

(a) Nano-cellulose production

What is Nanocellulose?

Nanocellulose is a light solid substance obtained from plant matter which comprises nanosized cellulose fibrils. This new material is a pseudo-plastic and possesses the property of specific kinds of fluids or gels that are generally thick in normal conditions. The lateral dimensions of nanocellulose range from 5 to 20 nm, and the longitudinal dimension ranges from a few 10's of nanometers to several microns.

Nanocellulose is transparent, electrically conductive, and stronger than steel.



Properties of Nanocellulose

- Lightweight
- Stiffer than Kevlar®
- Electrically conductive
- Non-toxic
- The crystalline form is transparent, and gas impermeable
- It can be produced in large quantities in a cost-effective manner
- It has a very high tensile strength - 8 times that of steel
- It is highly absorbent when used as a basis for aerogels or foams.
- The raw material - cellulose - is the most abundant polymer on earth

Basic Production process of Nanocellulose

Nanocellulose is generally produced from wood pulp though it can also be prepared from any cellulosic source material. Nanocellulose is produced using following steps:

- Remove non-cellulose impurities from the wood pulp using a homogenizer. The high-pressure homogenizers used in the production process helps delaminate the cell walls of the fibers and separate the nanosized fibrils.
- Separate the cellulose fibers by beating the mixture gently.
- Allow the fibers to form a thick paste of needle-like crystals or a spaghetti-like structure of cellulose fibrils.
- The thick paste that is obtained can be shaped and readily used to laminate surfaces.

Once it is completely separated from the wood pulp, the nanocellulose is in a water suspension. At this stage, care is taken to prevent the formation of rough clumps in cases when the cellulose fibers stick together as the material dries.

Contemporary processes have been developed that allows nanocellulose to dry without the formation of rough clumps. This process thus prevents the cellulose fibrils from sticking together and enables the cellulose fibers to retain their mechanical properties.

Applications of Nanocellulose

Nanocellulose with its lightweight, high strength and transparent properties is of great interest for many applications in a wide variety of areas.

- Nanocellulose is less expensive alternative to carbon fiber and glass fiber for application in **reinforced plastic composites**. It improves the environmental footprint of end products by replacing synthetic petrochemical-based materials.
- Nanocellulose is used to **improve the mechanical properties** of rubber latex, thermosetting resins, soy protein and starch-based matrixes.
- Nanocellulose can be used as a **food packaging** material that prevents the spoiling of food contents and entry of oxygen in the food contents. (bioplastic materials like PHAs & PLA reinforced with nanocellulose)

- It is considered a useful material by the paper and pulp industries that use nanocellulose as an efficient means to increase absorbency in several products such as napkins, kitchen towels, etc.
- Nanocellulose sheets can be used for electronic displays and windows.
- In food products, nanocellulose can be used as flavour carriers and suspension stabilizers.
- Nanocellulose is safe to be used as a food thickener.
- When used in paper products, nanocellulose helps to improve the fiber to fiber bond strength and acts as a barrier in grease-proof type papers.
- It can be used as wet-end additive to enhance retention, dry and wet strength in commodity type of board and paper products.
- In the medical field, nanocellulose can be used for antimicrobial films and water absorbent pads.
- Nanocellulose can be used in tampons, sanitary napkins or wound dressing in the form of freeze-dried nanocellulose aerogels.
- Intestinal disorders can be treated by tablets comprising dry solid nanocellulose.
- Nanocellulose in a powdered form is used as an excipient in pharmaceutical formulations.

As a first step we can prepare a Techno Economic Project Feasibility Report that will provide a realistic picture and help you to take an informed business decision.

Once you decide to go ahead we can assist in selection and sourcing manufacturing know-how and developing pilot plant for proof of concept. Thereafter we can assist you to set-up full scale production plant – selection of plant & machinery, plant layout and design, selection of utilities and support equipment, commissioning of plant, sourcing of additives, quality control and testing systems, product technical qualification, target market segments, end application know-how, market intelligence

(b) Nano-cellulose reinforced polymer composites

- Nano cellulose and thermoplastic starch polymer (TSP) composite prepared with appropriate solvent systems by solution casting method. Resulting composite has highly enhanced mechanical properties and much lower degradation in water.
- Bio foams prepared from potato starch and nano cellulose
- Cross linked PU elastomer with reinforced with Nano cellulose. Freeze dried Nano cellulose is dispersed in DMF solvent for addition with Polyols + MDI
- Nano cellulose fibers can be combined with bio-based biodegradable resins to produce 100% bio-composites with good mechanical properties (thus decreasing use of petroleum-based products)
- Nano cellulose fibers reinforced thermoset composites like epoxy and polyester to improve physical – mechanical properties and ensuring compatibility of the composite with current manufacturing processes (SMC, BMC, hand lay-up etc.).
- Cellulose nanocrystals are an environmentally friendly filler. They are bio-based, environment friendly, can be produced in large quantities in cost effective manner, are light weight and tough (8 times stronger than steel) with transparent colour. Nanocellulose reinforced thermoplastic composites in automotive components like bumpers, side panels and dashboards can be made 3-4 times stronger and around 30% lighter.

Dr. ANOMITRA CHAKRAVARTY

KPS Consultants & Impex Pvt. Ltd.

812 Devika Tower, 6 Nehru Place

New Delhi - 110019, India

(M): +91 98993 59661, (T) : +91-11 2621 3885 , 4161 6899

(e) : kpspltd@gmail.com(w) : www.kpsimpex.com

www.linkedin.com/in/anomitra-chakravarty-5a4b1414