Technical flax & polyamide 11:
performance with renewable ressources

These days, manufacturers are looking for new lighter-weight materials with high technical performance that are more environment friendly and compatible with a competitive eco-responsible approach. Fimalin offers some solutions.

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When such new materials are based on renewable plant-based raw materials, they need to be supported by reliable, well-structured production channels that are capable of supplying homogeneous materials over the long term and meeting the demand on a steady basis.
When manufacturers consider developing new applications for such materials, the first criteria they insist on are consistent quality, performance, compliance with specifications, and guaranteed supply. This aspect becomes even more important when the application involves complex specifications that can be met only using engineered materials with sufficiently high performance. Only a production channel that includes all players from seeds to final parts production can meet these specific manufacturer needs, because the requirements for technical flax for the composite industry are different from those for the flax used in clothing.

One aim of the FiMaLin network is to organize a flax production channel. Another is to provide long-term support for a technical flax industry that caters exclusively to the specifications of manufacturers who need natural fibres for reinforcing plastics and composites. In that capacity, FiMaLin brings together seed producers, flax producers, processors and other manufacturers, and research organizations to best meet these new requirements.

FiMaLin works upstream to help meet all the industry's specification criteria for fibre/resin semi-finished products, composite forming processes, and end users, according to:

- technical criteria for fibre standardization and characterization,
- cost criteria,
- quality, health, safety and environment (QHSE) criteria for traceability of materials and inputs,
- environmental impact criteria (life cycle analysis).

How to meet these criteria is set out in the "Technical Flax for Composites" Charter. FiMaLin members undertake to adhere to the charter and help to keep it updated.

The new "Technical Flax for Composites" Charter is part of a sustainable development initiative on the part of a group of manufacturers representing the value chain. It covers four main areas:

1. Securing a reliable supply that is adapted to the market
2. Applying suitable standards
3. Traceability of raw materials
4. Providing technical and safety data

This reference document is published on www.fimalin.com and describes the fundamentals of the typical specifications for producing technical flax for composites. Its implementation guarantees the compliance of technical flax with customary practice in the composite industry. Its content is flexible and subject to updates.

FiMaLin®'s strategy focuses on three advantages of flax fibre:

- its mechanical properties (close to those of glass fibre),
- its density (close to that of carbon),
- its status as a renewable resource (favourable carbon balance).

Thanks to the development over the past five years of flax-fibre forming technologies and to raw-material qualification procedures, Dehondt Technologies has been able to market a first range of reinforcements called Flax Technic®.

Flax Technic® reinforcements come in three different versions, Nattex®, Twinflax® and Lintex®. These can be used in plastics processing and composite applications for the automotive, aviation, railway, boating, sports & leisure, building and construction industries, among others.

Tab. 1: The range of Flax Technic®

Product name	Product type	Applications
Nattex® roving	Roving	Composites
Nattex® fabrics	Technical fabrics	
Nattex® P-Preg	Prepregs	
Twinflax®	"Design" fabrics	
Lintex® M06F	Short fibres	Plastics processing / Composites
Lintex® BT 2	Fillers	Plastics processing /
Lintex® PL 10	Mixed fibres & fillers	

FiMaLin players continue to work on developing technical flax grades in the field and in laboratories, reviewing all the important aspects of production and implementation from seed selection to utilization, including cultivation, extraction, and forming for use in plastics processing. Associating new or recent grades of calibrated fibres such as Lintex® with an entirely bio-sourced engineering plastic such as polyamide 11 (Rilsan®) paves the way for high performance in the field of entirely bio-sourced reinforced materials/composites.

The mechanical properties of a polyamide 11 reinforced with 15% Lintex® fibres (calibrated for length), obtained using Clextral twin-screw compounding technology, were studied and compared with those of a polyamide 11 compound containing the same proportion of tows (flax by-products) or of flax fibres mixed with shives (PL10). The results in Figure 1 show that the compound with Lintex® absorbs twice as much energy before material failure during a tensile test in comparison with the tow-reinforced product, and about eight times more than the one reinforced with the fibre/shives mix.

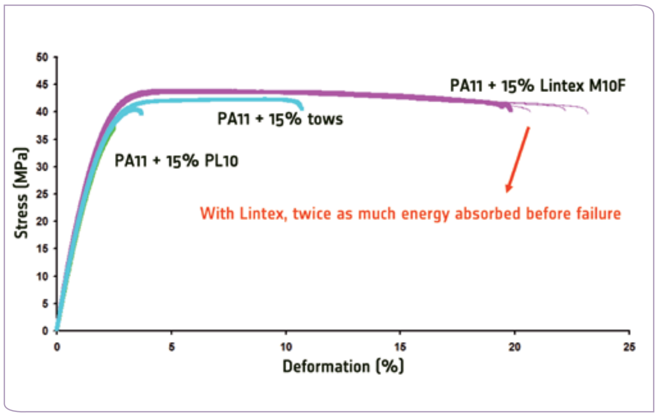

Fig. 1: Tensile tests at 23°C as per ISO 527 1A on PA 11 compounds reinforced with 15% Lintex M 10 F, PL10 or 15% tows

When you compare the performance of this product in wet conditions (obtained by immersion in water) with those of a PA66/glass-fibre compound, the results show a clear advantage in terms of water ingress for the 100% bio-sourced compound based on Rilsan® and Lintex® (Figure 2). The differences in stiffness and breaking-stress properties of these materials are much less marked once water has been absorbed (Figures 3 and 4). Note that tests for an actual application (Karver rigging flanges)

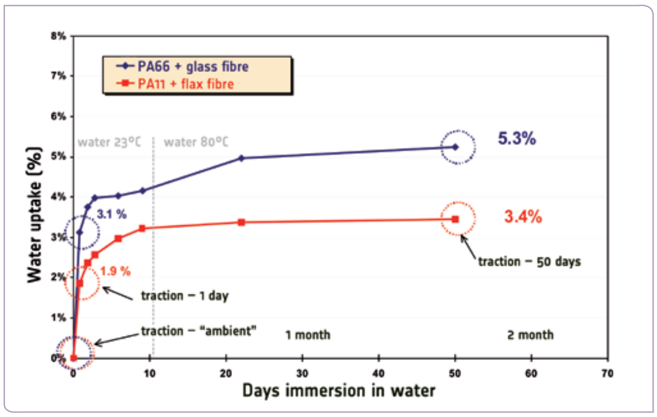

Fig. 2: Water uptake, First 10 days at 80° C (to accelerate) + 40 days at 23°C

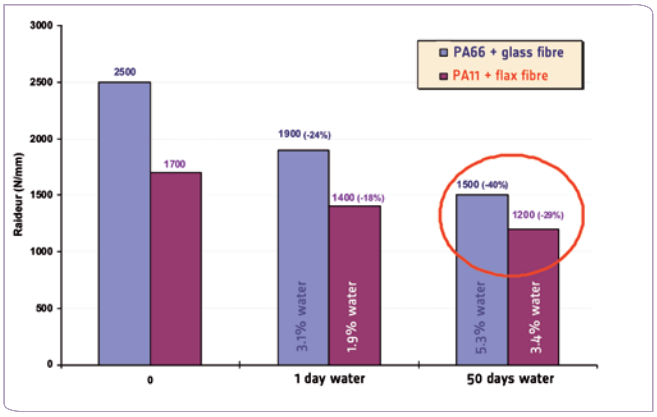

Fig. 3: Evolution of stiffness, ageing in water

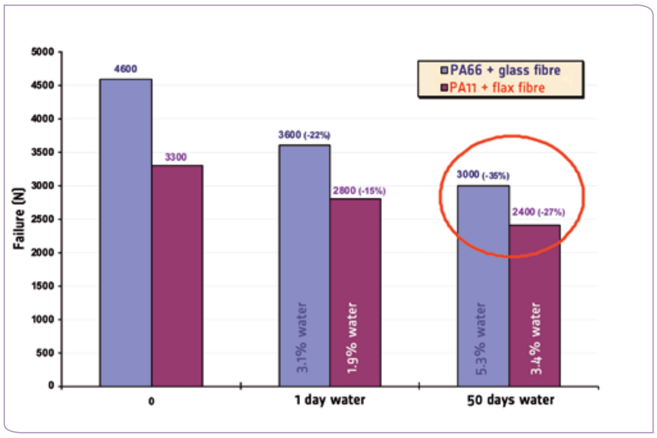

Fig. 4: Evolution of failure, ageing in water

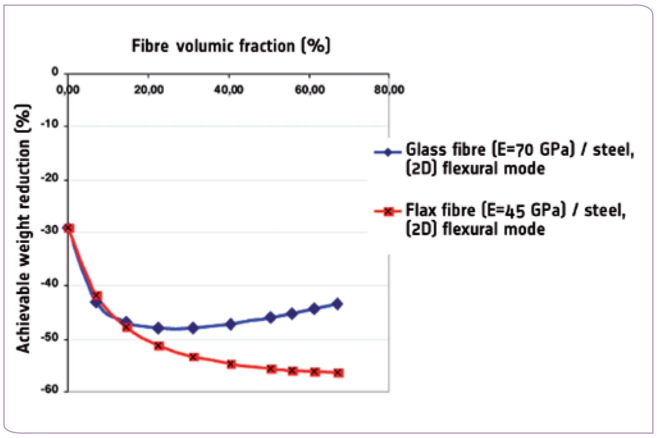

Fig. 5: Estimates of the weight savings for a flat composite panel made of Nattex®/Rilsan® composite under flexural stress, compared to a steel panel or to one made of glass-fibre/Rilsan®.

in real-life mechanical-stress conditions with exposure to the marine environment show excellent performance for the 100%-bio-sourced reinforced plastic containing technical flax. The technical fibre grades for continuous-fibre-reinforced composites are also developed, selected and offered in several different versions in accordance with the above-mentioned Charter's criteria. A system of categories will gradually emerge, as it has for carbon and glass fibres. It is already possible to supply a grade that allows an accurate estimate of the minimum weight savings to be had for a flat composite panel made of Nattex®/Rilsan® composite under flexural stress, compared to a steel panel or to one made of glass-fibre/Rilsan® composite (Figure 5). The estimate is based on the requirement for identical mechanical stiffness for all three materials.

The expected weight saving in comparison with steel is 43-57%. Even though there is a highly significant difference in modulus between flax and glass fibres, the lower density of flax fibres promises an additional 10% saving over glass-fibre-reinforced composites. In addition, the very low density of Rilsan® as compared with other plastics contributes a further weight saving in comparison with steel. There is no doubt that in coming years, the market will offer flax fibre grades with elastic moduli higher than 45 GPa. Thanks to these flax fibres of tomorrow, it will be possible to further improve on the weight savings offered by parts made with composites that are 100% bio-sourced. ■

More information:
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