



Increased functionality  
and cost benefits all along the line

## PC-based control becomes the standard for sheet extrusion applications

The plastics industry is one of the fastest growing industries in the USA. Many of the plastic products that we use every day start as huge sheets of plastic, manufactured from plastic pellets by sheet extrusion machines. American company Graham Engineering Corporation, based in York, Pennsylvania, manufactures, among other solutions, sheet extrusion machines under the Welex® brand name. These machines rely on Beckhoff controls to optimize their operation and processes.

In the Welex® Evolution® series, Graham Engineering Corporation has created a machine portfolio that provides robust, customizable sheet extrusion for winding, sheeting and in-line thermoforming systems. The state-of-the-art systems operate with a co-extrusion process, where up to nine extruders can be included in the system, for example to manufacture multi-layer products. The application-specific machine configurations from Graham Engineering Corporation feature, among other things, high-performance screen changers, melt pumps, mixers and co-extrusion feed blocks.

The XSL Navigator® machine control platform, which was developed by Graham Engineering Corporation, provides efficient operation of the Welex sheet extrusion machines. The basis of this control platform is a Beckhoff Industrial PC with TwinCAT automation software.

### **Graham Engineering Corporation optimizes extrusion process**

The raw material for the extrusion process is a plastic granulate, which is often mixed with recycled material. This granulate mixture is conveyed into an extruder. The rotating extruder screw, housed in a heated metal barrel, mixes and melts the filled material while conveying the material forward. The molten plastic is pressed through a metal screen to filter out any particulates before it enters the melt pump. The screen is continually changed and cleaned in an auxiliary unit. The resulting homogeneous plastic melt is fed to a pump in order to generate an

adequate plastic melt pressure. "The melt pump provides a reliable, continuous material flow through the slot die, which can be adjusted to provide the desired material thickness," explains Justin Kilgore, Vice President of Engineering at Graham Engineering Corporation. The material then flows onto polishing rolls. These rolls counter-rotate, pulling the material through and feeding it down through the rest of the line to be delivered either to a winder or directly into a thermoformer, where it is given its final shape.

Graham Engineering Corporation standardized on PC-based control from Beckhoff for its blow-molding machines 10 years ago. The company has now chosen to integrate the Beckhoff platform into its new control system, the XSL Navigator®. This powerful, feature-rich control system has been adapted for use in sheet extrusion lines. "The flexibility and scalability of the PC-based solution are the two biggest reasons why we chose to standardize on this platform," says Justin Kilgore. "The open control architecture makes it fast and easy to integrate with any downstream equipment we choose."

### **Universally PC-based: from PLC to motion control to safety solutions**

The control platform of the Welex sheet extrusion lines is based on a C6640-0040 Industrial PC with an Intel® Core® i3, dual-core processor running Windows 7. Justin Kilgore explains: "The C6640 has been our workhorse for many years and is used on a number of our systems. It provides ample pro-

A customized 21.5" CP3921-1009 multi-touch Control Panel serves as the front end of the Welex® sheet extrusion line.



cessing power for anything we've thrown at it, and has proven to be a reliable control platform."

Digital EtherCAT I/O terminals, thermocouple inputs and analog inputs for pressure measurement, all from Beckhoff, provide high-speed communication across the machine and with all field devices, including those for safety. "Standard on the sheet extrusion machines are EL-series TwinSAFE I/O terminals, networked via Functional Safety over EtherCAT (FSoE) to implement numerous safety functions in the system," as Kilgore explains: "We use RFID-enabled switches for safety doors, as well as numerous emergency stops. Some applications also integrate a light curtain into the control system via TwinSAFE. With this integrated solution, we can dispense with standalone safety controllers. The built-in diagnostic functionality in EtherCAT helps us precisely pinpoint any errors and push notifications to operators, increasing machine value."

#### Customized Control Panel forms robust machine front end

The XSL Navigator® control system integrates a customized Beckhoff CP3921 multi-touch Control Panel with 21.5" screen, providing superior access to machine data via the HMI software. "The Beckhoff control panels provide a modern and elegant look that enhances the appearance of our machines. In addition, integrating the push button extension and an RFID reader into the panel adds a high level of security, functionality and a uniqueness that sets our solutions apart in the industry," notes the engineering expert.

#### Openness of TwinCAT permits integration of customer expertise

The machine control is based on TwinCAT PLC software and Graham Engineering Corporation takes full advantage of the numerous programming tools offered by TwinCAT. Justin Kilgore explains: "Overall, the TwinCAT development environment gives us the flexibility to program all necessary process functions, regardless of the machine type or application we're working on. We

were also able to develop our own software libraries, including everything from PID temperature control to function blocks for integrated winder control. The ability to create a library of function blocks that we can then reuse across all of our extrusion lines is another way Beckhoff helps us maximize the value of our intellectual property (IP)."

#### Cost savings all along the line

"In terms of hardware costs, we've achieved cost savings of approximately 15 percent by switching to PC-based control, mainly due to the reduced wiring and installation labor cost," Justin Kilgore explains. "When we discussed the introduction of TwinSAFE, we quickly identified potential savings: routine queries are eliminated and the search for error sources can be minimized."

XSL Navigator is now the standard controls system for Graham Engineering Corporation's Welex sheet lines. The demand for plastic products will not slow in the foreseeable future, and Graham Engineering Corporation has the tools and expertise to continue innovating for the market via best-in-class solutions engineered to meet this demand.

Further information:

[www.grahamengineering.com](http://www.grahamengineering.com)

[www.beckhoffautomation.com](http://www.beckhoffautomation.com)