



**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?**

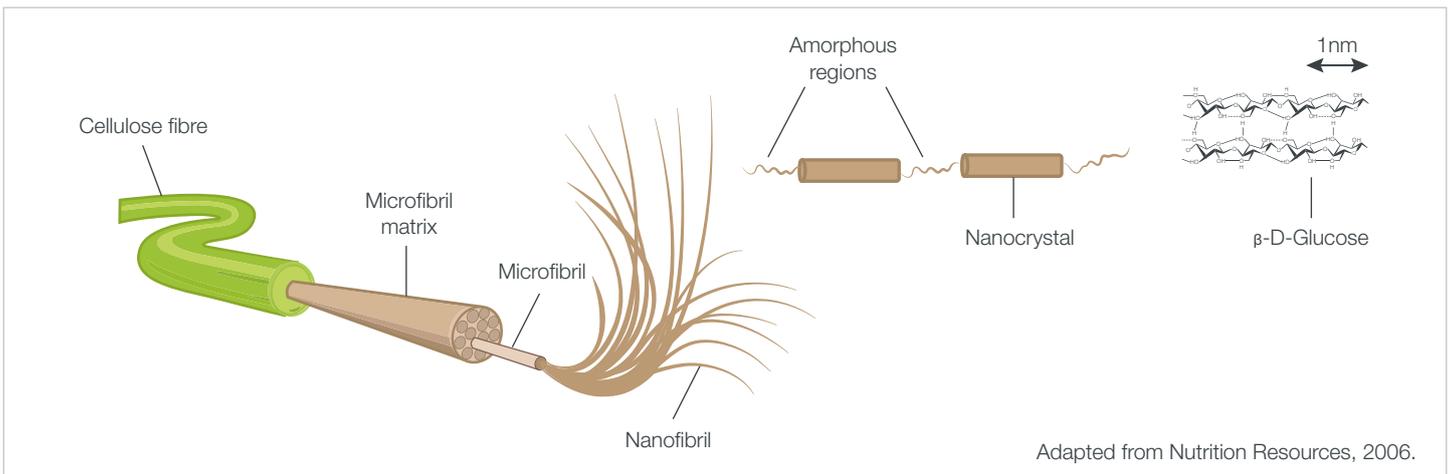
Derived from the Greek word 'nanos', meaning 'dwarf'. One nanometre is one-billionth of a metre.

**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.

**Sappi's nanocellulose** is branded as **Valida**.



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?<sup>1</sup>

- 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 Microfibrils)

**CNF** (Cellulose Nanofibrils)

**CNC** (Cellulose Nanocrystals)

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

### Is Sappi the first to develop nanocellulose?

No. Nanocellulose was developed during the 1980s,<sup>2</sup> 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 wood pulp 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?

Sappi has established a pilot-scale plant for the production of both aqueous and dry re-dispersible nanocellulose at the Brightlands Chemelot Campus in The Netherlands. Although designed to produce Cellulose Nanofibrils (CNF), the plant will also be capable of producing Microfibrillated Cellulose (CMF). Feedstock to the plant in the form of wood pulp will be obtained from various accredited and sustainable sources.

### 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**.<sup>3</sup>

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

Sappi has developed a unique process for the manufacture of high-quality nanocellulose, branded as Valida, which is easily dispersed into a variety of matrices. Valida, which is naturally hydrophilic, can also be subjected to surface modification to suit hydrophobic and other specific applications.

Key features of Valida include:

- A renewable and recyclable natural organic polymer.
- Non-toxic.
- Biodegradable and biocompatible.
- Film forming.
- Shear thinning.
- Lightweight with high stiffness.
- Stable in a wide range of temperature and pH.
- High viscosity.

### Other uses for nanocellulose

Among its many potential uses, nanocellulose can be used:

- 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.
- 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](http://www.academia.edu/8361088/Preparation_of_Nanocellulose_A_Review)

3 <http://www.sustainablechemicalprocesses.com/content/pdf/s40508-014-0023-0.pdf>