

The Global Market for Cellulose Nanofibers 2023-2033

https://marketpublishers.com/r/G0616DFD897BEN.html

Date: May 2023

Pages: 425

Price: US\$ 1,250.00 (Single User License)

ID: G0616DFD897BEN

Abstracts

Cellulose nanofibers, also called cellulose nanofibrils or nanofibrillated cellulose, are sustainable materials with high mechanical strength and stiffness (stronger than steel), high aspect ratios, high transparency, high chemical resistance and impressive rheological, optical and film-forming properties. Production is now at the industrial scale (mainly in Japan) with multi-ton production servicing the hygiene products, packaging, automotive, composites, medicine, textiles and plastics markets.

The Global Market for Cellulose Nanofibers 2023-2033 is an essential resource for anyone involved in the sustainable materials industry. The report provides extensive proprietary data on producers, cellulose nanofiber capacities, capacity utilization, production, trade, demand, applications, market share, and pricing.

Report contents include:

Global production capacities, by CNF producer, current and planned.

Production volumes by region.

Industry news 2020-2023.

Commercialized products incorporating CNFs.

Stage of commercialization for cellulose nanofiber applications by company (TRL).

CNF applications by industry.

Demand in tons per market, historical, current and forecast to 2033.



Market drivers, trends and challenges, by end user markets.

Competitive landscape of CNF by market, volumes, key trends and growth. Potential for CNF to gain market share by market volume across all end user markets. Markets covered include Polymer composites, Automotive, Building & Construction, Packaging, Textiles, Biomedicine, Pharma, Healthcare, Sanitary and Hygiene Products, Paints & Coatings, Aerogels, Oil & Gas, Filtration, Cosmetics, Food Additives, Electronics, Batteries, Aerospace and 3D printing.

In-depth market assessment of opportunities for CNF including potential revenues, growth rates, pricing, most likely applications and market challenges.

In-depth analysis of market by applications including estimated market size, penetration and growth. Applications covered include: Polymer composite parts; Biodegradable and renewable nanocomposites; Automotive composites; Packaging films; Aerogels; Construction materials; Packaging fillers/additives; Paint and coatings additives; Deodorant sheets; Pharmaceutical additives; Renewable plastic parts/casings; Transparent films for electronics; Flexible and printed electronics; Batteries; Flexible and paper batteries; Filtration membranes.

In-depth key player profiles of 148 companies, including products, current capacities and plans for new capacities, production processes, prices per kg and commercial activities. Companies profiled in the report include Asahi Kasei, Chuetsu Pulp & Paper Daicel, Daiichi Kogyo, Daio Paper, GranBio Technologies, Nippon Paper, Oji Holdings, Sugino Machine, Seiko PMC and more.

What you will receive:

Report by email (PDF)-print option also available.

Comprehensive Excel spreadsheet of all the data.

Mid-year update.



Contents

1 EXECUTIVE SUMMARY

- 1.1 The market for cellulose nanofibers
- 1.2 Market outlook in 2023 and beyond
- 1.3 Cellulose nanofibers (CNF) production capacities 2023
- 1.4 Microfibrillated cellulose (MFC) production capacities 2023
- 1.5 Global demand in metric tons, 2018-2033
- 1.6 Market challenges for cellulose nanofibers
- 1.7 Cellulose nanofibers market by region
 - 1.7.1 Japan
 - 1.7.2 China
 - 1.7.3 Malaysia
 - 1.7.4 Western Europe
 - 1.7.5 North America
- 1.8 Global government funding and initiatives

2 OVERVIEW OF CELLULOSE NANOFIBERS

- 2.1 Cellulose
- 2.2 Other "nanocellulose" types
 - 2.2.1 Cellulose Nanocrystals
 - 2.2.1.1 Synthesis
 - 2.2.1.2 Properties
 - 2.2.1.3 Production
 - 2.2.1.4 Applications
 - 2.2.2 Bacterial Nanocellulose (BNC)
 - 2.2.2.1 Production
 - 2.2.2.2 Applications
 - 2.2.3 Microfibrillated cellulose (MFC)
- 2.3 Properties
- 2.4 Feedstocks
- 2.5 Advantages of cellulose nanofibers
- 2.6 Synthesis and Production methods
 - 2.6.1 Acid hydrolysis
 - 2.6.2 TEMPO oxidation
 - 2.6.3 Ammonium persulfate (APS) oxidation
 - 2.6.4 Ball milling



- 2.6.5 Cryocrushing
- 2.6.6 High-shear grinding
- 2.6.7 Green production methods
 - 2.6.7.1 Ultrasonication
 - 2.6.7.2 High-pressure homogenization
- 2.6.8 Recent methods
 - 2.6.8.1 Microwave irradiation
 - 2.6.8.2 Enzymatic processing
 - 2.6.8.3 Deep eutectic solvents (DESs)
 - 2.6.8.4 Pulsed electric field
 - 2.6.8.5 Electron beam irradiation
- 2.7 Applications of cellulose nanofibers

3 MARKET OPPORTUNIT FOR CELLULOSE NANOFIBERS

4 REGULATIONS AND STANDARDS

- 4.1 Standards
 - 4.1.1 International Standards Organization (ISO)
 - 4.1.2 American National Standards
 - 4.1.3 CSA Group
- 4.2 Toxicity
- 4.3 Regulation

5 CELLULOSE NANOFIBERS SUPPLY CHAIN

- **6 CELLULOSE NANOFIBERS PRICING**
- 7 CNF-BASED COMMERICAL PRODUCTS
- **8 INDUSTRY NEWS 2020-23**

9 MARKETS FOR CELLULOSE NANOFIBERS

- 9.1 Composites
 - 9.1.1 Market overview
 - 9.1.2 Applications
 - 9.1.2.1 Automotive composites
 - 9.1.2.2 Biocomposite films & packaging



- 9.1.2.3 Barrier packaging
- 9.1.2.4 Thermal insulation composites
- 9.1.2.5 Construction composites
- 9.1.3 Global market in tons to 2033
- 9.1.4 Product developers
- 9.2 Automotive
 - 9.2.1 Market overview
 - 9.2.2 Applications
 - 9.2.2.1 Composites
 - 9.2.2.2 Air intake components
 - 9.2.2.3 Tires
 - 9.2.3 Global market in tons to 2033
 - 9.2.4 Product developers
- 9.3 Buildings and construction
 - 9.3.1 Market overview
 - 9.3.2 Applications
 - 9.3.2.1 Sandwich composites
 - 9.3.2.2 Cement additives
 - 9.3.2.3 Pump primers
 - 9.3.2.4 Thermal insulation and damping
 - 9.3.3 Global market in tons to 2033
 - 9.3.4 Product developers
- 9.4 Paper and board packaging
 - 9.4.1 Market overview
 - 9.4.2 Applications
 - 9.4.2.1 Reinforcement and barrier
 - 9.4.2.2 Biodegradable food packaging foil and films
 - 9.4.2.3 Paperboard coatings
 - 9.4.3 Global market in tons to 2033
 - 9.4.4 Product developers
- 9.5 Textiles and apparel
 - 9.5.1 Market overview
 - 9.5.2 Applications
 - 9.5.2.1 CNF deodorizer and odour reducer (antimicrobial) in adult and child diapers
 - 9.5.2.2 Footwear
 - 9.5.3 Global market in tons to 2033
 - 9.5.4 Product developer profiles
- 9.6 Biomedicine and healthcare
 - 9.6.1 Market overview



- 9.6.2 Applications
 - 9.6.2.1 Wound dressings
 - 9.6.2.2 Drug delivery stabilizers
 - 9.6.2.3 Tissue engineering scaffolds
- 9.6.3 Global market in tons to 2033
- 9.6.4 Product developers
- 9.7 Hygiene and sanitary products
 - 9.7.1 Market overview
 - 9.7.2 Applications
 - 9.7.3 Global market in tons to 2033
 - 9.7.4 Product developers
- 9.8 Paints and coatings
 - 9.8.1 Market overview
 - 9.8.2 Applications
 - 9.8.3 Global market in tons to 2033
 - 9.8.4 Product developers
- 9.9 Aerogels
 - 9.9.1 Market overview
 - 9.9.2 Global market in tons to 2033
 - 9.9.3 Product developers
- 9.10 Oil and gas
 - 9.10.1 Market overview
 - 9.10.2 Applications
 - 9.10.2.1 Oil recovery applications (fracturing fluid)
 - 9.10.2.2 CNF Membranes for separation
 - 9.10.2.3 Oil and gas fluids additives
 - 9.10.3 Global market in tons to 2033
 - 9.10.4 Product developers
- 9.11 Filtration
 - 9.11.1 Market overview
 - 9.11.2 Applications
 - 9.11.2.1 Membranes for selective absorption
 - 9.11.3 Global market in tons to 2033
 - 9.11.4 Product developers
- 9.12 Rheology modifiers
 - 9.12.1 Market overview
 - 9.12.2 Applications
 - 9.12.2.1 Food additives
 - 9.12.2.2 Pickering stabilizers



- 9.12.2.3 Hydrogels
- 9.12.2.4 Cosmetics and skincare
- 9.12.3 Global market in tons to 2033
- 9.12.4 Product developers
- 9.13 Other markets
 - 9.13.1 Printed, stretchable and flexible electronics
 - 9.13.1.1 Market assessment
 - 9.13.1.2 Product developers
 - 9.13.2 3D printing
 - 9.13.2.1 Market assessment
 - 9.13.2.2 Product developers
 - 9.13.3 Aerospace
 - 9.13.3.1 Market assessment
 - 9.13.3.2 Product developers
 - 9.13.4 Batteries
 - 9.13.4.1 Market assessment

10 CELLULOSE NANOFIBER COMPANY PROFILES 222 (148 COMPANY PROFILES)

11 RESEARCH SCOPE AND METHODOLOGY

- 11.1 Report scope
- 11.2 Research methodology

12 REFERENCES



List Of Tables

LIST OF TABLES

- Table 1. Market summary for nanocellulose-Selling grade particle diameter, usage, advantages, average price/ton, market estimates, global consumption, main current applications, future applications.
- Table 2. Markets and applications for nanocellulose.
- Table 3. CNF production capacities (by type, wet or dry) and production process, by producer, metric tons.
- Table 4. Microfibrillated Cellulose (MFC) production capacities in metric tons and production process, by producer, metric tons.
- Table 5. Global demand for cellulose nanofibers/MFC by market in metric tons, 2018-2033.
- Table 6. Market and technical challenges in cellulose nanofibers
- Table 7. Regional demand for Cellulose nanofibers, 2021, tons (total excludes MFC).
- Table 8. Cellulose nanofibers producers and product developers in Japan.
- Table 9. Cellulose nanofibers research centres, universities and companies in China.
- Table 10. Cellulose nanofibers producers and product developers in Europe.
- Table 11. Cellulose nanofibers producers and product developers in North America.
- Table 12. Summary of types of nanocellulose.
- Table 13. Types of nanocellulose.
- Table 14. Types of nanocellulose.
- Table 15. Synthesis methods for cellulose nanocrystals (CNC).
- Table 16. CNC sources, size and yield.
- Table 17. CNC properties.
- Table 18. Mechanical properties of CNC and other reinforcement materials.
- Table 19. Applications of nanocrystalline cellulose (NCC).
- Table 20. Applications of bacterial nanocellulose (BNC).
- Table 21. Properties and applications of nanocellulose.
- Table 22. Properties of nanocellulose, by type.
- Table 23. Chemical composition of different lignocellulosic feedstocks used for nanocellulose production (% dry basis).
- Table 24. Properties of cellulose nanofibrils relative to metallic and polymeric materials.
- Table 25. Extraction of nanocellulose (NC) from various lignocellulosic sources using different conventional technologies.
- Table 26. Applications of cellulose nanofibers (CNF).
- Table 27. Market opportunity assessment for Cellulose nanofibers, by application.
- Table 28. Safety of Micro/Nanofibrillated cellulose.



- Table 29. Global Cellulose nanofibers market supply chain analysis.
- Table 30: Product/price/application matrix of cellulose nanofiber producers.
- Table 31. Cellulose nanofiber-based commercial products.*
- Table 32. The Cellulose Nanofibers market 2020-2022-industry product and production activity.
- Table 33. Market overview for cellulose nanofibers in composites.
- Table 34. Comparative properties of polymer composites reinforcing materials.
- Table 35. Scorecard for cellulose nanofibers in composites.
- Table 36. Market assessment for cellulose nanofibers in composites-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global composites OEMs.
- Table 37. Global market demand for cellulose nanofibers in composites, 2018-2033 (metric tons).
- Table 38. Companies developing cellulose nanofibers in composites.
- Table 39. Market overview for cellulose nanofibers in automotive.
- Table 40. Scorecard for cellulose nanofibers in automotive.
- Table 41. Market assessment for cellulose nanofibers in automotive-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global automotive OEMs.
- Table 42. Components featured in the NCV.
- Table 43. Global market demand for nanocellulose in the automotive sector 2018-2033 (metric tons).
- Table 44. Companies developing cellulose nanofibers products in the automotive industry.
- Table 45. Market overview for cellulose nanofibers in building and construction.
- Table 46. Scorecard for cellulose nanofibers in building and construction.
- Table 47. Market assessment for cellulose nanofibers in building and construction-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global construction OEMs Table 48: Market demand for cellulose nanofibers in building and construction, 2018-2033 (tons).
- Table 49. Companies developing cellulose nanofibers in building and construction.
- Table 50. Oxygen permeability of nanocellulose films compared to those made form commercially available petroleum-based materials and other polymers.
- Table 51. Scorecard for cellulose nanofibers in paper and board packaging.
- Table 52. Market assessment for cellulose nanofibers in paper and board packaging-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global paper and board packaging OEMs.



- Table 53. Global demand for cellulose nanofibers in paper & board packaging, 2018-2033 (tons).
- Table 54. Companies developing cellulose nanofibers products in paper and board.
- Table 55. Market overview for cellulose nanofibers in textiles and apparel.
- Table 56. Scorecard for cellulose nanofibers in textiles and apparel.
- Table 57. Market assessment for cellulose nanofibers in textiles and apparelapplication, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global textiles and apparel OEMs.
- Table 58. Demand for cellulose nanofibers in textiles, 2018-2033 (tons).
- Table 59. Companies developing cellulose nanofibers products in textiles and apparel.
- Table 60. Market overview for cellulose nanofibers in medicine and healthcare.
- Table 61. Scorecard for nanocellulose in medicine and healthcare.
- Table 62. Market assessment for nanocellulose in medicine and healthcare-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global medicine and healthcare OEMs.
- Table 63. Global demand for cellulose nanofibers in biomedical and healthcare, 2018-2033 (tons).
- Table 64. Nanocellulose product developers in medicine and healthcare.
- Table 65. Market overview for cellulose nanofibers in the hygiene and sanitary products market.
- Table 66. Global demand for cellulose nanofibers in hygiene and absorbents, 2018-2033 (tons).
- Table 67. Cellulose nanofibers product developers in hygiene and sanitary products.
- Table 68. Market overview for Cellulose nanofibers in paints and coatings.
- Table 69. Scorecard for Cellulose nanofibers in paints and coatings.
- Table 70. Market assessment for cellulose nanofibers in paints and coatingsapplication, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global paints and coatings OEMs.
- Table 71. Global demand for cellulose nanofibers in paint and coatings, 2018-2033 (tons).
- Table 72. Companies developing nanocellulose products in paints and coatings, applications targeted and stage of commercialization.
- Table 73. Market overview for cellulose nanofibers in aerogels.
- Table 74. Scorecard for cellulose nanofibers in aerogels.
- Table 75. Market assessment for cellulose nanofibers in aerogels-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global aerogels OEMs.



- Table 76. Global demand for cellulose nanofibers in aerogels, 2018-2033 (tons).
- Table 77. Nanocellulose in product developers in aerogels.
- Table 78. Market overview for cellulose nanofibers in oil and gas.
- Table 79. Scorecard for cellulose nanofibers in oil and gas.
- Table 80. Market assessment for cellulose nanofibers in oil and gas-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global oil and gas OEMs.
- Table 81. Global demand for cellulose nanofibers in the oil and gas market, 2018-2033 (tons).
- Table 82. Cellulose nanofibers product developers in oil and gas exploration.
- Table 83. CNF membranes.
- Table 84. Market overview for Cellulose nanofibers in filtration.
- Table 85. Scorecard for Cellulose nanofibers in filtration.
- Table 86. Market assessment for Cellulose nanofibers in filtration-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global filtration OEMs.
- Table 87: Global demand for Cellulose nanofibers in the filtration market, 2018-2033 (tons).
- Table 88. Companies developing cellulose nanofibers products in filtration.
- Table 89. Market overview for cellulose nanofibers in rheology modifiers.
- Table 90. Scorecard for cellulose nanofibers in rheology modifiers.
- Table 91. Market assessment for cellulose nanofibers in rheology modifiers-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global rheology modifier OEMs.
- Table 92. Global demand for cellulose nanofibers in the rheology modifiers market, 2018-2033 (tons).
- Table 93. Commercial activity in cellulose nanofibers in rheology modifiers.
- Table 94. Properties of flexible electronics?cellulose nanofiber film (nanopaper).
- Table 95. Market assessment for cellulose nanofibers in printed, stretchable and flexible electronics-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global printed, flexible and stretchable electronics OEMs.
- Table 96. Companies developing cellulose nanofibers products in printed, stretchable and flexible electronics.
- Table 97. Market assessment for cellulose nanofibers in 3D priniting-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading, main global 3D printing OEMs.
- Table 98. Companies developing cellulose nanofibers 3D printing products.
- Table 99. Market assessment for cellulose nanofibers in aerospace-application, key



benefits and motivation for use, megatrends, market drivers, technology drawbacks, competing materials, material loading.

Table 100: Companies developing cellulose nanofibers products in aircraft and aerospace.

Table 101. Market assessment for cellulose nanofibers in Batteries-application, key benefits and motivation for use, megatrends, market drivers, technology drawbacks.

Table 102: Granbio Nanocellulose Processes.

Table 103. Nippon Paper commercial CNF products.

Table 104. Oji Holdings CNF products.



List Of Figures

LIST OF FIGURES

- Figure 1. Global demand for cellulose nanofibers/MFC in metric tons by market, 2018-2033.
- Figure 2. Regional demand for Cellulose nanofibers, 2021.
- Figure 3. Schematic diagram of partial molecular structure of cellulose chain with numbering for carbon atoms and n= number of cellobiose repeating unit.
- Figure 4. Scale of cellulose materials.
- Figure 5. Types of nanocellulose.
- Figure 6. Relationship between different kinds of nanocelluloses.
- Figure 7. Various preparation methods for nanocellulose.
- Figure 8. TEM image of cellulose nanocrystals.
- Figure 9. CNC preparation.
- Figure 10. Extracting CNC from trees.
- Figure 11. CNC slurry.
- Figure 12. Bacterial nanocellulose shapes
- Figure 13. SEM image of microfibrillated cellulose.
- Figure 14. Nanocellulose preparation methods and resulting materials.
- Figure 15. Production of nanocellulose from lignocellulosic biomass using enzymatic treatment (endoglucanases and xylanases) followed by mechanical treatment.
- Figure 16. EBI pretreatment combined with HPH for CNC production.
- Figure 17. Aruba 23.
- Figure 18. Dorayaki.
- Figure 19. ENASAVE NEXT.
- Figure 20. Flat4-KAEDE.
- Figure 21. GEL-KAYANO™.
- Figure 22. Hada care acty®.
- Figure 23. Hiteeth All in One Mouth Gel.
- Figure 24. HYPERNANO X series.
- Figure 25. Kirekira! toilet wipes.
- Figure 26. ONKYO® Scepter SC-3(B) 2-way Speaker System.
- Figure 27. Pioneer® SE-MONITOR5 Headphones.
- Figure 28. 'Poise' series Super strong deodorant sheet.
- Figure 29. RUBURI Precursor Lubris for raw concrete pumping.
- Figure 30. SC-3 (B) speakers.
- Figure 31. SE-MONITOR5 headphones.
- Figure 32. 'Skin Care Acty' series Adult diapers.



- Figure 33. Spingle Company sneakers.
- Figure 34. 'SURISURI' Lotion.
- Figure 35. X9400 series.
- Figure 36. X Premium Sound Speaker Alps Alpine.
- Figure 37. CNF nameplate.
- Figure 38. Applications of cellulose nanofibers in composites.
- Figure 39. Global market demand for cellulose nanofibers in composites, 2018-2033 (metric tons).
- Figure 40. CNF mixed PLA (Poly Lactic Acid).
- Figure 41. CNF resin products.
- Figure 42. Interior of NCV concept car.
- Figure 43. Applications of cellulose nanofibers in automotive.
- Figure 44. Interior of the NCV prototype.
- Figure 45. Global demand for nanocellulose in the automotive sector, 2018-2033 (metric tons).
- Figure 46: Daio Paper's cellulose nanofiber material in doors and hood of race car.
- Figure 47: CNF composite.
- Figure 48: Engine cover utilizing Kao CNF composite resins.
- Figure 49. CNF car engine cover developed in Japan Ministry of the Environment's (MOE) Nano Cellulose Vehicle (NCV) Project.
- Figure 50. Comparison of nanofillers with supplementary cementitious materials and aggregates in concrete.
- Figure 51. Applications of cellulose nanofibers in building and construction.
- Figure 52. Demand for cellulose nanofibers in construction, 2018-2033 (tons).
- Figure 53. Applications of cellulose nanofibers in paper and board packaging.
- Figure 54. Global demand for cellulose nanofibers in the paper & board/packaging, 2018-2033 (tons).
- Figure 55. Applications of cellulose nanofibers in textiles and apparel.
- Figure 56. Asics GEL-KAYANO™ 25 running shoe.
- Figure 57. Demand for cellulose nanofibers in the textiles sector, 2018-2033 (tons).
- Figure 58. CNF deodorant products.
- Figure 59. Applications of cellulose nanofibers in medicine and healthcare.
- Figure 60. Global demand for cellulose nanofibers in biomedical and healthcare, 2018-2033 (tons).
- Figure 61. Fibnano.
- Figure 62. Global demand for cellulose nanofibers in hygiene and absorbents, 2018-2033 (tons).
- Figure 63. Applications of cellulose nanofibers in paints and coatings.
- Figure 64. Global demand for cellulose nanofibers in paint and coatings, 2018-2033



(tons).

Figure 65. Hefcel-coated wood (left) and untreated wood (right) after 30 seconds flame test.

Figure 66: Global demand for nanocellulose in in aerogels, 2018-2033 (tons).

Figure 67. Global demand for cellulose nanofibers in the oil and gas market, 2018-2033 (tons).

Figure 68. Nanocellulose sponge developed by EMPA for potential applications in oil recovery.

Figure 69. Applications of Cellulose nanofibers in filtration.

Figure 70. Global demand for Cellulose nanofibers in the filtration market, 2018-2033 (tons).

Figure 71. Multi-layered cross section of CNF-nw.

Figure 72. Applications of cellulose nanofibers in rheology modifiers.

Figure 73. Global demand for cellulose nanofibers in the rheology modifiers market, 2018-2033 (tons).

Figure 74. 'SURISURI' products.

Figure 75. Foldable nanopaper antenna.

Figure 76: Flexible electronic substrate made from CNF.

Figure 77. Oji CNF transparent sheets.

Figure 78. Electronic components using NFC as insulating materials.

Figure 79: Anpoly cellulose nanofiber hydrogel.

Figure 80. MEDICELLU™.

Figure 81: Ashai Kasei CNF production process.

Figure 82: Asahi Kasei CNF fabric sheet.

Figure 83: Properties of Asahi Kasei cellulose nanofiber nonwoven fabric.

Figure 84. CNF nonwoven fabric.

Figure 85. Borregaard Chemcell CNF production process.

Figure 86. Celfion membrane.

Figure 87. Pressurized Hot Water Extraction.

Figure 88. nanoforest products.

Figure 89. Chuetsu Pulp & Paper CNF production process.

Figure 90. nanoforest-S.

Figure 91. nanoforest-PDP.

Figure 92. nanoforest-MB.

Figure 93. Daicel Corporation CNF production process.

Figure 94. Celish.

Figure 95. BELLOCEA™

Figure 96: Trunk lid incorporating CNF.

Figure 97. Daio Paper CNF production process.



Figure 98. ELLEX products.

Figure 99. CNF-reinforced PP compounds.

Figure 100. Kirekira! toilet wipes.

Figure 101. Color CNF.

Figure 102. DIC Products CNF production process.

Figure 103. DKS Co. Ltd. CNF production process.

Figure 104: Rheocrysta spray.

Figure 105. DKS CNF products.

Figure 106: CNF based on citrus peel.

Figure 107. Citrus cellulose nanofiber.

Figure 108. Imerys CNF production process.

Figure 109. Photograph (a) and micrograph (b) of mineral/ MFC composite showing the high viscosity and fibrillar structure.

Figure 110. Filler Bank CNC products.

Figure 111. Water-repellent cellulose.

Figure 112: Cellulose Nanofiber (CNF) composite with polyethylene (PE).

Figure 113: CNF products from Furukawa Electric.

Figure 114. Granbio CNF production process.

Figure 115: Cutlery samples (spoon, knife, fork) made of nano cellulose and

biodegradable plastic composite materials.

Figure 116. Non-aqueous CNF dispersion 'Senaf' (Photo shows 5% of plasticizer).

Figure 117. HeiQ AeoniQ.

Figure 118: CNF gel.

Figure 119: Block nanocellulose material.

Figure 120: CNF products developed by Hokuetsu.

Figure 121. Kami Shoji CNF products.

Figure 122. Dual Graft System.

Figure 123: Engine cover utilizing Kao CNF composite resins.

Figure 124. Acrylic resin blended with modified CNF (fluid) and its molded product

(transparent film), and image obtained with AFM (CNF 10wt% blended).

Figure 125: 0.3% aqueous dispersion of sulfated esterified CNF and dried transparent film (front side).

Figure 126. Kruger Biomaterials, Inc. CNF production process.

Figure 127. BioFlex process.

Figure 128. CNF deodorant.

Figure 129. Chitin nanofiber product.

Figure 130. Marusumi Paper cellulose nanofiber products.

Figure 131. FibriMa cellulose nanofiber powder.

Figure 132. Cellulomix production process.



- Figure 133. Nanobase versus conventional products.
- Figure 134. Uni-ball Signo UMN-307.
- Figure 135: CNF slurries.
- Figure 136. Range of CNF products.
- Figure 137: Nanocell serum product.
- Figure 138. Vatensel® product
- Figure 139: Hydrophobization facilities for raw pulp.
- Figure 140: Mixing facilities for CNF-reinforced plastic.
- Figure 141. Nippon Paper CNF production process.
- Figure 142: Nippon Paper Industries' adult diapers.
- Figure 143. All-resin forceps incorporating CNF.
- Figure 144. CNF paint product.
- Figure 145. CNF wet powder.
- Figure 146. CNF transparent film.
- Figure 147. Transparent CNF sheets.
- Figure 148. Oji Paper CNF production process.
- Figure 149. CNF clear sheets.
- Figure 150. Oji Holdings CNF polycarbonate product.
- Figure 151. Fluorene cellulose ® powder.
- Figure 152. A vacuum cleaner part made of cellulose fiber (left) and the assembled vacuum cleaner.
- Figure 153. Performance Biofilaments CNF production process.
- Figure 154. XCNF.
- Figure 155. Innventia CNF production process.
- Figure 156: Innventia AB movable nanocellulose demo plant.
- Figure 157. CNF insulation flat plates.
- Figure 158. Seiko PMC CNF production process.
- Figure 159. Manufacturing process for STARCEL.
- Figure 160. 3D printed cellulose shoe.
- Figure 161. Rubber soles incorporating CNF.
- Figure 162. CNF dispersion and powder from Starlite.
- Figure 163. Thales packaging incorporating Fibrease.
- Figure 164. Sugino Machine CNF production process.
- Figure 165. High Pressure Water Jet Process.
- Figure 166. 2 wt.? CNF suspension.
- Figure 167. BiNFi-s Dry Powder.
- Figure 168. BiNFi-s Dry Powder and Propylene (PP) Complex Pellet.
- Figure 169. Silk nanofiber (right) and cocoon of raw material.
- Figure 170. SVILOSA AD CNC products.



- Figure 171. Silver / CNF composite dispersions.
- Figure 172. CNF/nanosilver powder.
- Figure 173: Comparison of weight reduction effect using CNF.
- Figure 174: CNF resin products.
- Figure 175. University of Maine CNF production process.
- Figure 176. US Forest Service Products Laboratory CNF production process.
- Figure 177: Flexible electronic substrate made from CNF.
- Figure 178. VTT 100% bio-based stand-up pouches.
- Figure 179. VTT CNF production process.
- Figure 180: HefCel-coated wood (left) and untreated wood (right) after 30 seconds flame test.
- Figure 181: Bio-based barrier bags prepared from Tempo-CNF coated bio-HDPE film.
- Figure 182. S-CNF in powder form.
- Figure 183. Zelfo Technology GmbH CNF production process.



I would like to order

Product name: The Global Market for Cellulose Nanofibers 2023-2033

Product link: https://marketpublishers.com/r/G0616DFD897BEN.html

Price: US\$ 1,250.00 (Single User License / Electronic Delivery)

If you want to order Corporate License or Hard Copy, please, contact our Customer

Service:

info@marketpublishers.com

Payment

To pay by Credit Card (Visa, MasterCard, American Express, PayPal), please, click button on product page https://marketpublishers.com/r/G0616DFD897BEN.html

To pay by Wire Transfer, please, fill in your contact details in the form below:

First name:	
Last name:	
Email:	
Company:	
Address:	
City:	
Zip code:	
Country:	
Tel:	
Fax:	
Your message:	
	**All fields are required
	Custumer signature

Please, note that by ordering from marketpublishers.com you are agreeing to our Terms & Conditions at https://marketpublishers.com/docs/terms.html

To place an order via fax simply print this form, fill in the information below and fax the completed form to +44 20 7900 3970