



BLUE GOOSE BIOREFINERIES INC.™

Safety Data Sheet

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product name: BGB Ultra™

Other common names or synonyms: cellulose nanocrystals (CNC), nanocrystalline cellulose, cellulose nanowhiskers, crystallites, rod-like cellulose microcrystals, cellulose nano-spheres **CAS no:** 9004-34-6 (cellulose, nanocrystalline form)

1.2. Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses: For research and development purposes.

Uses advised against:

1.3. Details of the supplier of the safety data sheet

Company: Blue Goose Biorefineries Inc.

Address: 104-2518 Faithful Ave., Saskatoon SK, Canada, S7K 6R3

Phone number: 1-888-245-3756

E-mail: info@bluegoosebiorefineries.com

1.4. Emergency telephone number

Emergency phone number: (During normal business hours) 1-888-245-3756

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

STOT SE 3 (H335: May cause respiratory irritation)

2.2. Label elements

Hazard pictogram: GHS07: Exclamation mark

Signal word: WARNING

Hazard statements

H335: May cause respiratory irritation

Precautionary statements

Precautionary statements – prevention

P210: If dry, keep away from all ignition sources including heat, sparks, open flames. Prevent dust accumulations to minimize explosion hazard.

P261: Avoid breathing dust

P262: Do not get in eyes, on skin, or on clothing

P271: Use only outdoors or in a well-ventilated area

P280: Wear protective gloves/protective clothing/eye protection/face protection

Precautionary statements – response

P304+P340: IF INHALED Remove victim to fresh air and keep at rest in a position comfortable for breathing.

P305+P351+P338: IF IN EYES Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P312: Call a POISON CENTER or doctor/physician if you feel unwell.

Precautionary statements – disposal

P501: Dispose of contents/container in accordance with local/regional/national/international regulation.

2.3. Other hazards



Explosion hazard: Strong explosion hazard if dust is dispersed into air at high enough concentrations.

SECTION 3: Composition/information on ingredients

3.1. Substances

Description	CAS No.	Composition
Cellulose NanoCrystals	9005-22-5	1-15%
Water	7789-20-0	85-99%

SECTION 4: First aid measures

4.1. Description of first aid measures	Inhalation	If dry powder, move to fresh air. Get medical attention if symptoms appear.
	Skin contact	Soap wash. Get medical attention if irritation occurs.
	Eye contact	Remove any contact lenses. Irrigate immediately. Get medical attention if irritation occurs.
	Ingestion	Do not induce vomiting unless directed to do so by medical personnel. Get medical attention if symptoms appear.
4.2. Most important symptoms and effects, both acute and delayed	Acute effects	Potential symptoms: Hoarseness, cough and phlegm. Exercise-induced dyspnea.
	Delayed effects	No data available.
4.3. Indication of any immediate medical attention and special treatment needed	Note to physician	This product may contain nanoscale particles. At this time, there is no further guidance specific to nanomaterial exposure.

SECTION 5: Firefighting measures

5.1. Extinguishing media	Use water, alcohol-resistant foam, dry chemical, or carbon dioxide.
5.2. Special hazards arising from the substance or mixture	Carbon monoxide or carbon dioxide may form when heated to decomposition. Explosion: Avoid generating dust.
5.3. Advice for firefighters	As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective clothing.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures	Remove ignition sources and provide sufficient ventilation. Avoid dispersal in air (i.e. clearing with compressed air), use current good practices. If powder, wear protective clothing and contained breathing apparatus for spills, avoid inhalation, and wash skin following contact. See section 8 for more details on protective equipment.
6.2. Environmental precautions	In the case of accidental spill, keep away from drains, surface, and groundwater. No acute environmental hazard.
6.3. Methods and material for containment and cleaning up	Ensure the product is not present at concentration level above cellulose TLV (section 8.1). Use HEPA-filtered vacuum or wet wiping methods and avoid re-dispersion of nanomaterial powder into the air. For gel spills, use absorbent materials/liquid traps. Immediately dispose of cleaning materials and do not dry and re-use contaminated materials.
6.4. Reference to other sections	See sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling	Use precautions taken for handling and storage of dusts and fine powder. Minimize dust generation and accumulation. Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces.
7.2. Conditions for safe storage, including any incompatibilities	Store in closed, tightly sealed containers in cool (4°C), dry, well-ventilated area, away from sources of ignition, electrostatic sparks, extreme heat, or mechanical friction. Protect from freezing. Do not store food or beverages in areas where materials are handled. Store away from strong oxidizing agents. Do not smoke in work area where materials are stored.
7.3. Specific end use(s)	

SECTION 8: Exposure controls/personal protection

8.1. Control parameters	
CNC	Cellulose dust
Avoid inhalation exposure to dried/powder forms and dusts. No occupational exposure limits for nano-forms of cellulose exist. British Standards Institute has developed pragmatic guidance for Occupational Exposure Limit (OEL) - for insoluble	<i>OSHA Permissible Exposure Limit (PEL)</i> - 15 mg/m ³ (total dust); 5 mg/m ³ (respirable fraction) Time Weighted Average (TWA) <i>NIOSH Recommended Exposure Limit (REL)</i> – 10 mg/m ³ (total dust) TWA; 5 mg/m ³ (respirable fraction) TWA <i>American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV)</i> - 10 mg/m ³ TWA <i>British Columbia Occupational Exposure Limit (OEL)</i> – 10 mg/m ³ (total dust) TWA; 3 mg/m ³ (respirable fraction) TWA

nanomaterials a factor of 0.066*OEL of conventional material is proposed.	
8.2. Exposure controls	
<p>8.2.1. Appropriate engineering controls: If user operations generate dust, fume, or mist, handle in a negative pressure cabinet or fume hood which has been tested and shown to provide effective containment to keep exposure to airborne contaminants below exposure limits. It is recommended that dust control equipment contain explosion relief vents. Assess the most likely routes of exposure and minimize risk. Refer to section 4.2.8.1 of ISO/TR 13329 for more information.</p>	
<p>8.2.2. Personal protection equipment: As with handling all substances, good hygiene practices are recommended. If dermal exposure is possible gloves, protective clothing, and goggles are recommended. In the absence of confirmatory measurements, inhalation exposure to dry forms should be avoided through the use of appropriate respirators when handled outside a glove box or fume hood.</p>	
Gloves	Preliminary evidence suggests that butyl rubber gloves may be more protective than nitrile gloves. Regular disposal and replacement of gloves is recommended.
Protective Clothing	Cover skin to minimize dermal exposure, avoid direct contact with abraded or lacerated skin. Non-woven protective clothing is preferable to woven fabric laboratory coats. Prolonged use or reuse should be avoided. Respirators and filters Limit dispersion into the air, minimizing and contain operations for handling powders, and working with proper exhaust ventilation with HEPA filters is recommended. When handled outside a glove box or fume hood, full face respirators with N100 cartridges are recommended; see Guidance from NIOSH

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties	9.2. Other information Nano-specific properties
<p>Appearance: Translucent viscous gel Odor: Odorless Odor threshold: n/a pH: 5.0 - 8.0 Melting point/freezing point: n/a Initial boiling point and boiling range: n/a Flash point: Cellulose ca. 240°C Evaporation rate: n/a Flammability (solid, gas): n/a. Cellulose may be combustible at high temperature (240°C) Upper/lower flammability or explosive limits: n/a. Cellulose dust explosion class “St 2 – strong explosion”. Cellulose dust deflagration index Kst = 229. Vapor pressure: n/a; Vapor density: n/a Relative density: 1.05 g/mL</p>	<p>Particle core size: 5 nm width, 210 nm length Particle size distribution: 100 nm - 250 nm Agglomeration/aggregation state: 101 nm Shape and aspect ratio: rod shaped, Aspect ratio 40 Specific surface area: 400 m²/g Surface chemistry/elemental composition: Pure cellulose with low (0.20 mmol/g) carboxyl content Surface charge (zeta potential): -30 mV Dustiness: No information available Crystallinity: 91%</p>

<p>Solubility(ies): Insoluble; forms a gel</p> <p>Partition coefficient: n-octanol/water: No data.</p> <p>Auto-ignition temperature: n/a. Cellulose powder may self-ignite at high temperatures (ca. 310-330°C). Decomposition temperature: >349°C</p> <p>Viscosity: No information available.</p> <p>Explosive properties: No information available.</p> <p>Oxidizing properties: No information available.</p>	
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SECTION 10: Stability and reactivity

10.1. Reactivity

Cellulose is stable.
Cellulose dust is classified as “St 2 – risk of strong explosion”, due to dust deflagration index Kst = 229 (OSHA CPL 03-00-008).

10.2. Chemical stability: CNC is stable under normal conditions.

10.3. Possibility of hazardous reactions: No data for CNC. Cellulose is slightly flammable to flammable in presence of open flames and sparks, and non-flammable in the presence of shocks. Self-ignition may occur at high temperatures.

10.4. Conditions to avoid: For dust: high temperatures, extreme pressure, fast air currents, compressed air, electrostatic sparks, collisions, mechanical friction, flames. Avoid incompatible materials such as acids and oxidizing agents.

10.5. Incompatible materials: Oxidizing agents (e.g. chlorates, perchlorates, nitrates, peroxides, chlorine). Fire and explosions may occur from reactions involving pentafluoride, acetic acid and micro crystalline cellulose. Contact between cellulose and sodium nitrite at elevated temperatures results in vigorous burning from decomposition reaction.

10.6. Hazardous decomposition products: Smoke, carbon monoxide, oxides of sulfur, carbon dioxide may form when heated to decomposition.

SECTION 11: Toxicological information

[NOTE: Where available, data reported for CNC. Where not, studies with microcrystalline cellulose (MCC) or bulk cellulose.]

11.1. Information on toxicological effects

11.1.1. Likely routes of exposure

Inhalation, eye contact.

11.1.2. Immediate, delayed, or chronic effects

Short term exposure

Inhalation	Data are limited; dust may be harmful if inhaled. Acute rat inhalation (OECD 403) LC50> 0.3 mg/L.
Ingestion	CNC did not show any acute oral toxicity in rats: LD50 > 2000 mg/kg (OECD 425; O’Connor 2014). Acute oral exposure to micro-crystalline cellulose (MCC) did not find any adverse effects (unpublished report, WHO 1998).
Dermal	CNC found to have primary irritation index of 0 (OECD 404); non-sensitizing intradermally (OECD 406); non-sensitizing topically (No effect at 10.7%; OECD 429); and not a contact dermal sensitizer (O’Connor 2014). Acute dermal exposure to MCC in rabbits found no dermal irritation (unpublished report, WHO 1998).
Eye	CNC exposure had no effect in human corneal epithelial cells (Zoppe 2014). Acute ocular instillation of MCC reported only minimal irritation (unpublished report, WHO 1998).

Long term exposure

Inhalation	Data are limited. Occupational studies have shown long term exposure to dust and fibers in a factory setting ($>10 \text{ mg/m}^3$) may lead to decreased lung function (Kraus 2004).
Ingestion	No adverse effects from repeated oral exposure to CNC for 28 days: LD50 $> 2000 \text{ mg/kg}$ (OECD 407; O'Connor 2014). No adverse effects in rats consuming a 30% MCC diet for 72 days (WHO 1998); no death nor growth effects in rats with a 0-20% cellulose diet for 4 weeks (Hove 1978); at 5, 10, 20% cellulose diet for 21-days in rat, no deaths (Sundaravelli 1971); 10% MCC fed to rats for 35 weeks reported no effects (Lupton 1988).
Dermal	No data available.
Eye	No data available.

11.1.3. Other measures of toxicity

Immunotoxicity	In vitro exposures to CNC did not result in inflammation (Catalan 2015). Low concentrations of MCC caused acute inflammation that resolved (Nagato 2008).
Neurotoxicity	No data available.
Genotoxicity	No mutagenicity or genotoxicity observed for CNC in Ames assay (OECD 471) or in vitro chromosome aberration assay ($>5 \text{ mg/L}$; OECD 473; O'Connor 2014); in vitro (Catalan 2015) or in vivo (OECD 474; O'Connor 2014) micronucleus test. For cellulose, no mutagenicity in Ames assay (Pitkänen 2010); in vitro no DNA strand breakage nor chromosomal damage (Lindberg 2014); no micronucleus induction (Catalán 2014).
Carcinogenicity	No data available for CNC. Cellulose sulfate, sodium salt is not listed as a carcinogen by ACGIH, IARC, NTP or CA Prop 65. No increased tumorigenicity in rats fed 30% MCC diet (unpublished report, WHO 1998).
Reproductive Toxicity	Limited mammalian data for CNC. No reproductive effects noted in rats fed 30% MCC diet (unpublished report, WHO 1998).
Biodurability/Bio persistence	Data are limited. CNC in artificial lung fluid degraded (Seehra and Stefaniak 2013). CNC (sulfated and unsulfated) in artificial lung fluid and alveolar fluid did not degrade (Stefaniak 2014). Half time of cellulose fiber clearance from lungs was ~ 1000 days (Muhle 1997). MCC in artificial lung and alveolar fluid did not degrade (Seehra and Stefaniak 2013; Stefaniak 2014).

SECTION 12: Ecological information

12.1. Toxicity

Acute data

Zebrafish embryo	NOEC $> 500 \text{ mg/L}$	Clendaniel 2014
Zebrafish embryo	CNC (with various coatings: carboxylated, AEE, taurine, ethylenediamine, hexamethylene diamine, GMAC, rhodamine, sulfonated) NOEC $\geq 2000 \text{ mg/L}$.	Harper 2016

Zebrafish embryo	LC50 > 6 g/L	Kovacs 2010
Rainbow trout	LC50 > 1-10 g/L	Kovacs 2010
Water flea (D. magna)	LC50 > 1-5 g/L	Kovacs 2010
Water flea (C. dubia)	LC50 > 0.3-5 g/L	Kovacs 2010
Fairy shrimp (T. platyrus)	LC50 = 3.54 g/L (pH 2.3) LC50 > 13.2 g/L (pH 6.8)	Kovacs 2010
Hydra attenuata	LC50 = 0.36 g/L (pH 2.3) LC50 >14.22 g/L (pH 6.8)	Kovacs 2010
Bacteria (E. coli)	IC50(3h)=1200 mg/L	Due 2016

Chronic data

Water flea (C. dubia)	IC50 > 0.2-1.6 g/L	Kovacs 2010
Microalga (P. subcapitata)	IC25 = 0.12 g/L (pH 2.3) IC25 > 2.5 g/L (pH 6.8)	Kovacs 2010
Fathead minnow	IC 25 = 0.29 g/L	Kovacs 2010
Hydra attenuata	EC50 = 0.06-0.36 g/L (pH 2) EC50 = 2.6-6.8 (pH 6)	Kovacs 2010

12.2. Persistence and biodegradability	CNC: 54% biodegradation after 28d (Kümmerer et al. 2011). 42% after 10 days using OECD 301 (O'Connor et al. 2014). Cellulose fibers readily biodegradable: using ISO 14855-1999 and EN 14046-2003, complete degradation by 25 days (Fernandes et al. 2011). Using EN14046 cellulose powder and Whatman cellulose paper were >60% after 28 days, and 82% and 69% after 65 days (Vikman et al. 2014).
12.3. Bioaccumulative potential	Limited uptake of CNC in Danio rerio (except at 500 ppm); (Clendaniel et al. 2014)
12.4. Mobility in soil	No data available.
12.5. Results of PBT and vPvB assessment	No data available.
12.6. Other adverse effects	No data available.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

All components are derived from natural materials and not anticipated to require specific handling for disposal. Avoid dust generation upon disposal. Not specifically listed as a hazardous waste under Transport of Dangerous Goods Act (TDG) or the U.S. Resource Conservation and Recovery Act (RCRA). However, if waste exhibits one or more of the following characteristics: ignitability, corrosivity, reactivity, or toxicity as described by 40 CFR 261.21-24, then waste must be classified as hazardous. At present, no nano-specific

regulations exist. Waste must be disposed of in accordance with federal, provincial/state, and local environmental control regulations.

SECTION 14: Transport information

- 14.1. UN number:** None
14.2. UN proper shipping name: Not applicable
14.3. Transport hazard class(es): Not applicable
14.4. Packing group: Not applicable
14.5. Environmental hazards: Not classified as hazardous to the environment
14.6. Special precautions for user: No additional information available
14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC code: Not applicable
Cellulose is not a DOT controlled material (United States).

SECTION 15: Regulatory information

- 15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture**
None for CNC. For related substances, see Section 8. All components of this product are on the Domestic Substances List. This material is not listed as a Hazardous Product, as it is included in Non-Application of Part II in the Hazardous Products Act. This material is not regulated under WHMIS 2015.
15.2. Chemical safety assessment: Supplier has not carried out chemical safety assessment for this substance.

SECTION 16: Other information

- SDS preparation date:** July 19, 2021
SDS last known revision date and changes made: Version 3, July, 2021
SDS prepared by: Vireo Advisors, LLC. P.O. Box 51368, Boston, MA 02205 USA www.VireoAdvisors.com
SDS revised by: Vireo Advisors, LLC. P.O. Box 51368, Boston, MA 02205 USA www.VireoAdvisors.com

Other comments:

Refer to NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, for safe handling. See ISO TR 13329. See ISO TR 13329.

NFPA Rating (based on cellulose dust):

Health 1; Flammability 1; Reactivity 0; Special information 0

NOTE:

The information in the safety data sheet should be provided to all who will use, handle, store, transport or otherwise be exposed to this product. All information concerning this product and/or suggestions for handling and use contained herein are offered in good faith and are believed to be reliable as of the date of publication. No warranty is made regarding the accuracy of and/or sufficiency of such information. Nothing contained herein shall be construed as granting or extending any license under any patent. If the date on this document is more than three years old, call to ensure that this sheet is current.