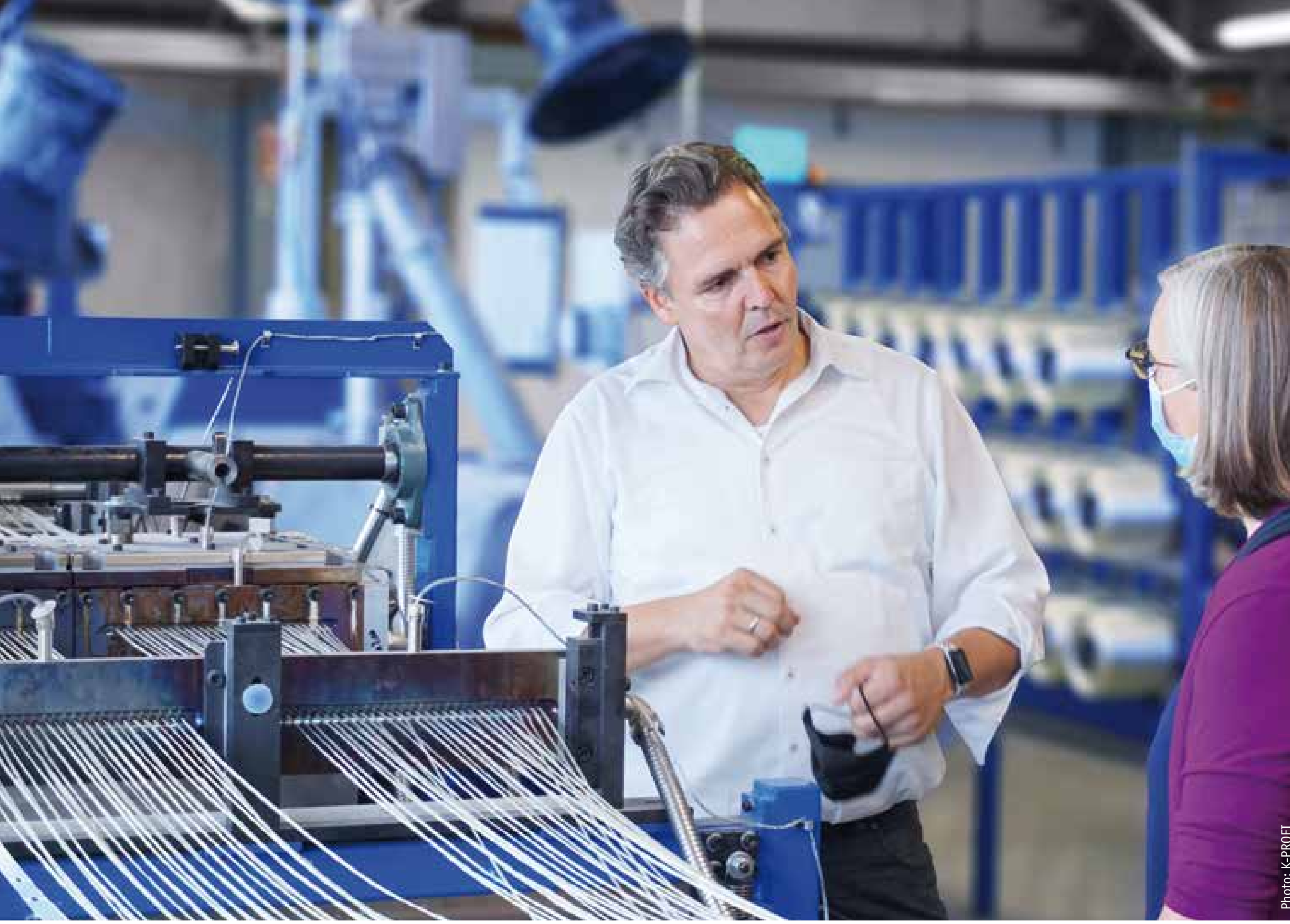


Thilo Stier, Division Manager Sales & Innovation at Akro-Plastic, envisions significant growth potential for long glass fibre-reinforced engineering thermoplastics in the coming years.

"We can also do long-fibre reinforced"

What Akro-Plastic considers when compounding LFT and which plant technology is used

Metal substitution and weight reduction are two areas that go hand in hand, and not only in electric vehicles. Substitute materials are often fibre-reinforced plastics that score points with their property combination of lightness, good processability and high mechanical strength. Long glass fibre reinforced engineered plastics (LFT) are particularly interesting. However, their production requires a lot of know-how in formulation and machine technology. The team around Thilo Stier and Dr Marcel Sittel-Faraj at Akro-Plastic GmbH in Niederzissen can tell you a thing or two about that. But they have made it. Today, three LFT lines with a capacity of 6,000 t/a are running here for high-quality granulates. During the on-site visit, K-PROFI found out what is so tricky about LFT production, what the solution looks like and where the journey is heading in terms of quantities and applications.

Text: Dipl.-Ing. (FH) Karin Regel, Editor K-PROFI

"Without our sister relationship, this development would not have been possible," makes Thilo Stier, Division Manager Sales & Innovation, at Akro-Plastic clear right at the beginning of the conversation. He is referring to the close cooperation between the polyamide compound manufacturer Akro-Plastic and its sister company, the machine manufacturer Feddem GmbH & Co. KG from Sinzig, both of which belong to the Feddersen Group from Hamburg, Germany.

Akro-Plastic not only has a wealth of experience in processing technical plastics – after all, the company specialises in these – but also in incorporating fibres. Feddem is fully geared to customised extrusion lines and knows the requirements for processing technical compounds as well as fibre-reinforced products. Feddem also understands the specific requirements in Niederzissen very well; after all, Akro-Plastic is a major customer in Sinzig and only operates extruders from there.

This is not the only reason why the two “sisters” are accustomed to working closely together. They have already realised many joint projects. For example, they recently developed the Innovative Compounding and Extrusion (ICX) technology. “The ICX technology, together with the certified quality management and the in-house testing laboratory, enables us to ensure the same quality of products at any location worldwide when using raw materials of the same quality,” Dr Marcel Sittel-Faraj, Head of Technology & Projects at Akro-Plastic, makes clear.

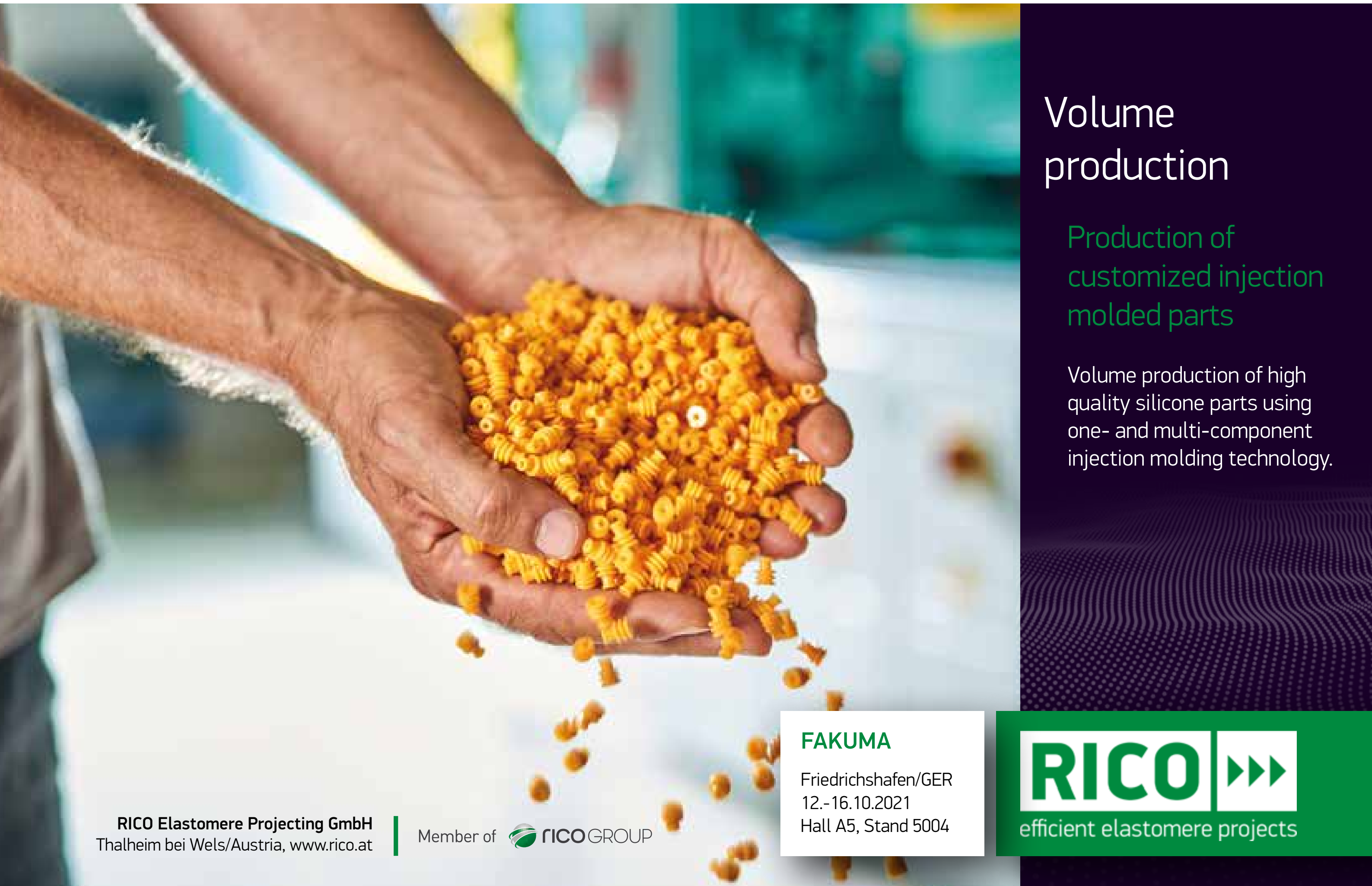
Substitution potential is wide-ranging

In the latest project, the companies used their joint know-how and cooperative partnership to develop and optimise formulation and plant technology for the production of LFT. The basis is formed by engineering plastics such as polyamide, but also PEEK, PPA and PBT as well as PP/PA blends. Even though the estimated market volume is only about a fifth of that of PP-LFT granulates, which are already established in the market and are used worldwide at around 100,000 t/a, Thilo Stier sees enormous growth potential here.


Photo: Akro-Plastic

Coil unwinding from the outside prevents twisting of the fibre strands and thus ensures better feeding into the impregnation die.

This is driven by various factors. All LFTs have certain properties in common: they have a very high creep resistance, which makes them particularly interesting for applications that are under permanent load, such as in automotive applications as seat structure components. From this derives the substitution potential for metals that are



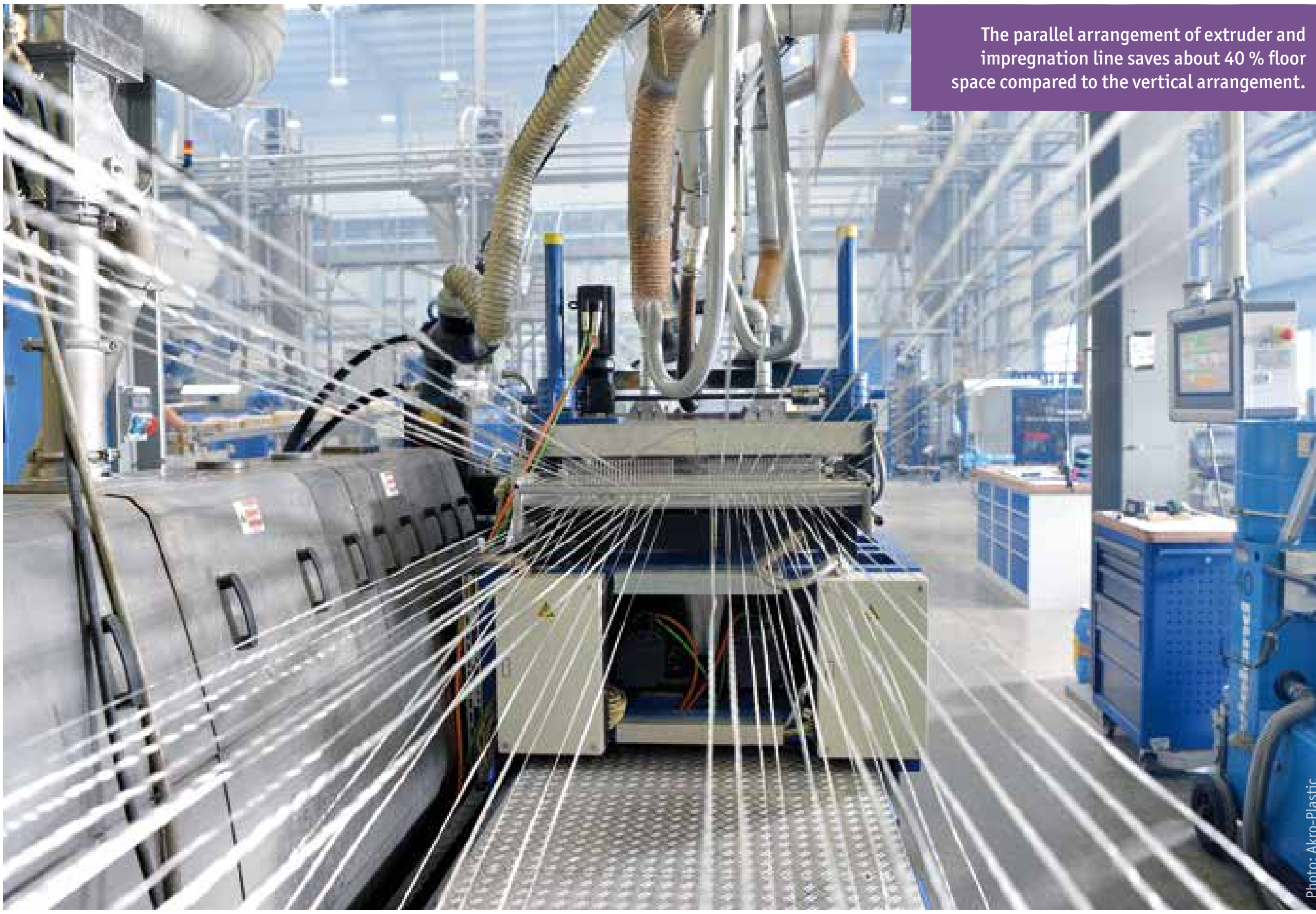

The parallel arrangement of extruder and impregnation line saves about 40 % floor space compared to the vertical arrangement.

Photo: Akro-Plastic

significantly heavier with comparable properties. The good flow behaviour of LFT also makes it interesting for many applications that were previously sourced from metals. For example, geometrically demanding parts for bicycles or for technical applications can be produced. “Equally, LFTs could replace short glass fibre-reinforced thermoplastics in some applications, as they have better reinforcement and thus strength due to the greater fibre length and are less brittle,” says Thilo Stier, naming another growth market. Long glass fibre reinforced thermoplastics can withstand temperatures around 40 °C higher than short glass fibre reinforced thermoplastics without a loss of strength, which makes them more interesting for some applications. In addition, LFTs could replace higher-grade thermoplastics with short-fibre reinforcement, but here they require a lower fibre content with a comparable property profile, so that the main argument of weight reduction applies again.

Even more potential in the future

Thilo Stier pays special attention to a PA/PP blend reinforced with long glass fibres. “This LFT combines several advantages. Compared to LFT based on pure PA, it is cheaper, has a density that is about 8 per cent lower, but

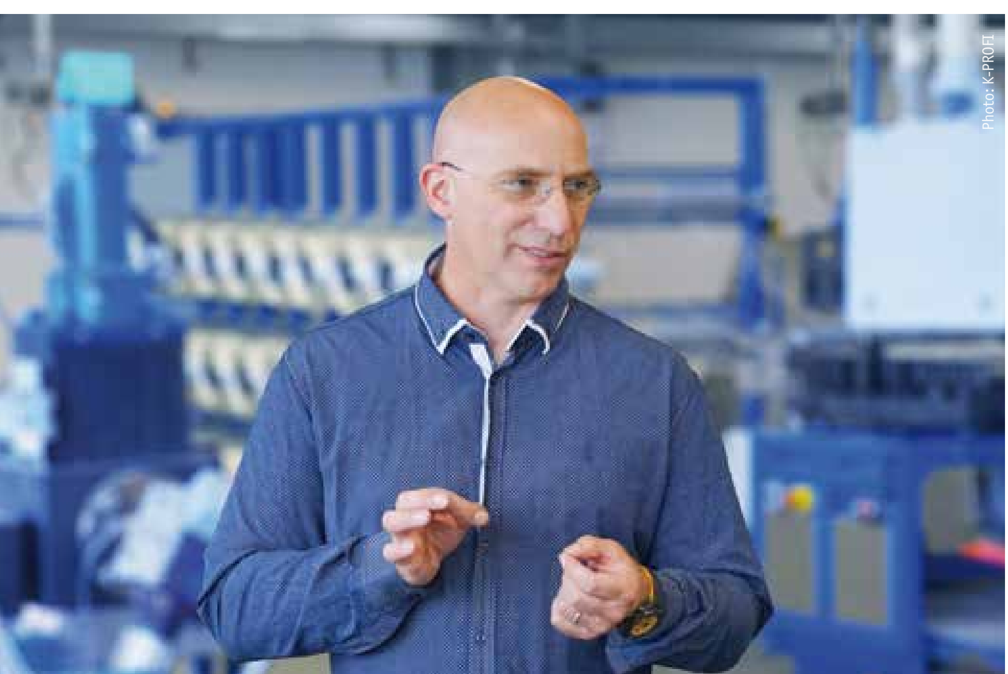


Photo: K-PROFI

Dr Marcel Sittel-Faraj presents one of the three lines optimally tailored to the requirements, which currently produce around 6,000 t/a of LFT granulate at Akro-Plastic.

in terms of strength and temperature resistance it is roughly on a par with PA." A long glass fibre-reinforced product based on bio-based raw materials is also conceivable, as Akro-Plastic will be showing in the form of short glass fibre-reinforced products at Fakuma in October. The plastic base is a bio-based PA 6.9 combined with a so-called bio-circular PP. The raw material source for the PP is vegetable oil and fat waste, which is generated in various processes, especially in the food industry. Reprocessed carbon fibres are used as fibres. The Akromid Next G presented here takes the concept of sustainability to a new level, the company announced in preparation for the fair.

Last but not least, Thilo Stier envisions enormous potential in foamed, fibre-reinforced products, which the polyamide specialist is currently manufacturing and investigating in its in-house R&D department. "This way, the reinforcing properties can be combined with a particularly low weight. This is of great interest for many lightweight construction applications," Thilo Stier is convinced, who of course also knows the downsides of LFT, "LFT components have two weaknesses that need to be taken into account." One is a weaker weld line strength, he says. "The weld line should not be in the load-bearing area," says Thilo Stier. On the other hand, the surfaces are somewhat more uneven due to the longer fibres, which could be a nuisance for components in the visible area. "However, we can compensate for this excellently with surface-improving additives." Finally, LFT compounds are up to 1 EUR/kg more expensive than conventional short-fibre reinforced products, to name the economic aspect.

Convinced by the plant technology

"With the plant technology we have developed and optimised, it is definitely possible to produce technical LFTs that have an excellent range of properties. The key to success is the complete wetting of the fibres," explains Dr Marcel Sittel-Faraj. The entire process starts at the creel, on which up to 58 bobbins or even more if required are mounted. Continuous glass fibres, which are already coated with a sizing, are wound onto each bobbin. "The unwinding of the fibres is done from the outside, so that twisting is impossible," Marcel Sittel-Faraj begins listing the special features that have been realised. Each spool also has a kind of "brake" that prevents it from unwinding too quickly. The pull of the fibres through the die is caused by the belt haul-off at the end of the cooling section, which was specially designed and built by Feddem for this application.

The fibres first "run" from the creel onto the tensioning device, where they are preheated. Preheating the fibres is the next special feature that is advantageous for complete wetting. From here, the fibre strands run

With the high-performance mill, the wetting condition is checked directly at the plant.


Photo: K-PROFI

side by side through the core component of the line, the impregnation station. The FED 52 MTS is positioned parallel to this part of the plant. “We deliberately decided against the right-angled arrangement because it saves us about 40 per cent of the installation space,” the head of technology and projects explains further. In the twin-screw extruder, the plastic is gently melted, which in the case of polyamides must take place within a narrow but relatively high temperature window.

The polymer melt enters the impregnation die from below via a melt line. “The melt guidance in the die is another decisive factor for good fibre wetting,” emphasises Thilo Stier. After wetting, each fibre strand is guided through the perforated plate, which is more or less open depending on the desired glass fibre content and thus strips off more or less melt. Now the impregnated strands pass into the cooling section, which has spray nozzles and otherwise functions purely as air cooling, and from here through a mould roll package and the belt take-off into the pelletiser. Here the long-fibre pellets are cut to their final length of 10 mm and finally transferred to the quarantine silo via the cooled spiral conveyor.

Highlight modularity

“The intensive cooperation with Feddem made it possible not only to realise an optimal process technology, but also to implement a few extras,” Thilo Stier praises the employees of the sister company. The mould has a modular design and consists of one unit each with 29 pick-up points for 29 fibre strands. “We can thus attach several moulds next to each other depending on the required output and increase or reduce the throughput accordingly, which makes us very flexible.” Since the changeover times are kept very short at around one hour, customer orders can be carried out on demand.

If a strand breaks off during processing or a bobbin contains less fibre length than the others, a hole nozzle can be closed on the impregnation die and the entire process can still continue without interruption. Another special feature. After all, the processing of glass fibres naturally causes wear, especially in the sliver take-off. “Feddem has designed the belt take-off as a cassette solution. If the belts are worn, we can replace the entire cassette and continue production,” Dr Marcel Sittel-Faraj underlines another highlight.

Photo: Akro-Plastic

At its site in Niederzissen with a total of 34 compounding lines, Akro-Plastic basically works with the principle of identical line set-ups. In this way, spare parts storage can be sensibly realised. Interchangeable machine components bring flexibility. The three new lines for LFT production now follow exactly this principle. They are built with the same line components, and a set of spare parts is always available, so that no line will be down for a long time.

Simple but effective quality control

Typically, when LFT pellets are processed, for example in the injection moulding process, there is a shortening of the fibre length. "Of the 10-mm fibres produced, more than 90 per cent of LFT must have at least 1-mm fibres remaining after processing. With short glass fibre reinforcements, it is only 0.3 mm," says Thilo Stier, naming the facts that are known and do not pose a problem for processors.

What is more of a problem are the fibre clusters that can form in conveying lines, for example, if fibres are not completely wetted and separation of fibre and matrix occurs. "If such a clump falls into the injection moulding machine during the production of a car oil pan, for example, the finished component has a weak spot at one point, which is not necessarily noticeable, but in practice can have serious consequences," Thilo Stier makes clear. That is why complete wetting is so important. However, since there is only limited space available for wetting in the compounding line, the process technology is so crucial. "We are sure that our pellets have optimal wetting. Our customers have already confirmed this to us."

Testing the wetting is simple and is carried out at Akro-Plastic directly at the plant. A sample is taken from production and crushed for 5 s in a very powerful mill. The result is immediately obvious, depending on whether the sample contains a lot of individual fibres and dust or not. "Our granulates are hardly attacked," Thilo Stier points out, not without pride, and invites all interested customers to test this. "We produce LFT with fibre weight percentages between 10 and 60 per cent, on request with customers' own polymer formulations in contract manufacturing. But of course, together with Feddem, we also offer the plant technology and support with formulation and process adjustment."

www.akro-plastic.com; www.feddem.com

The impregnated fibre strands pass through the moulding roller package into the belt haul-off developed and built by Feddem.