Extrusion Control System

General Information
Our extrusion control system is based on PLC (one or several) with remote I/O (Input/Output) stations. We offer the choice of Allen-Bradley, Siemens, Modicon, Mitsubishi and AutomationDirect. High speed field-bus network such as Profibus, DeviceNet or industrial-Ethernet is used to integrate the PLC with the remote I/O stations and to control drives and other instruments. The layout of PLC and remote I/O stations is tailored to optimize the system and keep the need for hard wiring to a minimum, resulting in reduced cost. For retrofitting of existing machines we optimize the PLC and remote I/O around the existing hardware of the machine.

The supervisory system software, also known as HMI (Human Machine Interface), runs on XP/Win2000/Vista operating systems. The system is supplied with a rugged industrial touch-screen computer and XP-Pro operating system. The HMI computer is Ethernet networked with the PLC. In addition to the HMI computer that control the machine, other computers can be added for management supervision, control rooms or additional HMI stations for large machines. The software has a Read-Only mode for remote computers which are not used to control the machine.

The HMI software is a pure Microsoft .NET application, as such its compatibility with future Microsoft operating systems is guaranteed. We use OPC server/client architecture for data communication with the PLCs.
**HARDWARE ARCHITECTURE**

Multiple computers (as many as required) can run the software simultaneously and independently. The project may include one or more PLC, with or without remote I/O stations. The PCs and PLCs are networked together by Ethernet.

**SOFTWARE ARCHITECTURE**

The OPC server includes definition of all tags (data points) and connection setup to the PLC(s). The HMI application includes the OPC client object which performs the exchange of information between the OPC server and the HMI software. The link between the OPC server and the VB application is direct, with no need for any medium (such as database) to facilitate the exchange of information. As a result the screen refresh rate of the HMI software is very fast, even with large amount of data.
THE SUPERVISORY (HMI) SYSTEM:

Heating Zones:
The screen image below shows our typical heating zone screen, for each zone we show on the screen:

- Process set (PS) in Red.
- Process value (PV) in Blue
- Spin Up/Down. Click and hold and the PS value quickly climbs up or down.
- Deviation bar
- Level of heating/cooling (the output of the PID calculation).

The “ALL” items at the right side of the screen allow for quick setting and Up/Down spin for the whole group of zones.

Graphical Trends of 5 (most recent) hours for all heating zones provide visual information on the performance of the PID controls. The trend screens include a “Print” button to copy the historical graph to paper.
Motion and pressure Control:

- Control of the drives is via DeviceNet, Profibus or other field-bus technology, or by analog signals from PLC cards.
- In addition to the speed adjustment options on the screen (by keyboard entry or the up/down spin), we use “digital potentiometers” to manually dial the speed higher or lower. These speed pots perform relative adjustments, much like the volume control in most car radios. With the manual speed adjustment our system is very easy to operate even for old generation operators.
- The On/Off switches (green in ON, red in OFF) are with time delay between states. When clicked, the background color changes to pink and the user must maintain the mouse (or touch-screen) pressed for about one second. This feature prevents accidental start or stop action just by touching the screen.
- The software includes scaling of drive information to engineering units (RPM, AMP etc.) with no need for programming changes. This feature ensures that if multiple computers are used, they all “see” the same data.
- Pressure control with bar-graph presentation. In automatic control the speed of the extruder is controlled to maintain pump suction pressure. The system allows manual adjustments of speed while in automatic mode.
Pressure Control Trend:
With this pressure control trend the operator can view the performance of the control over time.
The trend object keeps the information in a short-term buffer, typically 5 most recent hours. The vertical axis, as well as the horizontal (visible time) axis are adjustable. Print option is available. It would print the trend with WHITE background to save ink.
**Alarm System:**

The alarm screen is shown below. The system includes a beacon to indicate existence of alarms and a buzzer to alert the operator on every new alarm. Once all the alarms are cleared, the “Alarm” button at the left side of the screen turns gray. At the top-right corner of the screen we see (in RED) the active alarms, scrolling one after the other, even when the user is viewing other screens.

**“Classic” tabular view:**

**Non-tabular view:**
Emergency stop system:

Status of Emergency-Stop button and the safety relay:

After all E-stops are cleared, the operator is asked to press on the SYSTEM-RESET push button (not shown here) to energize the safety relay.

When Safety relay is energized:
Recipes:
Recipes for quick setting of all the heating zones. When downloading a new recipe from the PLC, the speed of the motors is included as comments. Additional comments can be added to the recipe.
Archive (historical data):
The system performs time-based archiving of all machine setup information into a
database. The archived data is stored in daily files in Microsoft Access database format.
To view previous days the user selects the date using the calendar. The archive view is
read-only and the information cannot be modified by the user.

Reports:
Printout report of current machine conditions, as well as historical data from archive.
Printer could be locally connected to the computer or a network printer.
Email:
Email messages from machine to management on pre-defined events. Machine generates and sends status report by email to management upon request (the request is by sending email message to the machine). This feature is fully protected from unauthorized access.

Since the software can run on multiple computers, email features can be performed by an office PC (not necessarily the line PC).

To activate this option the machine needs its own email address, the setting is at the right side of the screen in the picture below. The email address of up to 4 pre-authorized recipients for email notifications from the machine are at the left side of the screen.
User Control:
User Control is performed with our “TxqSecurity” object which is integrated with the HMI application. User information is stored in a secured, encrypted file. New users can be added and deleted at any time, according to strict rules. The access level determines which program features are accessible to the user.
Notebook:
An On-screen Notebook that includes a database for instructions, procedures and messages between machine operators.

Help Files system:
Our help files system is designed to assist machine operator with current work instructions and related documentations. The help files can be edited with any word processor, all that’s required is to copy these documents to a specific directory in the HMI computer and they become part of the list of help files. This feature allows existing work instruction, operation manuals, safety instructions and similar paper-work to become part of on-line help which is always available on the computer screen.
Additional Features:

- HMI software can run on multiple computers with only minimal added licensing cost.

- Software has a Read-Only mode for management use. In Read-Only mode the user cannot change any machine setup.

- The HMI software can support multiple (similar) extrusion lines. With this feature it takes only two mouse clicks to switch between machines. Each machine is assigned a different background color for easy identification. The ability to switch between machines is password protected and reserved for management only. With this feature one computer (typically in office or control room) can view or control multiple machines with a single HMI program.

- The software can run Full-Screen, or as a resizable form. Texarq recommends Full-Screen mode for computers used for machine control. In full-screen mode the termination of the software (EXIT button) is password protected.

Note: The HMI application was developed for 100% compatibility with Microsoft .Net framework. As such its future compatibility with hardware changes (new computers) and evolution of the operating system is guaranteed by Microsoft.

Final note:
Our control system is designed for new machines as well as for retrofitting of existing extrusion lines. It will give your old machines a “new look” and the benefits of the features outlined above. Because of our runtime licensing advantage the system will cost less than you would expect. Call us to find out…

Thank you for your interest.
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