Natural and Renewable Resources for Biobased Building Materials

An extensive research programme on transition from an oil based economy towards a bio-based economy

Professor Mizi Fan
Some facts?

• 6t building materials per head per year

• CO$_2$ emissions:
  • Mild steel: 1.7t/t
  • Cement: 0.80t/t.
  • Concrete: 0.07t/t
  • Plastics: Various. PE 0.3t/t.
  • Aluminium: 1.5-3.5t/t.

• Renewable materials/wood: CO$_2$ capture $1.1-1.9t/t$
<table>
<thead>
<tr>
<th>Material</th>
<th>Annual consumption (Billion tonnes)</th>
<th>Increase rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>3.600</td>
<td>11.10x</td>
</tr>
<tr>
<td>RM (Wood)</td>
<td>1.739</td>
<td>1.60x</td>
</tr>
<tr>
<td>Steel</td>
<td>1.520</td>
<td>4.26x</td>
</tr>
<tr>
<td>Plastics</td>
<td>0.280</td>
<td>48.33x</td>
</tr>
<tr>
<td>Aluminium</td>
<td>0.044</td>
<td>9.45x</td>
</tr>
</tbody>
</table>

Population growth during this period: 2.28x
And?

- 40% of energy consumption
- 36% CO$_2$ emissions in Europe
To cope with the 2010's European Energy Performance of Buildings Directive & the EU's Road Map 2050, in a near future all Member States must draw their national plans to enlarge the number of nZEB.

2018
Public buildings have to be nZEB

2020
Cut greenhouse gases emissions by 20%
New constructions must be nZEB

2050
Cut greenhouse gases emissions 80–95% below 1990 levels

And?

How?
Our Research-Facilitation?

• Positioning the UK as a World Leader in Innovative Plant Processing (Technology Foresight Challenge 1996)

• EU ‘PANELS’-QLRT-1640 Enhancing the Efficiency and Competitiveness of Natural Fibre Composites in Construction (2000).

• ‘NATCOM’ Optimally Efficient Production of High Strength Natural Fibre Composites (2004 TP/5/CON/6/I/H0565L)

• Composite Products from Recycle Cellulosic Materials (2006 PAP091)

• EU ‘CELLUWOOD’: Laminated Strong Eco-material for Building Construction Made of Nano-cellulose-strengthened Renewable Materials (2011)

• EU ‘ICECLAY’ Highly Efficient Production of Ultra-lightweight Clay-aerogel Materials and Their Integrated Composites for Building Insulation

• EU ‘VIP4ALL’ Highly Sustainable and Effective Production of Innovative Low Carbon Insulation Panels for Zero Carbon Building Construction

Technology Foresight Technology

• £5.342M-Potential huge benefits to the UK economy
• Research on
  • New products from renewable resources (bio-plastics, etc.)
  • Interactions between synthetics and natural materials (Chemicals)
  • Lightweight materials with a low and recoverable energy content (Materials, Manufacturing, Transport, construction, Defence)
  • Technologies for soil/water clean-up
✓ Novel solubilisation technology

Chemicals, Bioplastics, etc.

Enzymatic hydrolysis of cell wall: Release of (1-3, 1-4)-β-D-glucans from cell walls and the complete hydrolysis of the polysaccharide to glucose
Plant fibre for ion-exchange
Plant fibre for Composites

Materials, Manufacturing, Transport, construction, Defence
Plant for phenol resin for biocomposites

Bioenergy, polymer, coatings, etc.
✓ Plant for new pulping
Our Research-Facilitation?

- EU ‘VIP4ALL’ Highly Sustainable and Effective Production of Innovative Low Carbon Insulation Panels for Zero Carbon Building Construction (2014)
Grow2Build

• Identifying and solving the bottlenecks of stimulating bio-based building construction
Grow2Build

• Building up a network between pilots in the chain of bio-based materials, to develop wider market
Pilots

- ‘Fire reaction of hempcrete’ (ISOHEMP and CHANVRIBLOC)
- ‘Wood-oil biofilm’ Biocoating for wood (Regge hout)
- Bio composite for infrastructure (Tencate)
- Fibre reinforced composites and tubes (Exel Composites)
Pilots

- Hempcrete blocks (Eco-makelaar)
- Flax composite – street sign (NPSP); table (TripleE)
- Flax chipboard – acoustic inner part of doors (Linex Pro-grass), acoustic board (Pan-terre)
- Flax felt, flax insulation, prefab roofing elements with flax insulation (Isovlas)
Grow2Build

• Establishment of EU centre of excellence based building materials

-guarantees the continuation of the initiative
Centre of Excellence pictures
Thank you!