INCOMA

Industrial Production Processes for Nanoreinforced Composite Structures

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under the Grant agreement no 608746.

What is the purpose of this project?

The main objective of the INCOM project is to develop techno-economically viable solutions and production methods for manufacturing of lightweight structures based on advanced sustainable materials for use in vehicles, aeronautical applications and sporting goods. Special attention is dedicated to upscaling of production processes, pilot scale trials and industrial implementation.

Can you explain this in other words?

Lightweight and resistant composite sandwich structures are developed and manufactured for different applications. These structures are reinforced with nanofibrillated cellulose (NFC), a nano-scale material derived from cellulose found in biomass and bio-waste.

Glossary

Sandwich composites materials: a sandwich structure is a fabricated material that consists of two thin, stiff facing sheets joined to either side of a low density core material or structure. They have high mass specific stiffness and strength. Sandwich materials also offer a number of other potential benefits including possibilities for functional integration, space saving and modular construction (source: Best Practice Guide for Sandwich Structures in Marine Applications www.transport-research.info)

Nanomaterials: materials with at least one external dimension in the size range from approximately 1-100 nanometers (source: web.stanford.edu).

Nanofibrillated cellulose (NFC): nano-scale cellulose composed by long and semi-flexible fibrils obtained by top-down disintegration of wood or other plant materials (source: Lee et al. 2014, Comp.Sci.Technol, 105 15-27).

Why is this project important?

Sandwich composites materials can replace monolithic structures in many applications, thus saving input materials and reducing the overall weight. Sandwich structures with a low cost core material can be more lightweight and also more cost effective. Moreover, the reduced use of materials in sandwich composites, compared to monolithic structures, can reduce their environmental impact. The project also aims at adding value to bio-waste materials (e.g. carrot bioresidues) to be used for NFC production, focusing on the optimisation of energy consumption of the NFC milling process.

How is the project carried out?

The main modules of the INCOM project are:

- Nanofibrillated cellulose (NFC) production and modification
- Composites processing and sandwich structure manufacturing
- Mechanical testing, verification and modelling
- Life cycle assessment

In the INCOM project, two approaches are used for the manufacturing and modification of NFC. The first approach is the nanofibrillation of cellulose in a pre-polymer (monomer or oligomer) medium. This avoids problems related to incompatibility of aqueous medium and plastics and creates an optimal, high consistency, homogenous fibril dispersion in the resin to be used in composite structures. The second approach is the development of nanofibrillation in aqueous and other media and the optimization of the nanofibrillation of

1. bioresidue, wood

2. pretreatment

3. purification,
delignification

4. milling

panel applications

6. composite consolidation

5. skin treatment | bio PU expansion | honeycomb core | PLA expansion

NFC, NFC resin

bioresidues (e.g. carrot bioresidues). Resins and sol-gel coatings nanoreinforced with functionalised NFC are used in cores and skins of structural sandwich composites, to enhance mechanical properties.

Three types of cores are developed for composite sandwich structures, to meet different technical requirements: expanded NFC reinforced biobased PU foam, biobased PLA thermoplastic foam, thermoplastic honeycomb core.

Demonstrators, as automotive components, airplane cabin parts and sporting goods are produced during the project.

The quality and properties of the nanoreinfroced materials are constantly tested, and numerical models are used to simulate mechanical behaviour and facilitate industrial upscaling. During the development process LCA (Life Cycle Assessment) and LCC (Life Cycle Costing) are used to provide ecodesign feedback to project partners. Health and safety aspects are also taken into account, through a constant monitoring of existing national/international standards and health and safety related studies on nanocomposites.

Glossary

Pre-polymer: a substance which represents an intermediate stage in polymerization, and can be usefully manipulated before polymerization is completed (source: http://www.oxforddictionaries.com/).

Sol-gel process: materials technology, assuming preparation of a sol with its subsequent transition into a gel, i.e. a colloidal system consisting of a liquid dispersion medium contained in a spatial grid formed by connected particles of the dispersed phase (source: http://eng.thesaurus.rusnano.com/).

LCA – Life cycle assessment: compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle (source: ISO 14040).

Who are the project partners?

The consortium of the INCOM project is composed of industrial participants (eight SMEs and one large industry) together with leading European institutes and universities expert in biocomposites, processing technologies and sol-gel development from seven European countries. The value chain represented by the expertise of the R&D partners is coupled with the selection of the industrial partners' line of business. The whole production chain from bio-based raw materials processing to different fields of applications is included.

Technical Research Centre of Finland – VTT (Finland)
Luleå University of Technology – LTU (Sweden)
Fraunhofer Institute Silicate Research - Fh-ISC (Germany)
Technical University of Denmark – DTU (Denmark)
2B Srl - (Italy)
Diehl Aircabin GmbH (Germany)
Axon Automotive Ltd (United Kingdom)
Millidyne Oy (Finland)
VMA-Getzmann Gmbh (Germany)
SurA Chemicals (Germany)
Bergius Trading AB (Sweden)
CSI Composite OY (Finland)
EconCore N.V. (Belgium)

When is the project taking place?

INCOM is a four-years project started in 2013 and ending in 2017.

VTT
LULEÅ TEKNISKA UNIVERSITET
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