Injection molding from the ground up

In the expanding and competitive industry of injection molding, it is becoming increasingly vital that machinery manufacturers differentiate themselves with innovative and efficient designs to reduce both manufacturing and operating costs.

300 ton hybrid injection molding machine uses the latest servo technology from B&R, which delivers energy savings and integrated safety in a simple, modular design.

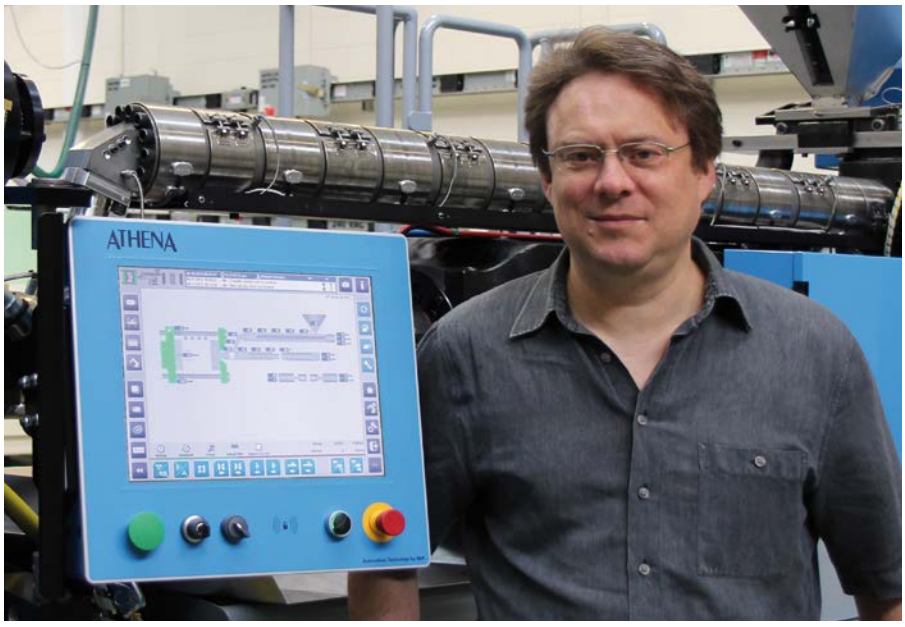
When Robert D. Schad founded the Canadian injection molding machine manufacturer Athena Automation in 2008, he placed the highest demands on efficiency, flexibility and performance for its new generation of hybrid injection molding machines. This meant taking a fresh look at every aspect of an injection molding machine, from the mechanics to the control system. Athena spent six months diligently evaluating various control systems with the objective to find not just the one solution that would allow them to realize all their objectives and beyond, but also a partner with the best expertise in the injection molding industry. At the end of this very thorough decision-making process, B&R came out on top as the future partner.

"The control system had to support hydraulic and electrical axes, distributed I/O, object-oriented programming, the latest servo technology, open connectivity and the sophisticated HMI we were developing. It was also important that local service be available to support development and startup," notes Marc Ricke, Athena's controls team leader.

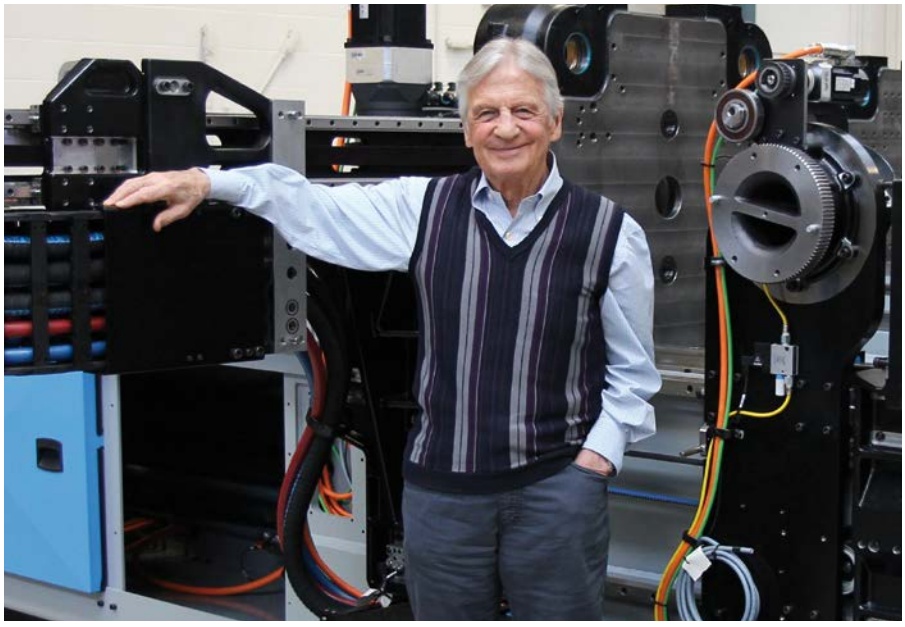
Modular and flexible on all fronts

One of Athena's main design goals in this new development was a modular and flexible machine concept that allows customers to pick from a variety of pre-engineered machine options while still keeping assembly and service of the machine simple and efficient. This put a challenge on both the software as well as the electrical design.

To turn this into reality, Athena took advantage of B&R's Power Panel technology, which combines the PLC, HMI and motion controller in one single unit and connects directly to the compact ACOPOSmulti multi-axis drive system with dual-axis modules



"B&R turned out to be not merely a vendor a vendor, but a real partner." Marc Ricke, Controls Team Leader at Athena Automation



"Together with B&R's flexible and powerful automation solution and the strong partnership we were able to even exceed all our design objectives." Robert Schad, Chairman and Founder of Athena Automation

Pairing B&R's Power Panel technology with ACOPOSmulti drives reduces the number of necessary components and saves cabinet space, resulting in a very clean and simple cabinet layout.

and high density X20 I/O via the real-time Ethernet-based POWERLINK protocol.

This solution allowed Athena to not only reduce the number of components, but also save cabinet space and come up with a very clean and simple cabinet layout built right into the machine base. Additional drives or I/O needed for machine options can be easily added; the machine software then recognizes them and enables the required functions. With a water-cooled mounting plate for the servo drives, the cabinet is kept cool without the need for additional air-conditioning devices. As a result, Athena reduces its costs in addition to saving energy.

The concept of simplicity and modularity extends into the software design and Automation Studio as machine functions and options are broken down into independent software units. "This shortens development time and allows us to test modules before we introduce them into the standard machine, which creates a more stable product," explains Ricke. "Delivering hardware on time was just a small part of B&R's contribution. Thanks to the great local support we received, including a cus-

ETHERNET POWERLINK

The high-speed Ethernet POWERLINK is deterministic and does not rely on proprietary hardware. This allows Athena Automation not only true flexibility and independence from licenses and specific vendors but also greatly reduced wiring as a result of the integrated safety system.

tomized training program, we were able to have the first prototype up and running on schedule," he adds.

Energy efficiency
With energy prices continuously on the rise, energy efficiency was another critical design goal for Athena's hybrid injection molding machine. A large portion of the energy is typically used by the machine's hydraulic system. Instead of using an induction motor that drives the hydraulic pump at constant speed regardless of the amount of oil flow needed, Athena took advantage of B&R's servo hydraulic concept where the hydraulic pump is driven by a servo motor on demand – i.e. only when oil flow and pressure are needed. In addition to the energy savings that resulted, the concept also allowed Athena to eliminate expensive servo valves.

The ACOPOSmulti drive system with energy regeneration capabilities and the 750 V regulated DC bus helped in achieving this goal as well. Whereas braking energy can be regenerated to the grid, the higher DC bus voltage allows motors to be operated at higher speed. By perfectly matching the mechanics to the motor and drives, Athena was able to use smaller and lower inertia motors that also reduced both energy and costs.

"Our 150-ton hybrid machines have been tested against a leading all-electric machine and provide about the same energy efficiency at higher output," states Robert Schad.

Operation and service have never been easier
With Automation Studio's Visual Components framework, Athena designed a visualization system that significantly shortens the learning curve through a very intuitive and consistent design philosophy while also introducing a new level of efficiency in navigation and machine setup. An interactive, web-based help system provides the operator with information on demand to assist in operating the machine or troubleshooting alarms.

Effortless remote diagnostics of all aspects of the machine is achieved by combining Athena's help and diagnostics system with B&R's embedded web-based System Diagnostics Manager. Easy service, a short build time and a simple, flexible design give Athena's machine an edge over other injection molding machines.

Flexible but safe
When it comes to flexibility, a hard-wired safety circuit has its limits with regard to accommodating all possible machine options without drastically increasing complexity or compromising safety. With B&R's integrated safety concept, Athena was able to implement the needed flexibility in addition to meeting the highest level of machine safety. A major advantage of B&R's "Integrated Safety Technology" concept is the elimination of redundant cabling and external monitoring modules for the safety technology. Data is transferred with virtual wiring via the machine bus system in an intrinsically safe protocol called openSAFETY, which enables easy data communication with the control system while reliably excluding feedback.

The fact that POWERLINK is deterministic and does not rely on proprietary hardware allows for true flexibility and independence from licenses and specific vendors. Wiring was also greatly reduced as a result of using the integrated safety system and distributing the safety I/O over the machine using IP67 safety I/O modules.

"B&R turned out to be a real partner instead of merely a vendor. Today, we both work very closely on the operational side as well. Our preconfigured parts are ordered for specific machines and do not even hit the stock room. The next steps for improving logistics, assembly and technology are being planned, and B&R's strong local expertise will help us to realize our future goals," concludes Ricke. ←

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> **Marc Ricke**
> **Athena's Controls Team Leader**