Opportunities for industries related to the application of natural fibres in the manufacturing of biocomposites materials

Biocomposites Centre of Competence

Francois Denner

What are Biocomposites?

A biocomposite is a material formed by a matrix (resin) and a reinforcement of natural fibers (usually derived from plants or cellulose).
Background and Context

- DST and CSIR have developed a biocomposites strategy linked to a national Biocomposites Research and Development-led industrial development programme.

- The strategy aims to develop a number of selected product technology platforms for downstream value addition, as well as strengthen and develop the upstream production of high quality natural fibres and other required raw materials.

- The development and commercialisation of advanced materials based on natural resources has as result been identified as a key industry development cluster in the Industrial Policy Action Plan of the Department of Trade and Industry.

Benefits of Bicomposites Products

- Environmental (“Green”):
  - renewable resources
  - biodegradable
  - carbon neutral
  - 20% lower energy consumption

- Lower Weight (-10 – 30% cf. GF)

- Lower Cost (- 30 – 50% cf. GF)

- Health & Safety
  - less abrasive, non-toxic

- Good Mechanical Properties
  - esp. for non-structural applications
Anything made from a hydrocarbon (petroleum) can be made from a carbohydrate (plants).” Henry Ford - The chemurgists (utilization of organic materials for industrial applications – biochemical engineering, biotechnology)

“Why use up the forests which were centuries in the making and the mines which required ages to lay down, if we can get the equivalent of forest and mineral products in the annual growth of the hemp fields?” - Henry Ford
Strategy on a Slide

- The development of appropriate product technology platforms, encompassing materials, manufacturing, and product technologies;
- Initial focus on higher volume markets, notably in Building and Construction as well as Packaging and Moulded Products, in order to achieve the economies of scale required for significant economic impact and sustainability. Higher value added market segments in the aerospace and automotive industries will be developed on this overall platform;
- Initial product development focus on natural fibre composites, with parallel technology platform development for full biocomposites.
- Strong and early efforts to establish a fibre production industry
- Establish an integrated manufacturing demonstration plant
- Industry involvement at all stages of projects
- Human capital development to support the industry
- Leverage and integrate existing initiatives

A value chain approach
Objectives of the Biocomposites Centre of Competence

- Facilitate development of an integrated biocomposites manufacturing industry by developing a set of product technologies across the biocomposites value chain.

- Strengthen industrial research and innovation capabilities (bridging the innovation chasm) by packaging and commercialising its outputs and outcomes.

- Increase the number of research and innovation specialists and practitioners oriented towards the needs of a biocomposites industry and to increase mobility between science and industry sectors.

- Improve the visibility and attractiveness to international partners of South African research and innovation.
Fibre Cultivation and Extraction

• Is no well-established supply chain for natural fibres in South Africa. The almost complete lack of commercial fibre production in South Africa is a significant disadvantage - a reliable and plentiful supply of good quality fibre is required to develop downstream markets and achieve commercial sustainability.

• Further work for purposes of biocomposites applications will be on bast fibres (kenaf, flax and hemp) with next step planting trials focussing primarily on kenaf.

• Agro-economic factors and a good understanding of the production costs related to these crops are essential in order to draw sound conclusions on the viability of crop cultivation. (Semi-commercial trials)

• A partnership with Government, Communities, IDC, ARC.
### Short-Term Objectives

- Development and demonstration of selected **product technology platforms**
- Refinement of industrialisation strategies, including **techno-economic feasibility studies**
- Creation of a **Human Resource pipeline**

### Early questions to answer / activities

- A **technology roadmap & product pipeline** for the construction industry
- **Fibre value chain analysis** – mapping and analysis of fibre types, land availability and suitability, yields, climate change impacts, fibre properties, fibre extraction and processing, properties of composites based on the different types of fibres and suitability of these composites for the various target markets.
- Which **manufacturing technologies** are most suited for which products?

---

### A South African Biocomposites Industry

A **sustainable** (10,000 - 15,000 tons per annum) South African **primary natural fibre supply industry**, providing fibres for both composite material and other uses.

A South African **downstream manufacturing industry** producing and fabricating **biocomposite products** for the targeted industry sectors for both local consumption and export.

**Economic value addition** – the potential size of fully developed industry is:

- Fibre production (rural): **R300 – 350 million p.a.**
- Final products: **R 2 – 2.5 billion p.a.**

**Job creation:**

- Upstream: **0.5 – 1 job / ha = 11,000 – 15,000 jobs in rural areas**
- Downstream: **2,500 – 3,000 jobs** in fabrication and manufacturing

**Human resource capacity** in biocomposite materials and product development and industrial production. After 5 years: **28 MSc’s, 16 PhDs, 7 Postdoctoral researchers**
Outputs from current projects

- **BioAERO**
  - Flax phenolic sandwich panel (patent)

- **BioBUILD**
  - Flax phenolic sandwich insulated panel

- **BioBUILD**
  - Flax fibre roof panel

- **BioPAC**
  - Bioplastic panel (provisional patent)

- **BioPAC**
  - Packaging crate from compostable, PLA derived materials

- **BioAUTO**
  - Kenaf - PP parcel tray

Focus of current work

- Develop a Human Capital Development programme
- Sustainable natural fibre supply chain (enterprise development and mentoring)
- Support to existing projects and extend project participation to industry and academia (consortia)
- Integrated demonstrator manufacturing facility for product demonstration and early phase industrialisation
- Sector/product focused industrialisation strategies
- Partnerships (national and international)
- Awareness, lobbying, advocacy, networking
- Funding and Sustainability
Thank you for your attention

Francois Denner
fdenner@csir.co.za
012 841 2002