For Partners and Customers

CyboSoft CyboEye pH Soft-Sensor and MFA pH Control Solution

CyboSoft, General Cybernation Group Inc.

www.cybosoft.com

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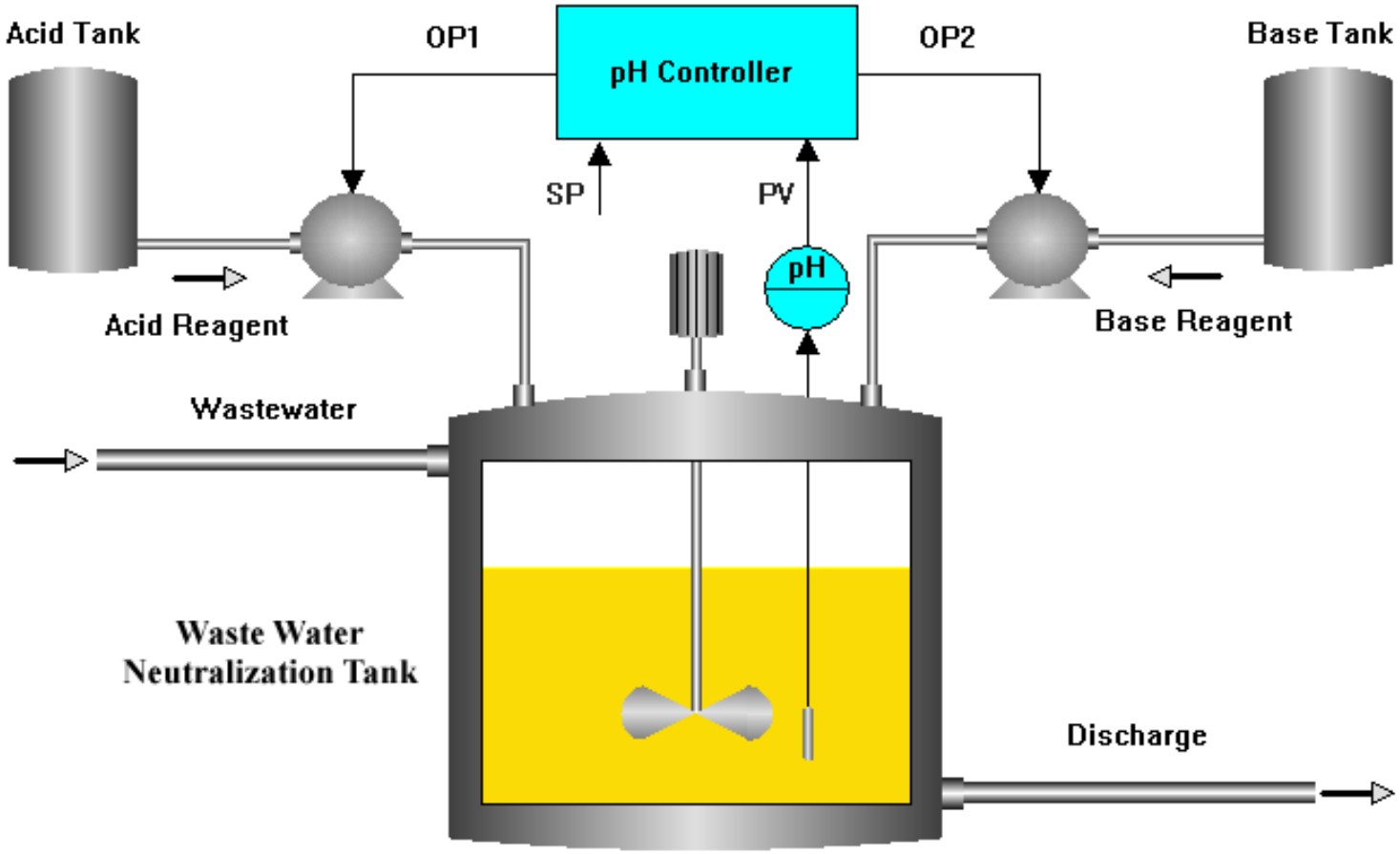
pH Control for Wastewater Neutralization



The pH controller manipulates the acid or base reagent that enters the neutralization tank to be mixed with the wastewater so that the pH value (PV) tracks the setpoint (PV).

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pH Soft-Sensor in CyboEye Software

Problem Statement

- Many industrial pH applications operate under harsh conditions, including corrosive chemicals, high temperatures, and process streams containing solids and fine particulates that can cause sensor fouling, coating, or abrasion.
- In zinc refineries, a leaching process uses acids to dissolve zinc from its ore. Industrial pH sensors are used to monitor and control such processes, but require frequent cleaning and calibration.

Our Solution

- Instead of relying solely on physical sensors, CyboEye uses an AI engine to derive pH values from process information that may be easy to gather or readily available in the plant.
- By using proven MFA pH controllers to control the pH processes, our solution can significantly reduce sensor maintenance work, achieve reliable pH control, and increase product yield.

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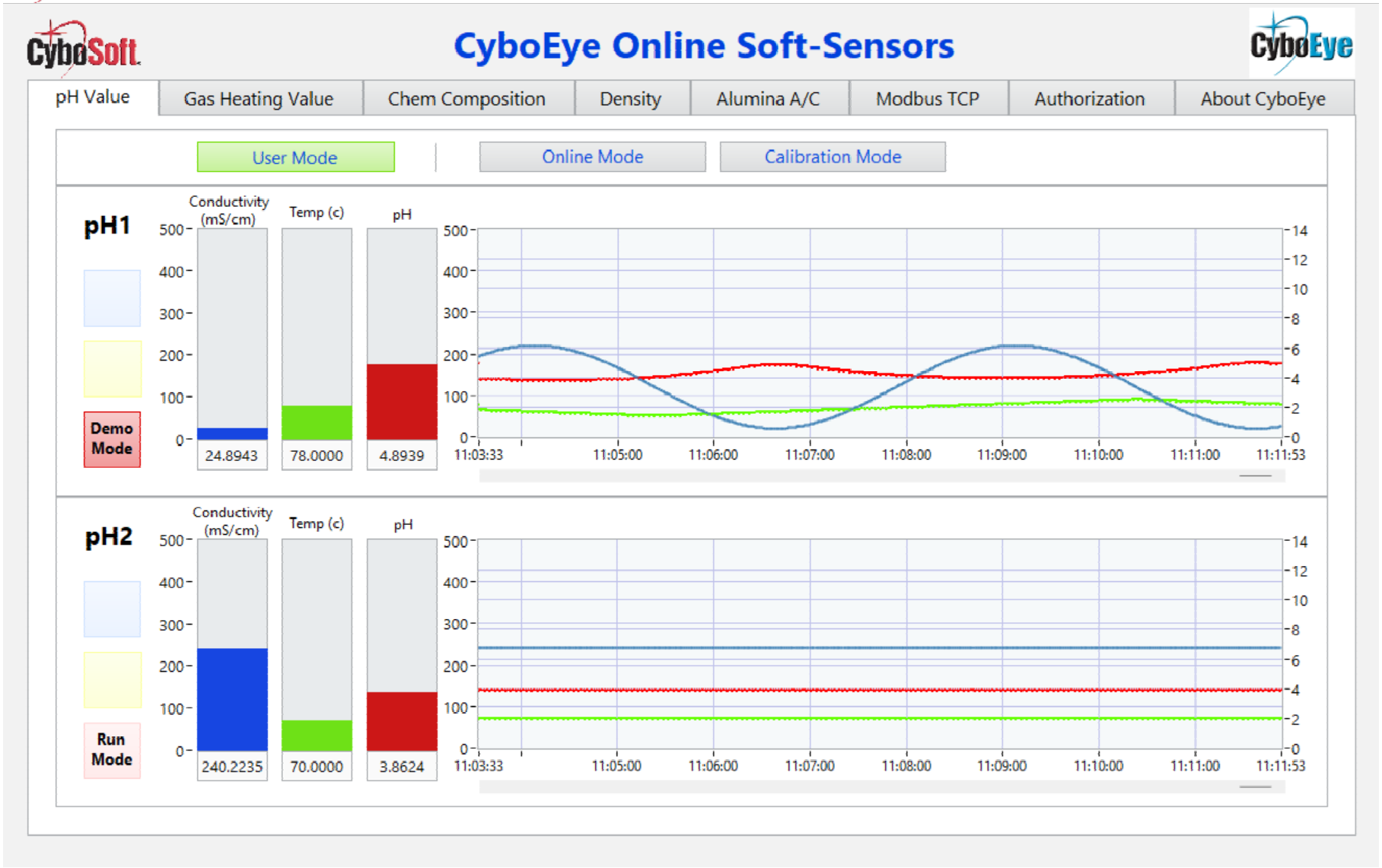
pH Soft-Sensor in CyboEye Software



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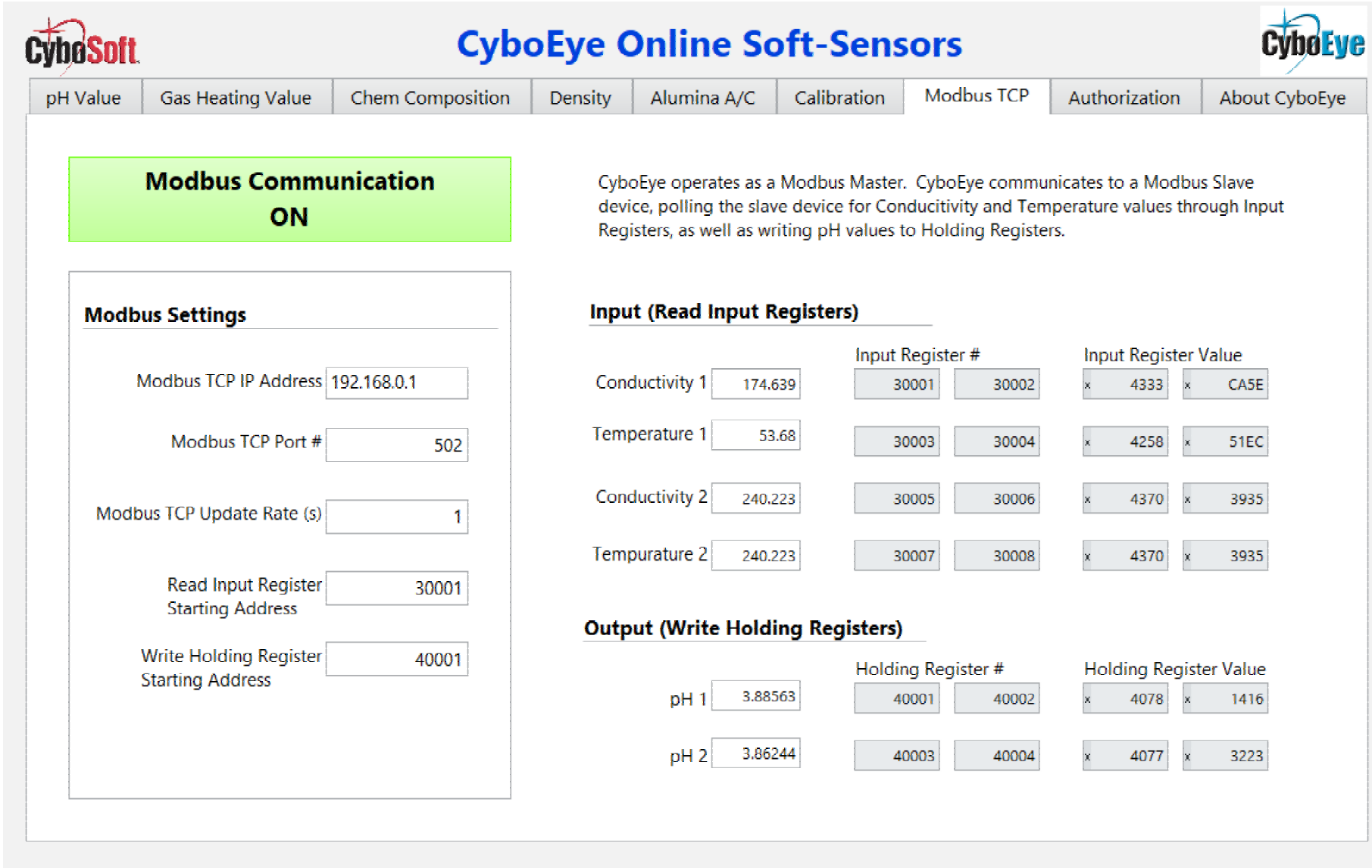
Modbus TCP Interface in CyboEye



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pH Soft-Sensor Application Areas

How It Works

- By replacing a physical pH Sensor with a Conductivity Sensor and using CyboEye Software, the pH measurement is reliable and requires much less maintenance.
- For a zinc leaching process involving sulfuric acid as the primary leaching agent, toroidal conductivity sensors with acid resistant coatings are well suited.
- Since a Conductivity Sensor can continue to operate in harsh environments where a pH sensor may fail, it can provide a more reliable pH measurement solution.

Application Areas

- Pulp black liquor, zinc and copper leaching, sulfuric acid processes, caustic soda processes, acid recovery systems, metal pickling baths, fertilizer production, and other highly corrosive industrial applications.

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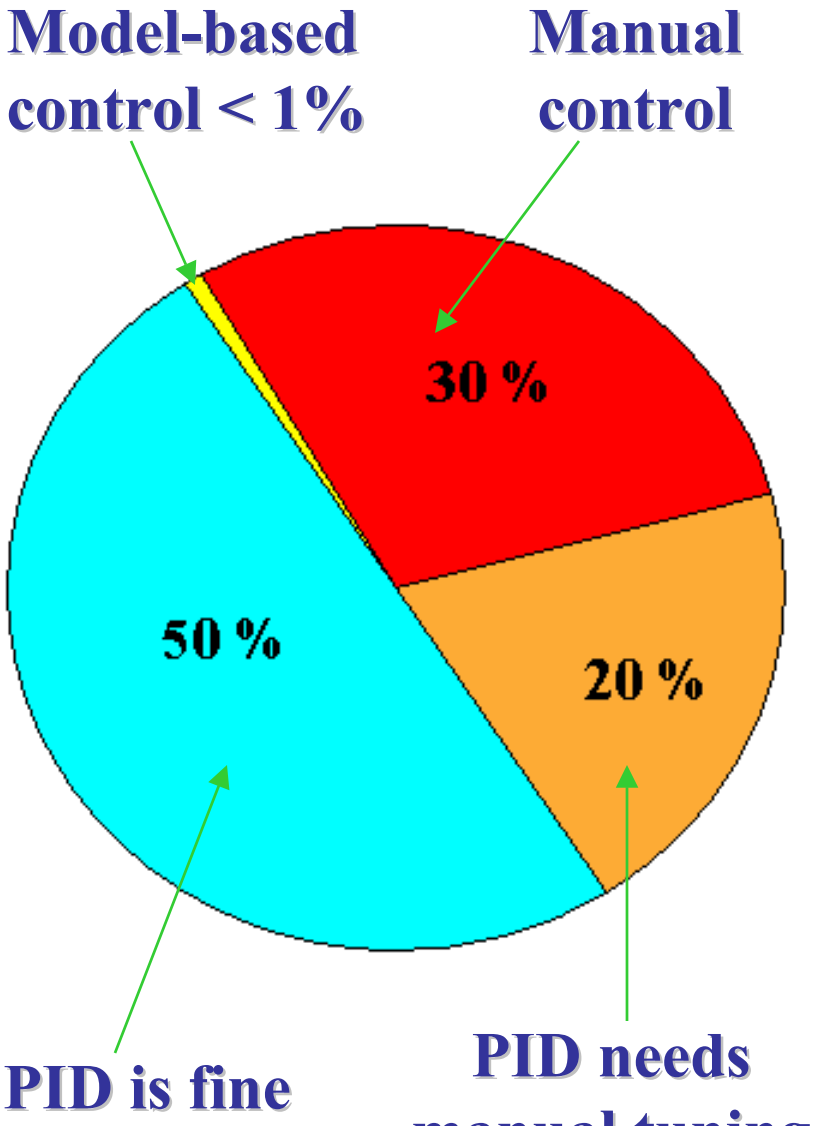
Control Can be a Big Factor



Control Can Play a Key Role in Industry 4.0

- Poor pH control causes major water pollution in rivers, lakes, etc.
- A Smart Factory needs to run by Smart Sensors and Controllers.
- Control difficulties slow down the adoption of renewable energy and advanced medical devices.
- Control relates to safety, quality, yield, and pollution, etc.

What Can We Do in this New Era?

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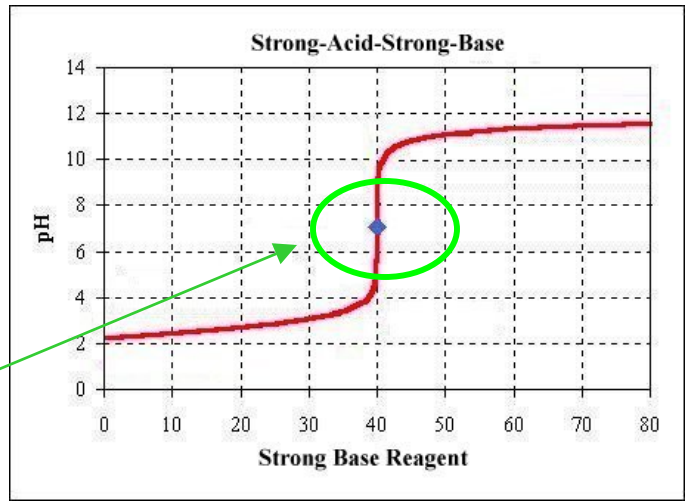
The Challenges of pH Control

pH Process Nonlinear Behavior

- Extremely nonlinear. The pH vs the reagent flow has a logarithmic relationship. Away from neutrality, the process gain is relatively small. Near neutrality, where pH=7, the process gain can be 1000 times higher.



It is impossible for a fixed controller like PID to control this process. On/Off Bang-Bang control is typically used.

The pH Control Puzzle

- The pH process needs to be designed properly with sufficient agitation to mix the chemical reagent with the effluent.
- Each pH control loop requires a pH sensor to measure the pH value online, an actuator to regulate the chemical reagent, and a pH controller that can deal with the "bad pH behavior."

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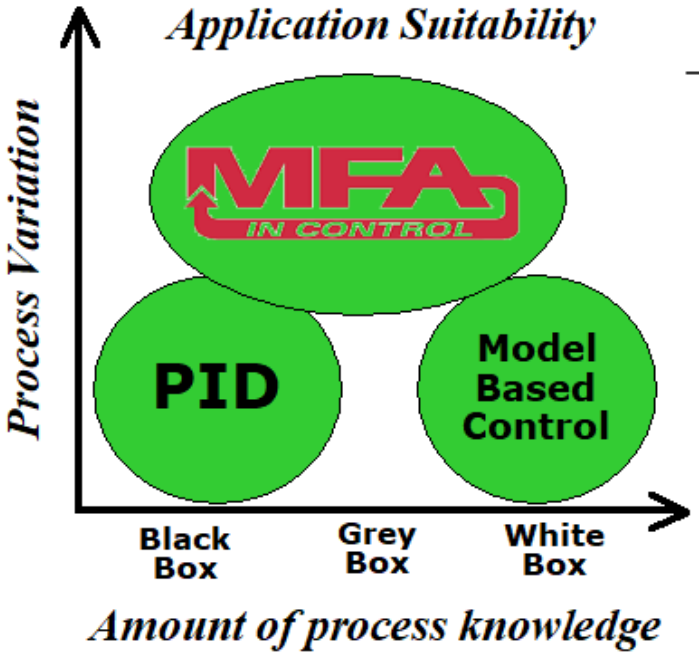
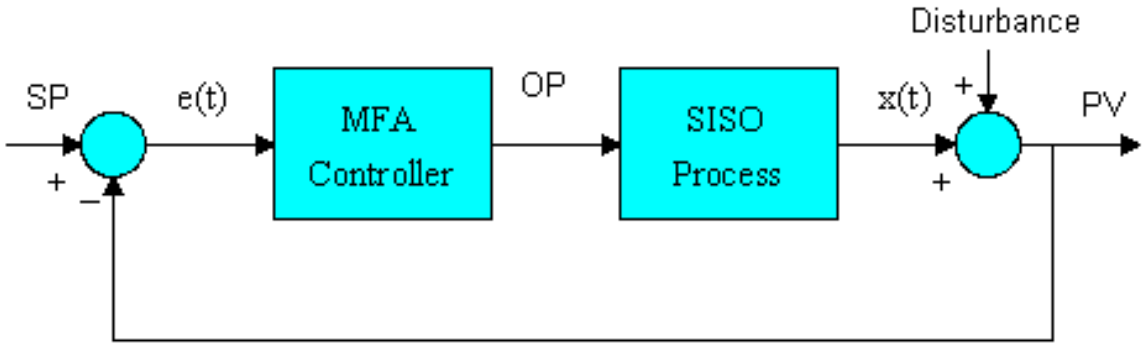
MFA Advantage & Suitability



MFA is suitable for Grey box problems, where the process has load, fuel, and dynamic changes.



Single-loop feedback control system.

MFA controls complex systems

- No process models;
- No identification;
- No controller design;
- No manual tuning.

PID – one algorithm for all, MBC – one algorithm fits one system, MFA – one algorithm solves one control problem.

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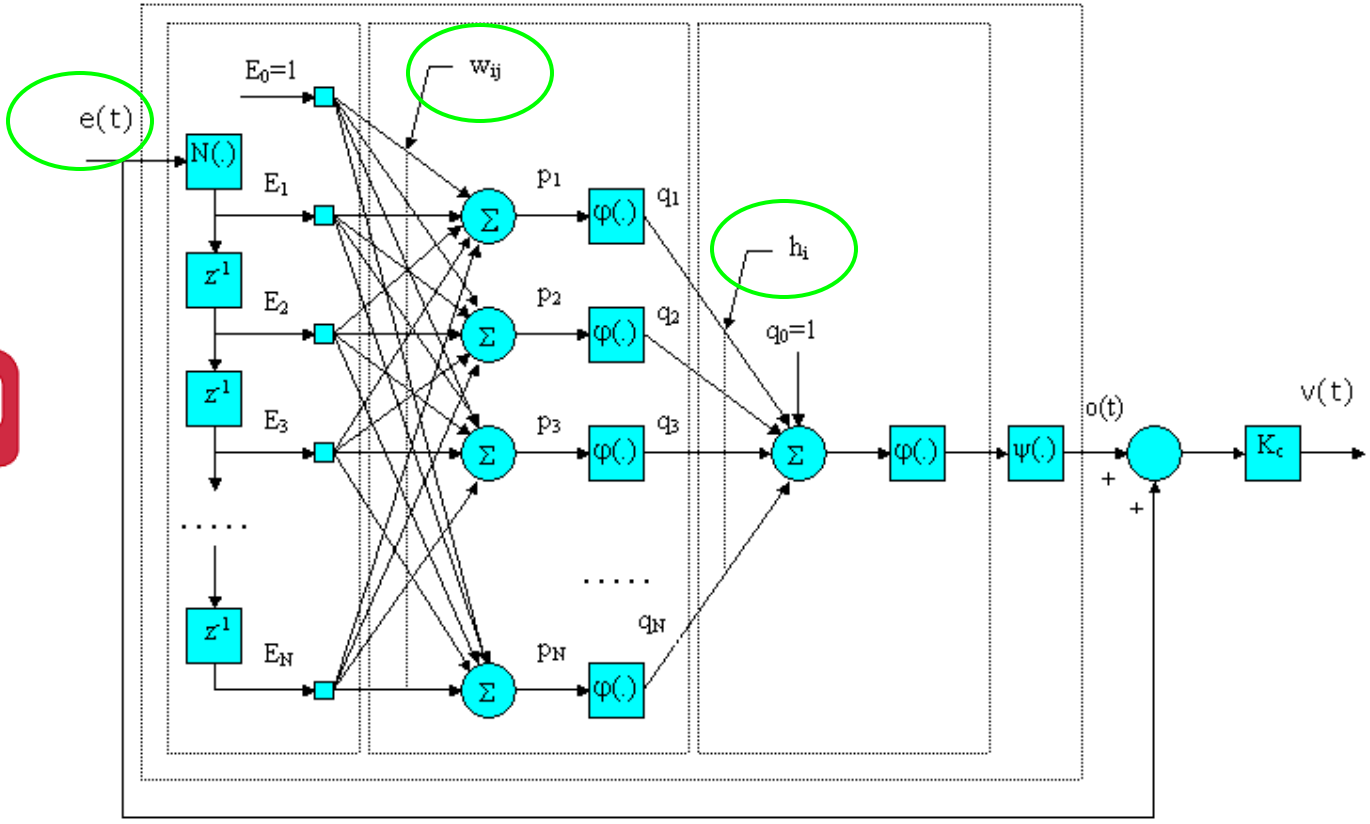
MFA – a Proven AI Technology

- No Model – An artificial neural network is part of the MFA.
- Adaptive - Weights are updated to help minimize control error, e(t).
- Robust - Provides a much wider robust range than PID.
- Speed - Controls immediately, no waiting on model training.



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MFA Controllers Case Examples

Controller	Control Problems Solved	Application
MFA (Turbo)	Adapts, no manual tuning required.	Building Control.
MIMO MFA	Controls multivariable systems.	Distillation column, multi-zone furnaces, etc.
Nonlinear MFA	Controls nonlinear processes.	Various nonlinear processes
MFA pH	Controls pH processes.	Wastewater treatment.
Anti-delay MFA pH	Controls pH processes with large time delays.	Quench water pH control.
Anti-delay MFA	Controls processes with time delays.	Quality variables.
MFA Flare Control Solution	Can deal with nonlinear, varying time delays, and large disturbances.	Combustion Zone Heating Value, Steam System, etc.
MFA XRT	Can deal with exponentially changing nonlinear behavior.	Exothermal reactor temperature.
MFA Optimizer	Search for min or max in close-loop.	Hydrogen Cyanide.

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MFA Control Solution at a Glance

Controller Name	Application
MFA for Industrial Flares	Combustion Zone and Vent Gas Heating Value Control to meet EPA 63.670 rules.
MFA for Alumina Process	Closed-loop control for Blow-off A/C or Alpha-K.
MFA for Tire Making Processes	Rubber extrusion and rubber calendaring processes, Breaker Marker, Ply Maker, Extrusion Lines etc.
MFA for Exothermal Reactors	Control of Reactor Temperature and Pressure.
MFA for Managed Pressure Drilling (MPD)	Control of surface back pressure, flow, standpipe pressure and bypass pressure.
MFA for Wafer Furnace	Can decouple interactions among temp zones with tight setpoint tracking.

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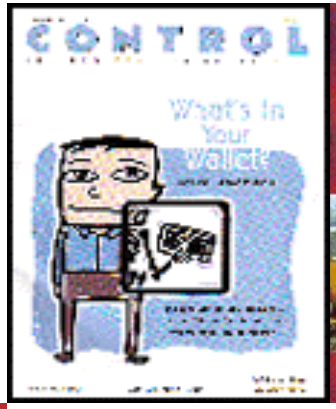
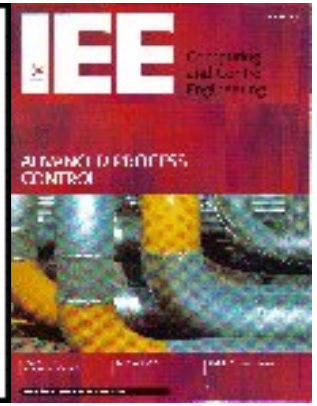
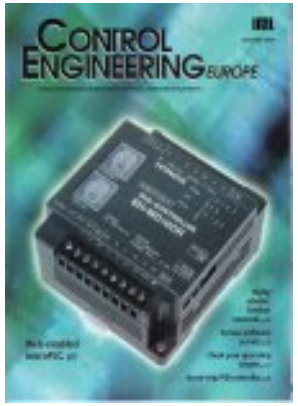
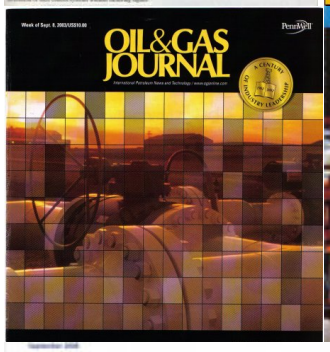
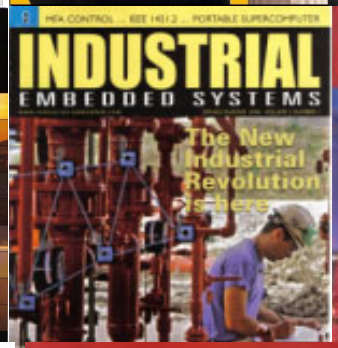
MFA Has Been Widely Deployed

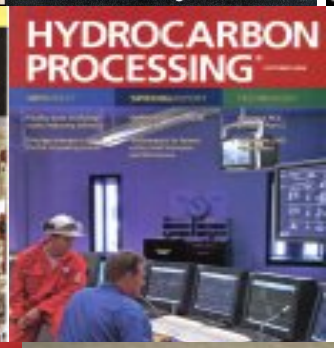


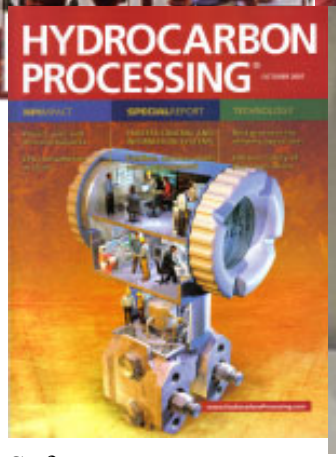


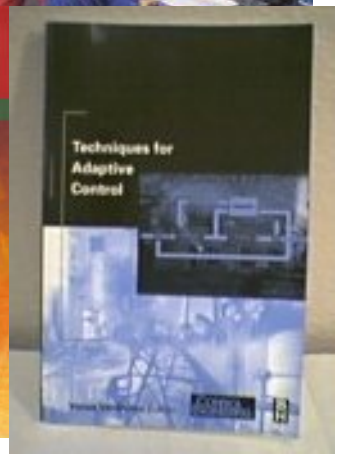


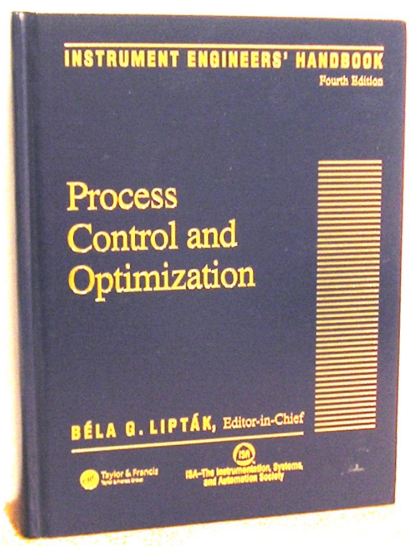


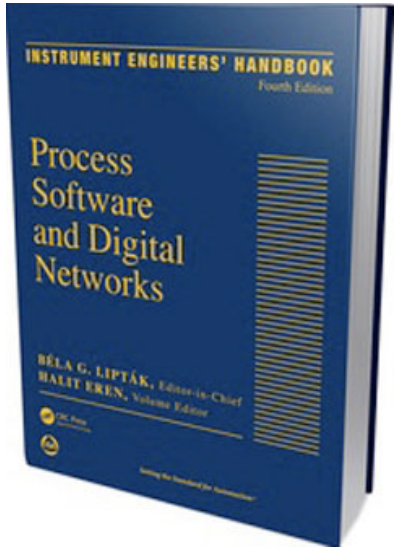












MFA is a proven AI-based control technology with customers all over the world.

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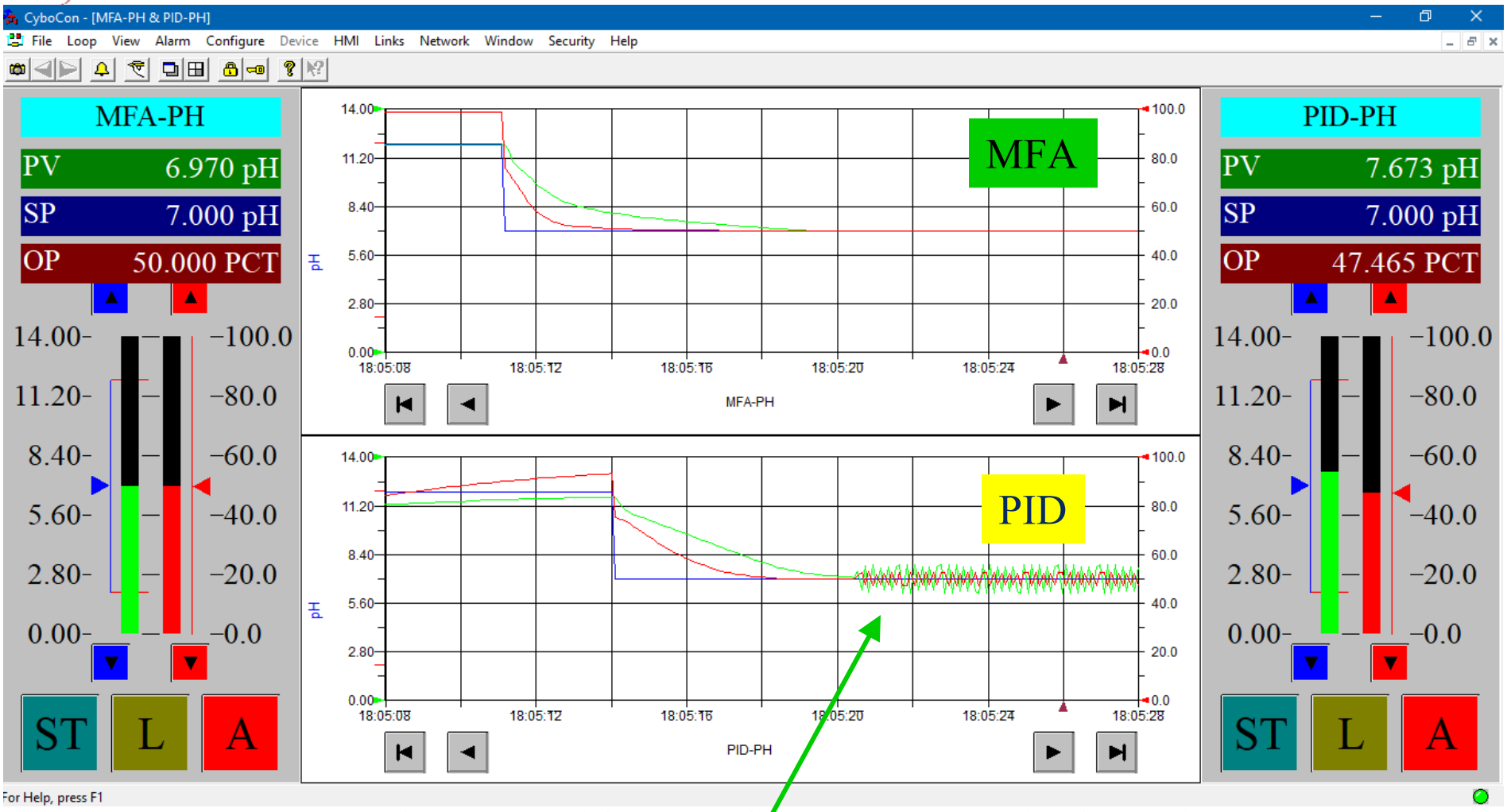
MFA vs PID pH Control Demo



MFA pH can control strong-acid-strong-base pH system in the entire pH range.

PID makes the pH system oscillate near neutrality or sluggish away from neutrality.

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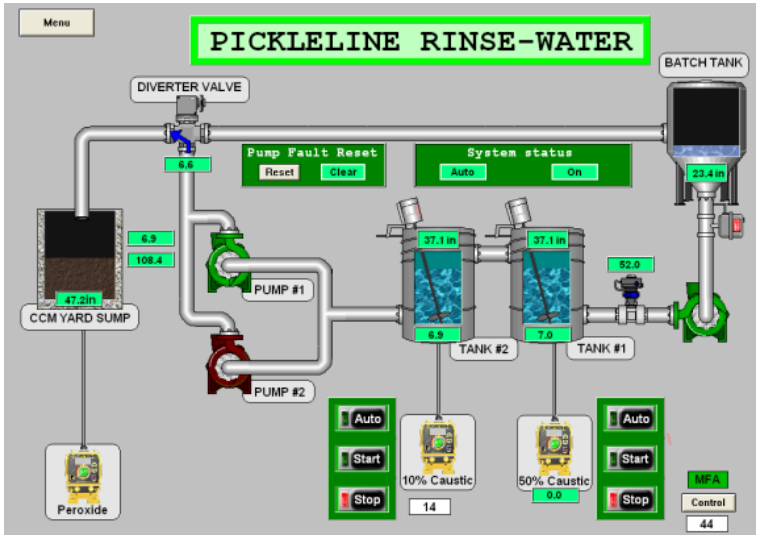
Case 1. MFA Rinse Water pH Control

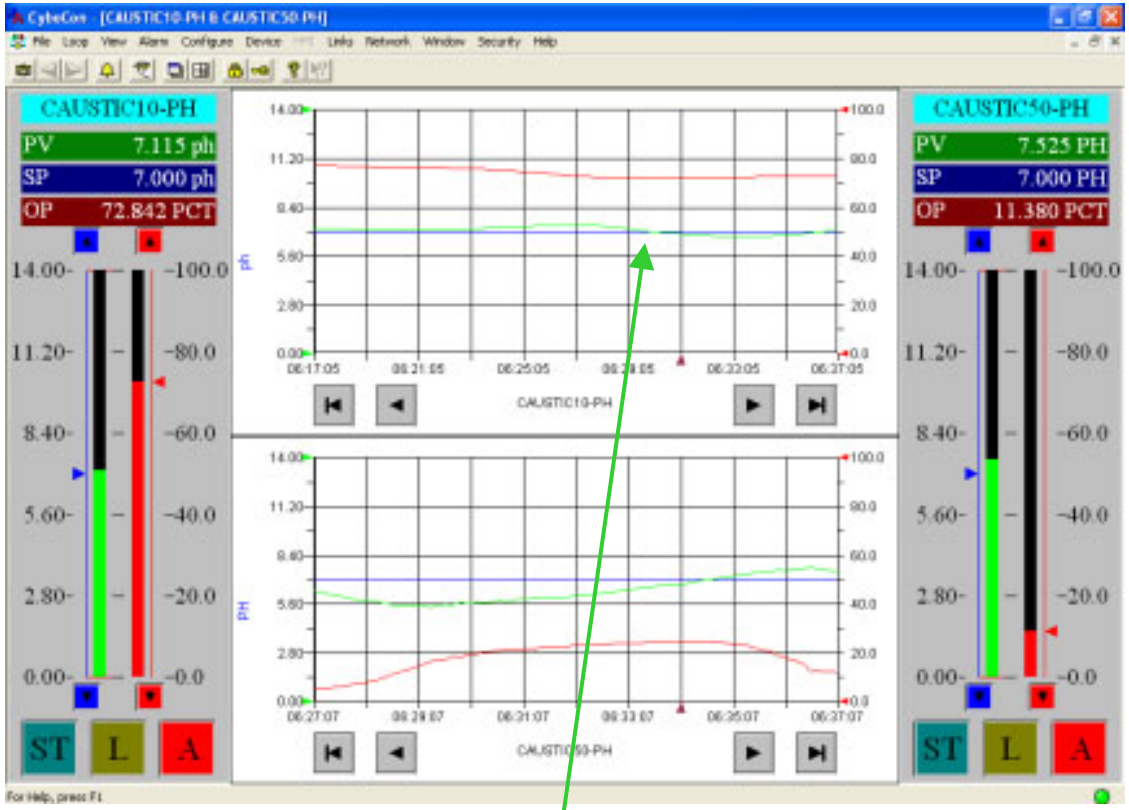
Article in InTech magazine, Sept, 2006



Tightly controls pickle-line rinse water pH using 2 MFA pH controllers for 2-stage pH control.

Handles large flow rate and pH value changes in inflow water.

Sharply reduces chemical reagent consumption.



Matt Ashby: "15 minutes after we launched the MFA, we saw a near straight pH line. Everybody in the control room was impressed. Had we not known the controllers had been changed, we would have suspected the pH probes were broken."

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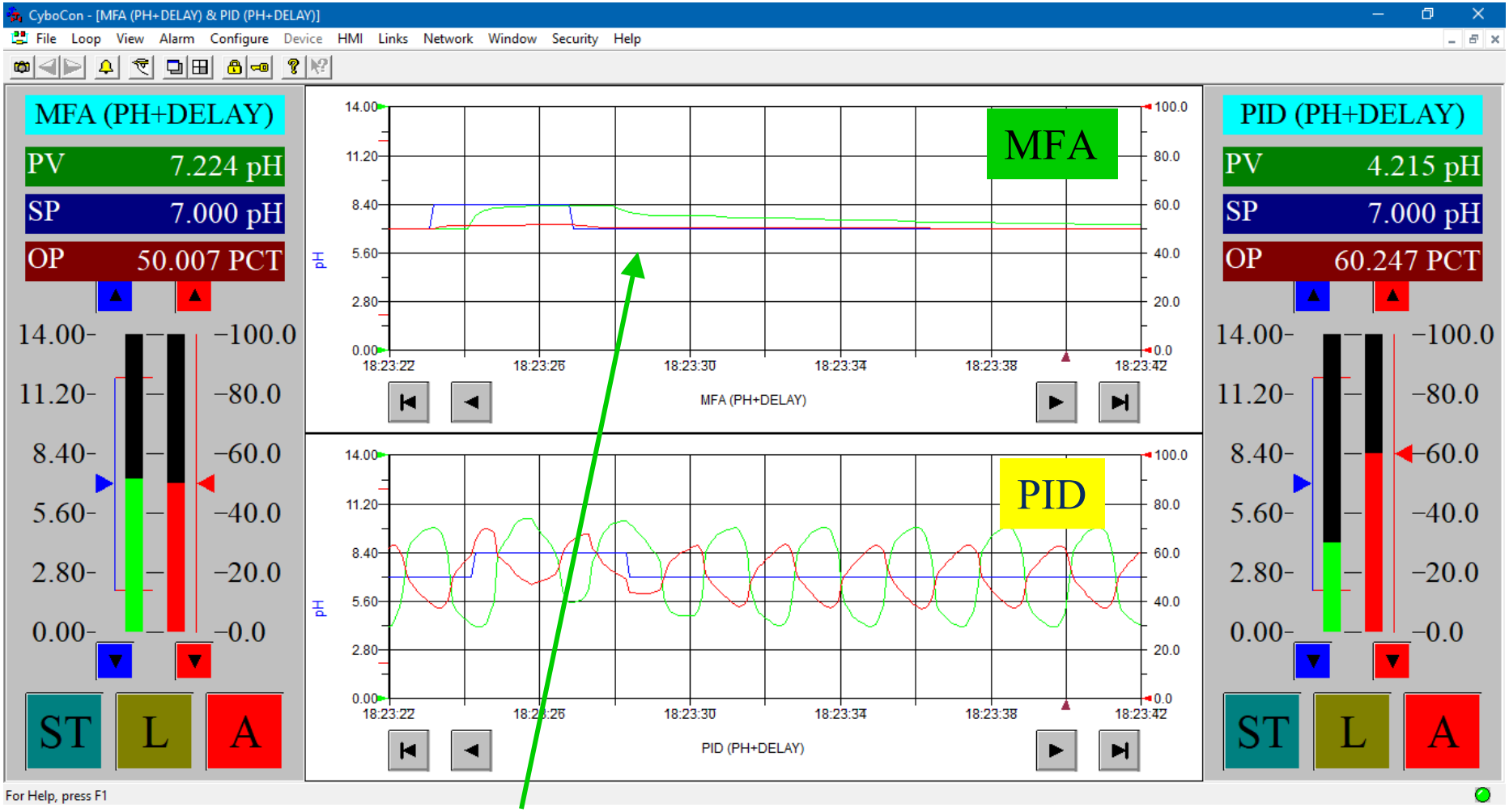
Anti-delay MFA pH vs PID pH Control



The Anti-delay MFA pH controller can control pH processes with large time delays.

PID cannot control this type of pH processes at all.

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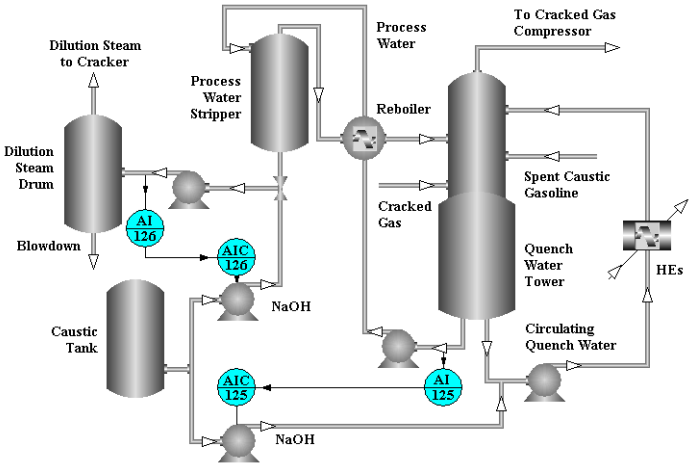
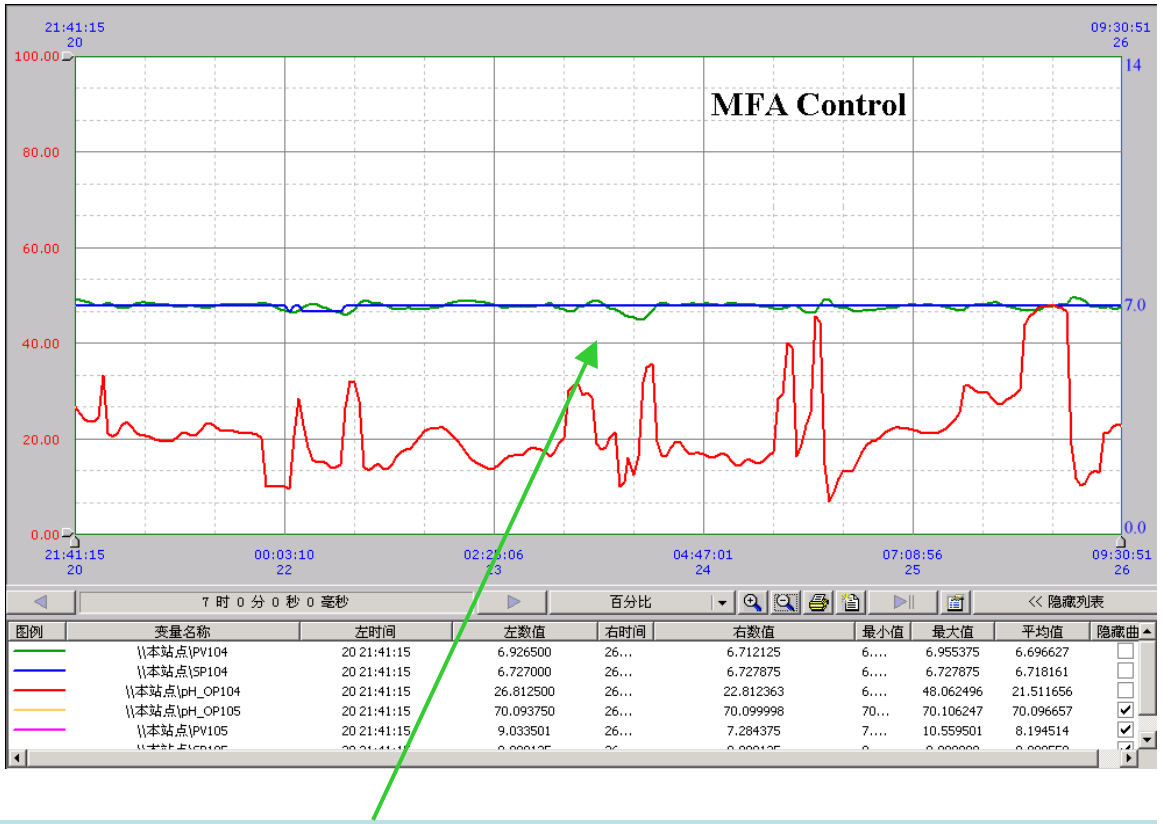
Case 2. MFA Quench Water pH Control

Article in Hydrocarbon Processing, Oct, 2007



Tightly controls ethylene quench water pH by using Anti-delay MFA pH Controller to deal with **nonlinear problems as well as large and varying time delays.**



Sharply reduced chemical reagent consumption, equipment corrosion, and maintenance cost.

pH process has a 30 minute delay. Trend shows 12 hours of data. MFA produced control signals in the range of 7% to 50% to make significant adjustments to the caustic flow in order to keep the pH (green) under control with only 0.28 variation range.

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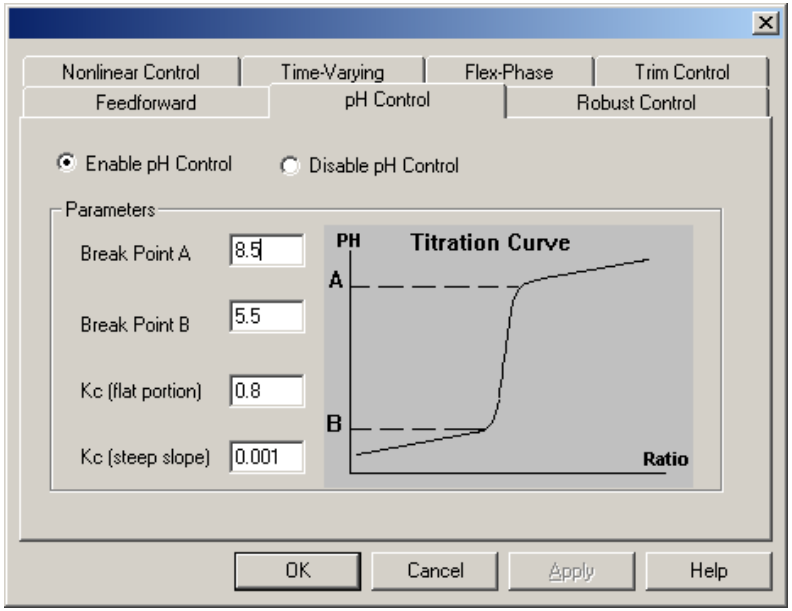
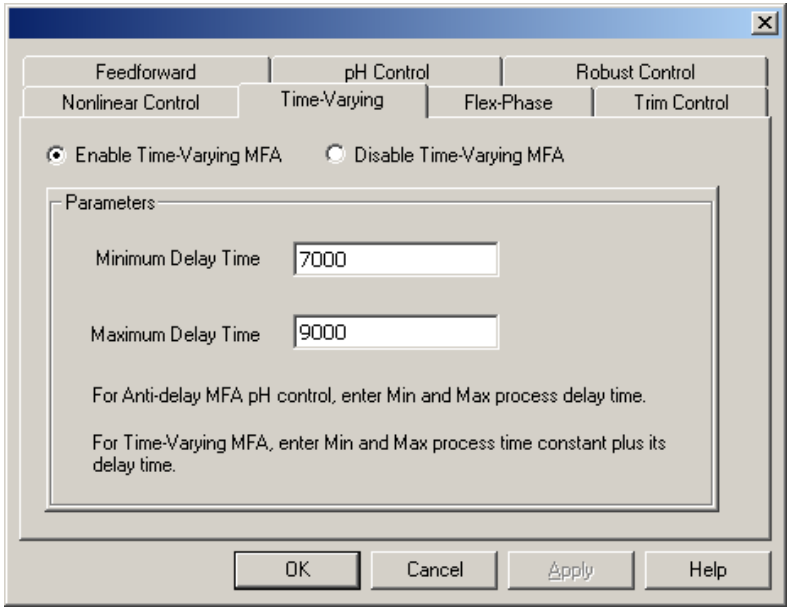
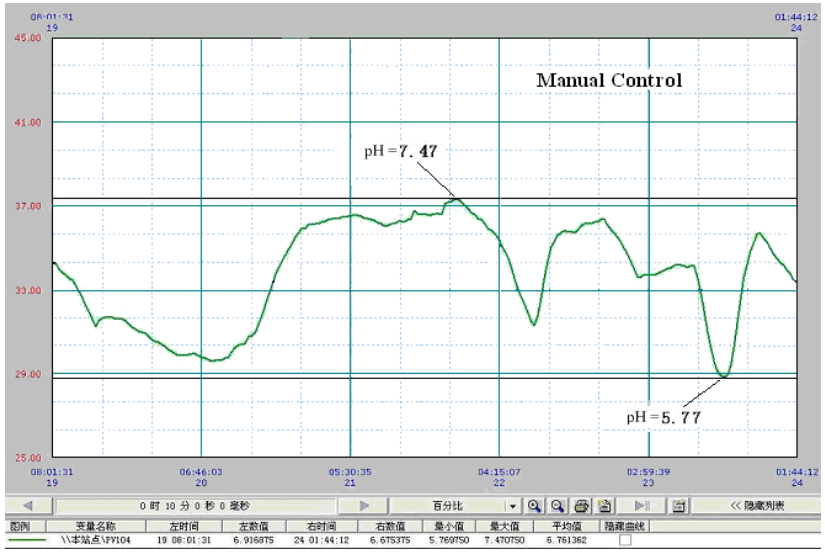
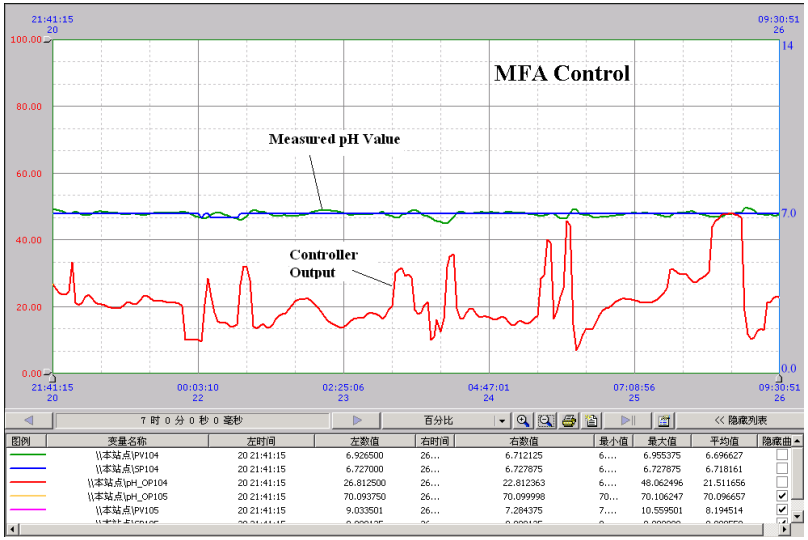
Anti-Delay MFA pH Controller









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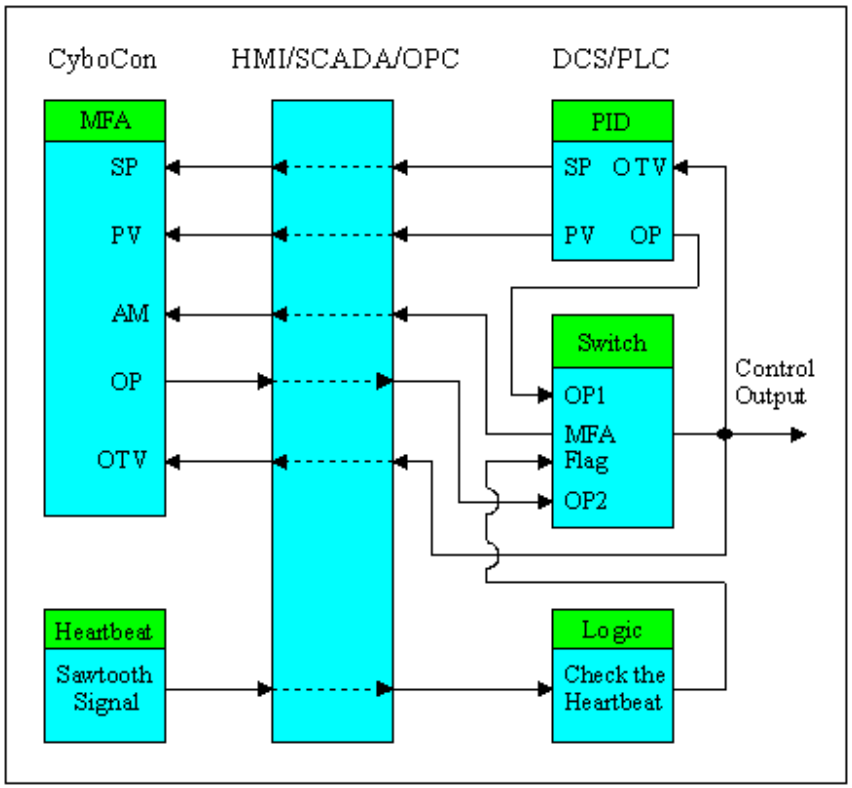
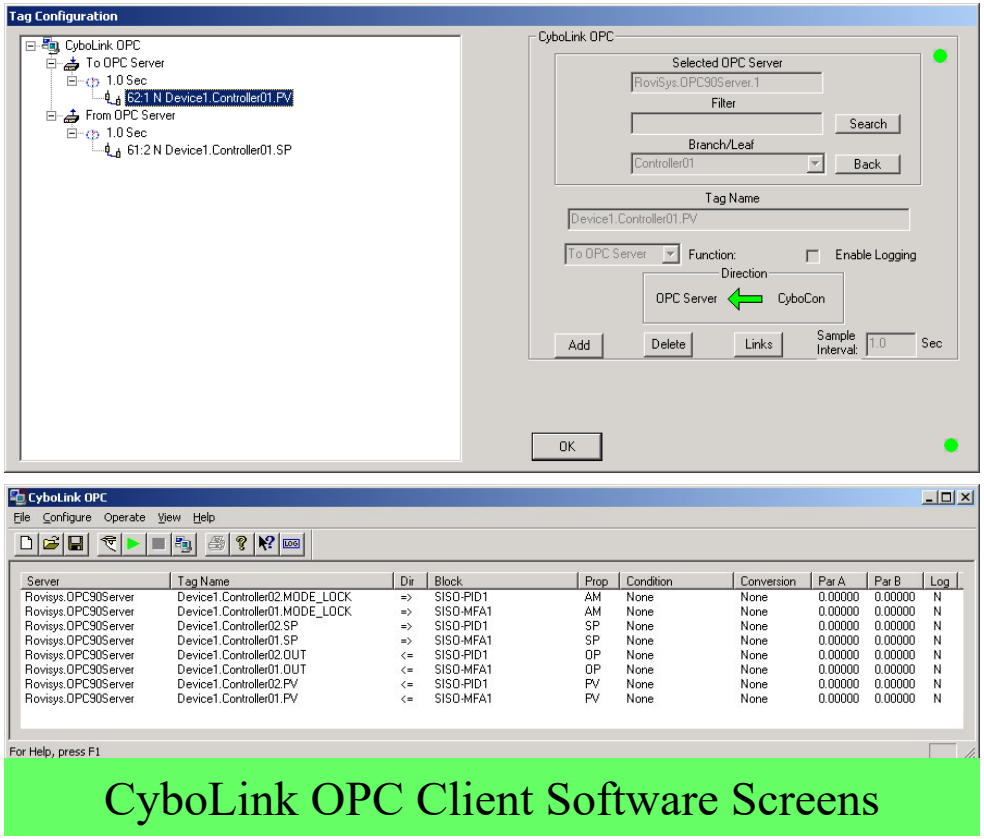
Signal Wiring of CyboCon to DCS





CyboLink OPC Client Software Screens

The Switch block in PLC is to switch between MFA and PID.

An MFA Button is added to the HMI screen so that the operator can easily switch the system between MFA, PID, or manual control.

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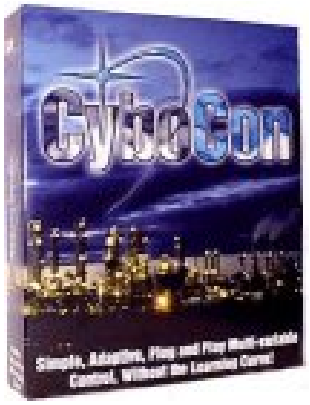
CyboCon in ControlLogix Compute Module

CyboCon MFA Control Software

- CyboCon MFA control software can run in Rockwell ControLogix Compute Module in Windows 10 or 11.
- CyboLink for ControlLogix software allows high-speed communication between CyboCon HS and the PLC through its backplane. Control loop rate is up to 1 millisecond.
- A seamless integration with ControlLogix, it is ideal for high-speed or regular speed mission-critical process and equipment control.



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CyboSoft's CyboCon pH Control System

The Delivered System Includes:

- A 10" Teguar Touch Screen Industrial PC with Windows 11 operating system,
- Industrial Ethernet AI, DI, and AO modules by ICP DAS or Acromag,
- CyboCon Model-Free Adaptive (MFA) Control Software, and
- CyboLink Modbus TCP Interface Software.

Case example: the CyboCon MFA Control Software is configured to include 2 MFA pH controllers to run the 2 pH loops, and the CyboLink Modbus TCP Interface Software is configured to have a 2-way digital communication with the Ethernet I/Os to interface to the pH process.

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CyboSoft Offerings

MFA Control Software and Solutions

- CyboCon MFA Control Software,
- MFA Control Toolset for LabVIEW,
- MFA Control ToolBox for MATLAB,
- CyboNoid Control System Design Software,
- Embedded MFA Control Software.

CyboNoid

AI, Soft-Sensor, Video-Detection

- CyboFlare Smoke Auto-Detection Software.
- CyboEye Soft-Sensor for pH, A/C ratio, etc.
- pH Modeling and Simulation Software.

CyboEye

Training, Consulting & On-Site Commissioning

- Training and consulting for building advanced control systems. Design, parts selection, on-site commissioning, and services.

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Proven Approach and Business Model

CyboSoft's Technical Approaches

- pH processes can all be different, but our solution is more generalized for easier implementation and maintenance.
- Standard platform: DCS, OPC, Modbus, CyboCon MFA software.
- Specially designed MFA pH controllers with simple parameters.
- Easy to install, commission, and maintain.

Why Use MFA pH Control

- Model-Free Adaptive (MFA) control is a proven control technology that has been deployed widely since 1997.
- MFA pH control system is delivered in standard platforms.
- Compliance with discharge codes in all operating conditions.
- Substantial amount of chemical reagent savings.
- Getting the job done quickly once and for all.
- Annual or perpetual software license options for quick ROI.

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About CyboSoft

- Founded in 1994 with headquarters in California, CyboSoft is the leader in control technology serving the worldwide process control, building control, and equipment control markets.

Rancho Cordova, CA

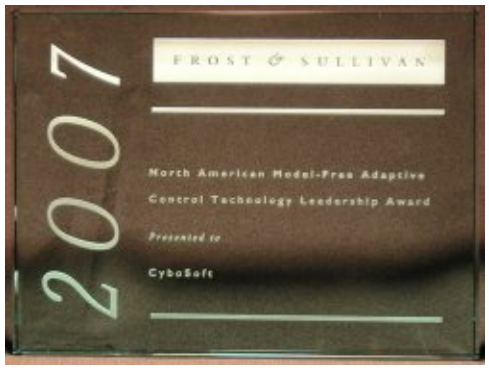
- CyboSoft's Model-Free Adaptive (MFA) control technology can play a major role in the 4th Industrial Revolution and AI Era.

- CyboSoft is advancing rapidly to become an IP and platform builder in Physical AI Revolution.

CYBO
The trusted brand in the AI era

MFA
IN CONTROL

CyboNoid



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