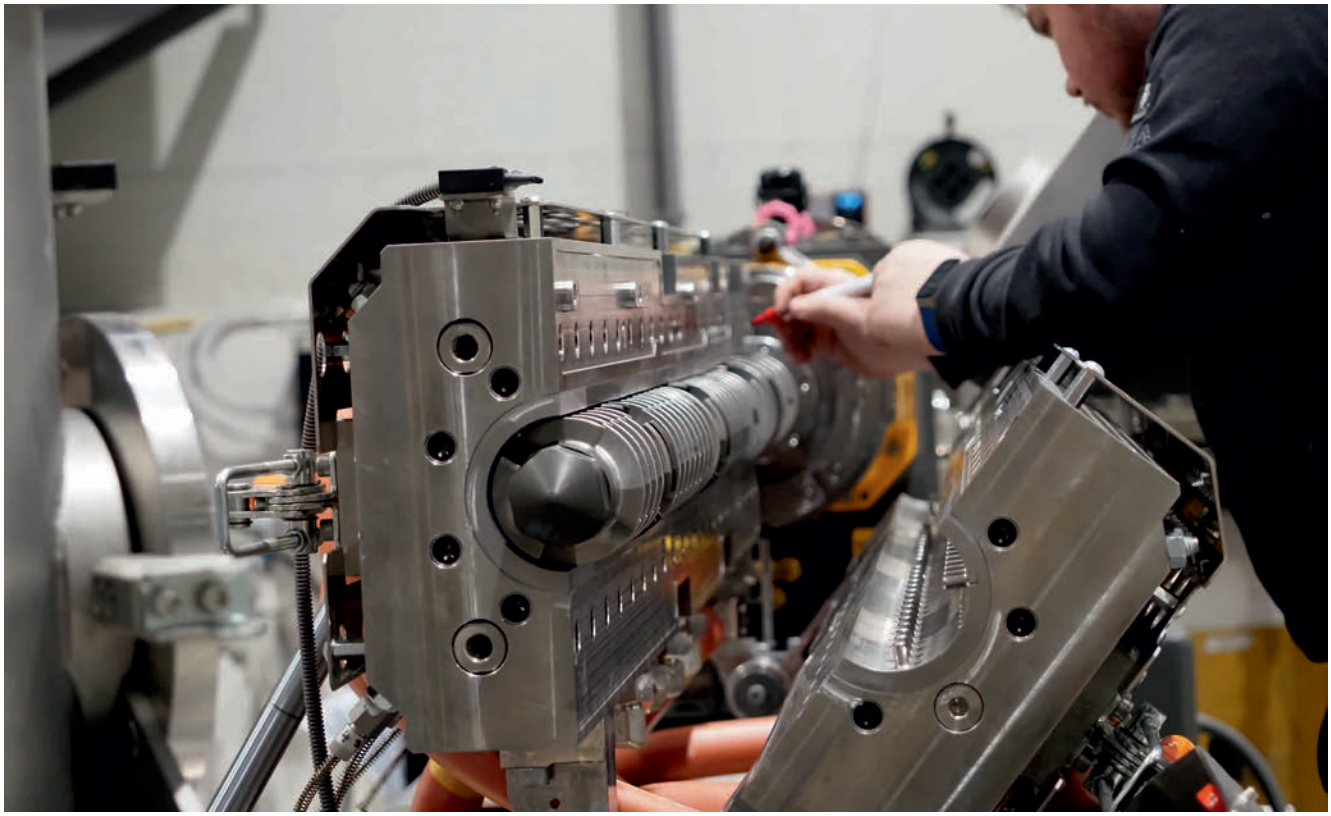
Co-Kneaders for Plastics Processing

Kneading in the Gentle Cycle

Clearly, only those who really need a Co-Kneader will use one. It is usually more economical if an application can be modeled on a twin-screw extruder. But those who want to process shear-sensitive or high-performance engineering compounds quickly discover the added value of this technology. For our on-the-spot report, Plastic Insights spoke to Buss managing director Dr. Philip Nising about the company's history, applications and market developments.



A view into Buss AG's main product, the Co-Kneader: Invented in 1945 by Heinz List – and enhanced ever since. © Hanser/Schröder

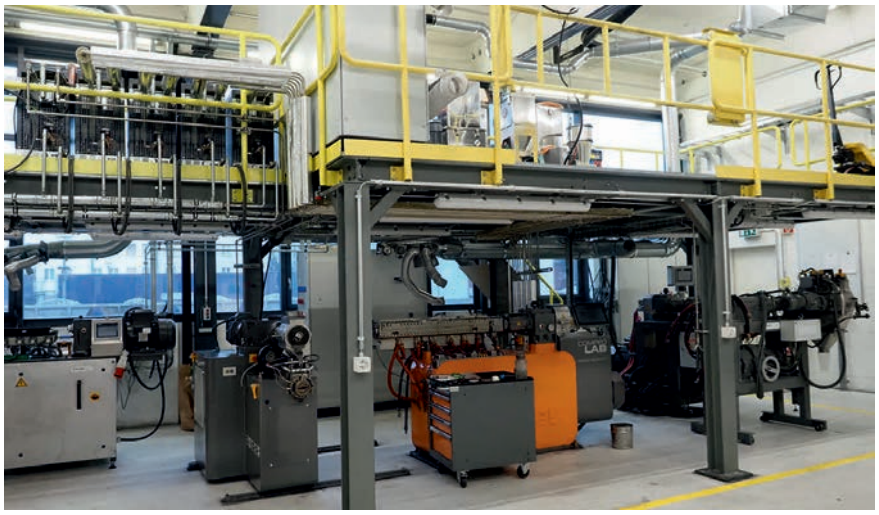
Whether plastics, electrode compound or chewing gums: Buss AG in Pratteln, near Basel, Switzerland, specializes in mixing and kneading. However, until they became familiar with these materials, a lot of time went by. When the company was founded in 1901, the focus was on steel construction.

"Then, in 1945, Heinz List, a German engineer at IG Farben came up with this stroke of genius: He invented the Co-Kneader," reports Dr. Philip Nising, President and CEO of Buss AG. Its principle, which was immediately registered for a patent, still forms the basis of the company's main products.

The Pioneer Becomes a Niche Product

"Our Co-Kneader was actually used in compounding much earlier than the twin-screw extruder. Most people don't know that, since the twin screw is now much more familiar," says Nising. "But from the 1950s to the 1980s, before the twin-screw extruder was developed to its full application range, the Buss kneader was the preferred machine for properly and continuously manufacturing plastic mixtures or dosing additives. It was only from the 1990s that the Buss kneader increasingly became a niche product for particularly challenging products."

Between 2001 and 2006, there was an attempt to create the world's leading supplier of compounding systems by combining the Buss, Werner & Pfleiderer and Wäschle brands: The Coperion Group was formed, which Buss was a member of for six years. "In this time, however, there were ultimately too many overlaps and strategic contradictions," says Nising, "so that they couldn't manage to make both areas flourish equally." Therefore, Buss was demerged in 2006 by a buy-out with the aid of Fabrel AG of Switzerland, and has operated independently as Buss AG ever since.



Up to five systems can run simultaneously in the pilot plant. The material feed is provided by means of feeds from the upper level. © Hanser/Schröder

The Headquarters Includes Design, Assembly – and a Punching Bag

Now, the company concentrates entirely on its core business: compounding systems for the plastics, aluminum, energy systems and food industries. At its headquarters in Pratteln around 100 employees are currently chiefly involved in design, process engineering, mechanical engineering and assembly – another 30 are responsible for overseas business at the Shanghai, Tokyo and Chicago subsidiaries.

In 2015, machining production of the kneader parts was outsourced to a nearby contract manufacturer in order to increase the utilization of Buss's own machinery, which had been used until then, and thereby remain internationally competitive. The production of the functional parts specific to Buss, with their special geometries and metallurgies, requires close and technically sophisticated cooperation between the two companies – we are proud of this decision today.

Nising himself has been with Buss AG since 2016 – and has made a lot of changes since then. The entire company was modernized: the assembly hall, together with the logistics infrastructure and test rigs, was completely overhauled. The pilot plant, too, was not only modernized, but completely reconceived. "We have not only invested in the work infrastructure, but also in the working atmosphere, including the cafeteria and social rooms," says the company head. In the cafeteria, a football table and punching bag catch your eye. »

Buss-CEO Dr. Philip Nising climbed into the ring with his employees for a boxing coaching session. © Hanser/Schröder

They actually have a wider importance: Nising brought a boxing coach into the company last year. He helps with team building, communication culture and conflict management. "At first, many of them turned up their noses, including me," he admits. "But at the end, we all stood in the ring in our assembly hall – and learned a lot about ourselves." Back at the desk or in production, however, everything revolves around one product: the Co-Kneader.

The Special Feature of the Co-Kneader

The key feature of the Buss kneader is its construction and mode of operation (**see Box p. 29**). The process results in significantly less shearing than in a twin-screw machine. With these conditions, the machine ensures gentle compounding of the materials with high mixing efficiency and good scalability. For example, the systems are suitable for very high filler contents, and the typical oscillation and rotational movement, in combination with the geometry of the Buss kneader, results in a very uniform mixing.

Another advantage is that both liquid and solid substances can be introduced directly into the plastic melt. They are properly injected and thereby pass to the center of the plastic melt. In other conventional compounding machines, additives are often introduced at the housing wall and smeared. The Co-Kneader principle also works particularly well for solids with low bulk density, high filler contents or materials that are abrasive and/or shear-sensitive, such as long fibers for manufacturing fiber-reinforced plastics.

What about the competition? "The original patent of 1946 expired long ago, of course, and the kneader principle has been copied by some other manufacturers. That's just the way things go. Of course, Chinese copies of the Buss kneader that are occasionally found can also perform mixing, but by no means provide the throughput performance and reliability that we deliver," says the CEO. In addition, Buss is the only supplier to be globally present with a strong service. Whether service engineers, after-sales support even for machines from the 1960s or support for process optimization. A large team of process experts brings the systems on stream together with customers or pursues joint developments.

What are the customers' requirements when they approach Buss? Nising: "Customers often only tell us which type of cable they want to manufacture. Together with our network of partners and our experience in the processing of cable compounds, we can then deduce what is required for a formulation and process geometry, down to the definition of the basic polymer. On this basis, we then lay out a complete compounding line. Ever more often, not only the kneader, but also the associated material handling, the metering, pelletization, through to the packaging of the pellet." Many components for drying, bagging and storage are purchased from long-term partners. However, as a contractual partner, Buss ultimately guarantees that the plant will be operational and that specific qualities will be achieved.

Economic Trend and the Advantage of a Long Transmission Line

How is the economic situation developing at present? Are there trends in different markets and industries? "As a plastics machine manufacturer, we are naturally part of the market and face similar trends

System for a high-voltage application. This allows the compounding of materials used for cable insulation in high-voltage applications. © Hanser/Schröder

to other machine manufacturers. We clearly felt that in the second half of 2023 – but by no means as severely as companies operating, e.g., in the packaging sector," says Nising. "There are two aspects working in our favor: First, before the Corona pandemic, we were able to launch our new Compeo series, which puts us well ahead of the competition (**see Box**). On the other hand, our main market, the cable and transmission line business, is currently running very well. That made up about 60 % of our business last year; insulation compounds for high-voltage cables are in particularly high demand worldwide."

For the mega-trend of e-mobility, electricity must be transmitted over long distances and made available for the charging infrastructure. "We are one of few suppliers who are capable of not only supplying a machine, but also the process technology behind it," says the CEO. "That is a very challenging field: cables above 200,000 volts, not everyone can handle that!" According to market studies, growth in the cable sector »

Forward, Backward, Allround: How the Co-Kneader Works

From a design point of view, the Co-Kneader is first and foremost a continuous single-screw extruder. However, its operating principle distinguishes it fundamentally from conventional designs. Its screw flights are interrupted by two to four gaps per convolution, resulting in the characteristic kneading flights. These intermesh with stationary kneading pins, which are fixed in the kneader housing, and thus shear the material being mixed. The main special feature of this technology is that the screw shaft of the Co-Kneader executes both a rotating movement and an oscillating movement. With each rotation, a complete stroke cycle is generated forward and back to the starting position. The movement sequence has great advantages as regards the mixing effect and self cleaning.
www.youtube.com/watch?v=oPXWLpjag_k

The latest generation of the kneader, the Compeo series, permits a new flexibility in the process parameters due to the following special features:

- Improved raw materials feeding
- Suitable for all temperature ranges up to 400 °C and a wide range of applications – from powder lacquer applications to PVC, cable compounds and engineering plastics
- Modular construction: a free combination of mixing and kneading elements with two to six flight lines
- Cloud-based machine state acquisition

The Compeo series is available in various sizes: from the laboratory plant with throughputs of 10 kg/h to the Compeo 176, which handles up to 12.5 t/h.

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Service

Buss AG
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Online Article with Picture Gallery:

www.plasticsinsights.com/a/article-5560586

Special feature of the Co-Kneader: Stationary kneading bolts in the kneader housing shear the material to be mixed.

Co-Kneaders for a powder coating application – popular with Swiss customers from the region.

is in the double digit range. Demand is also mainly coming from countries such as India, China and the USA, where government-led infrastructure projects are being implemented.

Do the Swiss Prefer Standard or Custom Manufacturing?

In general, we now use modular kits for the Compeo series and try to standardize as much as possible. That is also important for purchasing spare parts and stockholding. Thus, we have customers who still operate machines from the 1960s – and can confidently count on spare parts or upgrades from Buss.

At the beginning of a customer order, we define the correct design of the machine, including the screw geometry and drive performance, often making use of the customer test center. The diameter and length of the machine are usually determined by the application and throughput rate. If many fillers have to be introduced, the compounding line is longer because there are various feed points for the additives. That can be split into up to three dosing points. When the length has been determined, the process design takes place, i.e. the drive power is computed and the configuration of the screw is ascertained.

Which elements are to be plugged onto the screw also depends on the material. Some compounds require a lot of mixing energy, while others less. PVC, for example, burns if it is subject to excessive thermal or mechanical loads. In this respect, Buss differs from the Asian competition, which in many cases sells pure standard geometries. They run – or they do not. "For each product, we can perform tests in our test center and try out different geometries. Then, together with the customer, we choose the best, most flexible or the one with the best output. Our expert advice based on our decades of experience is invaluable here," says Nising.

Sounds like the salespeople are pretty deep into the technology ... Nising: "Our salespeople must understand our technology, and preferably be able to operate the machines themselves. That is the only way to know where problems can emerge later, or what the customer is talking about when processing carbon black or pigments. Only if you have seen a lot in the course of your career can you advise customers holistically and honestly."

Typical Switzerland!

What role does Switzerland play? As a sales market, the country plays a subordinate role. There are some regional customers, e.g. in the field of powder coating. But, on the whole, the Swiss site offers great advantages due to its very central location in Europe, with many customers and a very highly trained workforce with high quality standards.

Are there special features of the Swiss market? "There is a very active start-up scene here, very many small but globally active players. Such as a company in Western Switzerland, for example, which has developed a process for recycling the rubber of car tires. They strip the rubber from the treads in a very gentle manner and process it further. We set up a pilot plant there to develop the secondary processing of the recycled rubber into high-end compounds. This is typical of Switzerland: the proximity to universities and the resulting start-ups is very important to us," stresses Nising.

Customers and Export Markets

Besides European customers, international markets also play a major role. When he took over, the managing director made it his mission to advance the globalization of the market presence. Pilot plants are therefore now available at sites in China, the USA and Japan. His wish is to bring cultures together.

He describes himself as a "people person" and much prefers direct contact with his customers. Exotic markets are also served. For this purpose, the CEO also travels to the Amazon or to Patagonia. Another exciting project was also recently realized in Azerbaijan. Here, there is a machine for masterbatch production, a strategic government project to bring value creation into the country.

Overall, that is a fairly wide field, the "niche world" of the Co-Kneader. ■

Susanne Schröder, editor-in-chief