Start of series production in 2020: Fleig entered the field of processing bio-based plastics with the printable drinking cups from Heybico.

Photo: Heybico

A sure instinct for bio-based plastics

What experience Fleig is gaining in the first series project with injection moulding of bio-materials

"Hey I'm biological and compostable" is the meaning behind the label Heybico and at the same time expresses the requirements for the first product of the start-up of Green Sons GmbH, Sasbach, Germany. With its reusable cups, the young company from the Black Forest wants to create a regional, fair, sustainable and healthy alternative for the out-of-home consumption of coffee and cold drinks. The three Heybico founders were able to win the Hans Fleig GmbH from Lahr, 40 km away, as a development and production partner. Fleig's Managing Director Wolfgang Isenmann reports on the experiences the company, which focuses on mould making and technical injection moulding, made when entering the field of processing bio-based and (industrially) compostable materials.

Text: Dipl.-Ing. (FH) Sabine Rahner, Editor K-PROFI

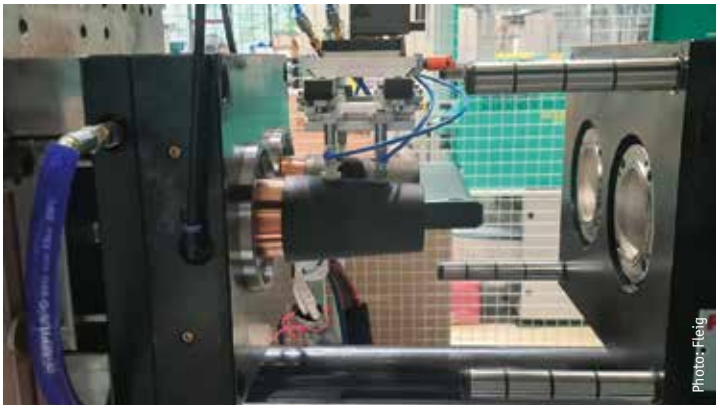
Fleig quickly understood the enquiry from Heybico two years ago as an opportunity. "Together with my three management colleagues, I knew it would be a lot of work. But the topics of sustainability, organic, renewable raw materials and compostability are gaining in importance. Moreover, the end date for the ban on single-use plastic articles, which has now been in force since July 2021, was already on the horizon at that time," informs Wolfgang Isenmann. Fleig did not have any significant experience with bioplastics at that time: "We had sporadically tested materials for their processability, but this project also meant new territory for us."

Together with Heybico, Fleig designed two versions of a food-safe drinking cup: a cup including the lid, twist-off cap and seal for hot drinks, and a pure cup, without latching for clicking in the lid, for cold drinks. Due to the high workload in the in-house mould making department at the time, Fleig built the moulds for the drinking closure and seal from TPE itself, while the moulds for the cup and lid were made by a nearby partner company. An interchangeable insert for the lid latch allows a single tool to be used for both cold and hot beverage cups.

Heybico had already brought a favourite material into play, which was to prove itself in the first samples. A material based on approximately 80 % renewable raw materials and compostable. "The material flowed very viscously, there were flow lines, and the parts really did look retro and organic. But the argument 'it's just organic' didn't satisfy us, because apart from the unsightly appearance, we didn't achieve a stable process even after weeks." An alternative was needed. During a visit to the Swissplastics trade fair, Fleig came across the offer of FKuR Kunststoffe GmbH, Willich, a supplier and producer of organic plastics. In a first step, FKuR provided a

The Fleig management team was delighted with the order, far from the everyday automotive projects (from left): Wolfgang Isenmann, Thorsten Braun, Edmund Barth and Bernhard Vetterer.

Photo: Fleig



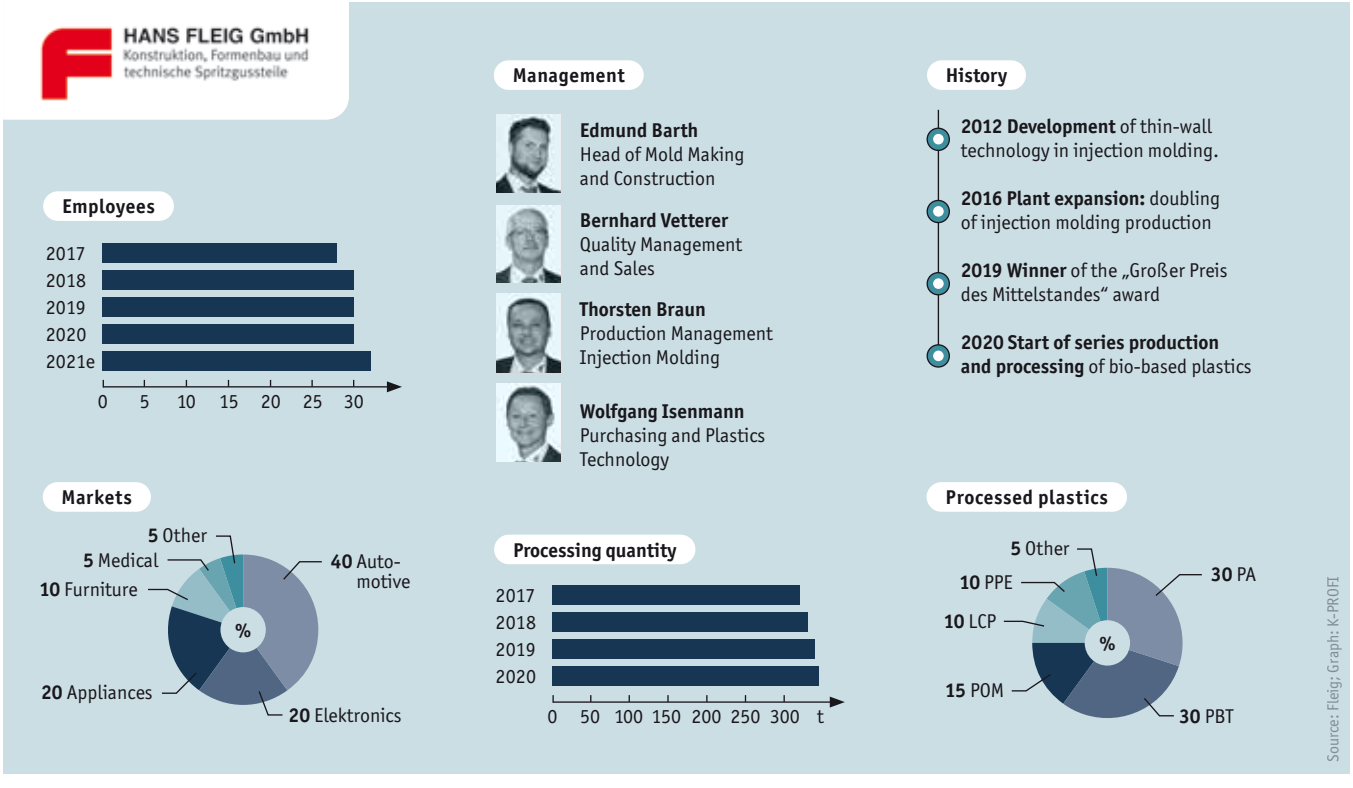
Fleig produces the drinking cups in a two-cavity mould. A mould insert makes it possible to switch between hot and cold beverage cups.

Stable process: The peculiarities of processing bio-based and compostable materials for these returnable cups are manageable.

one-to-one alternative, which, however, showed similar problems. With support from FKuR on-site directly at the injection moulding machine at Fleig, a material adapted to the special challenges was finally found.

"The flow index improved, we had easier mould filling, the cycle approached the calculated value and above all: we had a nice homogeneous surface", Wolfgang Isenmann is pleased about the first successes. The choice fell on a PLA blend (polylactide acid) from FKuR's Bio-Flex range, a biodegradable and compostable compound certified according to EN 13432 with a bio-based content of 75 %, which, according to FKuR, is suitable for a wide range of injection moulding applications due to its good flowability and high-temperature resistance. In addition, this material was able to cover another requirement: "Cups made of the predecessor material had an insufficient heat resistance of only 82 °C. The cups, when filled with coffee at a temperature of 86 °C, became plastic." Post-crystallisation of the structure through heat exposure would have prevented this. However, Fleig wanted to avoid this additional step. "The Bio-Flex material does not post-crystallise. In combination with a wall thickness of 2.2 mm, we achieve a heat resistance of 108 °C." For comparison: the wall thickness of the returnable cups of a well-known deposit system is around 1 mm. Reason: the conventional PP used has a significantly higher heat resistance.

Fleig produces the lids in six different colours, the cups in two versions, natural and black. The corresponding masterbatches come from Granula's all-colour concept. In this, the manufacturer combines its pigments tested for biodegradability and compostability according to EN 13432. These enable end customers to certify their products quickly and easily according to the home or industrial composting standard. Processing is straightforward. "After



Heybico specified the colours and Granula sampled them, we hit all the colours immediately in the first shot," affirms Wolfgang Isenmann.

In general, finesse and a sure instinct are required when processing bio-based materials. Moisture and heat are the enemy of bio-materials, knows Managing Director Isenmann. Accordingly, material drying is a sensitive process. "The higher the temperature or the longer the drying, the better, as we know from other sensitive materials from the PPE, LCP or PPT sector, does not work here. The producers recommend drying at a maximum of 50 to 60 °C for two to a maximum of three hours. That's why we use dryers directly on the injection moulding machine with container volumes adapted to the hourly throughput. If the drying time is too long, the processes get out of hand and you quickly see that on the moulded part."

In addition, the processing window of "the entire organic range" is also much narrower. In contrast, a bulk plastic such as PE or PP behaves very well with regard to temperature and dwell time. Bio-materials also do not forgive being injected too quickly and the frictional heat that this generates. This is where a high-quality hot runner, or rather the precise control of the temperature in a "narrow temperature window of perhaps ten or 15 degrees", comes in handy.

Wolfgang Isenmann's summary, however, is very positive: "We have the right material, we have the right machine parameters, the process is in place. The peculiarities are controllable and with experience, the whole thing is fun now. Recently, we moulded more than 10,000 cups at a time - including colour changes. Of these, we only discarded the first 50 from the start-up process and maybe one or two more per day. So our calculation also works out." In the meantime, customers are increasingly requesting the use of bio-plastics. But with price-intensive mass-produced or disposable articles, the idea of sustainability is usually not pursued. The coffee-to-go cup is the successful counter-example: as a reusable cup, it is also used, for example, in deposit systems, for equipping canteens and cafeterias or generally as an advertising medium with an individual logo.

www.fleig.de; www.fkur.com;
www.granula.eu; www.heybico.com

Granula supplies compostable masterbatches for the project based on pigments that are tested according to composting standards.