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Injection molding 4.0

Flexibly automated, digitally optimized

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Flexible, PC-based control technology and a harmonized drive system, plus modular software tailored for plastics processing and digitally supported development processes – these are the levers for Maicopresse S.p.A. to considerably shorter time-to-market and commissioning as well as highly efficient operation of future injection molding machines. The first result of the cooperation with Siemens is a high-performance, 600-ton hybrid machine with hydraulic and electric drives for economical manufacturing of large molded parts.

In times of advancing automation and digitalization, the importance of high-performance hardware and software also grows in injection molding machine engineering to ensure the market success of new developments. To be able to fully focus on its core competence, mechanical engineering, the renowned Italian injection molding machine manufacturer Maicopresse S.p.A. (Maico) in Borgosatollo near Brescia has decided to cooperate with Siemens even more intensively than before in the field of control, drive and digitalization technology in the future. The first result of the collaboration is the Maicopresse M-L 600 Hybrid, a 600-ton machine which is largely driven by electric servo motors. A hydraulic pressure accumulator, which is charged via a servo pump, merely ensures the build-up of the closing pressure and the injection axis. This leads to a higher degree of overall efficiency and reduces the energy consumption per kilogram of formed plastic to 0.30 kWh.

A typical trait of all of the machines from the Northern Italian company with a background in light-metal die casting is an extremely robust and long-lasting machine design with, among other things, a forged machine bed as well as clamping plates, toggle lever connecting rods and stays machined from solids. The interaction of all of the machine components that are decisive for the injection molding process was first examined on a virtual 3D machine model created by Siemens. The motion control was optimized and validated on this digital twin (see below).

Into the future with a new automation concept

The jointly developed automation concept, based on the SIMATIC ET 200SP Open Controller and the modular software library for plastics solutions from Siemens is completely new.

The new, open controller integrates the functions of a PC-based software controller with a visualization, PC applications and central input/output modules (I/Os) in a very compact design. The pre-configured software variant of the SIMATIC S7-1500F ensures high PLC performance with integrated safety functions. The compact "all-in-one" system is also the platform for visualization solutions with SIMATIC WinCC Runtime and other PC applications. It provides PC interfaces for the monitor (DVI), mouse, keyboard as well as PROFINET and Gigabit Ethernet and can be expanded in a decentralized manner. "Hardened" for continuous operation at temperatures up to 60 °C without loss of performance, the diskless and fanless, shock and vibration-resistant device is predestined for use in serially produced machines in the harshest conditions. The openness and scalability allow dedicated, cost-optimized automation solutions in each case. This allows Maico to implement individually tailored machines for all requirements in the future. As a global partner, Siemens guarantees a worldwide supply of replacement parts, comprehensive support, and innovative further developments for its customers.



Maicopresse M-L 600 Hybrid: Robust mechanical engineering meets innovative, modular automation from Siemens. On the left in the foreground: the SIMOTICS T-1FW3 torque motor, which performs fast, precise opening and closing movements of the toggle lever. (Picture: Maicopresse)



The SIMATIC ET 200SP Open Controller integrates the functions of a PC-based, fail-safe software controller in a very compact design, with visualization, PC applications and central input/output modules (I/Os). The fanless device is resistant to continuous temperatures up to +60 °C and is thus predestined for use in injection molding machines. (Picture: Maicopresse)

**Plastic library:
An individual solution using
standardized modules –
in only four months**

The Siemens plastics library was used on the open controller for the first time within the scope of this project. This is a modular software library with standardized, quality-assured blocks for SIMATIC controllers and ready-to-use operating screens for SIMATIC HMI. These can be easily and quickly combined into individual automation solutions, not only for injection molding machines, but also for extrusion, blow-molding and thermoforming machines.

The elementary basic function of any plastics processing machine – and therefore of the plastics library – is fast and sensitive temperature control. The Temperature Control Package (TCP), which has been optimized for this purpose, achieves the maximum control quality in all heating and cooling processes. It contains various monitoring functions, for example for cold starts, and automatic controller optimization (Auto Tuning).

With the Drive Package (DRV) software module, any number of main drives can be activated, controlled and monitored in extrusion, injection molding, blow-molding and thermoforming machines. The basic functions include a synchronous speed adjustment and the throughput and pressure control.

The software module for motion control (MOT) provides technology-oriented motion control functions and thus allows highly precise positioning of electric and hydraulic axes, even in synchronous operation.

Beyond the basic functions of these software modules, a parameterizable sequence control (ACL) allows high-performance cyclic processes. The integrated, sequencer-based processing system is scalable and must be parameterized via the HMI system. This allows machine processes to be extremely flexible in design and drastically reduces the development times.



More quickly to the goal with the plastics library: Thanks to standardized, quality-assured software modules for the most important control tasks in injection molding, it was possible to implement the machine functionality and user interface in just four months. (Picture: Siemens)



A customized user interface for a SIMATIC Flat Panel with 19-inch touch display has been created based on the requirements of Maico. (Picture: Siemens)

The project with the Italian OEM has confirmed that through the use of the standardized software modules from the Siemens plastics library, the entire sequential program, all of the method-specific technological functions and the operator interface can be created and implemented in just four months.

Optimized and validated on the digital twin

The previous simulation of important processes and the virtual commissioning of the control program with the aid of the digital twin played a key role in this. This allowed the machine properties to be validated, errors to be eliminated, and risks to be minimized early on. The virtual model of the machine resulted from close collaboration of the design engineers of Maico and Siemens specialists. In this case, the NX Mechatronics Concept Designer (MCD) was used for the "kinematics" of system components and the SIMATIC Machine Simulator was used for the virtual commissioning. The latter combines the virtual Controller SIMATIC S7-PLCSIM Advanced with the SIMIT simulation platform, which allows the processing behavior of programs to be examined and optimized. The digital approach permitted the implementation of additional customer requirements and substitute the competition's products.

Into the future with integrated automation

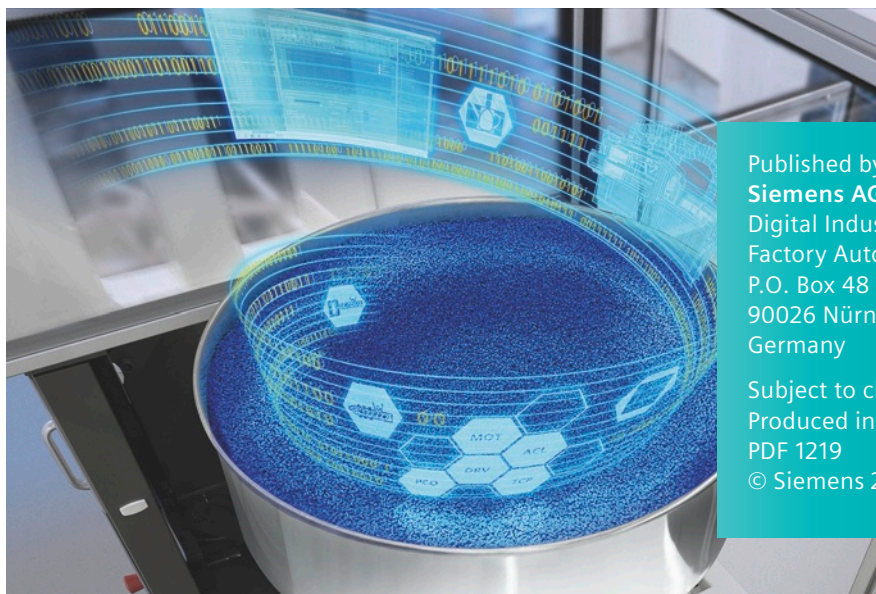
The modular SINAMICS S120 converter system is an additional decisive component of the new, integrated automation solution for efficient and economical injection molding. In addition to a SIMOTICS S-1FT7 servo motor, this also drives two SIMOTICS T-1FW3 torque motors, for the dynamic and precise opening and closing movements on the one hand, and for the plasticization on the other hand. A SIMATIC Flat Panel with a 19-inch touch display is installed on the front side for operator control and monitoring.

A positive summary from Mario Merlini, Marketing Manager at Maico:

"The high requirements for quality and the desire for a control platform that can be configured according to the needs of the user and meets not only current but also future requirements were the reasons for deciding in favor of this intensive cooperation with Siemens. The results that were achieved show that it was a sound, future-oriented decision."

The first follow-up projects also indicate the level of satisfaction of the Italian injection molding machine builder.

Editorial version is published at kunststoff-magazin September 2019.



Published by
Siemens AG
Digital Industries
Factory Automation
P.O. Box 48 48
90026 Nürnberg
Germany

For the U.S. published by
Siemens Industry Inc.

100 Technology Drive
Alpharetta, GA 30005
United States

Subject to change without prior notice
Produced in Germany
PDF 1219
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