



Melodea
Bio Based Solutions

Cellulose Nanomaterials – A Path
Towards Commercialization
Melodea Company Overview
Yoram Shkedi, CEO
May 2014

About Melodea

- A Cleantech & nanotechnology Israeli Startup
Founded by Prof. Oded Shoseyov, Dr. Shaul Lapidot and Mr. Tord Gustafsson (Sweden) in 2010
- Today we are 9 employees, CEO - Yoram Shkedi, Lab and offices in the Faculty of Agriculture, Rehovot
- The company is backed by Holmen AB, Sweden


Melodea's Technologies and Products

NCC production
Development of economically viable industrial process for the extraction of Nano Crystalline Cellulose (known as NCC or CNC) from the sludge of the paper industry

NCC Foam
Nano structured foams made from NCC for sandwich composites applications


NCC as additive
Development of NCC based applications:

- Paper industry
- Packaging
- Construction sector

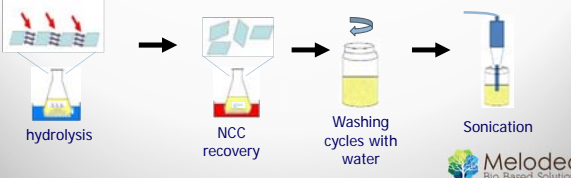



Nano Crystalline Cellulose (NCC or CNC) Basic building block of all living plants


Cellulose fibers contain amorphous and crystalline areas



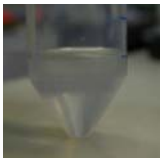
Production of NCC from the fibers (discovered by Ranby 1949)

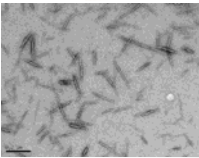
Pulp & Paper Industry Waste a Perfect Source for NCC



11M ton **waste** annually
in Europe
(Monte et al, Waste Management,
2009)




NCC produced
from P&P waste



NCC viewed under electron
microscopy (TEM)


Method For Production Of Cellulose Nano Crystals From Cellulose-Containing Waste
Materials PCT/IL2011/000613




Production of NCC from Pulp & Paper Waste

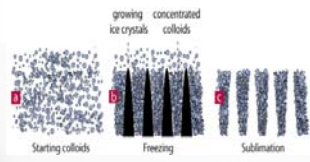
Main advantages as raw material:

- Investment in fiber growing, collection and handling was already done
- Most of the required energy and chemicals were already invested
- High availability, zero value
- Utilization of paper mills knowhow, infrastructure and utilities
- Paper mill sludge is converted into a valuable product
- Reduced carbon footprint of the industry

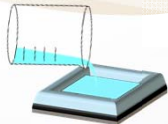





NCC Based Foam Formed by Ice Templating




<http://sylvaindeville.net/research/ice-templating-of-porous-materials/>



NCC suspension is cast into a mold,
Followed by Freezing/Solvent Drying





NCC Assembles into Foams with Highly Ordered Architecture

Foams at dimensions of A4 sheet X 1 to 2 cm are produced



“Virgin” NCC foam
Density: 35 Kg/m³

crosslinked NCC foam:
Water and fire resistance
compressive strength: 1.5 MPa,
Density: 150 Kg/m³

CELLULOSE-BASED COMPOSITE MATERIALS, PCT/IL2011/000714



Foams Fire Retardation Properties are Superior to Fossil-Oil Based Foams

NCC foam burning test

Commercial PVC foam burning test

results

Results in reversed colors

NCC-Foam PVC

NCC-Foam PVC

Development of NCC Foams into Bio-Based Core Material for Sandwich Composites

applications

Traditional cores are produced from fossil oil based materials

Melodea Participating in 3 European Programs

BRIMEE "Cost-effective and sustainable bio-renewable Indoor Materials with high potential for customisation and creative design in Energy Efficient buildings"

NCC-Foam "Self assembly of Nano Crystalline Cellulose for lightweight cellular structures"

FLHEA "Flax and Hemp Advanced Fiber Based Composites"


BRIMEE Cost-effective and Sustainable Bio-renewable Indoor Materials with High Potential for Customisation and Creative Design in Energy Efficient Buildings

Project objective: Development of novel insulating materials for the construction sectors.

Specific objectives:

- Production of NCC composite foams for acoustic and thermal insulation bearing structural and flame retardation properties
- The project starts at lab-scale production going to pilot scale panels

Project partners from different parts of the construction value chain
Information available at www.brimee.eu


 **Self Assembly of Nano Crystalline Cellulose for Lightweight Cellular Structures**


Project objective: develop commercially-viable, lightweight, rigid foam core materials from self-assembled NCC

Specific objectives

- Develop low cost, sustainable, structural cellular material from self-assembled NCC
- Develop a pilot-scale manufacturing cell for NCC foams
- validate the use of NCC foams as lightweight core materials in structural bio-composite sandwich components
- perform a thorough technical, economic and environmental evaluation of the developed NCC foams to support on-going development and future market appropriation

Project partners from different parts of the composite sector value chain
Information available at www.ncc-foam.eu




 **Flax and Hemp Advanced Fiber Based Composites**

Project objective: industrial scaled-up processes to obtain modified cellulose nanofibres, for the development of biocomposites with improved properties

Specific objectives:

- Melodea develops efficient extraction steps of nano-cellulose from flax and hemp fibers
- Chemical modification of the nano-cellulose for high compatibility with thermoplastic materials
- Develop nano-cellulose reinforced biodegradable composites for food packaging

Partners from fibres and bioplastics sectors
Information available at www.flhea.eu



Our Plan

2013


- *Upscale NCC production from waste to Kgs scale ✓
- *Upscale NCC Foam production to A4 X 1 cm sheet ✓
- *Development of NCC based applications for the Pulp & Paper industry and packaging ✓

2014

- *Launch of Industrial Pilot plant with capacity of 100Kg/day
- *Design and Engineering of first commercial plant
- *NCC foam with comparable technical performance to commercial foams

2015

- *Launch first NCC production plant with capacity of 1 ton/day
- *Upscale NCC foam production to commercial size sheets



Business Opportunities

- *Industrial Partners for production of NCC and products development
- *Joint development partners for NCC applications in foams, packaging, additives for paper, glues, construction, composite, . . .



