4

5

Figure 4. Minimising the visibility of connections, maximising the appearance of lightness © thomasmayerarchive.de
Figure 5. Night view © thomasmayerarchive.de

To give the garment an appearance as light as possible and to largely conceal the structure, the garment was not attached directly to the horizontal steel arches. Weld-on, curved steel strips form the visual terminator and enable the fabric panels to clamp elegantly and almost invisibly with clamping plates in front of the load-bearing arches. The welds of the individual panels are also barely visible they follow the vertically spanned valley and ridge cables. The cables have adjustable threaded fittings at their upper end with which the stiff fabric can be slightly readjusted. The fabric was structurally reinforced on the cut-outs membrane.

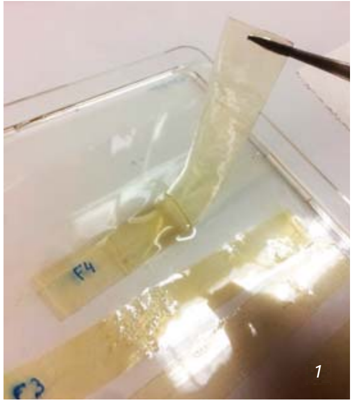
Day versus night

While during the day the building appears like a cloth-like form, even with a permeability of approximately 48 per cent, in the dark an exciting reverse effect manifests itself, for when the interior is illuminated, the variously sized window surfaces that are irregularly arranged across the façade come to light, creating a completely different and exciting look.

formTL ingenieure für tragwerk und leichtbau gmbh
info@form-TL.de
www.form-tl.de

BACTERIAL CELLULOSE BIOFILMS

a possibility for architectural membrane applications?



1

Figure 1. Retrieving samples after glycerol soaking © Bastien Damsin

Architectural tensile membrane structures are temporary or limited-lifetime structures that are mostly made of composites with fossil-fuel based components (polyester, PTFE …) for which recycling is difficult. Considering the temporality of some structures, it becomes even more interesting to investigate grown and biodegradable alternatives.

The master thesis "Bacterial cellulose – New bio-composites based on bacterial cellulose for architectural membrane applications" by Bastien Damsin studied a methodology to couple biotechnological knowledge to architectural applications with a multidisciplinary academic and biohacking approach.
Bacterial cellulose, a sheet material grown at the surface of a culture liquid, is assessed for the first time in the light of an application as a structural membrane. The aim is to define whether bacterial cellulose could complement today's commonly used membrane materials.
A wide exploration of alterations of the plain material has been done with a focus on post-processing such as soaking, coating, heat pressing, creating composites and mixing.

The parameters are the growth temperature, the type of nutrients, the growth time and the post-treatments. In this research, self-grown cellulose biofilms are fermented by the bacteria *Komagataeibacter xylinus* at the surface of a liquid culture. While cellulose is mainly known as the structural component of plant tissues, some aerobic bacteria are also able to produce cellulose from a wide range of carbon and nitrogen sources. A pellicle of intertwined cellulose fibrils is created wherein the bacteria are embedded. When a sufficient thickness (about 0.05mm) is reached, the sheet is harvested and cleaned. As a general comment it must be specified that a uniform thickness is difficult to be achieved. Finally, the sheet is dried. The result is a pure cellulose biofilm without hemicellulose, pectin and lignin like in plants. It owes its high strength to a high purity, a high degree of polymerization and high crystallinity. A total of twenty-five different processing methods was tested.

Three alterations of bacterial cellulose were able to improve the strength of the sheet.
For each processing method 4 samples were tested to measure the tensile strength. The lowest strength per 4 tests was retained as '5%-fractile' value.
The bacterial cellulose samples soaked in a cross-linking agent Ethylene Glycol achieve a tensile strength of 2.6kN/m, the samples soaked in Ethylene Glycol Choline Chloride 3.3kN/m and the glycerol soaked 3kN/m. To obtain values comparable to currently used coated fabrics a higher thickness must be produced.
Experimental materials were also tested with respect to water absorbance, by placing samples in a water-filled plate. The weight of the samples before the test and after 48h was measured.
The coatings with beeswax and the heat pressing treatment reduce the value of absorbed water by respectively 28% and 38% after 48h, compared to the 102% value for the reference sample. A total water repellent material is not yet reached.
Also, the approach to make strong connections, has to be further researched.

Once the properties based on the testing of small samples are satisfying, the upscaling of the production process has to be considered.

2

Bastien Damsin — *Bastien.Damsin@vub.be*
Elise Vanden Elsacker — *Elise.Vanden.Elsacker@vub.be*
Marijke Mollaert — *Marijke.Mollaert@vub.be*

Figure 2. Tested samples © Bastien Damsin
Figure 3. wet sheets placed together and dried © Bastien Damsin

3