Over 30 years of experience in custom large-scale machine manufacturing have gone into the 3D printer from Hage. That is why pure automation technology is also applied.

alle Bilder: Hage

At a Glance

The essentials in 20 sec.

- Flexible processing thanks to industrial 3D printers
- Control implemented via available G-code programs
- Those who build precise custom machines can also design 3D printers
- Machine manufacturer relies on proven automation technology
- Scalable solution provides freedom for further developments

3D Printing using G-Code

Machine manufacturer relies on an industrial control platform for their 3D printer.

With 30 years of experience in building custom machines, the company Hage has begun manufacturing 3D printers for industrial applications. Their specifications – generous operating space and precision at high speed – require mature control technology. Even CNC program data can be flexibly integrated to form the basis for controlling printers with up to 12 axes.

Our 3D printers contain the know-how of a custom machine manufacturer.

Thomas Janics, Hage

The G-Code Interpreter makes the transition to 3D printing easy.

Benjamin Hauser, Hage

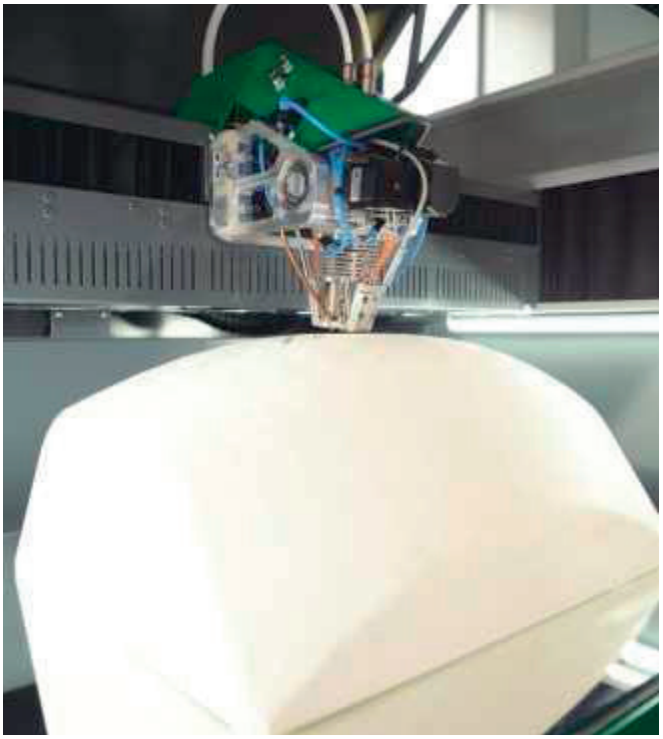
Additive manufacturing turns the material composition and placement into design variables. Commonly referred to as 3D printing, additive manufacturing processes are being used more frequently in industrial production. They enable the economic production of geometrically complex components in small series – when necessary down to a lot size of 1.

Currently, industrial use is still mainly limited to rapid prototyping. Thomas Janics, Business Unit Manager of the 3D division at Hage, cites one reason: "Most 3D printers are suited for use in a laboratory or drafting office, but not for real production – even for small lot sizes." For this reason, the custom machine builder already decided several years ago to use his experience from large and custom machine manufacturing to develop industry-suited 3D printers. For highly dynamic rapid prototyping processes, the machine manufacturer designed the 3D 72L with a position accuracy up to 0.1 mm, flexible material consumption and an installation space of 600 x 400 x 280 mm. The big brother, 3D 140L, reaches component sizes up to 700 x 500 x 400 mm and with melting temperatures up to 450° C, it also brings plastics exactly in form.

Due to the precise machine construction, the Hage printing units achieve a significantly better print quality and detail accuracy compared to commercial 3D printers – even at high speeds. The flatness of the print surface is thereby decisive for the quality. These stable systems are in use in several EU research projects, as well as industries such as automotive, aircraft and medical technology.

A Find in the Standard Control Toolkit

"Of course, the 3D printer must then meet the requirements of the production environment", knows Thomas Janics. This not only includes usual service of other production machines with installation and initial start-up on-site, but user training and support as well. The simple integration into the



Over 30 years of experience in custom large-scale machine manufacturing have gone into the 3D printer from Hage. That is why pure automation technology is also applied.

The G-code interpreter is a component of the engineering environment LASAL and was expanded with the sequential processing of large programs.

existing software environment is also an essential component for acceptance in practice. An important aspect here, is the option to process CNC programs in common file formats: G-Code, in accordance with DIN 66025/ISO 6983, is a common program format and can run on any CNC machine.

The first generation of compact 3D printers, which were based on commercial microcontroller modules and an external PC for data processing, worked well with it. During development of the large Hage 3D 140L, the engineers reached the limit of the hardware's capabilities. This problem was then solved by the automation provider SIGMATEK. Their CNC Interpreter from the development and operating system LASAL, proven in many other machines, translates G-code in internal control commands. But also fast enough? The successful performance verification was followed by the joint creation of the specifications for all process and motion control aspects of demanding 3D systems: up to twelve highly dynamic axes, driven via stepper motors. "The size of some G-code files proved to be the biggest challenge", remembers Control Engineer Benjamin Hauser. In this case large means several hundred MB. To permanently solve this problem, SIGMATEK expanded the G-code interpreter with capability to sequentially process large files when needed.

Still more: The technology-partnership with SIGMATEK enabled the machine manufacturer to expand the range of features of their 3D-systems. Because of the theoretically unlimited number of simultaneously usable print heads, objects made of several materials can also be constructed. Further details include the interruption-free printing of very large, long-running objects via standby printing heads with the same filament and functions for improved operating and maintenance comfort. These include, for example, the pre-calculation of the printing time, a 3D simulation to check the quality of the G-code files, user administration or e-mail notification in the event of certain system states, such as a pending filament change. The engineering-framework provides these functions from the standard toolkit practically free.

With the application programming, the Hage team was supported by SIGMATEK at the beginning only. "I had only modest experience in high-level language programming and was positively surprised how quickly and easily I learned object-oriented programming in the Sigmatek design environment", says Benjamin Hauser. The application development was further accelerated by the ready-to-use templates and Add-Ons for the design and functions of the engineering environment.

Central element of the control technology: Operating Panel ETT 732 with a 7-inch dual-touch TFT color display and EDGE2 Technology processor.

With the 3D printer 140L, the entire automation system is contained in a single control box. On the right, up to twelve axes are mounted.

Basis laid for future models

With the software, Hage also laid a new foundation for the control and drive technology of the 3D systems: This is designed to allow simple configuration of future models with currently unknown requirements. "We use the capabilities of SIGMATEK systems to construct a multi-processor architecture, in which different sections of the overall task can be distributed over different devices", according to Benjamin Hauser. The administrative and user-based tasks are for example, already outsourced to an intelligent ETT 732 operating panel with a high-performance processor (Edge2 Technology); which reduces the burden on the machine-based control. Space-saving and scalable for future tasks, it is constructed using the compact S-DIAS system. Output stages of the type VST 011 control the stepper motors. Each of these modules can control motors up to 5 A of continuous current in full, half or micro-step.

Two interfaces for the industrial Ethernet communication system VARAN enable, in addition to the connection to the control system, the configuration of systems of any size with different topologies (start, tree, line). After the first joint design (Hage 3D 72L), the scalable automation system allowed the Hage engineers to independently develop the larger 3D printer – the 3D 140L. "Based on this fundamental design, we will also develop future models or expansions of existing systems ourselves using the same process", says Thomas Janics regarding the future-proofing of his automation system.