space with poor ventilation (see Section 13). Regarding disposal from ocean vessel, see Section 14.

Other Hazards:

Angle of repose and drain are approximately 30 degrees and 35 degrees respectively. When working inside silos bridging and clogging may collapse without warning and cause engulfment of victim resulting in asphyxiation. Entry into confined containments such as silos and storage bins shall only be done following site specific Confined Space Entry Work Permit Procedures and rescue plan (see Section 8).

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Quality graded wood pellets are manufactured from ligno-cellulosic material sourced in accordance with ISO 17225-2 Standard (ref. 1 & 2). The chemical composition of wood pellets varies depending on species of trees, components of the tree, growing conditions and age of a tree. Wood pellets are often manufactured from a blend of source materials with typical composition as summarized in Table 1.



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Table 1. Oxygenated wood components

		CAS No.	w-%
Component	Cellulose	9004-34-6	30-40
	Hemi-cellulose	8024-508	25-30
	Lignin	6549-68-4	30-45
	Extractives (terpenes, fatty acids, phenols etc.)	-	3-5
Additives	None, except as stated in the manufacturers Product Specification		
Binders	None, except as stated in the manufacturers Product Specification		

Notes

1. Additives and/or binders are sometime used to increase the mechanical durability of the pellets or to inhibit slugging and fouling during combustion.
2. The IMO regulations IMSBC Code (ref. 15) under the IMO SOLAS Convention (ref. 10) for carriage of cargo stipulate requirement for fixed gas fire extinguishing equipment onboard during transportation of wood pellets containing binders and/or additives. Wood pellets not containing any additives and/or binders are exempt (see Table 7).

SECTION 4. FIRST-AID MEASURES

Off-gassing from Wood Pellets

Wood pellets release non-condensable odourless gases such as toxic carbon-monoxide (CO), carbon-dioxide (CO₂) and small amounts of methane (CH₄) in combination with oxygen (O₂) depletion. Whenever possible, bulk storage of wood pellet products should be stored in well ventilated areas. Wood pellet storages, both enclosed or confined spaces, must be thoroughly ventilated before entry. Carbon-monoxide (CO) and oxygen (O₂) monitors shall be used when entering storages to establish acceptable conditions (see Section 7). In all cases, unprotected exposure to oxygen deficient environment below 19.5% and CO above occupational exposure limits (OELs) is strictly prohibited. Refer to site-specific Confined Space Hazard Assessment and Entry Procedures for confined space entry. Refer to Section 11 for more detailed Occupational Exposure Guidelines..

Carbon-monoxide (CO) is classified as a chemical asphyxiant, which binds the hemoglobin in the blood and disrupt normal blood oxygen transportation to the brain and other vital organs.

Exposure to combined oxygen (O₂) deficiency and carbon-monoxide (CO) may exacerbate hyper-ventilation. In case of exposure it is important to quickly remove the victim from the contaminated area. Unconscious persons should immediately be given oxygen and artificial respiration. Time is of the essence. The administration of oxygen at an elevated pressure has shown to be beneficial, as has treatment in a hyperbaric chamber. Attending physician shall be informed that the patient has inhaled toxic quantities of carbon monoxide. Rescue personnel shall be equipped with self-contained breathing apparatus (SCBA) when entering enclosed spaces with gas.

Carbon-dioxide (CO₂) and methane (CH₄) are simple asphyxiants and displace oxygen.

In addition, wood pellets release low level condensable malodorous volatile hydrocarbons which may cause discomfort.

Dust from Wood Pellets



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The sizes of the particulate matter range from crumbs to extremely fine airborne dust. Some species of wood may cause acute or chronic toxic symptom if inhaled, or skin irritation. Some wood dust may contain allergenic wood species and may cause allergy or asthma symptoms or breathing difficulties if inhaled. (see Section 11).

Airborne dust may settle on horizontal surfaces and build up to unsafe levels over time. This may pose dust explosion hazard if exposed to heat, open flame, sparks or electrostatic discharge (see Section 7).

A summary of recommended first aid measures by routes of exposure is listed in Table 2.

Table 2. Recommended first-aid measures			
Entry	Substance	Observed Adverse Health Effects	Remedial Action
Ingest	Dust	Dry sensation.	Rinse mouth thoroughly with water. Do not induce vomiting.
Inhale	Dust	Coughing, dry throat. Wood dust containing allergenic species may cause allergy or asthamic symptoms. For toxicological data, see Section 11.	Rinse mouth thoroughly with water. Do not induce vomiting. Workers experience allergic or asthmic symptoms should seek medical attention immediately.
	Carbon-monoxide (CO)	Headache, dizziness, convulsion at lower exposures to unconsciousness and death at higher acute exposures. For toxicological data, see Section 11.	If adverse symptom is observed, evacuate worker to a safe well-ventilated area and seek medical attention if required. Ensure CO is below occupational exposure guidelines via proper ventilation.
	Oxygen depletion (O ₂)	Dizziness, mental confusion, loss of judgement, loss of coordination, weakness, nausea, fainting, loss of consciousness and death.	If oxygen level < 19.5%, evacuate and ventilate thoroughly. Seek medical attention if required.
Skin contact	Dust	Itching for some people. For toxicological data, see Section 11.	Remove contaminated clothing. Rinse skin thoroughly with water.
Eye contact	Dust	Tearing, burning. For toxicological data, see Section 11.	Flush with water and sweep out particles inward towards the nose.

SECTION 5. FIRE-FIGHTING MEASURES

Wood pellets do not burn with a flame unless exposed to forced air. Wood pellets are not ignitable without the presence of oxygen. However, wood pellets contain approximately 42-45% oxygen and once ignited may continue to smolder without external oxygen present. Fires inside large storages such as warehouses and silos are very difficult to extinguish and may take several days.

Large storage spaces like silos may be equipped with temperature sensing vertical cables fixed at the top and sometimes anchored at the bottom to provide a thermal profile of the temperature in various parts of the storage. Set points shall be such that alarm is given when safe temperatures are exceeded (ref. 4 and 14 and 15).

Extinguishing Media

Suitable Extinguishing Media

The most efficient extinguishing media to cool and douse burning wood pellets in contained spaces is nitrogen (N₂) and carbon-dioxide (CO₂).

Burning or smoldering material outside of containment and exposed to ambient air may be extinguished with foam (see Table 3), water or sand to block penetration of oxygen.

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Unsuitable Extinguishing Media

Use of water is not recommended as extinguishing media for fire-fighting in enclosed containment since wood pellets are swelling 3-4 times in volume and may rupture the storage containment.

Table 3 summarizes recommended fire extinguishing strategies under different conditions as outlined in ISO 20024 (ref. 4).

Table 3. Recommended fire fighting strategies		
Condition	Extinguishing measures	Additional information
Wood pellets stored in contained space (silo, enclosed bin etc.)	Restrict oxygen supply by turning off ventilation, seal openings, slots, ducts, cracks etc. In case explosion panels have not engaged, consider inertation if headspace is intact. In case the explosion panels have released or if the headspace is compromised or in case of open fire, use foam to block oxygen supply.	Equipment: Preferably use Fixed Deluge Foam/CAF (Compressed Air Foam). Alternatively High Expansion Foam System (ref. 4). Foam: Class A (ref. 15).
	Inject inert gas at the bottom through ventilation piping or piping specifically configured for fire-fighting. If the interior of the containment can not be reached by piping, piercing the containment with lances should be considered. The total expected gas consumption (dosage) is depending on the severity of the fire and may require a dosage rate ¹ of 5-10 kg/m ² /hour (area refers to cross section of containment) and reaching 5-15 kg/m ³ for less severe fire and 30-40 kg/m ³ for more severe fires.	Recommended gas is nitrogen (N ₂), specific volume 0.862 m ³ /kg and a vapor temperature of -196°C. Carbon-dioxide (CO ₂), specific volume 0.546 m ³ /kg and a vapor temperature of -78.5°C (-173°F) is an alternative gas only to be used on open flame . CO ₂ may generate icing in couplings and small static electrically charged icicles when transported in insulative pipes which may cause electrostatic discharge and explosions in an environment with high concentration of CO and other flammable gases. Use of CO ₂ in temperature zones above 650°C (1200°F) may react with carbon resulting in generation of CO.
Wood pellets stored in flat non-enclosed bin	Restrict oxygen supply by covering the pile with foam. Dig out the hot material and use water on open fire and for cooling.	Be careful when walking on wood pellets due to collapse of bridges and under-lying burning cavities. Fire fighting personnel and driver of wheel loader working the material shall have access to Self-Contained Breathing Apparatus (SCBA) (see Section 8).
Wood pellets during handling	Burning material on conveyors or in auger shall be shunted aside to safe location to prevent spread of fire. Use water for cooling.	
Wood pellets during transportation in railcars	Restrict oxygen supply by closing hatch covers. Dump content in safe location. Use water for cooling.	
Wood pellets during transportation in trucks	Dump content in safe location. Use water for cooling.	
Wood pellets during ocean transportation	Transportation of wood pellets in ocean carriers is regulated by IMSBC Code which prescribes closed hatch covers to restrict oxygen supply and no ventilation in cargo spaces. Ocean carriers transporting wood pellets containing additives and/or binders are required to have fixed gas fire extinguishing systems onboard.	Wood pellets not containing additives and/or binders may be carried in ocean carriers without fixed gas fire extinguishing systems as per IMO List 1 of Circular 1395 (see Section 14).

Note

1) Dosage recommendations according to RISE Research Institute of Sweden (ref. 15).

Special Precautions and Advice to Fire-fighters

Puncturing storage containment is not recommended since the pyrolysis gases developed inside the containment are highly flammable and might explode or violently catch fire if in contact with air (oxygen) and ignition source.

Large storages such as silos often have an underground tunnel for conveyors. During extreme heating,



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smoldering or fires these tunnels, ventilation shafts and casings in communication with the storage space may contain high concentrations of carbon-monoxide and other pyrolysis products. Fire fighters are recommended to have self-sustaining breathing apparatus when working closely to such areas.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Methods for Containment and Cleaning Up

If wood pellets are released in a populated area, the material shall be removed by vacuuming whenever possible. Sweep cleaning should be used in conjunction with effective personal protective equipment. Never use compressed air for dust cleaning. Regarding disposal [see Section 13](#).

Personal Precautions, Protective Equipment, and Emergency Procedures

Disposal of wood pellets or related dust shall be done in ventilated area such that gas from the material does not accumulate in space accessible by humans or animals. Wood pellets may be used as absorbent and animal bedding in ventilated areas.

Wear properly fitted respirator to prevent inhalation of dust above occupational exposure limits during clean-up ([see Section 8](#)).

SECTION 7. HANDLING AND STORAGE

Precautions for Safe Handling and Storage

ISO 20023 Standard ([ref. 3](#)) provides guidance for design and operation of small-scale storage.

ISO 20024 Standard ([ref. 4](#)) provides guidance for design and operation of large-scale storage.

Classification in accordance with the NFPA ([ref. 11](#)) or ATEX ([ref. 13](#)) guidelines using the Zone 20/21/22 classes for installations such as production, terminal handling and storages facilities at heating and power plants is recommended for identification and management of risk areas during normal operation as well as emergency situations, including fire fighting ([see Section 5](#)).

Local regulations issued by WorkSafeBC or similar authorities may apply for risk assessment and stipulate safety procedures relating to:

- plant and machine operation
- dust management
- preventive maintenance
- remedial maintenance
- training of personnel
- reporting

Some jurisdictions have safety audit procedures for certification of safe handling of wood pellets and this SDS may be an integral part of the required documentation.

Temperature Control and Alarm

Storage temperature shall be as even as possible and preferably below 30°C (86°F). Temperatures above 60°C tend to accelerate self-heating in wood pellets and is a risk factor.

Temperature of wood pellets during storage is usually rising with time and ambient temperature conditions. It is recommended to have permanent temperature monitoring and forced cooling through bottom ventilation in large storage containments (silos and bins). Due to very low thermal conductance in wood pellets it is essential



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to have sensing dispersed throughout the pile of material. If the temperature of the wood pellets in a silo with forced ventilation increases more than 1.5°C/h from a temperature of 60°C the wood pellets should be circulated for cooling outside the silo.

Moisture Control

Wood pellets are hydrophobic (absorb moisture from ambient air and penetration by water) and should be kept dry at all times. Elevated moisture content promotes self-heating, off-gassing and oxygen depletion. Ventilation with ambient air should not be done if air temperature is higher than pellets temperature or at relative humidity higher than 80%.

Self-heating Control

ISO 20049 Standard (ref. 6) specifies methods for determination of propensity for self-heating of wood pellets. Depending on source materials used for manufacturing wood pellets and method of manufacturing the self-heating characteristics may vary between qualities of wood pellets (ref. 2). Propensity increases with increased moisture content of the wood pellets.

Dust Management

Dust is generated during handling of wood pellets. Unsafe accumulation of settled fine wood dust can be highly explosive (see Section 9) when dispersed in air and in contact with ignition source such as spark, hot particle, open flame, electrostatic discharge etc. Dust may exist in lofted state as a dust cloud or as a deposited layer on horizontal surfaces such as floor, equipment and beams. The ignition temperature for a dust cloud is usually in the range of 450°C (840°F) and for a layer as low as 250°C (480°F) depending on the thickness of the layer (see Table 5). Diligent housekeeping by means of sweeping and vacuuming is of the essence at all times in order to keep any accumulation of dust below 3 mm (1/8") in thickness (ref. 12). Use of compressed air for cleaning should be prohibited.

Inspection of electrical grounding and bonding of mechanical parts in direct contact with wood pellets and related dust is important. Monitoring temperature of moving parts such as motors, gearboxes, bearings, idlers etc. is equally important in order to eliminate sources of ignition.

Smoking shall be prohibited in areas handling and storing wood pellets.

If front loader is used for moving wood pellets on floor, the edge of the bucket penetrating the floor shall be equipped with non-metallic electrically dissipative material to avoid electrostatic build-up and sparks.

Moving equipment working in areas with high concentration of dust from woody source material or wood pellets shall be equipped with automatic built-in fire extinguishers in the engine compartment. The temperature of hot components in the engine compartment shall be monitored to set-off alarm when exceeded.

Off-gassing and Oxygen Depletion Management

Wood pellets release non-condensable gases such as carbon-monoxide (CO), carbon-dioxide (CO₂), small amounts of methane (CH₄) as well as volatile hydrocarbons, which may build up over time in poorly ventilated storage space. To prevent unsafe accumulation of off-gassing gaseous hazards, storage space shall be well ventilated and checked by gas monitors prior to access.

In case of confined space storage extreme caution shall be used. The ISO 20048 Standard (ref. 6) specifies methods for determination of propensity for off-gassing and related oxygen depletion from wood pellets. Depending on source materials used for manufacturing wood pellets and method of manufacturing the off-gassing characteristics may vary between qualities of wood pellets. Reference 5 provides a method for



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determination of emission factors for wood pellets and a procedure for calculating the necessary ventilation to keep the concentration of carbon-monoxide (CO) as well as oxygen (O₂) depletion in a given storage containment within acceptable limits based on emission factors for a particular wood pellet product quality. Consult with a qualified professional such as ventilation engineer or industrial hygienist for proper ventilation requirement if necessary. Refer to the company site-specific confined space program for details.

Conditions for Safe Storage and Confined Space Entry Work Permit

Storage containments (silos and bins) shall be well ventilated before entry. For larger containments Confined Space Entry Work Permit procedures shall be followed. If confined space entry is required, an effective confined space entry program must be in place as completed by a qualified professional. In all cases, confined space locations shall be identified and carry a warning placard similar to this illustration.



SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

All wood pellet related hazards shall be controlled to within safe and acceptable levels based on the following hierarchy of control from high to low priority:

Hazard Elimination:

Avoid build-up of off-gassing hazard by refraining storage of wood pellet in confined space or poorly ventilated environment.

Engineering Controls

The handling and storage shall be designed as to keep the exposure to dust below the allowable exposure guidelines (see Section 11). Use properly designed local exhaust ventilation to prevent fine dust build up. Set up proper general air ventilation system to prevent the build-up of off-gassing hazards inside storage space. Implement safety by design to reduce the total horizontal surface areas whenever feasible.

Administrative Controls

Maintain good housekeeping and implement effective dust cleaning program to minimize the amount of wood dust in indoor environment. Set up effective safe work procedures such as Confined Space Entry Program to ensure workers are properly prepared to mitigate and protect themselves from the identified hazards.

Personal Protective Equipment (PPE)

Personal protective equipment shall be used when entering space where large volumes of wood pellets in bulk are handled and stored and risk for exposure to dust or off-gassing exist.

Eye Protection: Wear safety glasses or safety goggles.

Skin Protection: For hand protection wear appropriate protective gloves (nitrile or leather gloves are recommended but should be selected based on anticipated work activities). Wear clothing with long sleeves or overall. Protective gloves and skin cream shall be used when practical to avoid direct skin contact with material. For work in a more contaminated environment, the use of long-sleeve disposable coverall may be necessary.

Respiratory Protection: Wear optional dust mask with filter (P2) in areas where dust level is expected to be below the occupational exposure guidelines. The use of appropriate properly fit-tested respirator with HEPA cartridge is required if dust level is above occupational exposure guidelines.



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Minimum respiratory protection requirement for mould abatement is 1/2 –face respirator with N95 cartridge.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Most of the wood pellets manufactured in Canada comply with the ISO 17225-2 Standard (ref. 2) as summarized in Table 4 and the supplementary product data summarized in Table 5.

Parameter	Measure	Test method	Value	
Appearance			Light to dark blond to dark brown, glossy to semi-glossy	
Odour	Fresh in bulk and ventilated space	above 5°C	smells like fresh wood	
	Poorly ventilated space		smells like aldehydes	
Diameter	D	ISO 17225-2 Table 1/Table 2	6/8/10/12	
Length	L		<40	
Pellet particle density			>1000	
Moisture content	M		w-% as received	0.7-10.0
Ash content	A		w-% dry	0.7-3.0
Ash melting temperature			°C	As stated 1)
Mechanical durability	DU		w-% as received	97.5-96.5
Fines content	F		w-% as received	1.0-6.0
Calorific value	Q		MJ/kg as received	>16.5
Bulk density	BD		kg/m ³	>600
Nitrogen content	N		w-% dry	0.3-0.6
Sulfur content	S		w-% dry	0.04-0.05
Chlorine content	Cl		w-% dry	0.02-0.1
Max additives			w-% as received	As stated 2)

1) Typically 1,000 - 1,500°C

2) Max 3% under ISO 17225-2. Canadian wood pellets do not have additives and/or binders

Parameter	Measure	Test method	Value
Appearance			Light to dark blond to dark brown, glossy to semi-glossy
Odour	Fresh in bulk and ventilated space	above 5°C	smells like fresh softwood
	Poorly ventilated space		smells like aldehydes
Trace metal content (with no additive)	w-% dry		0.1
Solubility (trace metals) in sea water	ug/L	1)	<500
Bio-degradability	%		100
Swelling	%		300-400
Angle of repose (cone)	degree		28-32
Angle of drain (cone)	degree		34-36
Flammability of composite off-gasses	ISO 10156:2009 (ref. 7)	UN MTC Part III	Not flammable
Flammability of solids		UN MTC Test N.1 Class 4 Div 4.1	Not flammable
Self-heating	100x100 mm cube/140°C	UN MTC Test N 4.2	UN self-heating
Pyrophorocity		UN MTC Test N.2	Not pyrophoric
Dust cloud from wood pellets (particle size 95%<75 micron, 5% moisture)			
Auto-ignition temperature	T _c	°C	ASTM E1491
Minimum Ignition Energy	MIE	mJoule	ASTM E2019
Max Explosion Pressure	P _{max}	bar	8.0-8.2
Max Explosion Pressure Rate	R _{max}	bar/s	520-540
Deflagration Index	k _{St}	bar. m/s	140-160
Dust Classification	St		Class St 1
Min Explosible Concentration	MEC	g/m ³	ASTM E1515
Limiting Oxygen Concentration	LOC	%	ASTM E1515 mod.
Dust layer from wood pellets (particle size 95%<75 micron, 5% moisture)			
Hot Surface Ignition Temperature (19 mm)	T _{SS}	°C	ASTM E2021
Hot Surface Ignition Temperature (5 mm)	T _{S19}	°C	250-275

1) Environment, Health and Safety Publications, Series of Testing and Assessment No 29, Environment Directorate, Annex 10 Guide on transformation/dissolution metals and metal compounds in aqueous media, OECD UN 2011.



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For more detailed specification of raw materials used for production of Canadian wood pellets, classification, specification and testing methods used for characterization, see ISO 17225-2 (ref. 2).

SECTION 10. STABILITY AND REACTIVITY

Wood pellets are highly hydrophilic and, other than a fuel, are also used as absorbent and animal bedding.

- Chemical reactivity: Stable when kept in dry condition.
- Physical reactivity: May swell 3-4 times of its compressed volume if subjected to water.
Hygroscopic uptake of moisture from ambient air with Equilibrium Moisture Content (EMC) in the range of 20-25 w-%.
- Dust from wood pellets: Highly explosive if ignited by spark, open flame, hot particle or electrostatic discharge (see Table 5 and ref. 4).
- Incompatible substances: Oxidizing agents capable of transferring oxygen molecules such as poly-oxides e.g. permanganate, perchlorate) or reducing agents (chemicals with low electro-negativity (e.g. ferrous ions (rust) sodium ions (dissolved sea salt).
- Decomposition products: Carbon-monoxide (CO), carbon-dioxide (CO₂), small amounts of methane (CH₄) in combination with oxygen depletion, oxides of nitrogen, volatile hydrocarbons including terpenes and polyaromatic hydrocarbons.
- Conditions to avoid: Exposure of wood pellets to hot surfaces, open flame, sparks, electrostatic discharge.

SECTION 11. TOXICOLOGICAL INFORMATION

The toxicity assessment of dust consists primarily of literature references related to dust of various woody source materials used for production of wood pellets. The assessment of toxicity to human health is based on comparing actual toxicity tests done on Canadian wood pellets (see Section 12) with generally accepted reference values from multiple databases (see Table 6).

Inhalation and Skin Contact of Dust from Wood Pellets

Respirable dust is defined as particles with an Aerodynamic Equivalent Diameter (AED) 50% cut-off size at 4 µm or smaller. Respirable dust is capable of reaching the alveoli, the air-exchange region of the lung.

Total dust, or referred as inhalable dust, is defined as particles with an AED 50% cut-off size at 100 µm or smaller. Inhalable dust can deposit directly throughout the respiratory tract from nasal, thoracic, and lower respiratory region of the lung.

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Table 6. Toxicological information on graded wood pellets

Feedstock	PEL (OSHA)	REL (NIOSH)	TLV (ACGIH)	WorkSafeBC	Health effects
Softwood (fir, pine, spruce, hemlock)	15 mg/m ³ Total Dust	TWA (8h) = 1 mg/m ³	TWA (8h) = 1 mg/m ³	TWA (8h) = 2.5 mg/m ³	Acute or chronic dermatitis, asthma, erythema, blistering, scaling and itching (ACGIH).
	5 mg/m ³ Respirable Dust				
Softwood (western, red cedar)	15 mg/m ³ Total Dust	TWA (8h) = 1 mg/m ³	TWA (8h) = 0.5 mg/m ³	TWA (8h) = 1 mg/m ³	Acute or chronic rhinitis, dermatitis, allergy, asthma (ACGIH).
	5 mg/m ³ Respirable Dust	TWA (8h) = 1 mg/m ³			
Hardwood (alder, aspen, cottonwood, hickory, maple poplar)	15 mg/m ³ Total Dust	TWA (8 h) = 1 mg/m ³	TWA (8h) = 5 mg/m ³	TWA (8h) = 1 mg/m ³	Acute or chronic dermatitis, asthma, erythema, blistering, scaling and itching (ACGIH).
	5 mg/m ³ Respirable Dust				Suspected tumorigenic at site of penetration (IARC).
Hardwood (oak, walnut, beech)	15 mg/m ³ Total Dust	TWA (8h) = 1 mg/m ³	TWA (8h) = 5 mg/m ³		Suspected tumorigenic at site of penetration (ACGIH).
	5 mg/m ³ Respirable Dust				

Toxicity of Wood Pellets to Humans and Animals

While not all Canadian wood pellets are classified as hazardous to human health or animals based on toxicological lab tests of softwood and hardwood pellets, some wood pellet products may be classified as human or animal carcinogen depending on the sources and composition of wood components. For example, if the wood pellet contains > 0.1% of oak, beech, birch, mahogany, teak, and walnut, the final wood pellet may be listed as wood containing carcinogenic ingredients. Nevertheless, users should be able to distinguish the difference between hazard and risk. The exposure risk arising from the carcinogen hazard depends on many factors such as level of wood dust exposure, duration and frequency of exposure, and whether effective exposure mitigation measures are in place. Since the primary wood pellet products are typically large size pellet, range from 6 mm – 12 mm in diameter, they are unlikely to become airborne and directly ingested or inhaled by handlers. Therefore, the exposure risk of wood dust should remain low during normal handling of wood pellet provided an effective dust control system is in place.

The wood pellets are compliant with ISO 17225-2 Standard (ref. 2) with a compositional data as per Table 1 and have been tested in accordance with particle size distribution using the mixtures rule of GHS (UN 2013b) (ref. 16) and MARPOL Annex V regulations conditions 3-6 (ref. 9).

General Carcinogenicity of Wood Dust

Dust from certain hardwoods has been identified by IARC as Group 1 carcinogenic to human substance. (IARC Monographs: Wood Dust No. 100C (2012)). The American Conference of Governmental Industrial Hygienists (ACGIH) have also listed oak and beech wood dusts as A1 – Confirmed Human Carcinogen and birch, mahogany, teak, walnut as A2 – Suspected Human Carcinogen (ref. 18 Section 5.59 Table 1). Unsafe exposure to wood dust has been associated with elevated risk of nasal and sinus cavity cancer. Some wood dust species



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such as Western Red Cedar are considered to be allergenic. Unsafe exposure of allergenic wood dust may lead to allergy and asthmatic symptoms (ref. 18 Section 5.48-6 Allergenic Species of Wood Dust). Cedar oil is a skin and respiratory irritant. The risk of exposure to allergenic wood dust is less likely a concern as Canadian wood pellets are mostly made from source material in Western Canada consist almost exclusively of non-allergenic softwood such as pine, spruce and fir. Nevertheless, dust from Canadian pellets made from source material in Eastern Canada may contain some allergenic wood species such as yellow and white birch, ash, poplar, linden and some oak.

Exposure to carbon-monoxide (CO)

Consult local occupational exposure guidelines regarding Occupational Exposure Limit (OEL) and Immediately Dangerous to Life and Health (IDLH) limit.

SECTION 12. ECOLOGICAL INFORMATION

Aquatic toxicity

Aquatic toxicity as classified by the criteria under Class 9 of the International Maritime Dangerous Goods (IMDG) Code (IMO 2012) (ref. 17) as well as by the Recommendations on the Transport of Dangerous Goods Model Regulations (UN 2013a) (ref. 16) indicates that the metal concentration of Canadian wood pellets dissolved in sea water is not Harmful to the Marine Environment (HME). The tests and conditions are spelled out in the MARPOL Annex V regulations conditions 1 & 2 (ref. 9) and compared to generally accepted eco-toxicity reference values for marine organisms (Markich et. al. 2002, CSIRO 2009, ANZECC 2000, US EPA 2013 Ecotox) and are not classified as Miscellaneous Dangerous Goods (Class 9) Environmental Hazardous Substances for the purpose of marine transport:

1. Acute Aquatic Toxicity Category 1; or
2. Chronic Aquatic Toxicity Category 1 or 2; or
3. Carcinogenicity 1A/1B AND high bioaccumulation AND not rapidly degradable; or
4. Mutagenicity 1A/1B AND high bioaccumulation AND not rapidly degradable; or
5. Reproductive Toxicity 1A/1B AND high bioaccumulation AND not rapidly degradable; or
6. Specific Target Organ Toxicity Repeated Exposure (STOT-RE) Category 1 AND high bioaccumulation AND not Rapidly degradable; or
7. If a solid bulk cargo contains or consists of synthetic polymers, rubber, plastics or plastic feedstock pellets, it is automatically classified as HME.

Solubility in seawater

Solubility in seawater of 24 metals from crushed wood pellets indicates a solubility of <500 µg/L.

Criteria limit according to UN Model Regulations and IMDG section 2.9.3.3.1 for substance **not** HME is:
100 mg/L loading \leq L(E)C₅₀

Phytosanitary condition

Freshly produced wood pellets from various parts of Canada have been tested for bacterial content in accordance with Health Canada MFHPB-18 Standard (ref 19) and for yeast and mould content in accordance MGHPB-22 Standard (ref 20). The Colony Forming Units (CFU) count indicates undetectable presence of such microbes. Evaluation of sanitary conditions as a result of exposure to comminution, heat and pressure during manufacturing indicates compliance with International Standards for Phytosanitary Measures (ISPM) #15 (ref 22) under the International Plant Protection Convention (IPPC ref 21).



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SECTION 13. DISPOSAL CONSIDERATIONS

Wood Pellets are a fuel and shall be disposed of by means of burning or composting.

Disposal from ocean vessel

The IMO Marine Pollution (MARPOL) Convention (ref. 9) regulates the release of substances to the ocean. All commodities carried in ocean vessels have to be classified based on their aquatic eco-toxicity when mixed in water. Substances classified as Harmful to the Marine Environment (HME) can only be disposed of at receiving facilities set up by Port State for destruction. Wood pellets and related dust is under MARPOL classified as garbage and is regulated under MARPOL Annex V. The aquatic eco-toxicity of Canadian wood pellets has been tested (see Section 12) and found not HME. Remnants of substances not HME, such as cargo residue and washing water in holds (dust accumulated on deck and on the outside of a ship is exempt), may be disposed of 12 nautical miles from the nearest land, provided cleaning agents also qualify as not HME. Records of all discharges shall be kept in a Garbage Record Book or the Ship's log.

SECTION 14. TRANSPORT INFORMATION

Ocean transportation

Ocean transportation of wood pellets in bulk is regulated under the IMO SOLAS Convention (ref. 10). The IMSBC Code (ref. 8) provides hazard classification and instructions for handling cargo during loading, ocean carriage and discharge. The IMSBC Code stipulates a requirement for fixed gas fire extinguishing equipment onboard during transportation of wood pellets containing binders and/or additives. Wood pellets **not** containing any additives and/or binders are exempt under IMO Circular 1395 List 1 (see Table 7).

Wood pellets are not classified as self-heating or release gases in sufficiently high concentration to be flammable as per definition under UN GHS (see Table 5). Therefore wood pellets are not classified as Dangerous Cargo under the IMO regulations (ref. 8 and 16).

Table 7 summarizes the IMSBC Code hazards classification of wood pellets.

Table 7. Summary of hazards classification under IMSBC Code						
Wood pellets	Materials hazardous only in bulk	Classification of cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship	Readily combustible solids	Hazard class	Segregation	Require fixed gas fire extinguishing systems onboard
Not containing any additives and/or binders	MHB	Group B	Class 4.1 Flammable solid	OH (Other Hazard)	IMSBC Code § 9.3.3.1	Exempt as per Circular 1395 List 1
Containing additives and/or binders				WF (May release Flammable gases when wet)		yes

For segregation, wood pellets are incompatible with oxidizing agents capable of transferring oxygen molecules such as poly-oxides e.g. permanganate, perchlorate) or reducing agents (chemicals with low electro-negativity (e.g. ferrous ions (rust) sodium ions (dissolved sea salt)).

The IMO Marine Pollution (MARPOL) Convention (ref. 9) regulates the release of substances to the ocean (see Section 12).

Durability of wood pellets exposed to moisture will degrade resulting in increased fines content.



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Open hatch loading or discharge of wood pellets from ocean vessels shall be avoided during drizzle or rain since they lose their mechanical integrity when wet, which results in generation of dust. The potential moisture accumulation in the wood pellets depends on the geometry of the hatch opening, operational geometry of the loading/discharge and duration of the exposure. Ship's Master is responsible for making decision regarding whether to close hatches or not as per shipping charter party.

Land transportation

Wood pellets are not a regulated product under Canadian Transportation of Dangerous Goods (TDG) Regulations or the US Department of Transportation (DOT) Regulations.

Transportation of wood pellets to end user locations may be done in consumer bags, big bags, blower tankers and tipping or walking floor trucks. The ISO 20023 Standard (ref. 3) provides guidance for small scale safe transportation, handling and storage. Recommendations include mitigation of dust, minimizing risk for self-heating and exposure to off-gassing and how to protect wood pellets from uptake of moisture.

The ISO 20023 Standard (ref. 3) provides guidance for safety related to safe delivery to and storage in residential buildings, including minimizing risk for dust explosions and exposure to carbon-monoxide (CO) and oxygen (O₂) depletion.

SECTION 15. REGULATORY INFORMATION

Hazard classification under this SDS is limited to wood pellets **not containing any additives and/or binders.**

This SDS is prepared in accordance with the Workplace Hazardous Material Information System (WHMIS) 2015 as set out in the Canadian Hazardous Products Regulation (HPR), Schedule 1 and the Global Harmonized System of Classification and Labelling of Chemicals (GHS) 2013 as well as recommendations by Canadian Center for Occupational Health and Safety (CCOHS).

Wood pellets are **not** classified as a hazardous product under the Canadian Hazardous Products Regulations (HPR) 2015.

Under IMO Regulations wood pellets is not classified as Dangerous Cargo. However, wood pellets is classified as Material Hazardous only in Bulk (MHB) under the IMSBC Code and is assigned a Class B, sub-Class OH (Other Hazard) as cargo which possesses a chemical hazard (off-gassing and oxygen depletion) which could give rise to a dangerous situation on a ship.

Wood pellets are **not** classified as Harmful to the Marine Environment (HME) according to rules for testing stipulated by the MARPOL Convention.

Wood pellets are **not** classified as hazardous to human health or animals according to rules for testing stipulated in UN GHS.

SECTION 16. OTHER INFORMATION

This document replaces all earlier versions released by Wood Pellet Association of Canada. Contact the manufacturer/supplier to obtain the latest version of the following documents;

- SDS for Wood Pellets in Bulk (this document)
- Wood Pellet Product Specification with more detailed data for wood pellets delivered and covered by this SDS under **Section 9.**



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This SDS applies only to wood pellets not containing any additives and/or binders and which are manufactured or supplied by the organization named in **Section 1** herein. The information in this SDS is based on consensus by occupational health and safety professionals, manufacturers of wood pellets and other sources, and is believed to be accurate or otherwise technically correct. No warranties are expressed or implied, and no liabilities are assumed, by the manufacturer or supplier, in regards to the completeness or accuracy of the information herein, or as to the merchantability or fitness of wood pellets for a particular purpose.

The purchaser and/or user are solely responsible for ensuring that the information and data given is applicable and that the latest version of the SDS is used, and for determining the suitability of wood pellets for their purposes. The purchaser and/or user assumes all responsibility for using and/or handling wood pellets in accordance with all applicable regulations and laws, and further assumes all risk of injury, loss, damage or expense, resulting from the use of or reliance upon the information contained herein.

The manufacturer and/or supplier are not in any way responsible for any direct, indirect, special, incidental, or consequential damage, or any other damages whatsoever and however caused, arising out of or in any way connected with the use of the wood pellets, or in reliance upon the information herein, whether the action is in contract, tort (including negligence), bailment, or on any other grounds or causes of action whatsoever.

The manufacturer and/or supplier further disclaim any liability for unauthorized use or reproduction of any portion of the information in this SDS.

References:

1. ISO 17225 Solid biofuels - Fuel Specifications and Classes – Part 1: General requirements.
2. ISO 17225 Solid biofuels - Fuel Specifications and Classes – Part 2: Graded wood pellets.
3. ISO 20023¹ Solid biofuels – Safety of solid biofuel pellets - Safe handling and storage of wood pellets in residential and other small-scale applications.
4. ISO 20024¹ Solid biofuels – Safety of solid biofuel pellets – Safe handling and storage of wood pellets in commercial and industrial applications.
5. ISO 20048¹ Determination of off-gassing and oxygen depletion.
6. ISO 20049¹ Determination of self-heating.
7. ISO 10156 Gases and gas mixtures – Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets.
8. International Maritime Solid Bulk Cargoes (IMSBC) Code, 2013 edition (ISBN 978-92-801-1587-1).
9. Marine Pollution (MARPOL) Convention, Guidelines for the implementation of MARPOL, 2012 edition, ISBN 978-92-801-1564-2.
10. Safety Of Life At Sea (SOLAS) Convention, consolidated edition July 1, 2014, ISBN 978-92-801-1594-9.
11. National Fire Protection Association (NFPA 70) – National Electrical Code.
12. National Fire Protection Association (NFPA) 499 – Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.
13. ATEX 137 Directive 99/92/EC on minimum requirement for improving the safety and health protection of workers potentially at risk from explosive atmospheres.
14. The Pellet Handbook, 2010, ISBN 978-1-84407-631-4.
15. Silo Fires: Fire Extinguishing, Preventative and Preparatory Measures, Henry Persson, The Swedish Civil Contingencies Agencies (MSB), 2013.
16. UN Globally Harmonized System for Classification and Labelling of Chemicals (ST-SG-AC10-30-Rev6e).
17. International Maritime Dangerous Goods (IMDG) Code, 2014 Edition, (ISBN-10: 9280115979; ISBN-13).
18. British Columbia Occupational Health and Safety Code, Guidelines Part 5.



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19. Health Canada. Determination of the aerobic Colony Counts in Foods (MFHPB 18), July 2015.
20. Health Canada. Enumeration of Yeast and Molds in Foods (MFHPB 22), January 2004.
21. International Plant Protection Convention (IPPC), February 13, 2012.
22. International Standards for Phytosanitary Measures (ISPM) #15, 2016.

Note:

- 1) To be published 2017-2018.

Abbreviations and acronyms:

ACGIH	American Conference of Governmental Industrial Hygienists
AED	Aerodynamic Equivalent Diameter
ASHRAE	American Society of Heating Refrigerating and Air-conditioning Engineers
ASTM	American Society of Testing and Materials
ATEX	ATmosphere EXplosible
atm	atmosphere pressure
bar	10 ⁵ Pascal (Pa) or 100 kPa or 0.9869 atm
CCOHS	Canadian Center for Occupational Health and Safety
DOT	US Department of Transportation Regulations
EMC	Equilibrium Moisture Content
g	gram(s) = 0.001 kg
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
h	hour(s)
HME	Hazardous for the Marine Environment
HPR	Hazardous Products Regulations
HS	Harmonized System Code
IDLH	Immediately Dangerous to Life and Health
IARC	International Agency for Research on Cancer
IMO	International Maritime Organization (UN)
ISO	International Standards Organization
L	litre
LEL	Lower Explosible Limit (MEC=LFL=LEL)
LFL	Lean Flammability Limit (MEC=LFL=LEL)
m ³	cubic meter
µg	microgram = 0.0000001 kg
µm	micrometer = micron= 0.000001 meter
mg	milligram = 0.000001 kg
min	minute
MHB	Material Hazardous (only) in Bulk
MSDS	Material Safety Data Sheet
NTP	National Toxicology Program
MARPOL	Marine Pollution Convention issued by IMO
MEC	Minimum Explosible Concentration (MEC=LFL=LEL)
MTC	Manual of Tests and Criteria, Recommendations on the transport of Dangerous Goods, United Nations
NFPA	National Fire Protection Association (USA)
NIOSH	National Institute for Occupational Safety and Health (USA)
NTP	Normal Temperature and Pressure (+20oC, 101.325 kPa or 1 atm)
OEL	Occupational Exposure Limit
OSHA	Occupational Safety and Health Administration (USA)
PEL	Permissible Exposure Level
ppmv	parts per million on a volume basis. For example, 5,000 ppmv means 5,000 molecules per 1 million molecules of gas, which also corresponds to 0.5 %.
	A concentration of 10,000 ppmv corresponds to 1 % of volume
REL	Recommended Exposure Limit



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s	second
SCBA	Self-Contained Breathing Apparatus
SDS	Safety Data Sheet
SOLAS	Safety of Life at Sea (SOLAS Convention) issued by IMO
STEL	Short Term Exposure Limit
STP	Standard Temperature and Pressure (0°C, 101.325 kPa or 1 atm)
TDG	Canadian Transportation of Dangerous Goods Regulations
TLV	Threshold Limit Value
tonne	1000 kg
TWA	Time Weighted Average
UN	United Nations
WHMIS	Workplace Hazardous Materials Information System
WPAC	Wood Pellet Association of Canada
w-%	% of weight