High Performance, Economical and Sustainable Biocomposite Building Materials (BioBuild)

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Project Aims

TARGET

To use biocomposite materials to reduce the embodied energy in building facade, supporting structure and internal partition systems by at least 50% over current materials with no increase in cost.

HOW?

By overcoming current actual and perceived shortcomings in biocomposites, such as:

- Resistance to degradation by microbial attack
- Flame resistance
- Dimensional stability

WHY?

Natural fibres have significantly lower environmental impact than glass in particular in the areas of climate change, ozone depletion, toxicity and eutrophication.

The consortium

Thirteen partners

Seven countries

Budget €7.7M

Part funded by the European Commission

Coordinated by NetComposites

Duration: 3½ years

End: 31st May 2015

About NetComposites – www.netcomposites.com

A world-leading technology business working in the following areas of composite materials:

- Materials and process research & development
- Prototypes and pre-production moulding
- Consultancy
- Information services: conferences, training, newsletter

Role in BioBuild

- Assembled consortium
- Wrote original proposal & negotiated grant
- Manage the project both technically & administratively
- Produce pre-preg for other partners (e.g. IVW, Amorim, Fiber-Tech) to mould, using resin from TFC

Background to project

The energy required by a building:

- energy to heat the building during its useful life
- embodied energy (i.e. that need to build it)

In 1970s the energy needed for heating, lighting etc. was 10 to 20 times the embodied energy. Now the figure is 1-3x due to improvements in insulation etc[1].

Embodied energy has increased due to material developments.

Hence need to reduce embodied energy in construction materials.

1. "BUILDING MATERIALS AND CO2: Western European emission reduction strategies", D.J. GIELEN. Dutch National Research Programme on Global Air Pollution and Climate Change Netherlands Energy Research Foundation; ECN project number 7.7018

Embodied Energy

The embodied energy is that required to produce a component from its raw materials. It can include energy indirectly used in production, such as energy to transport the materials to site. Figures per unit mass can be found[2] but converting these to unit area of panel is subjective.

Material	***Embodied Energy*** MJ/kg	***Embodied Energy*** MJ/m^2
Bricks, Facing	8	1968
Aluminium Virgin	218	1177
Steel Sheet Galvanised	39	612
Timber Plywood	15	594
FRP (Glass/Polyester)	100	540
Steel Sheet Virgin	32	495
Timber MDF	11	462
Hemp/Polyester composite	69	249

2. Inventory of Carbon and Energy (ICE) Hammond, Jones, University of Bath 2008

Benefits of Composites

- Offer high stiffness to weight ratios and can be very strong
- Allow reduction in mass of structures therefore allows smaller/lighter supports etc.
- Great freedom of form
- Can be prefabricated off site
- Can be quick to erect
- Composite materials have lower embodied energy than many traditional building materials
- Biocomposites offer lower embodied energy than glass fibre composites and a different aesthetic

Biomaterials used in this project

Flax fibres

- Flax grows well in NW Europe
- Fibre stiffness: 60-70 GPa (glass: 70-80 GPa)
- Only 15% of plant used

Jute fibres

- Grown in India & Bangladesh
- Much cheaper than flax
- Lower embodied energy for yarn

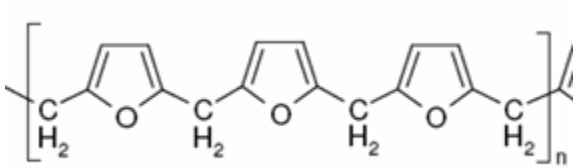
Cork

- Bark of cork oak
- Harvested every 9 years
- Increased use of screw tops means new markets required

Biomaterials used in this project

Polyfurfuryl alcohol resin

- Derived from hemicellulose
- Agricultural waste hydrolysed & distilled to give furfural
- Furfural then processed into resin
- No impact on food supply



Biobased polyester resin

- Vegetable oil used as raw material

Cashew nut shell liquid

- Dropped from project

Project Approach

Fibre treatments

- Improved adhesion of resin to fibre for increased mechanical properties
- To reduce moisture uptake by fibre
- To improve fire resistance

Coatings

- To improve fire resistance
- To act as a moisture barrier
- For aesthetics

Adhesives & Sealants

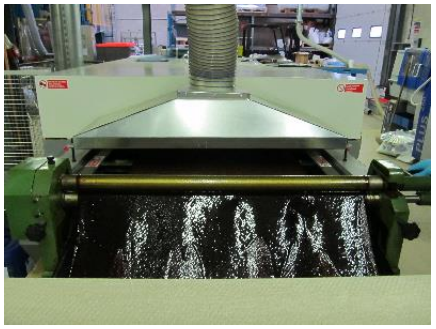
- To join sections
- To fill gaps to prevent moisture ingress

Processing methods

Components to be prefabricated off site & assembled on site. Traditional composite forming techniques will be used but adapted for natural fibres:

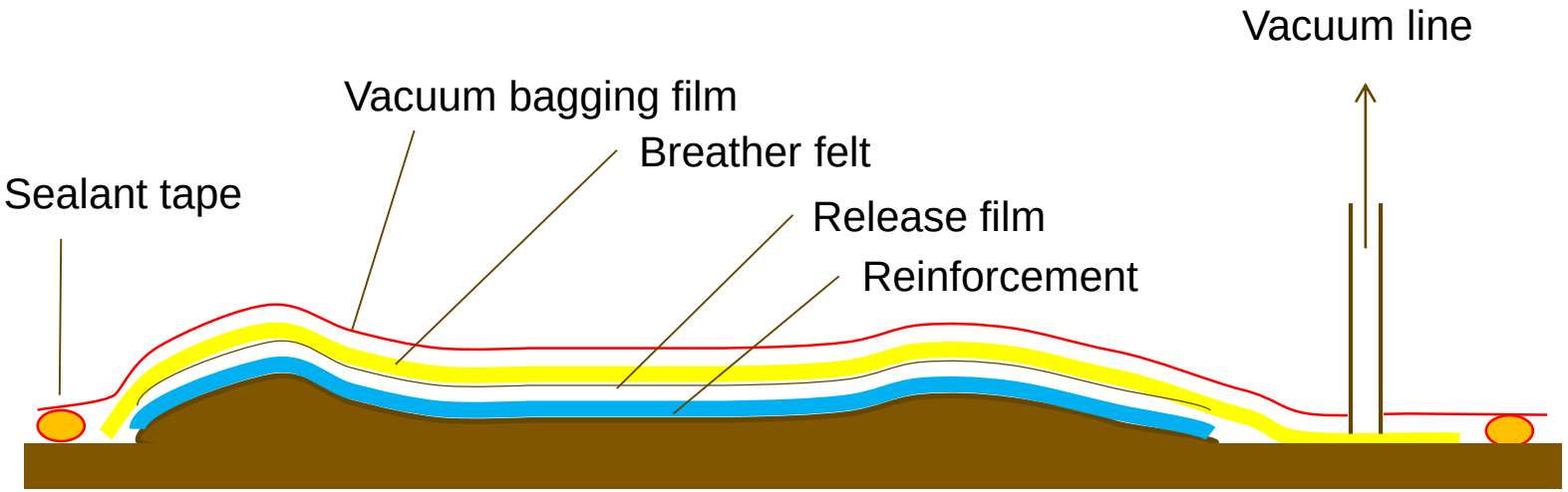
- Vacuum infusion
- Pultrusion
- Pre-pregging
- Compression moulding
- Vacuum bagging

Core materials (e.g. cork) to be used to improve thermal & acoustic insulation. Sandwich panels produced for high stiffness to weight.



Vacuum bagging

- Impregnated reinforcement laid up on tool (can use pre-preg, SMC, resin films, or hand lay-up)
- Cover with release film (perforated to let air escape)
- Cover with breather felt
- Cover with vacuum bagging film which forms a seal with the tool
- Evacuate bag & heat to cure



Demonstrators

Full sized parts to be produced.

Processing methods need to be improved to allow large scale parts.

Tests to be done on full scale or large scale components:

- Wind load
- Single burning item fire test

Tests done on coupons:

- Weathering
- Microbial attack
- Water swell
- Mechanical properties

Impact

The project intends to prove the following:

- Biocomposite materials can be used as construction materials
- The parts have the required fire resistance, durability, mechanical performance, thermal conductivity etc.
- The manufacture & installation of biocomposites is safe
- The use of biocomposites offers a significant reduction in environmental damage – reduced energy consumption & hence reduced greenhouse gas emissions (hence need for LCA)

Get Involved

Please complete the feedback form so we can improve future meetings.

Join the LinkedIn group & get your contacts to do the same

Tell us what you need from biocomposite building materials.

For more information:
See the website: **www.biobuildproject.eu**

Contact the co-ordinator:
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Speak to any project partner

Thank you for listening

Acknowledgement

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