sappi

Inspired by life

Sustainability FAQs

Nanocellulose

Nanocellulose is a lightweight, solid substance which is comprised of nano-sized fibrils - the **high strength building blocks** of **cellulose fibres**.	Our pilot plant is focused on the production of **high quality** functionalised **nanocellulose fibrils**.	Our nanocellulose manufacturing process is designed to **minimise energy** use and to **maximise** the **recycling** of **process chemicals** — respecting our environment.

Nanocellulose — the core of high performance natural solutions

What does 'nano' mean?

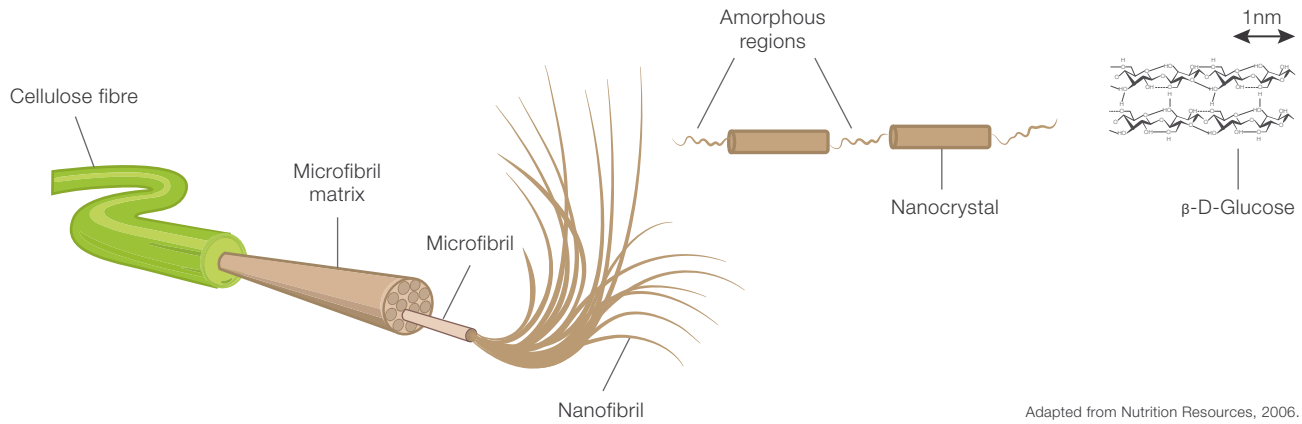
Derived from the Greek word 'nanos', meaning 'dwarf'. One nanometre is one-billionth of a metre.

What is nanocellulose?

Nanocellulose is a lightweight, solid substance obtained from cellulosic fibres (plant materials). It is comprised of crystals and amorphous cellulose, with a diameter of less than 100 nanometres.

What is cellulose?

Cellulose, bound in the cell walls of plants and bacteria is the most abundant biological polymer on the planet. It consists of long chains of glucose (a sugar), linked together to form a polymer, a natural plastic-like material. It is the main component of plant stems, leaves and roots, and gives wood its remarkable strength. Traditionally, the main commercial uses for cellulose have been in producing paper and textiles. Nanocellulose, produced by separating cellulose fibres down to the smallest fibril component, opens up opportunities in new and adjacent markets for Sappi.



Adapted from Nutrition Resources, 2006.

Nanocellulose is **very stiff** and **lightweight**.	Crystalline nanocellulose has **8x** the **tensile strength** to **weight ratio** of **steel**.	Nanocellulose is **sustainable**, **renewable**, **biocompatible** and **biodegradable**.	Nanocellulose aligns with Sappi's **strategy** of **developing opportunities** in **new** and **adjacent markets**.

Nanocellulose continued

What are the properties of nanocellulose?

- Lightweight
- Electrically conductive
- Non-toxic
- The crystalline form is transparent and gas impermeable
- Very high tensile strength in crystalline form — eight times that of steel
- Highly absorbent when used as a base for producing aerogels and foams.

Are there different types of nanocellulose?

Nanocellulose currently exists in three forms:

CMF Cellulose Micro Fibrils
CNF Cellulose Nano Fibrils
CNC Cellulose Nano Crystals.

All processes involve the separation of CMF, CNF and CNC from woodpulp.

Is Sappi the first to develop nanocellulose?

No, nanocellulose was developed during the 1980s[2], but was not successfully commercialised because the production process is energy intensive. Today there are a number of companies around the world manufacturing limited amounts of nanocellulose.

What is unique about Sappi's process?*

Sappi's patented process, developed in conjunction with Edinburgh Napier University, uses a unique chemistry which easily breaks down woodpulp fibres into nanocellulose without requiring significant energy inputs. The chemicals used in the process can be recycled easily and reused without generating large amounts of effluent.

How is Sappi focusing on nanocellulose?

In 2016, Sappi successfully commissioned a nanocellulose pilot plant at the Brightlands Chemelot Campus in The Netherlands.

To accelerate our work in this fast-growing field, we are growing our nanocellulose capacity at three of our global R&D facilities.

Does nanocellulose have applications within the paper industry?

Adding nanocellulose to paper and reducing other ingredients, such as pulp, offers paper producers a way to create lighter, yet stronger sheets. Requiring less material and thus less energy to make, these sheets could have a lower carbon footprint.

Nanocellulose acts as a barrier in grease-proof papers used in the food and barrier industries, and it can be used as a wet-end additive to enhance retention and dry- and wet-strength in board and paper products.

What is possibly one of the most significant uses for CNF?

The use of CNFs in films, composites, and coatings has been found to **substantially reduce the oxygen permeability**.[3]

What will nanocellulose, produced by Sappi, be used for?

The **CNF** produced by Sappi will have **unique morphology**, specifically modified for either **hydrophobic** or **hydrophilic** applications. Products produced using Sappi's CNF will be optimally suitable for conversion in lighter and stronger fibre-reinforced composites and plastics, and could, for example, replace glass-fibre in the production of next-generation lighter, fuel-efficient vehicles.

Sappi-produced CNF could also be used in a wide range of industrial and everyday products and devices because of the way it can improve on the properties of materials with which it is combined, for example, thickening water-based products such as paints, foods and concrete. Because of CNF's low oxygen permeability, it could also be a possible replacement for plastic films in packaging.

Other applications include additive manufacturing for 3D printing, containing-films in lithium batteries and touch-screens. As cellulose is inherently biocompatible and bio-absorbable, there is considerable potential in biomedical applications such as wound dressings and regenerative medicine. Further development will also include additive manufacturing technologies, both for industrial as well as biomedical applications.

Other uses for nanocellulose

Among its many potential uses, nanocellulose can be used as:

- As a substitute for heavy materials in new lightweight composites for the manufacture of cars
- In antimicrobial films and water absorbent pads in medical applications
- In flexible electronic displays and batteries
- In sensors that could help monitor structures like bridges to detect stresses
- In food packaging material that prevents oxygen entry and spoiling
- As a flavour carrier, suspension stabiliser and thickener in food thickeners in industrial applications
- In aerogels to mop up oil spills, and
- As an additive to improve the mechanical properties of rubber, latex, thermosetting resins, soya protein and starch-based matrices.

What benefits and advantages does nanocellulose offer?

- Unlike lightweight, high-strength materials derived from fossil fuels, nanocellulose is derived from cellulose — the most abundant polymer on earth — and most importantly a renewable resource.
- Nanocellulose offers great potential value in helping the world shift to materials that do not require petroleum as a feedstock
- Nanocellulose is biocompatible and biodegradable
- Unlike corn or other food crops, using wood-based cellulose does not impinge food supply or affect food prices.

1 http://www.sciencedaily.com/releases/2012/03/120325173010.htm
2 http://www.academia.edu/8361088/Preparation_of_Nanocellulose_A_Review
3 http://www.sustainablechemicalprocesses.com/content/pdf/s40508-014-0023-0.pdf