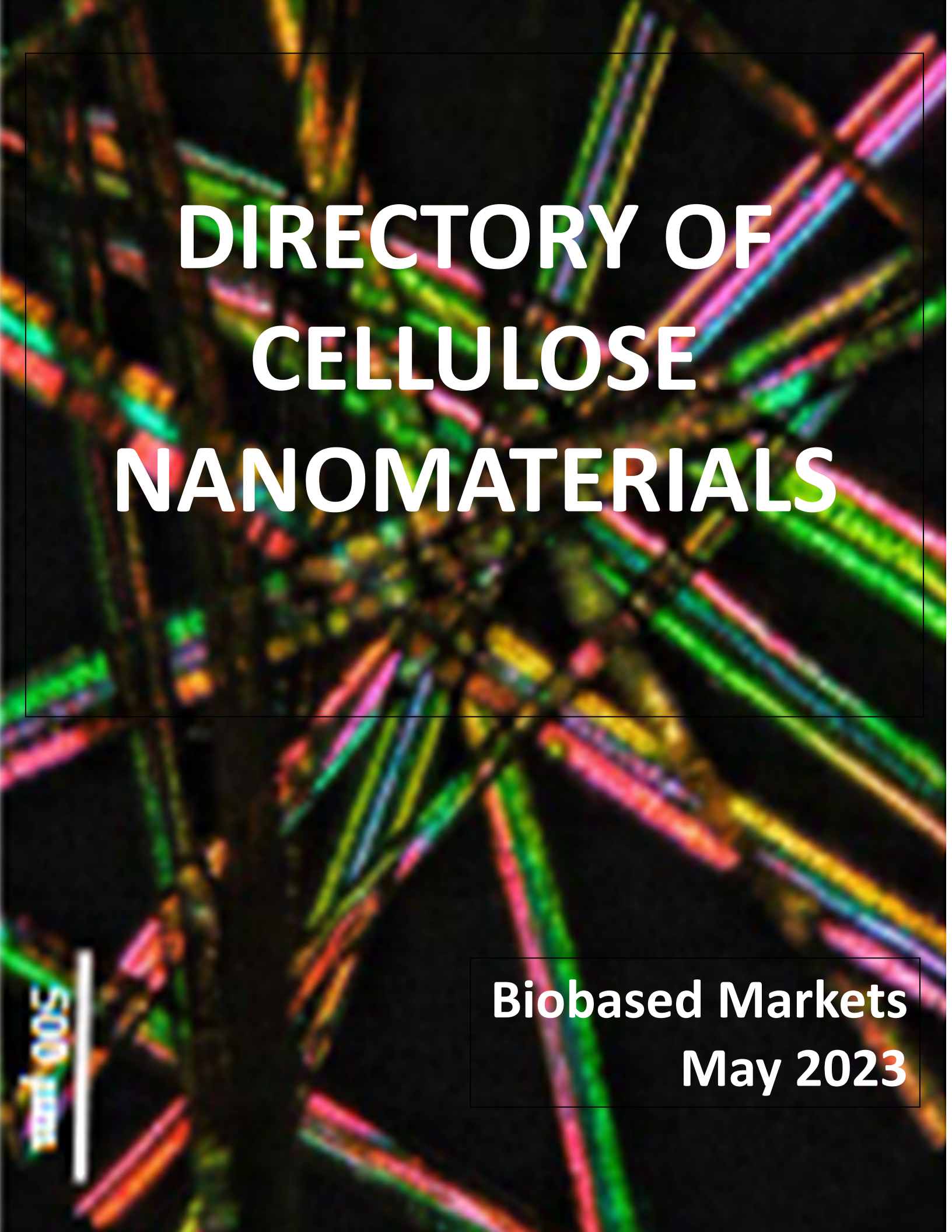
DIRECTORY OF CELLULOSE NANOMATERIALS



Biobased Markets
May 2023

sappi | Valida

Sappi is a leading global provider of everyday materials made from woodfibre-based renewable resources.

As a diversified, innovative and trusted leader focused on sustainable processes and products, we are building a more circular economy by making what we should, not just what we can.

Our market offerings such as dissolving pulp, wood pulp, biomaterials, timber, packaging and speciality papers, graphic papers, casting and release papers and forestry products are manufactured from woodfibre sourced from sustainably managed forests and plantations, in production facilities powered, in many cases, with bio-energy from steam and existing waste streams.

Sappi Valida is a leading producer of fibrillated cellulose with naturally derived functionality for a wide range of applications including personal care, agriculture, coatings, construction additives and packaging. Sappi Valida is available in commercial volumes from a number of production facilities.

For more information on Valida visit our website:
https://www.sappi.com/valida-home

Contact: Valida@sappi.com

sappi

Biobased Markets
May 15, 2023

On the Cover

Thanks to Jeff Youngblood, Professor, Purdue University School of Materials Engineering, for the micro-photograph of polyvinyl alcohol/cellulose nanocrystal fibers.

The Youngblood Group at the School of Material Engineering investigates nanotechnology, surface science, advanced processing, and biomaterials. Sustainable Nanotechnology in the Youngblood Group focuses on cellulose nanomaterials which are sustainable, non-toxic and derived from biomass.

Commercially available fiber-spinning methods are being explored to produce high strength, high stiffness nanocellulose reinforced commodity polymer fibers where nanoparticle alignment and nanoparticle concentration are critical to performance.

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Contents

Introduction

About The Directory of Cellulose Nanomaterials

Following the update of the TAPPI Nano Production Summary (https://www.tappinano.org/whats-up/production-summary/), Biobased Markets, TAPPI, and TAPPI's Nanotechnology Division agreed that it would be good for the industry for Biobased Markets to publish *The Directory of Cellulose Nanomaterials.*

It was agreed that *The Directory* should be free, and listings should also be free, and that *The Directory* should be funded entirely through advertising. TAPPI Publications and the TAPPI Nanotechnology Division will help distribute it, and Biobased Markets will pursue other channels as well to get the broadest possible circulation and maximum exposure for the organizations listed in *The Directory*.

We believe *The Directory* is the world's most complete global listing of producers of nanocellulose, providers of technology related to nanocellulose, and service providers, research organizations and universities working with nanocellulose. Companies and other organizations who wish to be included in any future issues of *The Directory* should contact Biobased Markets.

Feel free to distribute *The Directory* yourself, in its entirety, as you see fit.

About Biobased Markets

Market-Intell LLC was founded in 2005 by Jack Miller to provide market intelligence in paper, print, and re-branded as Biobased Markets in 2018. Biobased Markets is now focused primarily on biobased materials, especially nanocellulose and lignin.

Market-Intell LLC and Biobased Markets have collaborated with organizations such as TAPPI, Fastmarkets RISI, and Biofuels Digest, as well as a number of independent associate consultants, universities, and research organizations. Services include business development, lead development, market research, support for due diligence for potential investors, and custom Webinars to provide education about lignin and nanocellulose applications and markets.

Market-Intell and Biobased Markets have served clients in North America. South America, Europe, and Asia.

Since 2005, Jack Miller has been Principal Consultant, Market-In tell LLC. Jack has served as an Associate Consultant with RISI and a member of the Advisory Board of Sweetwater Energy, a biorefinery company. Jack was Business Development Consultant with CelluForce, Inc., from 2011 to 2013, and was Consulting Manager, Global Nanocellulose Sales, American Process, Inc. (now GranBio), in 2014 and 2015. Prior to 2005 Jack enjoyed a long career in the pulp and paper industry.

Jack is the author of:

- TAPPI Cellulose Nanomaterials Production Summary, TAPPI, November 2022
- *Lignin 2021: A Pivotal Year*, published by Biofuels Digest in March 2021
- Nanocellulose: Packaging Applications and Markets published by RISI in 2019
- Nanocellulose Challenges and Opportunities: End User Perspectives, published by TAPPI in 2018
- Lignin: Technology, Applications, and Markets published by RISI in 2017
- Nanocellulose Producers, Products and Applications, A Guide for End Users, published by TAPPI in 2017
- Nanocellulose: Technology, Applications and Markets, published by RISI in 2014.

Overview of Cellulose Nanomaterials

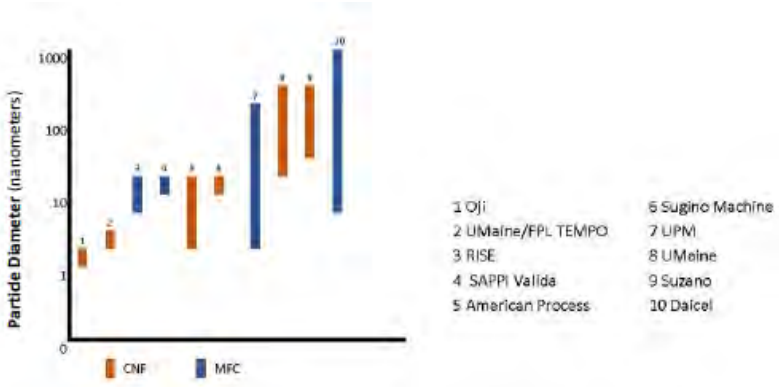
It is well known that the distinction between microfibrillated cellulose or cellulose microfibrils (MFC), and nanofibrillated cellulose or cellulose nanofibrils (CNF) is not clear cut. As reported in the previous Production Summary, some materials called CNF are primarily micro-scale while some called MFC are primarily nano-scale, and some are a mix of nano- and micro-scale particles (Figure 1). Accordingly, some producers have suggested the term "cellulose fibrils" rather than CNF or MFC. This point is well taken, but in this Summary, we use the terminology the producer uses. If nano or micro are not specified, the material is included under MFC.

It has also become apparent that the difference between CNF and CNC (cellulose nanocrystals) is not clearly defined. CNC was originally produced primarily from bleached pulp by means of sulfuric acid hydrolysis, which essentially separates the crystalline portion of cellulose from the non-crystalline or amorphous portion. CNF was produced by primarily mechanical means, in some cases with enzymatic or chemical pretreatment to reduce energy cost. CNF and CNC were very different, and the difference was quite clear.

Now, however, biorefinery processes have emerged that produce CNF or CNC from biomass. GranBio (American Process) uses sulfur dioxide and ethanol (AVAP® Process) to fractionate biomass into lignin, hemicellulose and cellulose, and can produce either CNC or CNF, or a blend of the two.[1] More recently, Sweetwater Energy introduced its SunburstTM reactive extrusion process which also fractionates biomass into lignin, hemicellulose and cellulose, and with further enzymatic hydrolysis can yield CNC or CNF.[2] CNC and CNF cannot be definitively distinguished by particle size, crystallinity, or other metrics, though cellulose nanofibrils tend to be longer, and may be entangled, while nanocrystals tend to be more crystalline and can be presented as discrete particles.

A more detailed discussion is beyond the scope here, but we can report that ISO, with support from TAPPI, is working to develop standards for the measurement of cellulose nanomaterial particle size.

Figure 1
CNF and MFC Particle Diameters



Source: *Nanocellulose: Producers, Products, and Applications, A Guide for End Users*, TAPPI, 2017

[1] Miller, J. Nanocellulose Producers, Products and Applications, A Guide for End Users, TAPPI, 2017.
[2] Miller J. *Lignin 2021: A Pivotal Year*, BioFuels Digest, 2021.

Production Summary

Cellulose Nanocrystals (CNCs)

CNC Capacity 2022
(tonnes per year, dry basis)

Producer	Process	Capacity
CelluForce, Canada	sulfuric acid hydrolysis	300
Anomera, Canada	carboxylated	170
GranBio, U.S.	SO_2 fractionation	130
Navitas, Slovenia	proprietary	50
Melodea, Sweden	sulfuric acid hydrolysis	35
Fibenol, Estonia	reactive extrusion	6
Forest Products Lab, U.S.	sulfuric acid hydrolysis	3
Blue Goose Biorefineries, Canada	metal catalyzed oxidation	2
Innotech Alberta	sulfuric acid hydrolysis	1
Cellulose Lab, Canada	various	<1
Sweetwater Energy, U.S.	reactive extrusion	pilot
FPInnovations, Canada	sulfuric acid hydrolysis	pilot
Hangzhou Yeuha Technology Co., China	proprietary	pilot
Tianjin Haojia Cellulose Co. Ltd., China	modified and unmodified	pilot

Cellulose Nanofibrils (CNF) and Microfibrillated Cellulose (MFC)

CNF Capacity 2022
(tonnes per year, dry basis)

Producer	Process	Capacity
Sappi Biotech, Global	proprietary	650
Nippon Paper, Japan	TEMPO, carboxylated	560
University of Maine, U.S.	mechanical	260
GranBio, U.S.	SO_2 fractionation	130
CelluComp, UK	chemical pretreatment	100
Oji Paper, Japan	phosphate esterification	40
Chuetsu Pulp and Paper, Japan	aqueous counter collision	30
Sugino Machine, Japan	oblique collision	26
Seiko PMC, Japan	modified hydrophobic	24
Cellulose Lab, Canada	TEMPO, other	18

Tianjin Haojia Cellulose Co., Ltd, China	TEMPO, carboxylated	3
Dai-ichi Kogyo (DKS), Japan	TEMPO	1
U.S. Forest Products Lab, U.S.	TEMPO, mechanical	<1
ITENE, Spain	mechanical	pilot
VTT, Finland	chemical, enzymatic, mechanical	pilot

MFC Capacity 2022
(tonnes per year, dry basis)

Producer	Process	Capacity
Weidmann Fiber Technology, Switzerland	mechanical	100-150
FiberLean Technologies, UK	mechanical w. minerals	13,000
Sappi Biotech, Global	proprietary	6,220
Borregaard, Norway	proprietary	1,000
Suzano, Brazil	mechanical	500
Norske Skog, Norway	mechanical	365
Klabin, Brazil	mechanical	350
RISE, transportable container factory	enzymatic pretreatment	200
Daicel, Japan	high pressure homogenizer	200
CTP/FCBA, France	enzymatic pretreatment	25
RISE, Sweden	enzymatic pretreatment	25
Empa, Switzerland	enzymatic pretreatment	pilot
InoFib, France	chemical pretreatment	pilot
ITENE, Spain	mechanical	pilot
Stora Enso, Finland	n/a	pilot
Tianjin Haojia Cellulose, China	modified: TEMPO, other	pilot
UPM, Finland	n/a	pilot

Cellulose Filaments (CFs)

Cellulose filaments are a variant of MFC or CNF in which long, thin filaments are produced from pulp "by peeling the filaments from wood fibers using a mechanical process that uses no chemicals or enzymes."[3] Cellulose filaments have a greater aspect ratio than MFC or CNF, i.e., 1,000 or more, with width of 80 to 300 nm.

[3] https://fpinnovations.ca/media/factsheets/Documents/cellulose-filaments.pdf

Cellulose filaments were developed by **FPInnovations** and were first commercialized by **Kruger Inc.** under the brand name FiloCell™.

Cellulose Filaments Capacity 2022
(tonnes per year, dry basis)

Producer		Capacity
Performance BioFilaments, Canada	mechanical	7,000
Kruger, Canada	mechanical	6,000
Tianjin Haojia Cellulose, China	n/a	n/a

Save the Date!

2023

TAPPI International Conference on Nanotechnology for Renewable Materials

12-16 June 2023

The Westin Bayshore, Vancouver

Vancouver, BC Canada

TAPPI NANO DIVISION

Conference.tappinano.org

Innovations are always on the horizon. See you in 2024!

International Conference on Nanotechnology for Renewable Materials

10-14 JUNE 2024

ATLANTA, GEORGIA USA

at the Westin Buckhead Atlanta

TAPPI NANO DIVISION

Producers of Cellulose Nanomaterials

At Pilot Scale or Larger

Alberta Innovates (Canada)

See Innotech Alberta

American Process (U.S.)

See GranBio

Anomera (Canada)

805-460, rue Sainte-Catherine Ouest
Montreal, Québec, Canada H3B 1A7
514 845 4444
https://www.anomera.ca/

In July 2022, Anomera, Inc. began production at its 170 tpy carboxylated CNC facility in Canada. Anomera operates a pilot plant at the Montreal R&D Lab as well its Pilot facility at XRCC in Mississauga, Ontario. Anomera has the capability to ramp up production to meet demand. In November 2020, Anomera and Croda International announced a collaboration to develop high quality carboxylated CNC for the cosmetics and personal care markets. Croda is the exclusive supplier of Anomera's materials in the personal care market.

Contact:
info@anomera.ca

Asahi Kasei (Japan)

Hibiya Mitsui Tower
(TOKYO MIDTOWN HIBIYA)
1-1-2 Yurakucho, Chiyoda-ku,
Tokyo 100-0006 Japan
https://www.asahi-kasei.com/

Asahi Kasei is a leading global producer of fiber products, chemicals, and electronic related materials based on its core technology of chemistry. Asahi Kasei products include Ceolus™ and Celphere™ microcrystalline cellulose, and NanoAct™ cellulose nanobeads.

Contact:
https://www.asahi-kasei.com/contact_us/

Axcelon Biopolymers Corporation (Canada)

7-717 Richmond Street,
London, Ontario N6A 1S2
http://axcelonbp.com/

Axcelon Biopolymers Corporation (ABC) is an innovative biomaterials company focused on leveraging its unique bacterial nanocellulose (BNC) platform technology to develop high-value products for wound care, medical devices, tissue engineering, and industrial applications. Axcelon's products include Nanoderm®, a microfibrillar biosynthetic cellulose film that stimulates the skin's natural regenerative mechanism to help promote quicker wound healing with a one-time application dressing.

Contact:
Dino Mili, President & COO
dmili@axcelonbp.com

Blue Goose Biorefineries Inc. (Canada)

#104-2518 Faithfull Avenue
Saskatoon, Saskatchewan
306-280-6831
www.bluegoosebiorefineries.com

Blue Goose Biorefineries (BGB) is a wholly-owned subsidiary of Nano-Green Biorefineries Inc., a privately held Canadian company. Blue Goose's BGB Ultra™ CNC is an aqueous suspension of carboxylated cellulose nanocrystals that is produced with a transition metal catalyzed oxidative process. Samples of BGB Ultra™ are available at https://bluegoosebiorefineries.com/shop/.

Contact:
Blaine Kunkel, CEO
bkunkel@bluegoosebiorefineries.com

Borregaard ASA (Norway)

PO Box 162
1701 Sarpsborg
+47 (0) 69 11 80 00
www.borregaard.com

Borregaard, a leading biorefinery company, has produced commercially available cellulose fibrils since 2016, in Sarpsborg, Norway. Exilva is an insoluble microfibrillated cellulose, which interacts both physically through its extreme surface area and chemically through hydrogen bonding. Its novel nature gives it rheological, mechanical and barrier functionalities, which as an additive, imparts a unique combination of properties in finished product systems. Free samples of Exilva are available online.

Contact:
Chief Technology Officer, Cellulose Fibrils
hans.henrik.ovrebo@borregaard.com

CelluComp Ltd (UK)

Unit 3, West Dock
Harbour Place
Burntisland, Fife
KY3 9DW
+44 (0)1592 870335
https://www.cellucomp.com/

CelluComp is a Scottish-based company whose "principle activity is to develop and commercialize Curran®," CNF, from root vegetables, primarily from sugar beet pulp. Curran is a commercial product. produced as a slurry, with a solids level of approximately 20%.

Contact:
enquiries@cellucomp.com

CelluForce (Canada)

2000 McGill College Avenue, 6th Floor
Montreal, Quebec, H3A 3H3
514-360-1023
www.celluforce.com

CelluForce is the world leader in the development, production and commercialization of Cellulose NanoCrystals (CNC). The company operates the world's largest CNC plant, capable of producing 300 tonnes per year of high-quality sulfated cellulose nanocrystals. The company's products are currently used in several applications including oil and gas completion fluids, cosmetics and rubber products. CelluForce was created in 2010 and its current shareholders are Domtar, FPInnovations, Schlumberger, Suzano and Investissement Quebec.

Contact:
info@celluforce.com

Cellulose Lab (Canada)

2 Garland Court, Room 212, Enterprise Bld.
Fredericton, NB, E3B 5A3, Canada
www.celluloselab.com

Cellulose Lab has been producing nanocellulose products since 2016. Cellulose Lab offers a diverse range of nanocellulose products including CNC, CNF, and bacterial cellulose (BC). CNF is available in a number of forms including TEMPO and more conventional forms. CNC capacity is 1kg per day and CNF capacity is 50 kg/day.

Contact:
contact@celluloselab.com;

Centre Technique du Papier (France)

Domaine Universitaire - CS 90251
38044 GRENOBLE - Cedex 9
+33 (0) 4 76 15 40 15
https://www.webctp.com/

Centre Technique du Papier (CTP) is the French Pulp and Paper Research and Technical Centre located at the University Campus, in Grenoble. CTP, in partnership with FCBA, operates the "NaMiCell" MFC/CNF pilot plant. The plant produces up to 100 kg per day of MFC/CNF in batches of 30 kg to 70 kg in the form of a 3% gel by way of a patented protocol. TEMPO MFC/CNF can also be produced on request.

Contact:
https://www.webctp.com/fr/contact/-acces

Chemkey Advanced Materials Technology (Shanghai) Co., Ltd (China)

B316, No.4226 Duzhuang Road,
Shanghai, China
021-64196821
http://chemkey.com.cn/

Chemkey can provide lab samples of cellulose nanocrystals, microfibrillated cellulose, and cellulose nanofibers: http://en.chemkey.com.cn/c/l-142-0.html.

Contact:
http://en.chemkey.com.cn/c/127.html

Chuetsu Pulp and Paper (Japan)

282 U.J., Takaoka-shi
Toyama Prefecture, 933-8533
0766 26 2401
www.chuetsu-pulp.co.jp

Chuetsu is a leading pulp and paper producer. In June 2017, Chuetsu started commercial production at Satsuma-Sendai, Kagoshima, Japan, to produce CNF using bamboo, hardwood and softwood bleached kraft pulp as its raw material. Chuetsu manufactures a unique CNF called Nanoforest® using the Aqueous Counter-Collision Method ("ACC method"). Nanoforest-S is a commercial product available as 2 wt. % and 10 wt. % solids.

Contact:
https://www.cpc-cenf.com/form.html

Daicel (Japan)

Grand Front Osaka Tower-B, 3-1
Ofuka-cho, Kita-ku, Osaka
+81 6 7639 7171
https://www.daicel.com/en/

Daicel is a leading Japanese chemical company. Daicel produces CELISH cellulose fiber, microfibrillated by special manufacturing process, and is produced from highly refined, pure fiber raw materials. The raw material fiber is unraveled into tens of thousands of strands, and the fiber thickness is refined to between several µm and 0.01µm. Because it is refined so that it does not impair the exact basic characteristics of the cellulose raw material (physical and chemical stability etc.), high-value-added product settings are possible.

Contact:
https://www.daicelmiraizu.com/en/inquiry/index.html

Daio Paper Corporation (Japan)

Tokyo Headquarters
Iidabashi Grand Bloom, 10-2
Fujimi 2 chome, Chiyoda Ward, Tokyo 102-0071
+81 3 6856 7500
http://www.daio-paper.co.jp/en/index.html

Daio is a full range of papermaking company that manufactures and sells paper, converted paper products, and functional materials. Daio products include cost-competitive ELLEX CNF. ELLEX is available as an aqueous dispersion (capacity 100 tpy), dry powder (capacity 10 tpy), and molded sheet.

Contact:
https://www.daio-paper.co.jp/en/contact/form-08/

DKS Co., Ltd. (Japan)

5 Ogawara-cho, Kisshoin, Minami-ku
Kyoto 601-8391, Japan
+81-75-323-5911
www.dks-web.co.jp

DKS Co. Ltd. (DKS) focuses on chemistry for a broad range of fields, including textiles, resins, industrial materials, materials for daily living, the environment, and energy. DKS produces carboxymethyl cellulose (CMC) and TEMPO oxidized cellulose nanofibers “RHEOCRYSTA” as aqueous functional additives.

Contact:
https://www.dks-web.co.jp/english/form/inquiry/

Empa (Switzerland)

Ueberlandstrasse 129
8600 Dübendorf / Switzerland
+41 58 765 11 11
https://www.empa.ch/web/empa/

An institute of the ETH domain., Empa is the Swiss Federal Laboratories for Materials Testing and Research. Empa operates a MFC pilot plant and conducts applications research with industry partners.

Contact:
https://www.empa.ch/web/empa/contact-form

Fibenol OÜ (Estonia)

Mõisa 4, 13522
Tallinn, Estonia
+372 5323 3550
https://fibenol.com/

Fibenol has developed a new generation of sugars, high purity hydrolysis lignin, and microcrystalline cellulose (MCC) from hardwood. Fibenol provides three different grades of MCC as aggregated CNC or CNF. The three grades differ in lignin content: crude MCC (25-30% of lignin), blonde MCC (5-10% of lignin), white MCC (less than 5%). Fibenol CNC is disaggregated MCC. Fibenol has the capabiily to produce 10 tons of each grade of CNC paste, 20 wt%, 30 tons total, 6 tons dry basis.

Contact:
info@fibenol.com

FiberLean Technologies Ltd. (UK)

Par Moor Centre
Par Moor Road, Par, Cornwall PL24 2SQ
www.fiberlean.com

FiberLean® Technologies Ltd., a joint venture between Imerys and Omya, was acquired by Werhahn KG in 2021. FiberLean is the leading global producer of Microfibrillated Cellulose (MFC). In FiberLean's proprietary process, pulp and minerals such as calcium carbonate, kaolin and talc are ground together to produce FiberLean® MFC mineral composite. FiberLean MFC plants are available in different capacities ranging from 1,000 tons to over 10,000 tons of FiberLean MFC per year and are installed at paper mills.

Contact:
https://www.fiberlean.com/contact/

Fibria Celulose S.A. (Brazil)

Fibria merged with Suzano in 2019. See Suzano.

FPInnovations (Canada)

570 Boulevard St-Jean,
Pointe-Claire, Quebec H9R 3J9 Canada
+1 (514) 630-4100 or info@fpinnovations.ca
http://www.fpinnovations.ca/

Specializing in innovative scientific solutions, FPInnovations inaugurated its first CNC research facility with a state-of-the-art pilot plant in 2011. We also produced the first cellulose filaments (CF) in the laboratory and its pilot plant. Today we collaborate with many strategic research alliances, members, and partners. Using the technology developed by our research staff, industry now benefits in developing nanocellulose markets and applications. CelluForce (CNC), Kruger Biomaterials, and Performance Biofilaments (CF) are examples of our collaborations.

Contact:
stephan.lariviere@fpinnovations.ca

GL&V USA Inc. (U.S.)

1 Cellu Drive
Nashua, NH 03063
603-882-2711
http://www.glv.com/

GL&V was acquired by Valmet. See Valmet

GranBio USA

300 Mcintosh Parkway
Thomaston, Georgia, 30286
http://www.granbio.com.br/en/

GranBio has developed two patented BioPlus® nanocellulose production technologies for different markets, BioPlus® with AVAP® and BioPlus® with GreenBox®. Both processes are demonstrated at the scale of 1/2 tpd at GranBio Biorefinery in Thomaston, Georgia. These processes allow for the economical extraction of commercial-scale nanocellulose from any biomass with adjustable particle size and composition. Nanocellulose fibrils produced through the chemical-free GreenBox process have exceptionally low cost that enables their use in large volumes.

Contact:
Kim Nelson, CTO Nanocellulose
knelson@granbio.com

Guilin Qihong Technology Co. Ltd. (China)

12 Jiangan Road, Qixing District,
Guilin City, Guangxi Province.
156#7706#2278
http://www.qh-tech.cn/en/h-default.html

Guilin Qihong Technology Co., Ltd. focuses on research for the production and application of cellulose Nanofiber. Our products include carboxylated cellulose nanofibers (CNF), sulfate esters nanocrystals (CNC), hydrophobic nanocellulose (hydrophobic-CNC), and bacterial cellulose (BC). We own several national patents for inventions and processing technology and we are sincerely looking forward to cooperating with partners.

Contact:
Email 414328106@qq.com

Hangshi Technology Development (Hangzhou) Co., Ltd. (China)

No.168 Qianwu Road, Qingshanhu Science and Technology City,
Lin'an District, Hangzhou City, Zhejiang Province, China
+86-572-8276858
http://www.hangshitech.com/index_en.html

Led by Hangzhou Research Institute of Chemical Industry Co. with Zhejiang University Quzhou Research Institute, Hangshi Group, Jingxiu Environmental Protection, Dubai Technology, and other research institutes and enterprises, Zhejiang Biodegradable and Nano Materials Innovation Center is a new type of industry-university-research innovation alliance with the strong support of governments at all levels of the country. The Innovation Center and South China University of Technology and has built a 100kg/d micro and nano cellulose green pilot test line.

Contact:
http://www.hangshitech.com/contact_en.html

Hansol Paper (South Korea)

23-24F, Tower B, 100, Eulji-ro, Jung-gu,
Seoul, Republic of Korea
https://www.hansolpaper.co.kr/eng/main

Hansol is a leading producer of paper and biomaterials. Hansol Paper has been concentrating its investment on developing nanocellulose from pulp since 2010, and set up the production system in late 2018. Hansol's goal is to advance into the material industry beyond the paper industry through nanocellulose, which has great potential for business expansion across different industries.

Contact:
https://www.hansolpaper.co.kr/eng/customer/inquiry

Holmen AB (Sweden)

PO Box 5407
SE-114 84 Stockholm
+46 8 666 21 00
www.holmen.com

One of the largest forest owners in Sweden, Holmen is a major producer of paper, paperboard and wood products, plus renewable energy from wind and water. Holmen is also a 42.4% owner of Melodea Ltd., a producer of CNC.

Contact:
https://www.holmen.com/en/contacts/

InnoTech Alberta (Canada)

250 Karl Clark Road
Edmonton, AB T6N 1E4
780-450-5111
www.innotechalberta.ca

InnoTech Alberta, a subsidiary of Alberta Innovates, is a leading research and technology organization serving the needs of industry, entrepreneurs, and public sector. Our organization's multidisciplinary expertise, cross-sector teams, and pilot-scale research facilities accelerate technology development. InnoTech Alberta operates a cellulose nanocrystals (CNC) pilot plant that can produce up to 20 kg per week of CNC from a variety of feedstocks.

Contact:
info@innotechalberta.ca.

Innotech Materials LLC (U.S.)

10437 Innovation Drive, Suite 324
Wauwatosa, WI 53226
414-488-2092
http://www.innotechmaterials.com/

Innotech Materials has developed a process for catalytic oxidation of commercial cellulose to produce hydrophobic and hydrophilic nanocellulose. Innotech products include: Oxidized Nanocellulose for applications in polymer biocomposites; Methyl Nanocellulose and Hydroxypropyl Methyl Nanocellulose for personal care, cosmetics, and pharmaceuticals; Carboxy Methyl Nanocellulose for bioadhesives; Hydrophobic Nanocellulose for bioplastic packaging.

Contact:
info@innotechmaterials.

Innovatech Engineering (U.S.)

1650 Summit Lake Dr. Suite 103
Tallahassee, FL 32317
United States
(850) 391-2396
https://innovatech.us/

Innovatech is focused on bringing new technology to the market, specifically the commercialization of nanocellulose. Innovatech produces Nanopaper nanocellulose sheets in thicknesses from 0.012 to 0.015 millimeters. Nanopaper can be translucent, or transparent, made from TEMPO oxidized cellulose nanofibers.

Contact:
info@innovatech.us

Innventia (Sweden)

See RISE.

Klabin S.A. (Brazil)

Avenida Brigadeiro Faria Lima
3600 - 3, 4 e 5 andares, Itaim B
Sao Paulo 04.538-132
+55 11.30465800
https://www.klabin.com.br/en/home/

Klabin is Latin America's leading producer of containerboard, boxboard and packaging papers. In February 2018, Klabin acquired a minority interest in Israel-based Melodea Ltd., a producer of cellulose nanocrystals. In September 2018, Klabin announced an investment of Real 32 million for its research and development program for the construction of a Pilot Mill Complex in Telêmaco Borba (Paraná) to begin operating in 2019. The complex was developed to conduct testing and research on MFC to be incorporated into the company's paper production lines.

Contact:
https://www.klabin.com.br/general/contact-us/contact-us/

Kruger (Canada)

3285, Chemin Bedford
Montréal, Québec H3S 1G5
514-343-3100
http://bio.kruger.com/

Kruger Inc. is a major Canadian producer of tissue products, renewable energy, paper and paperboard made from recycled fibers, specialty papers for eco-friendly food packaging and labelling products, and cellulosic biomaterials. In September 2013, Kruger Biomaterials formed a strategic alliance with FPInnovations to produce and commercialize cellulose filaments, a form of cellulose nanofibrils. FiloCell is produced at 30% solids, with width of 30-500 nm, and most frequently 80-300 nm, and with length of 100-2,000 µm. Current capacity is 6,000T/y.

Contact:
https://biomaterials.kruger.com/contact-us/

Marubeni (Japan)

4-2, Ohtemachi 1-chome, Chiyoda-ku,
Tokyo 100-8088, Japan
[81] (3) 3282-2111
https://www.marubeni.com/en/

Marubeni Corporation and its consolidated subsidiaries use their broad business networks, both within Japan and overseas, to conduct importing and exporting, as well as domestic business, encompassing a diverse range of business activities across wide-ranging fields including lifestyle, ICT business & logistics, food, agri business, forest products, chemicals, and much more. In 2022 Marubeni and Chuetsu Pulp announced new agricultural material that uses the ACC cellulose nanofiber nanoforest® manufactured by Chuetsu. See Chuetsu.

Contact:
https://www.marubeni.com/en/contact_form/

Melodea Ltd. (Israel)

Faculty of Agriculture
The Hebrew University of Jerusalem
76100 Rehovot
www.melodea.eu

Melodea was founded in 2010 by researchers from the Hebrew University in Israel and industrial experts from the clean-tech sector. Melodea is backed by investors from the pulp and paper industry: Holmen, Klabin, Double A, Bazan Group, and Asia Plus. Melodea has developed a unique technology for the extraction and production of CNC from wood pulp and paper production side streams. Melodea's focus is CNC-based barrier coatings, including MelOx for oxygen barrier, and VBSeal and VBCoat for oil and grease and water vapor barrier,

Contact:
info@melodea.eu

Navitas d.o.o (Slovenia)

Podcerkev 1A
1386 Stari trg pri Ložu
Slovenia (EU)
+386 41 648 879
https://www.nanocrystacell.eu/

Navitas started production of Nanocrystacell CNC in 2020 in Slovenia following development beginning in 2018. Capacity is 10 tonnes per year, and the glycol-based process results in CNC with negligible sulfur content. Nanocrystacell is available as freeze vacuum dried powder or aqueous suspension. Capacity is 50 tonnes per year, dry basis.

Contact:
contact@nanocrystacell.eu

Nippon Paper Group (Japan)

1-2-2 Hitotsubashi, Chiyoda-ku
Tokyo 100-0003
81-3-6665-1000
https://www.nipponpapergroup.com/english/products/cnf/

Nippon Paper is Japan's largest manufacturer of paper and paperboard, and is also one of the world's largest producers of CNF with capacity for 560 tonnes per year. In October 2013, Nippon established the first pre-commercial plant in Japan at its Iwakuni mill. Nippon later started operations at the Ishinomaki Mill (TEMPO), the Fuji Mill (Kyoto Process), and the Gotsu Mill for food and cosmetics additives. Nippon Paper's work with CNF is focused on composites, cosmetics, filtration, gas barrier films and health care products.

Contact:
https://www.nipponpapergroup.com/english/inquire/

Norske Skog ASA (Norway)

PB 294 Skøyen
0213 Oslo, Norway
https://www.norskeskog.com/products/energy-bio-products/cebina

Norske Skog installed their MFC pilot plant at Saugbrugs in 2017 with an announced capacity of 365 tonnes of CEBINA™ MFC. Recently they have reported progress in areas of water-based paint. In 2022 the application of MFC in solvent free epoxy spray was announced and the company has supplied material to three industry-scale projects in onshore fish farming, drinking water treatment and storage. Progress in fibre and particle boards has also been reported.

Contact:
CEBINA@norskeskog.com

Oji Holdings (Japan)

47-5, Ginza 4-chome
Chuo-ku, Tokyo 104-0061
+81 3 3563 1111
https://www.ojiholdings.co.jp/english/

Oji is a leading Japanese paper company. Oji produces CNF through nanofibrillation of pulp, and has developed a manufacturing process using a unique chemical treatment, "phosphorylation," which enables Oji to produce CNFs with high quality (high transparency, high viscosity, and thixotropy). Oji manufactures transparent CNF slurry and coarse CNF slurry (AUROVISCO), hydrophobic CNF powder, and CNF sheet (AUROVEIL).

Contact:
https://www.ojiholdings.co.jp/english/r_d/contact.html?frmid=29

Performance BioFilaments Inc. (Canada)

Suite 1120, 700 West Street
Vancouver, BC, Canada V6C 1G8
(1) 604 806-0261
www.performancebiofilaments.com/

Performance BioFilaments, Inc. was launched in 2014 as a joint venture between Mercer International, Inc. and Resolute Forest Products. Performance BioFilaments supplies BioFilaments supplies NanoFibrillated Cellulose (NFC) as wet crumb (30% solids), and as a dispersed pumpable slurry (2-10% solids).

Contact:
Keith Gourlay, Director of Technology Development
kgourlay@performancebiofilaments.com

RISE Research Institutes of Sweden AB (Sweden)

Sven Hultins plats 5, 412 58,
Gothenburg, Sweden
010-516 50 00
https://www.ri.se/en

RISE is Sweden's research institute and innovation partner. RISE Innventia, an early leader in the development of MFC, reduced energy usage in producing MFC through six generations of development, including enzymatic pretreatment. RISE operates a 100 kg/day MFC pilot plant at Innventia and a mobile demonstration plant for MFC trials at mills around the word. The mobile demo plant is able to produce highly refined fiber (HF), highly refined enzyme treated fiber (HFE) or MFC at the rate of 100 kg of dry product per hour.

Contact:
https://www.ri.se/en/about-rise/contact-us

RISH Research Institute for Sustainable Humanosphere (Japan)

Kyoto University
Gokasho, Uji City, Kyoto Prefecture, Japan. 611-0011
+774-38-3346
https://www.rish.kyoto-u.ac.jp/?lang=en

The RISH at Kyoto University is a leader in cellulose nanofibril research. Professor Hiroyuki Yano of RISH was the first in Japan to become engaged in the research of cellulose nanofibers. The Kyoto Process is based on the "Pulp Direct-Kneading Method." RISH has a pilot plant with capacity of 1 tpy of thermoplastic resins with 10 wt. % CNF. One application is the Nanocellulose Vehicle (NCV): the use of CNF in 13 components enables weight reduction of 16% compared to standard vehicles. https://www.youtube.com/watch?v=06H8wP9axjU

Contact:
Prof. Hiroyuki Yano
yano@rish.kyoto-u.ac.jp

Sappi | Valida (The Netherlands)

Sappi Biochemtech BV
Biesenweg 16 | 6211 AA Maastricht | The Netherlands
https://www.sappi.com/valida-home

Sappi is a leading global provider of everyday materials made from woodfibre-based renewable resources. As a diversified, innovative and trusted leader focused on sustainable processes and products, we are building a more circular economy by making what we should, not just what we can. Our market offerings such as dissolving pulp, wood pulp, biomaterials, timber, packaging and speciality papers, graphic papers, casting and release papers and forestry products are manufactured from woodfibre sourced from sustainably managed forests and plantations, in production facilities powered, in many cases, with bio-energy from steam and existing waste streams. Sappi Valida is a leading producer of fibrillated cellulose with naturally derived functionality for a wide range of applications including personal care, agriculture, coatings, construction additives and packaging. Sappi Valida is available in commercial volumes from a number of production facilities.

Contact:
Valida@sappi.com

ScienceK (China)

Zhejiang, China
http://www.sciencek.com

ScienceK, a pioneer in the nanocellulose industry, provides a full range of scientific research services. Science K provides CNC 5 kg/day dry power; CNF 200 kg/day, 1% by mechanical method; CNF 200kg/day 1% TEMPO plus mechanical; BC, 200 kg/day 5%.

Contact:
sciencek@qq.com

Seiko PMC Corporation (Japan)

Wakamatsu Bldg. 8th Floor, 3-6, Nihonbashi Honcho 3-chome,
Chuo-Ku, Tokyo, Japan 103-0023
+81-3-6202-7331
http://www.seikopmc.co.jp

Seiko PMC Corporation produces papermaking chemicals and resin products. Seiko produces STARCEL® CNF resin composite using the Kyoto Process.

Contact:
http://www.seikopmc.co.jp/cgi-bin/contact_e.cgi

Shengquan Group (China)

Shengquan Industrial Park,
Zhangqiu District, Jinan City, Shandong Province, China
https://e.shengquan.com

The Jinan Shengquan Group Share-Holding Co., Ltd. industrial layout includes biorefinery, high-performance resin and composites, foundry materials, health & pharmaceutical industry, new energy, etc. Shengquan 超变力 ® nanocellulose is made of plant fiber as raw material and has diameter is less than 100nm and aspect ratio not less than 200. It can be modified into anionic, cationic, silane-coupled chemical functional nanocellulose by oxidation, lipidation, silanization and other modification technologies.

Contact:
zacktang@shengquan.com

Stora Enso Oyj (Finland)

PO Box 309
FI-00101 Helsinki
+358 20 46 131
http://www.storaenso.com/

Stora Enso was one of the first companies to successfully launch paperboard enhanced with MFC commercially.

Contact:
https://www.storaenso.com/en/contact-us

Sugino Corp. (Japan)

1380 Hamilton Pkwy.
Itasca, IL 60143
888.784.4661
www.suginocorp.com

Star Burst, Sugino's full line of wet jet milling devices, disperse, emulsify, pulverize, and reform surfaces of raw materials by obliquely colliding the particles pressurized up to 245 MPa at the relative velocity of Mach 4. Star Burst does not use any grinding media and can deliver homogenized particle size with minimal contamination. BiNFi-s are Sugino original nano-sized nanofibers utilizing Star Burst technology. They are biomass fibers of cellulose, chitin, chitosan, and silk with 10 to 20nm diameter and multiple micron lengths.

Contact:
kyoneda@suginocorp.com

Suzano S.A. (Brazil)

Av. Brigadeiro Faria Lima
1355 – do 6º ao 1º andar
Pinheiros
CEP 01452-919
São Paulo, SP, Brasil
www.suzano.com.br

Suzano is the largest eucalyptus pulp producer in the world and Latin America's largest producer of printing & writing papers. Suzano produces microfibrillated cellulose in a pilot plant at Aracruz-ES, Brazil. Capacity is 2 ton per day (dry basis) of MFC. Woodspin, a joint venture between Suzano and Spinnova was scheduled to be completed in 2022. With Woodspin, Suzano produces MFC on site in Finland for use in Spinnova textiles. Suzano is also an equity partner in CelluForce.

Contact:
https://www.suzano.com.br/en/contact-us/

Sweetwater Energy (U.S.)

2400 Mt. Read Blvd., Dock 55
Rochester, NY 14615
www.sweetwater.us

Sweetwater Energy is a privately held biotechnology company. Sweetwater's Sunburst™ reactive extrusion process deconstructs biomass into lignin, hemicellulose and cellulose in 20 seconds, and with further enzymatic hydrolysis can yield low-cost CNC or CNF. Sweetwater operates a pilot plant in Rochester, and in March 2022 Sweetwater received final acceptance of its first commercial Sunburst unit at the Sweetwoods Project in Tallinn, Estonia. Samples of MCC and CNC can be available to potential customers and partners subject to NDA and MTA.

Contact:
info@sweetwater.us

TPI Chemicals FZCO (UAE)

Premises No:HD155, Floor No:25, Sheikh Rashid Tower,
Dubai World Trade Centre, Dubai, UAE
+ 90 536 561 3709
https://www.tpi-chemicals.com/

TPI Chemicals is a know how based and technology oriented Cellulosic Polymers Developer and Supplier. MFC (Micro fibrillated Cellulose) is one of the Cellulose Derivatives TPI Chemicals develops and supplies. Please feel free to contact us for more information.

Contact:
e-mail: info@tpi-chemicals.com

University of Maine (U.S.)

The Process Development Center
5737 Jenness Hall
Orono, ME 04469
207-581-2237
https://umaine.edu/pdc/

The Process Development Center (PDC) offers a broad range of technical services and resources. The University of Maine (UMaine) Nanomaterial Pilot Plant opened in 2012 at the PDC and is a joint project with the US Forest Service. The pilot plant has capacity for 1 ton per day of CNF and is the largest CNF plant in the US. The UMaine PDC supplies cellulose nanofibrils (CNF) and cellulose nanocrystals (CNC) to academic, public, and private research groups interested in evaluating and developing applications for these materials.

Contact:
umaine.pdc@maine.edu

UPM Biomedicals (Finland)

Alvar Aallon katu 1
P.O. Box 380
00101 Helsinki, Finland
+358 204 15 111
https://www.upmbiomedicals.com/

UPM Biomedicals offers our natural biocompatible innovation, UPM Nanocellulose. UPM Nanocellulose is already used in in vitro 3D cell culture (>180 protocols available for GrowDex®), in in vivo cell transplantation, in bioinks (GrowInk™) and in CE-marked wound dressings (FibDex®, medical device class II). We already supply several companies, such as BICO AB (Cellink), with our material for formulation of their own products.UPM also offers licenses for specific application fields.

Contact:
biomedicals@upm.com

USDA Forest Service, Forest Products Laboratory (U.S.)

One Gifford Pinchot Drive
Madison, WI 53726
608-231-9200
https://www.fpl.fs.usda.gov/

In 1910, the US Forest Service, Forest Products Laboratory (FPL) was established in Madison, Wisconsin. In August 2012, the US Department of Agriculture (USDA) Forest Service Forest Products Laboratory (FPL) unveiled a $1.7 million production facility for renewable, forest-based nanomaterials. This facility was the first of its kind in the United States. The FPL pilot plant produces CNC and TEMPO-based CNF with weekly production capacity of 30 kg or 5 kg, respectively.

Contact:
https://www.fpl.fs.usda.gov/contact/index.php

VTT Technical Research Centre of Finland

PO Box 1000
FI-02044 VTT
+358 20 722 111
www.vtt.fi

VTT, a non-profit research organization, can make various MFC and CNF grades for application testing. These grades can be produced from customer's raw materials with varying degrees of fibrillation (coarse, medium, fine fibre size). VTT can also produce specific aseptic grades for cosmetic and pharmaceutical applications. VTT produces tailor-made samples for R&D purposes from lab to pilot scale using standard equipment such as Masuko grinders and microfluidizers, unmodified, chemically modified, and enzymatically aided, up to 20 kg/day.

Contact:
Erkki Hellen
erkki.hellen@vtt.fi
+358 20 722 7422

Weidmann Fiber Technology (Switzerland)

Neue Jonastrasse 60
8640 Rapperswil SG
Switzerland
https://weidmannfibertechnology.com/

Part of Weidmann Holding AG, Weidmann Fiber Technology operates a production plant that produces Celova® microfibrillated celluloses and cellulose powder. The purely mechanical process uses no chemical or enzymatic pretreatment. Raw materials include pulp and perennial plants. Applications include personal care, barrier and film coatings, home and industrial care, energy storage, paints and adhesives.

Contact:
https://weidmannfibertechnology.com/#Contact%20us

Werhahn KG (Germany)

Acquired FiberLean in 2021. See FiberLean.

Zhejiang Jinjiahao Green Nanomaterial co., ltd (China)

No.37 Venus Road, Longyou Industrial Zone,
Quzhou City, Zhejiang Province, China
0570—7566665
http://www.cnjjh.cn/

Zhejiang Jinchang Specially Paper Co., Ltd. was founded in March 2009. The company specializes in design, development, production, processing, and sale of specially papers. Jinjiahao nanofibers allow new or improved products and processes in different applications.

Contact:
http://www.cnjcpaper.com/contacten.aspx

Technology Providers

Betulium Oy (Finland)

Tekniikantie 2,
FI-02150 Espoo
Finland
www.betulium.com

Betulium Oy is a Finnish clean-tech company established in 2013. Betulium provides renewable, biodegradable, and high-performance water-based cellulose materials to replace or supplement synthetic organic polymers in a vast number of industrial applications. The company manages versatile production premises and application laboratories in Espoo, Finland. Betulium's business model involves setting up production facilities with producers of raw materials.

Contact:
Marko Lauraeus,
Managing Director
marko.lauraeus@gmail.com
Tel. +358 45 6734159

FineCell Sweden AB (Sweden)

Stockholm, Sweden
www.finecell.se

FineCell Sweden AB has developed a new way to produce dry dispersible micro- and nano-sized cellulose from dry chemical pulp. The technology is based on research at KTH, Royal Institute of Technology, and is patented globally. FineCell's cellulose has key applications such as reinforcement in lightweight composites, ingredients for skincare products with multiple functions, rheology modifier, and several hydrogel applications. A continuous demo plant (1 ton/day) is under construction and is expected to be operational 2024.

Contact:
peter.axegard@finecell.se (CEO)
monica.ek@finecell.se (Professor KTH)

GL&V (U.S.)

GL&V was acquired by Valmet in 2019. Please see Valmet.

Hielscher Ultrasonics GmbH (Germany)

Oderstr. 53, 14513 Teltow, Germany
+1 (973) 532-6488
https://www.hielscher.com/ultrasonic-homogenizers-for-liquid-processing-3.htm

Hielscher Ultrasonics specializes in the design and manufacturing of high- power ultrasonic homogenizers for lab, bench-top and production level. Ultrasonic power is an effective and energy-efficient means to apply high shear and intense stress to liquids, powder/liquid mixtures and slurries. Hielscher equipment includes devices for the ultrasonication of any liquid volume, from several microliters through hundreds of cubic meters per hour.

Contact:
info@hielscher.com

HS Manufacturing Group (U.S.)

41 Madison Avenue, 31st Floor
New York, NY 10010
646-202-2566
https://www.hsmgrp.com/

HS Manufacturing Group (HSMG) is a technology provider focused on biodegradable packaging solutions. HSMG's PROTĒAN® is an environmentally friendly and non-toxic barrier coating and additive technology platform that can deliver critical water, oil and grease resistance properties. PROTĒAN® has been proven to provide excellent oil and grease barrier, especially when combined with wet end surface applications of MFC or CNF, and the performance can be further improved with the addition of MFC or CNF in the base sheet.

Contact:
https://www.hsmgrp.com/contact/

Masuko Sangyo Co., Ltd. (Japan)

1-12-24 Honcho, Kawaguchi-city,
Saitama-pref, JAPAN 332-0012
+81-48-222-4343
http://www.masuko.com/English/index.html

In 1965, Masuko became the first manufacturer in the world to commercialize an innovative friction grinder using a grinding wheel, the "Supermasscollider" Since then, Masuko has introduced a broad range of machines that achieve ultra-fine pulverization for an expanding range of materials, including the production of cellulose nanofibrils (CNF). Masuko grinders are in commercial production of CNF at various locations globally.

Contact:
http://www.masuko.com/English/form/index.php

MetGen (Finland)

Rakentajantie 26
20780 Kaarina, Finland
+358 2 237 7077
https://www.metgen.com/

MetGen is a privately held company founded in 2008 on the core competence of genetic engineering and synthetic biology. Today MetGen offers a full range of biotechnology solutions, including enzymes to support biorefineries. Full technology solutions are not only in the field of hydrolysis for biomass fractionation, but also for the production of clean sugars, sugar fermentation, and lignin refining. MetGen's business model is collaborative and driven through open innovation**.** METNIN™ is a unique market driven technology to valorize the underutilized lignin streams from modern biorefineries, and pulp and paper mills. METNIN™ enables the transition towards bio-based economy by producing replacements for fossil-based chemicals helping to reduce environmental pollution and minimize the carbon footprint.

Contact:
Sami-Pekka Rantanen, Sales Director
sami-pekka@metgen.com

Microfluidics International Corporation (U.S.)

90 Glacier Drive, Suite 1000
Westwood, MA 02090
Telephone: +1 (617)-969-5452
https://www.microfluidics-mpt.com/

Microfluidics International Corporation, the manufacturer of Microfluidizer® high shear fluid processors, is a leader in the design and production of laboratory and commercial processing equipment used in the production of micro- and nano-scale materials including nanocellulose. Microfluidizer® technology is employed in the production of cellulose nano- and micro- fibrils at corporations and research centers around the globe.

Contact:
https://www.microfluidics-mpt.com/contact-us

Sugino Corp. (Japan)

1380 Hamilton Pkwy.
Itasca, IL 60143
888.784.4661
www.suginocorp.com

Star Burst, Sugino's full line of wet jet milling devices, disperse, emulsify, pulverize, and reform surfaces of raw materials by obliquely colliding the particles pressurized up to 245 MPa at the relative velocity of Mach 4. Star Burst does not use any grinding media and can deliver homogenized particle size with minimal contamination. BiNFi-s are Sugino original nano-sized nanofibers utilizing Star Burst technology. They are biomass fibers of cellulose, chitin, chitosan, and silk with 10 to 20nm diameter and multiple micron lengths.

Contact:
kyoneda@suginocorp.com

Sweetwater Energy (U.S.)

2400 Mt. Read Blvd., Dock 55
Rochester, NY 14615
www.sweetwater.us

Sweetwater's Sunburst™ reactive extrusion process deconstructs biomass into lignin, hemicellulose and cellulose in 20 seconds, and with further enzymatic hydrolysis can yield low-cost CNC or CNF. In March 2022 Sweetwater received final acceptance of its first commercial Sunburst unit at the Sweetwoods Project in Tallinn, Estonia. Sweetwater will consider joint product development agreements, as well as licensing and other partnership structures to continue to deploy the technology commercially. Samples can be available subject to NDA and MTA

Contact:
info@sweetwater.us

Valmet North America (U.S.)

3720 Davinci Court
Norcross, GA 30092
www.valmet.com

Valmet is a leading global developer and supplier of process technologies, automation, and services for the pulp, paper, and energy industries. In 2019, Valmet acquired GLV and combined joint capabilities to form a MFC Business Research Team. They have since installed various MFC production plants and continue with the development of MFC production and application. In addition to the pilot research plants in Finland, Valmet continues its alliance with the University of Maine Process Development Center (PDC).

Contact:
Eric MacDougall
eric.macdougall@valmet.com
na.communications@valmet.com

Vireo Advisors LLC (U.S.)

WBENC Certified Woman Owned Business
P.O. Box 51368, Boston, MA 02205 USA
https://www.vireoadvisors.com

Vireo Advisors, LLC is an international expert advising firm with significant experience supporting the commercialization of novel forms of celluloses and other biobased materials. We conduct occupational and product-specific safety evaluations and create market and regulatory documentation and roadmaps to set clear expectations, reduce business risk, and inform product design. Tapping into our broad network, we build consortia, identify opportunities, and convene key stakeholders to identify solutions to complex problems.

Contact:
https://www.vireoadvisors.com/contactus

Government, University, Research, and Other

Aalto University (Finland)

Aalto University
P.O. Box 11000 (Otakaari 1B)
FI-00076 AALTO
+358 9 47001
https://www.aalto.fi/en/department-of-bioproducts-and-biosystems/biobased-materials-technology

The biobased materials technology group (BIOMAT) led by Dr. Maloney carries out research in the development of next generation fiber products. The target is to develop technologies that enable renewal of the paper and board industries: nanocellulose films, nanopapers and nanostructuring of fibers for high-bulk board. Various grades of nanocellulose can be produced in our labs. Specialized methods for measuring nanocellulose quality are available. Methods for measuring nanocellulose/water interactions including water removal are especially notable.

Contact:
thaddeus.maloney@aalto.fi

Alberta Innovates (Canada)

250 Karl Clark Road
Edmonton, BC T6N1E4
780-427-1956
www.albertainnovates.ca

See InnoTech Alberta in the Producers Section.

Alliance for Pulp & Paper Technology Innovation (U.S.)

1101 K Street, NW, Suite 700 (AF&PA)
Washington, DC 20005
202-463-2742
https://www.appti.org/

The Alliance for Pulp & Paper Technology Innovation (APPTI) is an industry-led consortium that promotes development of advanced manufacturing technologies for the pulp and paper industry. With cellulosic nanomaterials, APPTI's goal is to facilitate commercial development for a broad range of applications through development of pre-competitive methods and technologies. Top priorities include characterization of cellulose nanomaterials, plus two “Classic Challenges” i.e., drying and redispersion, and compatibilization for composites.

Contact:
Chris Luettgen
Executive Director, APPTI
chris.luettgen@rbi.gatech.edu

Auburn University (U.S.)

Auburn, Alabama 36849
(334) 844-4000
https://www.auburn.edu/

Beijing Forestry University (China)

No. 35 Tsinghua East Road
Haidian District, Beijing, P.R. China
http://eng.bjfu.edu.cn/

BioApplied Innovation Pathways (Canada)

1 Research Drive, Suite 107
Dartmouth, NS B2Y 4M9
+1 (902) 701-9761
https://bioapplied.com/

BioApplied™ is a consulting firm that specializes in helping clients deliver innovation. Our focus is on advanced technologies in renewable resource sectors. We support clients who are developing new products, new services, new processes, new industrial partnerships, and building new businesses through innovation.

With a tier-one network of technical scouts, resources, global organizations, and expertise at the ready, BioApplied™ accelerates the innovation process by bringing focus and energy.

Contact:
https://bioapplied.com/contact-us/

BioPRIA (Australia)

Monash University
15 Alliance Lane
Clayton 3800, Australia
+61 3 99053456
https://www.monash.edu/; https://www.biopria.com.au/

BioPRIA at Monash University has lab refiners, homogenisers and reactors for producing CNC, CNF and TOCN at the 10-100s of gram scale. The Institute has developed new methods for characterizing cellulose nanomaterials and can rapidly manufacture 10-200 freestanding pure and composite cellulose nanofiber films using spray coating. The Institute has a comprehensive suite of equipment for measuring nanocellulose film properties, including barrier performance.

Institute Contact:
nancy.hawe@monash.edu

BioProducts Institute (Canada)

See University of British Columbia.

Biorenewable Deployment Consortium LLC (U.S.)

2875 Ashton Road
P.O. Box 17182
Sarasota, FL 34276
https://biorenewabledc.com/

The Biorenewable Deployment Consortium LLC (BDC) is an international company that assists its membership with the deployment of leading-edge advanced biofuels, biochemicals, and bioproducts technologies that do not require long-term subsidy making them more profitable and sustainable. The company identifies, performs due diligence, and promotes those processes that add value to its member companies under its brokering partnership initiatives.

Contact:
Eric.Horn@biorenewabledc.com

Center for Renewable Carbon (U.S.)

See University of Tennessee.

Centre Technique du Papier (France)

Domaine Universitaire - CS 90251
38044 GRENOBLE - Cedex 9
+33 (0) 4 76 15 40 15
http://www.webctp.com/gb/default.cfm

Centre Technique du Papier (CTP) is the French Pulp and Paper Research and Technical Centre located at the University Campus, in Grenoble. CTP, in partnership with FCBA, operates the "NaMiCell" MFC/CNF pilot plant. The plant produces up to 100 kg per day of MFC/CNF in batches of 30 kg to 70 kg in the form of a 3% gel by way of a patented protocol. TEMPO MFC/CNF can also be produced on request.

Contact:
https://www.webctp.com/en/contact/-access

CERMAV-CNRS Domaine Universitaire (France)

601 Rue de la Chimie,
38610 Gières, France
+33 (0)4 76 03 76 03
https://cermav.cnrs.fr/en/

The CERMAV, the Centre de recherches sur les macromolécules végétales, is a CNRS research unit. CERMAV is a leader in glycosciences in Europe, focused on cellulose and lignin.

Contact:
direction@cermav.cnrs.fr

CETIM (Spain)

CETIM TECHNOLOGICAL CENTRE
Parque Empresarial de Alvedro calle H-20. 15180 Culleredo, A Coruña, Spain
+34 881 105 624
https://cetim.es/

CETIM, a private research center based in A Coruña, Spain, has been producing MFC and CNF since 2017 at pilot scale. They have also been involved in the production of lab-scale CNC. CETIM conducts research in advanced lignocellulosic materials for polymers, textiles, adhesives, coatings, papers and other high value-added applications. CETIM produces cellulose nanoparticles from recycled paper, biomass, and other sources.

Contact:
Info@cetim.es

Chinese Academy of Forestry (CAF) (China)

Wan Shou Shan
Beijing 100091, China
+86-10-62888927 62889092
http://en.caf.ac.cn/

Contact:
http://en.caf.ac.cn/Contact_Us/Contact_Us.htm

Chinese Academy of Sciences (CAS) (China)

52 Sanlihe Rd., Xicheng District,
Beijing, China (100864)
86-10-68597521 (day)
https://english.cas.cn/

The Chinese Academy of Sciences is the linchpin of China's drive to explore and harness high technology and the natural sciences for the benefit of China and the world. Comprising a comprehensive research and development network, a merit-based academic society and a system of higher education, CAS brings together scientists and engineers from China and around the world to address both theoretical and applied problems using world-class scientific and management approaches.

Contact:
cas_en@cas.cn

CIRCOT (India)

See ICAR-CIRCOT

Donghua University (China)

Songjiang Campus 2999 North Renmin Road 201620
Yan'an Road Campus: 1882 West Yan'an Road 200051
Shanghai-ICP-05003365 China
http://www.dhu.edu.cn/

Edinburgh Napier University (Scotland)

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United Kingdom
+44 (0)333 900 6040.
http://www.napier.ac.uk/

Empa (Switzerland)

Ueberlandstrasse 129
8600 Dübendorf / Switzerland
+41 58 765 11 11
https://www.empa.ch/web/empa/

An institute of the ETH domain., Empa is the Swiss Federal Laboratories for Materials Testing and Research. Empa operates a MFC pilot plant and conducts applications research with industry partners.

Contact:
https://www.empa.ch/web/empa/contact-form

FIBIC (Finland)

Innopoli 3, C-Building
Vaisalantie 6
02130 Espoo
Finland
www.fibic.fi

Finnish Centre for Nanocellulosic Technologies (Finland)

P.O. Box 1000, FI-02044
VTT, Finland
+358 20 722 111

See VTT.

FPInnovations (Canada)

570 Boulevard St-Jean,
Pointe-Claire, Quebec H9R 3J9 CANADA
+1 (514) 630-4100 or info@fpinnovations.ca
www.fpinnovations.ca

Specializing in innovative scientific solutions, FPInnovations inaugurated its first CNC research facility with a state-of-the-art pilot plant in 2011. We also produced the first cellulose filaments (CF) in the laboratory and its pilot plant. Today we collaborate with many strategic research alliances, members, and partners. Using the technology developed by our research staff, industry now benefits in developing nanocellulose markets and applications. CelluForce (CNC), Kruger Biomaterials, and Performance Biofilaments (CF) are examples of our collaborations.

Contact:
stephan.lariviere@fpinnovations.ca

Fujian Agriculture and Forestry University (China)

No. 15 Shangxiadian Road
Cangshan District
Fuzhou City, Fujian Province, 350002, China
http://english.fafu.edu.cn/

Georgia Institute of Technology (U.S.)

Renewable Bioproducts Institute
North Avenue
Atlanta, GA 30332
+1 404.894.2000
https://research.gatech.edu/rbi

Georgia Tech's Renewable Bioproducts Institute (RBI), formerly the Institute of Paper Science and Technology, champions innovation in converting biomass into value-added products, developing advanced chemical and bio-based refining technologies, and advancing excellence in manufacturing processes.

Contact:
Pamela Peralta-Yahya
Associate Professor
pperalta-yahya@chemistry.gatech.edu

Georgia Southern University (U.S.)

See Herty Advanced Materials Development Center

Grenoble Institute of Technology (INP) (France)

46 avenue Félix Viallet
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France
+33 4 76 57 45 00
www.grenoble-inp.fr

Herty Advanced Materials Development Center (U.S.)

110 Brampton Rd.,
Savannah, Georgia 31408

The Herty Advanced Materials Development Center is an applied research center of Georgia Southern University, with focuses in contract research, development, and manufacturing; and a global leader in technology development. Herty offers laboratory, pilot, and production quantities of nanocellulose and a range of nanocellulose types including nanocrystalline and nanofibrillar morphologies. Applications include pharmaceutical and cosmetics, plastics and film, filled composites, viscosity modifiers, and proppants.

Contact:
https://research.georgiasouthern.edu/herty/contact-us/

ICAR-CIRCOT (India)

Adenwala Road, Matunga(East),
Mumbai-400 019.
022-24146002

India's Central Institute for Research on Cotton Technology (ICAR-CIRCOT) is one of the premier constituent institutes of the Indian Council of Agricultural Research (ICAR). Research related to nanocellulose includes development of a chemo-mechanical process for preparation of nanocellulose from cotton linters, and development of applications such as barrier films, packaging, and paint.

Contact:
director.circot@icar.gov.in

InnoTech Alberta (Canada)

250 Karl Clark Road
Edmonton, BC T6N1E4
780-427-1956
www.albertainnovates.ca

InnoTech Alberta is a wholly owned subsidiary of Alberta Innovates. The organization's multidisciplinary, cross-sector teams offer a diversified range of scientific, engineering and technological research and testing capabilities, and the facilities to support technology scale-up. InnoTech Alberta operates a CNC pilot plant that is capable of producing up to 20 kg per week of CNC from a variety of feedstocks.

Contact:
info@innotechalberta.ca.

Innovatech Labs, LLC (U.S.)

13805 1st Ave N, Ste 100
Plymouth, MN 55441
888-740-5227
https://www.innovatechlabs.com/

Innovatech Labs, a material testing lab, specializes in unique materials analysis. Our analysts work directly with customers to determine which analytical technique(s) will obtain the data necessary to solve the problem at hand. The material testing methods include SEM, FTIR analysis, Auger, DSC, Light Microscopy, Ion Chromatography, GC/MS, Thermogravimetric analysis, and ESCA.

Contact:
info@innovatechlabs.com

INRAE (France)

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+33(0)1 42 75 90 00
https://www.inrae.fr/en

National Research Institute for Agriculture, Food and the Environment
INRAE is France's National Research Institute for Agriculture, Food and Environment. Its mission is to carry out excellent science in order to provide innovative solutions addressing global challenges, notably climate change, biodiversity and food security while at the same time enabling the much needed agroecological, nutritional and energy transition.

Contact:
https://www.inrae.fr/en/contact

Instituto Tecnologico del Embalaje, Transporte y Logistica-ITENE (Spain)

Parque Tecnológico
C/ Albert Einstein, 1. 46980 PATERNA · VALENCIA
+34 96 182 00 00
http://www.itene.com/en

The Additives and Raw Materials Research Unit has expertise in research & development of cellulose nanomaterials for packaging applications. The MFC Pilot Plant can produce MFC from different sources (agricultural wastes, recycled fibres, food wastes, annual plants or common trees). MFC production is 50kg/day of aqueous suspensions (up to 3 wt%). ITENE can also produce other cellulose nanoadditives (CNC and CNF) and can be functionalized for target applications such as barrier coatings for flexible packaging or reinforcements for biocomposites.

Contact:
Dr. Miriam Gallur, miriam.gallur@itene.com

Korea Forest Research Institute (South Korea)

Korea Forest Service
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189 Cheongsa-ro, Seo-gu, Daejeon
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www.forest.go.kr

KTH Royal Institute of Technology (Sweden)

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KU Leuven (Belgium)

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Kyoto University (Japan)

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See RISH Research Institute for Sustainable Humanosphere in the Producers Section.

Luleå University of Technology (LTU) (Sweden)

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McGill University (Canada)

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McMaster University (Canada)

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http://www.mcmaster.ca/

Minho University (Portugal)

Biological Engineering Department
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Portugal
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Centre of Biological Engineering / Centro de Engenharia Biológica (uminho.pt)

The Functional Carbohydrates Group at the Center of Biological Engineering investigates the use of polysaccharides for various applications, including Bacterial NanoCellulose production, processing and application: fermentation (static & stirred culture), production scale up, dry formulations for Pickering emulsions, applications in textiles, biomedicine and food.

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See BioPRIA.

Nanjing Forestry University (China)

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National Center for Nanoscience and Technology (NCNST) (China)

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+86 10-82545545
http://english.nanoctr.cas.cn/

National Institute for Nanotechnology (NINT) (Canada)

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www.nrc-cnrc.gc.ca

National Institute of Standards and Technology (NIST) (U.S.)

100 Bureau Drive, Stop 1000
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www.nist.gov

National Research Council of Canada (NRC) (Canada)

1200 Montreal Road
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Canada
613-993-9101
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North Carolina State University (U.S.)

Department of Forest Biomaterials
2820 Faucette Drive, CB 8005
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Lavoine research group provides technical and consulting services on research & development of cellulose nanomaterials. We can produce aqueous suspensions (up to 5 wt%) of cellulose nanocrystals and cellulose nanofibrils/microfibrils, from different (ligno)cellulosic sources. Our lab has capabilities of producing few milliliters to liters of both materials, with different surface functionalities and performance for target applications and specifications. Also open to research/industrial partnerships and collaborations.

Contact:
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Northeast Forestry University (China)

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Oregon State University (U.S.)

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Paper and Fibre Research Institute (Norway)

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http://www.pfi.no/

Process Development Center (U.S.)

See University of Maine

Purdue University (U.S.)

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https://www.purdue.edu/

The Youngblood Group at the School of Material Engineering investigates nanotechnology, surface science, advanced processing, and biomaterials. Sustainable Nanotechnology includes CNC and CNF processing: Fiber Spinning, Roll to Roll Continuous Fabrication, and Nanocomposites. CNC has also been demonstrated as an effective additive in cementitious materials, reducing stress while increasing degree of hydration at very low dosages. This technology is being commercialized under license.

Contact:
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Renewable Bioproducts Institute (U.S.)

See Georgia Institute of Technology

Research Council of Norway (Norway)

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+47 22 03 70 00
www.forskningsradet.no

Research Institute of Forestry New Technology (China)

http://en.caf.ac.cn/Organizational/jj7.shtml

See Chinese Academy of Forestry (CAF).

Research Institute of Wood Industry, Chinese Academy of Forestry (CRIWI) (China)

Haidian District, Beijing 100091, China.
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http://criwi.caf.ac.cn/

RISE Research Institutes of Sweden AB (Sweden)

Sven Hultins plats 5, 412 58,
Gothenburg, Sweden
010-516 50 00
https://www.ri.se/en

RISE is Sweden's research institute and innovation partner. RISE Innventia, an early leader in the development of MFC, reduced energy usage in producing MFC through six generations of development, including enzymatic pretreatment. RISE operates a 100 kg/day MFC pilot plant at Innventia and a mobile demonstration plant for MFC trials at mills around the word. The mobile demo plant is able to produce highly refined fiber (HF), highly refined enzyme treated fiber (HFE) or MFC at the rate of 100 kg of dry product per hour.

Contact:
https://www.ri.se/en/about-rise/contact-us

RISH Research Institute for Sustainable Humanosphere (Japan)

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+774-38-3346
https://www.rish.kyoto-u.ac.jp/?lang=en

The Research Institute for Sustainable Humanosphere (RISH) at Kyoto University is a leader in cellulose nanofibril research. Professor Hiroyuki Yano of RISH was the first in Japan to become engaged in the research of cellulose nanofibers that form the cell walls in plants, beginning in 1996.The Kyoto Process is based on the "Pulp Direct-Kneading Method. RISH has a pilot plant with capacity of 1 tonne per year of thermoplastic resins with 10 wt. % CNF. Seiko PMC constructed a pilot plant based on this Kyoto process in 2013, and Nippon Paper did so in 2017.

Contact:
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Sichuan University (China)

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South China University of Technology (SCUT) (China)

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http://www2.scut.edu.cn/gzic_en/

SCUT Guangzhou International Campus is a state-level campus jointly developed by the Ministry of Education, the People's Government of Guangdong Province, the People's Government of Guangzhou Municipality and South China University of Technology (SCUT). Research with nanocellulose includes preparation of CNC and CNF as well as development of applications.

Contact:
global@scut.edu.cn

TAPPI International Nanotechnology Division (U.S.)

15 Technology Parkway South
Peachtree Corners, GA 30092
(770) 446-1400
https://www.tappinano.org/

Members of TAPPI's NanoDivision strive to advance the responsible use and production of renewable and sustainable nanomaterials. TAPPI Nano has established itself as the preeminent conference on nanotechnology as it relates to renewable nanomaterials. The 2023 TAPPI Nanotechnology Conference will be held in Vancouver on June 12th - 16th, 2023. The 2024 conference will be help in Atlanta, GA in June 2024.,

Contact:
https://www.tappi.org/menus/functional-navigation/contact-us/

Technikum Laubholz (Germany)

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https://technikumlaubholz.de/en/

The Technikum Laubholz is the first independent non-university institute for leading-edge research in Baden-Württemberg with an exclusive focus on the development of all processes and products relating to wood as a renewable raw material. Technikum Laubholz is planning and building a plant for the production of nanocellulose from beech wood fibers using fully automated technology to optimize the entire process workflow with the help of artificial intelligence. Called KlckBio, the project is part of the ERDF's Innovation and Energy Transition program.

Contact
https://technikumlaubholz.de/en/contact/

Tianjin University of Science and Technology (China)

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University of Alberta (Canada)

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https://www.ualberta.ca/

University of British Columbia (Canada)

BioProducts Institute
2385 East Mall
Vancouver, BC Canada V6T 1Z4
https://bpi.ubc.ca/

The University of British Columbia BioProducts Institute (BPI) is an innovative ecosystem of high-impact fundamental and applied researchers working on solutions to today's climate and environmental challenges. Research themes center around biocatalytic transformation and engineering of biomass, bio-nanoparticle enabled materials, bio-based polymers and carbon materials, and biorefinery and biofuels systems.

Contact:
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University of Grenoble Alpes (France)

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Contact:
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University of Helsinki (Finland)

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University of Maine (U.S.)

The Process Development Center
5737 Jenness Hall
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https://umaine.edu/pdc/

The Process Development Center (PDC) offers a broad range of technical services and resources. The University of Maine (UMaine) Nanomaterial Pilot Plant opened in 2012 at the PDC and is a joint project with the US Forest Service. The pilot plant has capacity for 1 ton per day of CNF and is the largest CNF plant in the US. The UMaine PDC supplies cellulose nanofibrils (CNF) and cellulose nanocrystals (CNC) to academic, public, and private research groups interested in evaluating and developing applications for these materials.

Contact:
umaine.pdc@maine.edu

University of Tehran (Iran)

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+98 21 61113411
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University of Tennessee (U.S.)

Knoxville, Tennessee 37996
865-974-1000
https://www.utk.edu/

The UTK Center for Renewable Carbon conducts research on nanocellulose from pulp, agricultural sources and recycled cellulose. Research areas include MFC, CNF, and CNC, as well as nanocellulose composites, foams, films, coatings, suspensions and viscosity modifiers, and water absorbents. The University of Tennessee and Battelle Memorial Institute co-manage Oak Ridge National Laboratory.

Contact: Siqun Wang
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University of Tokyo (Japan)

7-3-1 Hongo, Bunkyo
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http://www.u-tokyo.ac.jp

The University of Tokyo was established in 1877 as the first national university in Japan. The Department of Biomaterial Sciences conducts extensive research in nanocellulose characterization, preparation, performance, and applications under the direction of Dr. Akira Isogai.

Contact:
aisogai@mail.ecc.u-tokyo.ac.jp

University of Toronto (Canada)

Centre for Biocomposites and Biomaterials Processing
33 Willcocks Street
Toronto, Ontario M5S 3B3
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1-416-978-5480
http://forestry.utoronto.ca/centre-for-biocomposites-and-biomaterials-processing/

University of Waterloo (Canada)

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USDA Forest Service, Forest Products Laboratory (U.S.)

One Gifford Pinchot Drive
Madison, WI 53726
608-231-9200
https://www.fpl.fs.usda.gov/

In 1910, the US Forest Service, Forest Products Laboratory (FPL) was established in Madison, Wisconsin. In August 2012, the US Department of Agriculture (USDA) Forest Service Forest Products Laboratory (FPL) unveiled a $1.7 million production facility for renewable, forest-based nanomaterials. This facility was the first of its kind in the United States. The FPL pilot plant produces CNC and TEMPO-based CNF with weekly production capacity of 30 kg or 5 kg, respectively.

Contact:
https://www.fpl.fs.usda.gov/contact/index.php

Virginia Polytechnic Institute and State University (U.S.)

800 Washington Street, SW
Blacksburg, VA 24061
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https://vt.edu/

VTT Technical Research Centre of Finland

PO Box 1000
FI-02150 VTT
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www.vtt.fi

VTT, a non-profit research organization, can make various MFC and CNF grades for application testing. These grades can be produced from customer's raw materials with varying degrees of fibrillation (coarse, medium, fine fibre size). VTT can also produce specific aseptic grades for cosmetic and pharmaceutical applications. VTT produces tailor-made samples for R&D purposes from lab to pilot scale using standard equipment such as Masuko grinders and microfluidizers, unmodified, chemically modified, and enzymatically aided, up to 20 kg/day.

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BioBased Markets

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