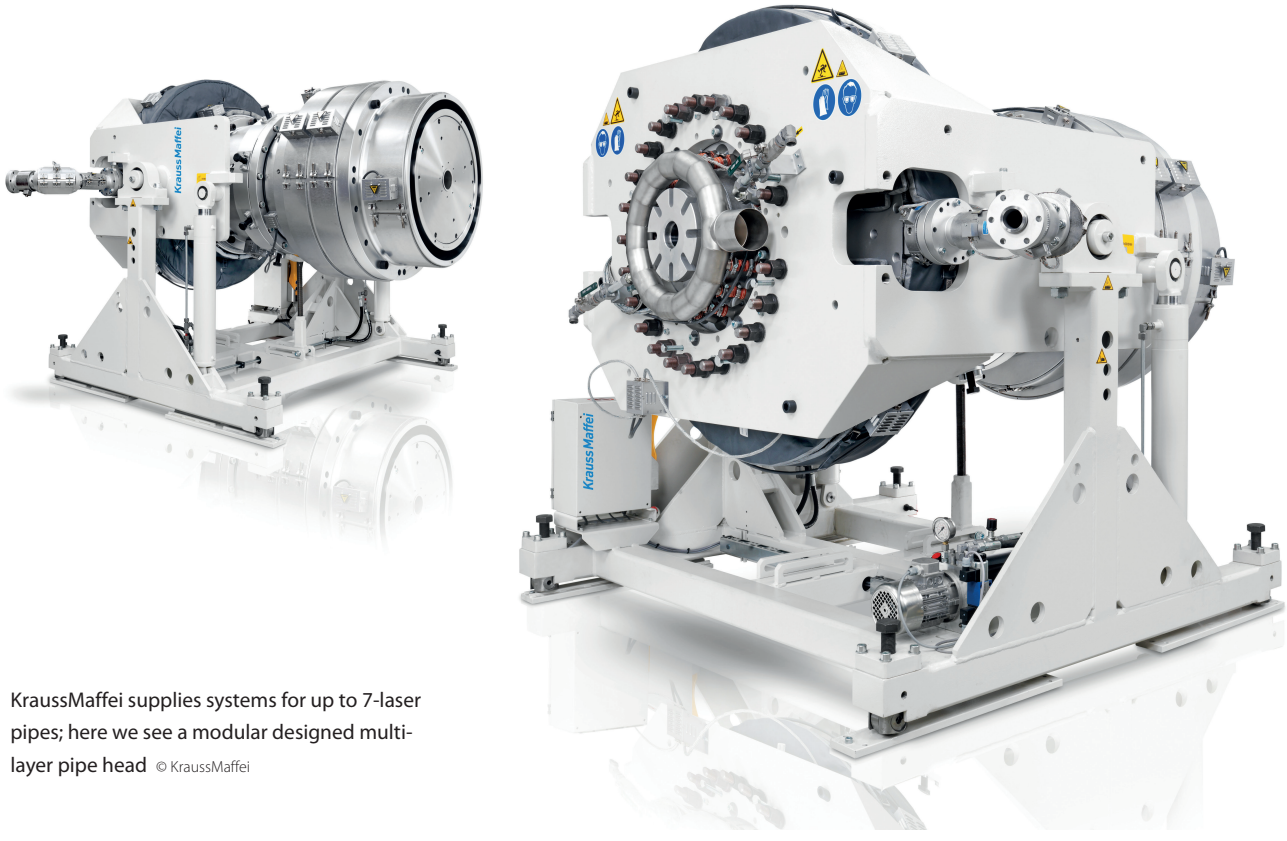
# Between New Material Mix and Energy Efficiency

## *Impressions of the Current Status of Pipe and Profile Extrusion*

***Kunststoffe*** *international* asked manufacturers in the field of pipe and profile extrusion what developments are influencing their product portfolios – and what trends are determining their future. Due to the many different types of application – ranging from microcatheter tubes to gas pipes – these companies are faced with very different challenges. Even so, they have much in common where extrusion, the use of recyclates, or digitization are involved.




KraussMaffei supplies systems for up to 7-laser pipes; here we see a modular designed multi-layer pipe head © KraussMaffei

Rarely has planning or prognosis been as difficult as in the last two years. In the meantime, many machine manufacturers in the plastics industry are smiling again over well filled order books. Based on interviews with manufacturers, ***Kunststoffe*** *international* presents their impressions of the mood vis-à-vis the status quo in the field of pipe and profile extrusion.

The manufacturers are in a consistently positive mood. Following the challenges presented by last year's pandemic, many have been reporting very positive developments in incoming orders in the previous year. "The increase in orders is largely due to growing demand for compounding extruders in the fields of food and medicinal packaging, emphasizes Clemente Bausano, Vice President of Bausano & Figli.

### *Mood and Economic Situation: Consistently Positive*

Christoph Scabell, Managing Director at Extrudex Kunststoffmaschinen describes the situation thus: "In the wake of a very

difficult two-year period, postponed investments are being caught up with. We expect a very satisfying annual statement for 2021 with further recovery in 2022."

Dr. Friedrich Kastner, CEO and Managing Partner at Collin Lab & Pilot Solutions recently made this statement: "The year 2020 was challenging. Of course, we reckoned with setbacks that in fact took place. However, we used free capacities to proceed with our program of improvements and development even more intensively and continued to realize the resulting new opportunities in the very important medicinal/pharmaceutical area." Collin also reckons with a positive annual financial statement for 2021.

## *What Trends Are Influencing Technology and Product Portfolios?*

In recent years, various tendencies have shown up in product portfolios or in developments in system technology that differ from one application and/or segment to another. Clemente Bausano: "The developments in recent years have mainly affected applications of plastic pipe. From water and gas distribution networks to rainwater drainage and the transport of various fluids all the way to energy supply systems and sprinkler systems, worldwide demand has grown exponentially and will continue to strengthen. For this reason, Bausano has completely revamped its product portfolio for the extrusion of PVC, PP, and PE pipes in order to keep up with increasing demands from manufacturers for melt homogeneity, process flexibility, maximized throughput, and reduced energy consumption. After all, demand is growing for profiles made from materials that can be manufactured from recovered polymers and up to 80% natural fibers: products that have proven to be better than wood in terms of reliability, performance, and production costs."


Clemente Bausano, Vice President of Bausano & Figli: "Environmental sustainability and recycling will be the two most important issues influencing pipe and profile extrusion in the future. Production hast to undergo a paradigm shift." © Bausano

KraussMaffei also offers a wide range of products in the field of pipe extrusion. Among other items they include systems for drinking and heating water, or gas pipes. Coextruded pipe can be produced from various combinations of materials in as many as seven layers. Some examples are PVC foam core pipes, PU foamed pipes, or a material mix of PP-R, glass fibers, adhesion promoters, and an EVOH oxygen barrier. "The classic product »

Dr. Friedrich Kastner, CEO and Managing Partner at Collin Lab & Pilot Solutions: "We are seeing stronger demand for high-speed lines and 3D printing. A nut that still has to be cracked is the automated start-up." © Collin

program for building construction is stable and has been expanded to include multilayer technologies. We are pleased that we will be able to introduce fair visitors personally to these multilayer technologies in particular at the Fakuma," says Dr. Volker Nilles, Executive Vice President New Machines at KraussMaffei.

ETA Kunststofftechnologie is active in the field of (co)extrusion dies and manufactures mainly spiral distributor dies for the production of round products such as pipes, hoses, hollow body blow molded products, or blown films. With these dies, products can be manufactured with low single-layer thickness and tight wall thickness tolerances by mono and coextrusion in up to nine layers. The sizes of them range from dies for medicinal technology in weights ranging from a few kilos up to large pipe or hose heads weighing up to several tons. In the area of automation and digitization, ETA has developed the electromagnetic centering of extrusion dies in recent years. "This enables extrusion dies to be "set at the push of a button" in such a way that products can be extruded with uniform wall thickness. Defined setpoints are entered on a touch panel. We are planning to couple this system to existing wall thickness measurement systems with feedback and optimization of the real measured values next year," explains Dr. Patrick Weiss, Managing Director of Development and Design at ETA. The thermal separation of individual plastics layers in coextrusion dies represents a further development. With it, high-quality coextruded products consisting of different plastics can be manufactured despite considerable differences in the melting temperatures. It will enable the manufacture of new types of functionalized composite products.

Extrudex's product portfolio includes systems for media-carrying lines in the fields of medicine, vehicles, sanitary pipes, and lines for cable sheathing, as well as for the production of microfilaments. The manufacturer sees a trend toward energy optimized extruders and systems. For this area, the company has developed their patented Helibar line of single-screw extruders, touting its energy efficiency as a unique selling point. The Helibar principle is suitable for many different types of applications such as blow molding and films, as well as for processing PE, PC, PP, PMMA, PET and many other thermoplastics. With Helibar, a special application was developed to produce 3D filaments from PC in which up to four monofilaments can be produced simultaneously on one system. With only minimal retooling, the system can alternate between water and air cooling and thus be used for a wide range of materials.

Collin supplies systems for manufacturing pipes and hoses. They range from microcatheter tube with less than 0.5 mm overall diameter – even by multilayer coextrusion – to multilayer pipe systems in diameter up to approx. 60 mm. Their own modular die concept permits a number of materials combinations or even from one to several strips in various layers. Collin sees a strong demand for high-speed lines for various markets. Medicinal applications and 3D printing are pushing demand; the material mix is becoming more and more varied and presents new challenges. In the Collin Medical Line of products – these include hoses and strand systems – the requirements for precision are ever stiffer. That means ever tighter tolerances together with increased throughput. Among pharmaceutical strand systems the number of layers is increasing, all of which are laden with several different active ingredients. Here, too: more throughput and tighter tolerances.

## *Using Recyclates*

Volker Nilles brings the role played by recyclates at KraussMaffei down to the point: "The recycling issue is playing an increasing role, of course. In the field of pipes and profiles, many solutions have been in place for years. KraussMaffei provides solutions for the production of multilayer pipes with recycled layers. Of course, where composite pipes are involved, recyclability is difficult to impossible – that has to be taken into consideration."

"The use of recycled material is playing a main role in our sector," says Clemente Bausano. "For instance, the recycling of post-industrial PVC residues by granulation offers a double benefit: environmental protection, since energy consumption by the production of the equivalent amount of new PVC is reduced, as is the emission of hot-house gasses from it. Moreover, company costs for the disposal of PVC wastes are minimized, creating a closed cycle that

Dr. Volker Nilles, Executive Vice President for New Machines at KraussMaffei: "We are also offering solutions for multilayer pipes with recycle layers. However, we must keep in mind that composite pipes are difficult to impossible to recycle." © KraussMaffei

Dr. Patrick Weiss, Managing Director of Development and Design at ETA: "We are observing constant further developments in coextruded composite products with the functionalization of single or multiple layers." © ETA

turns the administrative effort into an advantage. A closed cycle represents a real alternative, especially in times like this that are characterized by difficulties in the disposal of new raw materials. One of the greatest challenges in PVC recycling, however, is the transformation of regenerated materials into a high-quality product. To this end, machine manufacturers will be concentrating increasingly on researching and developing high-performance systems that can process such wastes."

At ETA, as well, the recyclate issue is gaining in importance: "Among our customers, we have been observing the development toward a constantly increasing use of recyclates for a long time. The homogeneity of recyclate melts has a high priority here. To achieve it, ETA manufactures special mixing screws as well as plasticizing units," says Patrick Weiss. At Collin, too, more and more recyclates are being used, whereby the processibility of shredded material is a major issue.

## *Digitization and Interfaces*

Digitization is playing a main role in all fields. Collin is betting on an SPS platform capable of connecting all different types of bus systems. Components can be connected via ethernet-based field bus systems, such as EtherCAT, ProfiNEt, Ethernet/IP, or classically via CANopen, Profibus, »


## Acknowledgments

This article was written with the assistance of **Prof. Daniel Schwendemann**, since 2010 Head of the Department of Materials Development, Compounding, and Extrusion at the Institute of Materials Engineering and Plastics Processing (IWK) at the Ostschweizer Fachhochschule (OST) in Rapperswil-Jona, Switzerland.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# Questions for ...

**... Prof. Daniel Schwendemann, since 2010 Head of the Department of Materials Development, Compounding, and Extrusion at the Institute of Materials Engineering and Plastics Processing (IWK) at the Ostschweizer Fachhochschule (OST) in Rapperswil-Jona, Switzerland.**

*Many manufacturers see a trend toward multilayer composite products. Doesn't that stand in the way of the greater goal of recyclability?*
The path will be narrow between maximally feasible technology, on the one hand, and recyclability on the other. The decision to use a multilayer composite design or a monomaterial construction has to be made specifically for each component. My personal opinion is that the use of multilayer composites is justified by the properties gained. In the packaging field, however, the trend will be toward monopackaging. Pipes are very durable products whose service life is longer than 20 years in many infrastructure areas. Ultimately, the question will be to what extent are the polymers damaged, and whether materials recycling is still possible.

*What trends do you see in the field of pipe and profile extrusion?*
As is the case for injection molding, extrusion will be increasingly simulated. "Digital twins" will be created to enable faster and better targeted developments. This is failing now for two reasons: the lack of materials data and simulation tools, for example, for cooling, crystallizing, and calibrating extrusion profiles. Aside from that, the digitization of entire processes and the use of new production technologies such as additive manufacturing will find their way.

*What role will the energy efficiency of systems play?*
Everyone is talking about sustainability, and the $CO_2$ footprint of products is playing an important role. In addition to the energy expense of plastics production, processing is an essential factor. The manufacturers of extrusion lines have already done a lot to optimize their extruders, but peripheral systems and devices have not been sufficiently included in the overall assessment.

*"The energy of the entire system can be optimized only with the aid of digitization."*

**Prof. Daniel Schwendemann** © Ostschweizer Fachhochschule

*Where do the challenges lie? Which "nut still has to be cracked?"*
Pipe and profile extrusion is divided up into several different areas, and complete systems are made up of modules from various components. For digitization, there exist no or insufficient exchange protocols. The linkage is thus system specific and not fed with enough data from the periphery. Energy consideration and digitization must join hands here. At the moment, many processers do not know how much energy is being consumed by which parts of the system. In the future, processers will be faced with the challenge of having to supply such data to their customers. Solutions must be provided to do this.

or Modbus. Unless proprietary protocols are used, OPC UA is used as an interface.

Bausano recently introduced its Orquestra software that uses modern 4.0 technologies to control all components of an extrusion line. These include, among other items, intelligent diagnosis and predictive maintenance. The central control system is also suitable for revamping and ensures continuous monitoring of the entire line in real time. Moreover, it enables immediate reporting with intuitive graphs of performance indicators including machine status, waste production, and man hours. The analysis of the raw data collected and made available by Orquestra makes it possible for the end user to independently optimize the entire extrusion process, refine the final product, and avoid damage to the line.

With smartAssist, KraussMaffei allows, at the touch of a button, worldwide service contact via professional and secure audio/video communication, e.g. between technicians at the machine and experts wherever they may be. Virtual texts and symbols can be superimposed on actual objects via augmented reality, increasing the quality and speed, e.g. for troubleshooting.

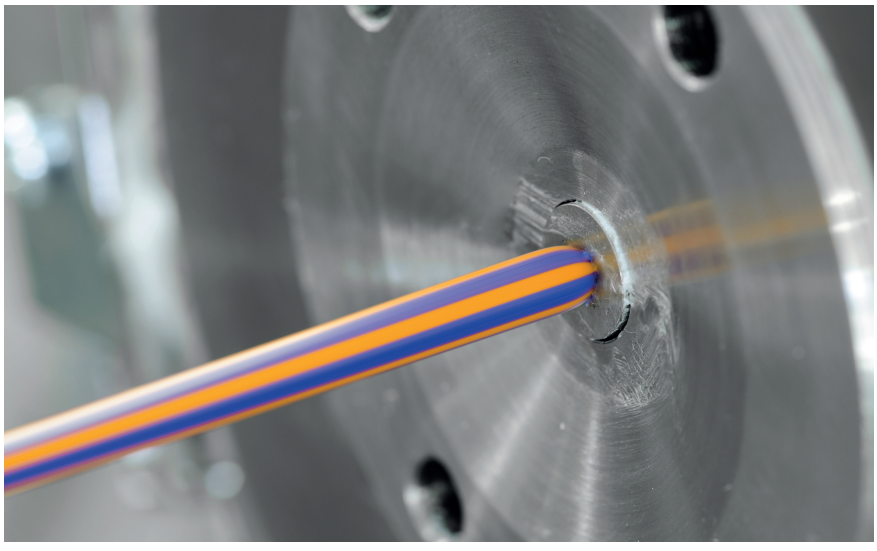
## Remote Maintenance Is Standard

In the year of pandemic, system monitoring gained ever greater significance. "Remote maintenance has become a must, as all have established during the time of Corona," emphasizes Volker Nilles. "With its multiple interfaces, KraussMaffei's C6 control is well equipped for the data world of tomorrow. In addition to proven, conventional paths (USB, PDF Export), various network-based data interfaces (e.g., OPC UA, Euromag 84) are available to access to machine and operational data. Internal and external data recorders support the analysis and optimization of processes. The availability of remote diagnosis via internet and secure access to machine operation through contactless identification by RFID reader round off our digital portfolio."

At Bausano, as well, remote maintenance is meanwhile standard: "Thanks to Orquestra software, we can remotely access operational machine data if our cus-

tomer has granted us permission to transfer data to the cloud and report possible anomalies in advance," says the company chief. "This simplifies the remote assistance performed via our Acty augmented reality app, which happens to be an interactive app. Our technicians have the option to make contact through 3D glasses in order to provide customers with qualified assistance and undertake remote start-up of the complex system.

At Collin, the option used most last year was remote machine observation. With it, their own Scada system can control machines remotely. Via remote access, the system can be monitored in home office. In addition to remote maintenance, the user has the opportunity to monitor production or laboratory procedures in home office.



In Collin's pharmaceutical strand systems the number of layers is increasing, all of which are laden with several different active ingredients. The challenges: more throughput and tight tolerances © Collin

## What Will Be Important in the Future

What issues will be important for the field of pipe and profile extrusion in the future? Volker Nilles of KraussMaffei sums them up: "Energy savings, materials savings, digitization and recyclability".

ETA is focusing on coextrusion and throughput maximization: "In pipe extrusion, besides ever higher system speeds, we are mainly observing further developments with new coextruded composite products to fulfill all sorts of requirements with a functionalization of single or multiple layers. In addition, a rising level of automation will become more and more important for extrusion processes in order to produce as efficiently as possible and prevent quality variations," Patrick Weiss reports. In addition to introducing their product for electromechanical centering for extrusion dies and the further development of technology for thermal separation of individual plastics layers in coextrusion dies, ETA is working at the moment on the configuration of new melt distributor concepts to obtain additional process and production technical advantages.

"Environmental sustainability and recycling are the two most important topics that will influence the future of pipe and profile extrusion. We at Bausano are of the opinion that our current understanding of the production and consumption of plastics has to undergo a paradigmatic shift, so that the entire life cycle is truly sustainable and repeatable over the course of time. The real challenge consists in developing technologies that improve the environmental footprint of materials such as PVC in order to accelerate the transition to a circular economy and contribute to mitigating the climate change," according to Clement Bausano.

Christoph Scabell of Extrudex thinks that energy savings, good service lives, and low maintenance requirements together with high production quality will be decisive in the future. He spots a trend toward turnkey systems and away from individual components. Innovations at Extrudex include variable die heads with exchangeable sheets for various pipe superstructures, as well as energy optimized extruders with special insulating heat bands. Since the pandemic the company is also feeling increased use of the remote maintenance modules offered for several years.

Collin sees the future challenges mainly in high speed and smaller space requirements. Beyond that, the company perceives increased demand in the area of 3D printing. "A nut that still has to be cracked is the automated start-up," Kastner adds.

## Squaring the Circle

To summarize the opinions of the manufacturers we interviewed, a difficult task is growing for the developers of extrusion systems. On one hand is the call for maximizing throughput and multi-material composites. On the other, energy and materials savings, as well as recyclability are being demanded. ***Kunststoffe** international* will continue to serve you with reports of the latest developments. ■

*Susanne Schröder, editor*