Deterministic Networking and Supervisory Control Offers Flexible Alternative to DCS for SXEW Copper Process

Application Profile

Silver Bell Mining LLC, Marana, Arizona was able to establish a closed loop system for SXEW (Solvent Extraction Electrowinning) processing of copper by using products from Rockwell Automation. These included Allen-Bradley controllers and software tools from Rockwell Software, as well as the latest ControlNet networking technology. The resulting system provides an architecture that is both flexible and predictable, control that is highly distributed, and software that offers fast access to key process variables.

In the first year of operation, from July 1997 to June 1998, 34 million lbs. of cathode copper were produced. The Bechtel Metals and Mining Group in Denver conducted the project engineering and construction. Engineering began in January 1996 and the plant was commissioned on July 16,1997.

Products

- PLC-5/20 and PLC-5/40 ControlNet programmable controllers
- 1771 Series I/O, including N-Series Analog modules
- SLC 5/03 modular programmable controllers
- RSView software
- RSTrend software
- Reliance DutyMaster motors
- PanelView 550 operator station
- Communication software for ControlNet

Key Benefits

- The flexibility of the ControlNet PLC-5 allows communication through a variety of means, including ControlNet to other PLC-5 controllers, Remote I/O Chassis and the RSView32 supervisory stations. In addition, the PLC-5 uses its RS-232 port to communicate DF1Half Duplex for radio modem communication to remotely located SLC 500 controllers which in turn are linked to Multilin motor protection relays on the large pump motors via Modbus.

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- RSView software collects and graphically displays data for the entire mine site, making it possible for an operator in the control room to analyze current process conditions such as pump motor amperage and solution flow as well as equipment conditions such as bearing temperatures on critical pump and agitator motors.
- RSTrend allows operators to perform long term analysis for process optimization and record keeping.

Key Features

GPM, Amps, and operating conditions are displayed on the easily configured graphical displays and faceplates. RSTrend provides tracking of critical PID loop parameters such as heat exchanger temperature, and incoming temperature of electrolyte. Seven days of information is kept on-line.

The RSView32 workstations are nodes on the ControlNet supervisory network which also connects to the ControlNet PLC-5 controllers and Remote I/O chassis. The main PLC-5/40C controls the electrowinning cells, SX trains and tank farm as well as serving as a SCADA master for the 12 remote SLC for pumps. Remote Termination strips are used together with 1771-NIC and 1771-NOC High Resolution Isolated Analog modules . This main processor has over 400 points of I/O, with 70-80 analog. Most of the analog I/O are associated with 30 PID loops.

Overview

Operations at the mine consist of:

- Three active dump leaching areas (scada area)
- SX (Solvent Extraction) trains tank farm
- Electrowinning tank house

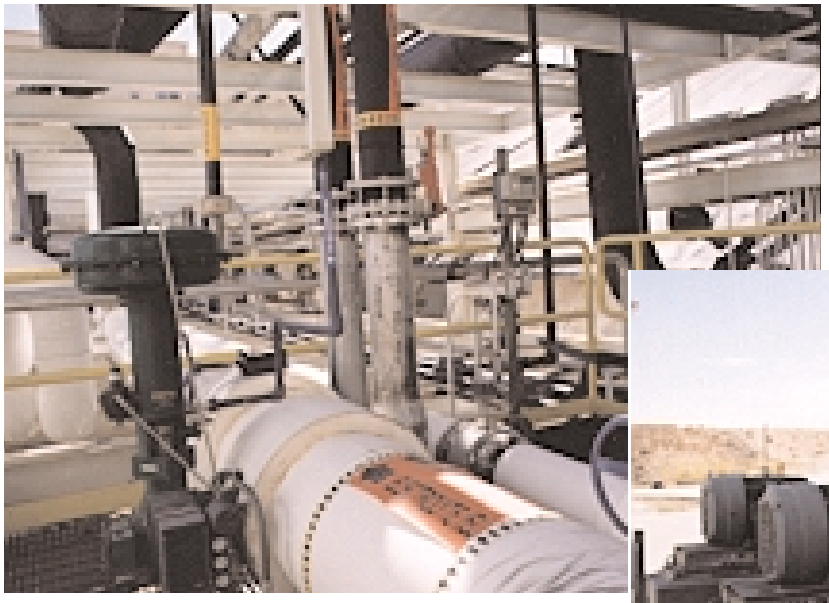
Leaching

Three dump leaching areas are currently active. Raffinate is recycled from the solvent extraction process and pumped to each of the three leach areas. The solution leaches the copper ion from ore and the resulting PLS (Pregnant Leach Solution) flows to an adjacent collection pond where an SLC controller is used to monitor and control the pump that delivers the PLS to the SX plant. Radio modems provide communication between the SLCs and the main PLC-5 in the central control room. Currently 14 SLCs and 14 radio stations (including repeaters) make up the SCADA system in the field. The system is designed to be expanded for more pump stations.

The SLC controller controls and monitors the medium voltage pump motors (on/off), flow rate, and all information available from the Multilin motor protection relay. This is accomplished with the use of a Prosoft module. The Prosoft module, a Rockwell Automation Encompass partner product, allows the SLC controller to communicate via Modbus communication protocol to the Multilin motor protection relays.

Solvent Extraction Trains

The PLS flows down from the main PLS pond to one of two SX trains. The first stage of SX transfers the copper from the aqueous to an organic solution. The loaded organic solution then travels through a strip stage, where the copper is stripped from the organic solvent using an electrolyte solution. The resulting rich elec-



The process flow through solvent extraction trains (above) as well as bearing temperature on Reliance DutyMaster motors (right) are monitored with RSView software using data received via the ControlNet network.

trolyte solution passes through dual media filters (garnet sand and crushed anthracite coal) before arriving in the electrowinning tank house.

Electrowinning

The electrowinning process uses electrical current (current flow through the cells is 40 kilo amps) to plate copper ions onto positively charged stainless steel blanks or cathodes. Tight control of copper concentration and temperature of the electrolyte in the cells is critical to achieving production and quality from the process. The ControlNet PLC-5 controller and 1771 N-Series I/O continuously regulates the solution's copper concentration to 38 grams/liter of copper, while the temperature control of the electrolyte in the tank house is kept at 120° F.

A six day cathode harvesting schedule is followed. Purity of the plated copper is analyzed and meets COMEX and LME specifications for Grade 1 copper, making the copper produced at the Silver Bell Property exceedingly high quality.

A mechanical cathode stripping machine removes the copper from the stainless steel cathode blank. This machine has a dedicated PLC-5 controller as well as and PanelView 550 display. The Electrowinning Tank House filters are controlled by the plant's third PLC-5 which is also on ControlNet and from which alarm points are monitored.

Supervisory Process Control is provided by two RSView32 Workstations for the entire SXEW facility with over 1,978 database tags being monitored. Conditions such as motors running, motor winding temperatures, solution flows and collection pond levels are continuously monitored.

Summary

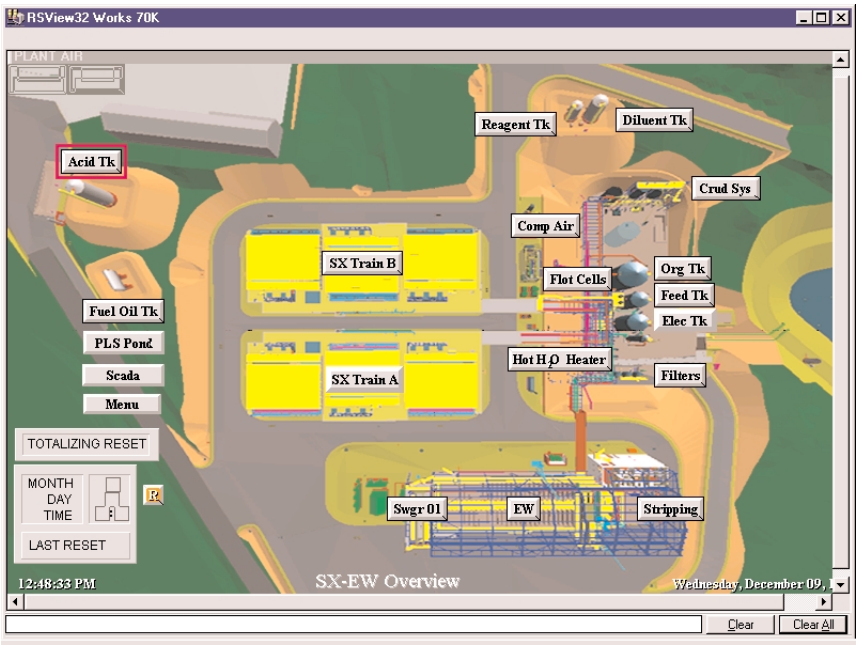
The resulting system offers an alternative to DCS systems by applying cost-effective modular PLC-5 and SLC 500 programmable controllers, the high speed deterministic ControlNet network, and RSView32 and RSTrend for state-of-the art graphical interface software.

Two SLC controllers are used to monitor and control the pump that delivers the PLS from each heap pad to the SX processing area.

An Allen-Bradley PLC-5 programmable controller and 1771 N-Series I/O continuously regulates copper concentration during the electrowinning process (left), while another PLC-5 controller and a PanelView display provide control of a cathode stripping machine (above).

Silver Bell Mining LLC Solution Summary	
Production Data	36 million pounds of high quality EW cathode are produced per year.
	Cathode meets LME and COMEX specifications for high quallity EW cathode.
Application Data	Three active leach areas
	14 radio station SCADA system
	1978 database tags
	Total of 400 I/O points, 30 PID loops, 70 to 80 analog I/O points
	ControlNet network for solvent extraction and electrowinning
Rockwell Automation Products Used	PLC-5/20, PLC-5/40 ControlNet Programmable Controllers
	1771 I/O, including N-Series Analog modules
	SLC 5/03 programmable controllers
	RSView Software
	RSTrend Software
	Reliance DutyMaster motors
	PanelView 550 operator station

From this RSView32 Overview process graphic, users can view any area of the SXEW site.



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Americas Headquarters, 1201 South Second Street, Milwaukee, WI 53204, USA, Tel: (1) 414 382-2000, Fax: (1) 414 382-4444
European Headquarters SA/NV, avenue Herrmann Debroux, 46, 1160 Brussels, Belgium, Tel: (32) 2 663 06 00, Fax: (32) 2 663 06 40
Asia Pacific Headquarters, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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