



Based on the reports from the ten workshops on “The Future Use of Composites in Transport”, organised within the framework of the COMPOSITE thematic network, a four-year work programme has been established to investigate the application of textile structures and processes in the following four of the 10 areas of R&D priorities.

- **Manufacturing**
- **Light weighting**
- **new material concepts**
- **recycling**

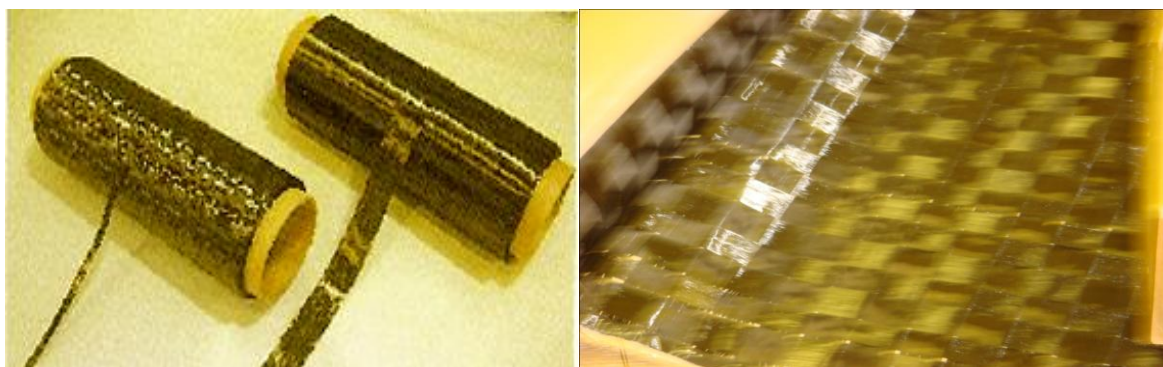
**Manufacturing:** The interest is in textile pre-forming and thermoplastic technologies. Work has begun on woven multilayer fabrics for 3D structures and cellular panelling (**Fig.1**). In addition to carbon and glass fibre, our studies include basalt fibres.



**Fig.1 Composite members from woven 3D pre-forms of basalt fibre**

**Light weighting:** This area of our studies involves an investigation into spread tow technology (**Fig.2**), where 12k filament tows are widened from 5mm to 20/ 25mm width and woven to produce lower basis weight fabrics. The reduced crimp facilitates increased composite modulus.

**Fig.2 Spread Tow Tape and Woven Fabric**



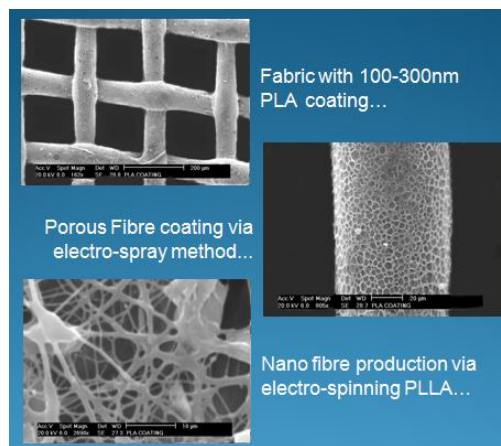
**New Material Concepts:** Our interest is in commingling technologies and nanocomposite fibres. Studies to date have involved various textile processes for commingling basalt fibres with PP, and an investigation into the up-scaling of nanocomposite PP yarns using our laboratory melt spinning pilot line

**Recycling:** Work has recently begun on evaluating several primary textile processes for the recycling of materials from different composite waste streams.



**Nanotechnology:** the application of nanomaterials and nanotechnology in the production of textile products is widely seen as a platform for new product development and innovation. The work undertaken is focused on technology transfer and the development of enabling technologies. Plasma systems (vacuum and atmospheric) and electrostatic techniques are being studied for the production of novel coatings. **(Fig.1)**

**Fig.1 Nanocoating of Fabrics**

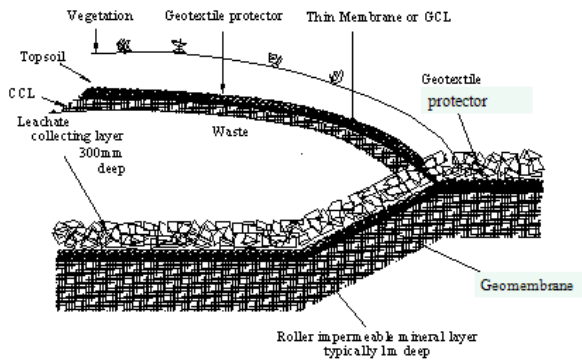


**Geosynthetics:** research is focused on the structure-property relations of geotextiles, geomembranes (HDPE & PP), and geocomposites. Studies are carried out in a UKAS accredited laboratory which undertakes commercial testing and analysis.

Nonwoven geotextiles are often used as protection layers for Geomembranes in containment structures (e.g landfill, water storage,..) where it is required that the geotextile prevents localised stress cracking of the geomembrane by stone projections **(Fig 1)** over the long-term usage of the constructed facility. There is a need in the industry for a better understanding of how the structure-property relation of a geotextile translates into improved protection efficiency. Currently the practice is to design the basal layers of containment systems using the basis weight (i.e.  $\text{gm}^{-2}$ ) of the nonwoven protector. This does not take into account the structural variations that the nonwoven manufacturer can

utilise for improved performance. Our work has involved analysing the fibre configurations within the geotextiles and attempting to derive generalised models to predict the compressive resistance of these structures.

**Fig.1**  
**Basic Structure of MSW Landfill**



**Early stage of stress puncture by angular-semi-rounded stone**



The nonwoven structure can be simply represented by a column-beam arrangement (**Fig.2**). It can be shown that compressive stress is related to the compressive modulus of a nonwoven protector by:

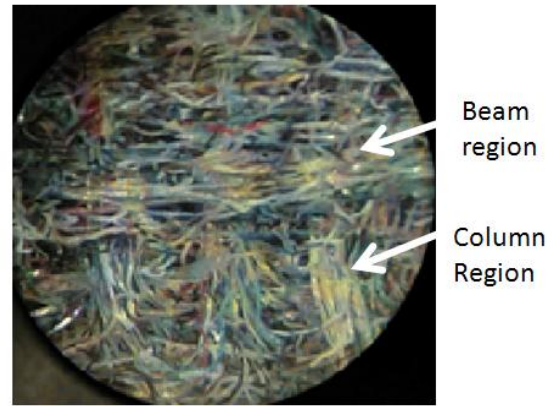
$$P - P_n = \left[ \frac{na\lambda_c}{1 - \varepsilon_n} + (1 - na)\lambda_b \right] (\varepsilon - \varepsilon_n)$$

Where  $P$  &  $P_n$  are the initial and subsequent pressures applied to the material,  $\lambda_b$  &  $\lambda_c$  are the compressive modulus of the beam and column areas,  $\varepsilon_n$  is the strain in the beam areas,  $\varepsilon$  is the overall compressive strain,  $n'$  is the number of columns per unit area; and  $na$  the total fraction of unit area occupied by the needed columns.

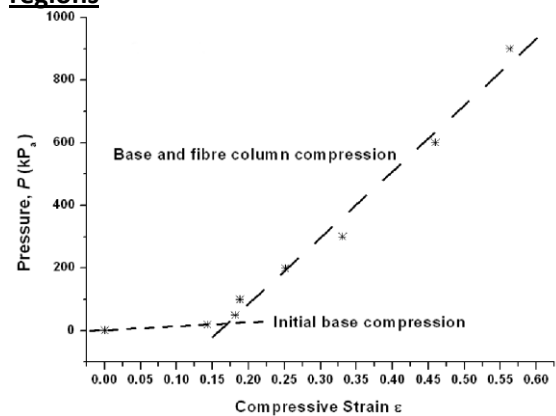
**Fig 3** illustrates that the most effective resistance to compression occurs in column

regions, and **Fig. 4** shows the effectiveness of  $\lambda_c$  in reducing localised strain.

**Fig.2 nonwoven cross -section**



**Fig.3 compression in beam and column regions**



**Fig.4 Effect compressive modulus of the column regions on membrane strain**

