# CSIR facilities geared to support the Biocomposites Centre of Competence

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Over the past few years, the CSIR has made a significant investment into fibres and biocomposite research and infrastructure at its Port Elizabeth campus. The Department of Science and Technology (DST) has invested approximately R10.8 million in new equipment to complement this research. With the hub of the country's newly created Biocomposites Centre of Competence situated in Port Elizabeth, the CSIR is ideally positioned to provide optimum support.

**Natural fibres such as flax are being used in biocomposites.**

**THE MAJORITY OF RESEARCH** done at the CSIR's facilities in Port Elizabeth focuses on nonwoven products and the more traditional fibre processing route. Fibre modification (where chemicals and techniques are applied to fibres to change their properties) also remains a strong focus, with continued support given to industry on fibres and textiles.

## Research production area

This 4 300 $m^2$ facility includes extensive infrastructure for processing and analysing natural fibres and natural fibre-based composites along the whole value chain, from fibre extraction and processing, through intermediate products such as nonwovens, to final natural-fibre composite products and components. It is, essentially, a complete pilot production line.

The CSIR's world-class nonwoven platform offers a unique, custom-made combination of several technologies for the production of a wide range of nonwoven fabrics and other related products.

The processes involved in the pilot production line include fibre blending and opening; carding and cross lapping for web formation; needlepunching; hydro-entanglement; foam impregnation; hot air bonding; the curing and drying process; and hot calendaring and winding. The pilot plant facility is also supplemented by a comprehensive range of testing instruments to characterise nonwoven materials for a variety of properties.

These instruments can test for air and water permeability; filtration efficiency, dynamic contact angle; surface tension; pore size and its distribution; water-vapour permeability; universal tensile testing with attachments for pull-out force and puncture resistance measurement; hydraulic transmissivity; as well as abrasion and peeling. In addition, digital image processing and microscopy analysis are also done.

## Composites and biopolymers

Composites are prepared using natural fibres such as flax, hemp, kenaf and agave; thermoplastic and thermoset resins; as well as biopolymers such as soy protein, polylactic acid and polyfurfuryl alcohol. The mechanical, thermal, thermo-mechanical and fire-retardant properties of fibre-reinforced composites are optimised for application in the automotive and aerospace industries.

These two sectors are keen to increasingly use composites in the many parts needed in aircraft and cars, but materials used have to be strong as well as heat and fire resistant.

Developing new biopolymers and resins is an important activity in the development of biocomposites. For this, the CSIR's fully integrated composite processing facility includes a 2 700 kN compression moulding hydraulic press, vacuum-assisted resin transfer moulding, twinscrew extruder and an injectionmoulding machine.

The composites laboratory houses state-of-the-art equipment for measuring the mechanical and thermal properties of composites. A weathering chamber studies the influence of temperature, humidity and sunlight on composite materials, which are crucial for components that are used in outdoor environments.

| Client and partnerships | Initiatives |
|---|---|
| Airbus | Interior panels for airplanes |
| Bombardier | Interior panels for train carriages |
| Volkswagen | Parcel tray |
| Experico | Packaging |
| Woolworths and suppliers | Characterisasion |
| De Gama, Frame, Brits Textiles | Natural fibre composites |
| University of Delaware | Biopolymers for housing |
| BIRN | International Biocomposites Network |
| IDC | Sisal fibre production |
| Sustainable Fibre Solutions | Kenaf processing |
| The House of Hemp and Hemporium | Establishment of hemp industry |
| Chemcity | Biocomposites for construction industry |

## Fire testing laboratory

The facility also supports fire-retardancy testing. The fire testing laboratory is being upgraded with the purchase of a rate-of-heat-release apparatus and a smoke density chamber.

Plans are afoot to seek approval for the fire testing laboratory from the Civil Aviation Authority. This will allow the CSIR to undertake fire testing according to Federal Aviation Administration standards. It will be the only facility of its kind on the African continent.

## Not just research

Apart from research and development, this centre is also characterised by elements of industry seeking assistance with problem-solving, quality control, and guidance on maintaining ecological standards. In addition, the centre conducts hands-on training sessions for university students and the industry. The CSIR's world-class researchers and well-equipped laboratories in Port Elizabeth have a valuable role to play in growing South Africa's natural fibre-reinforced composites industry, in close partnership with role players from academia, government and industry.

### DEVELOPING NATURAL FIBRE - BASED COMPOSITES FOR INDUSTRIAL APPLICATIONS

Current research programmes focus on the development of natural fibre composites for various industrial applications. An interesting product that has been developed is a natural fibre-reinforced sandwich panel for aircraft interiors. For the first time, natural fibre-based panels for aerospace applications have been developed using an environmentally benign flame-retardant treatment to comply with flame, smoke and toxicity (FST) requirements. The major advantages of these panels include being lightweight (leading to energy savings), environmentally friendly, fully degradable and sustainable. They are, therefore, truly 'green'. Other advantages include implementation of REACH (registration, evaluation, authorisation and restriction of chemicals) guidelines and alignment with the European Union's Clean Sky Initiative.