Amalgamated Research LLC

From sugar to fuel production, more efficient industrial separation process control

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THAT'S ONE SWEET BEET

A lot of people probably think the world's sugar supply comes from the common sugarcane crop. But in reality, the sugar on a typical grocery shelf comes from a variety of sources. And one of those sources is sugar beets.

Today over 20% of the world's sugar supply comes from running sugar beets through industrial separation processes, diffusing the sugar in the beet into a liquid form, and leaving the cellulose and pulp of the plant behind for other uses, like animal feed.

Industrial separation processes like these take apart various organic and inorganic mixtures, separating usable product from impurities. From sugar production to fuel production, industrial separation processes are used in a wide variety of applications.

Like many other technologies, these processes have become increasingly efficient over time. For example, fractal and chromatography technologies are passive separation systems that require very little energy to blend or separate components.

And one of the companies at the forefront of developing these new and more efficient separation process technologies is Amalgamated Research LLC (ARi) in Twin Falls, Idaho.

SCALING UP INDUSTRIAL SEPARATION PROCESSES

In the 1970s, ARi was the research and development department of Amalgamated Sugar. Today Amalgamated Sugar is more than 75 years old, and CEO John McCreedy believes the company is on a solid trajectory to become the lowest-cost sugar producer in the world.

ARi continues to improve sugar extraction while developing efficient processes for other industries all over the world.

Biomass simulated moving bed (SMB), during construction

As the company's R&D department, ARi began with a mission focused on developing processes to efficiently extract sugar from sugar beets. But over time, their continuous research and process development in the industrial separation field has moved them far beyond just sugar.

A leader in the industry for providing efficient industrial separation and mixing technologies, ARi has continued to improve sugar extraction. And in addition, the company has developed efficient processes for other industries all over the world.

ARi focuses on developing turnkey solutions utilizing chromatography separation principles. ARi installed its first industrial-scale simulated moving bed (SMB) chromatography system in 1981 for high-fructose corn syrup (HFCS) production in the starch/corn syrup industry. Since that time, ARi has installed SMB systems worldwide in numerous applications.

Simulated moving bed (SMB) for molasses (sugar recovery)

The walls of ARi house a lot of brainpower. And that brainpower is focused on developing process systems for everything, from removing metals from mining waste to separating petroleum components for China's energy industry.

ARi uses a patented fractal fluid control method to maximize process media and equipment use and performance. The resulting fluid control provides remarkable plug flow characteristics, such as nearly identical +/- 2% distribution variance, and the capability to provide flow densities of greater than 100 points per square foot.

As a result, engineers can intensify the process, often resulting in a 10:1 reduction in equipment size. Fractal mixers consume very little energy, minimize contact time, and maximize reaction homogeneity.

Biomass SMB for recovery of basic sugars from cellulose waste

ARi has developed many industrial installations related to ion exchange processes. The company's unique, patented fractal fluid distribution provides significant cost and operational advantages over conventional ion exchange systems.

As an example, installations throughout the world use their patented and compact Fractal Shallow Bed ion exchange softening technology.

ARi also has extensive experience in specifying and providing membrane separation solutions. For instance, nanofiltration is utilized in syrup decolorization applications to recover regenerant chemicals. This process reduces chemical consumption and waste generation by up to 80%.

Cost-effective filtration and separation systems and equipment from ARi also simplify processes and reduce capital costs for producers of fuels and chemicals, by utilizing renewable feedstocks.

ARi develops separation processes in-house and then either builds a separation system for their customer or, for larger installations, contracts the work out to a partner company. The company also offers extensive pilot facilities for evaluating specific biomass processes.

"In research, we're always changing things in the process. We need a control system with a lot of flexibility."

- Bill Jacob, Group Leader, ARi

AUTOMATING PROCESS CONTROL

To provide control and monitoring capabilities for the industrial separation systems they build, ARi turned to Opto 22.

ARi has shipped five industrial separation systems powered by Opto 22 automation and control equipment. They also appreciate the reliability and flexibility of Opto 22 equipment for pilot systems.

Each separation system varies in design based on the application. A variety of hardware—including valves,

Pilot-scale SMB

pumps, flow meters, refractometers, density meters, and pressure and temperature measurement equipment—must be continuously monitored and controlled during the separation process.

While the hardware used in the separation process varies from system to system, all ARi systems have one core similarity: at the heart of each system is the SNAP PAC control system from Opto 22.

Typical ARi systems consist of a standalone SNAP-PAC-S1 controller with numerous SNAP-PAC-EB1 and -EB2 I/O brains, several racks of I/O, and up to 250 assorted analog and digital I/O points.

One of the competitive advantages ARi offers their customers is the smallest separation system possible, so saving space in the design of the separation system wherever possible is key.

To help reduce the size of the control and I/O system, ARi chose SNAP-AIMA-32 analog input modules and SNAP-ODC-32-SRC high-density digital output modules, both of which offer 32 channels in a small form factor.

The SNAP-AIMA-32 provides 32 channels of -20 mA to +20 mA analog current input. Although the 32 channels are not isolated from each other, the module is transformer isolated and optically isolated from other modules and devices. The SNAP-ODC-32-SRC provides 32 digital output channels of 5-60 VDC (load sourcing).

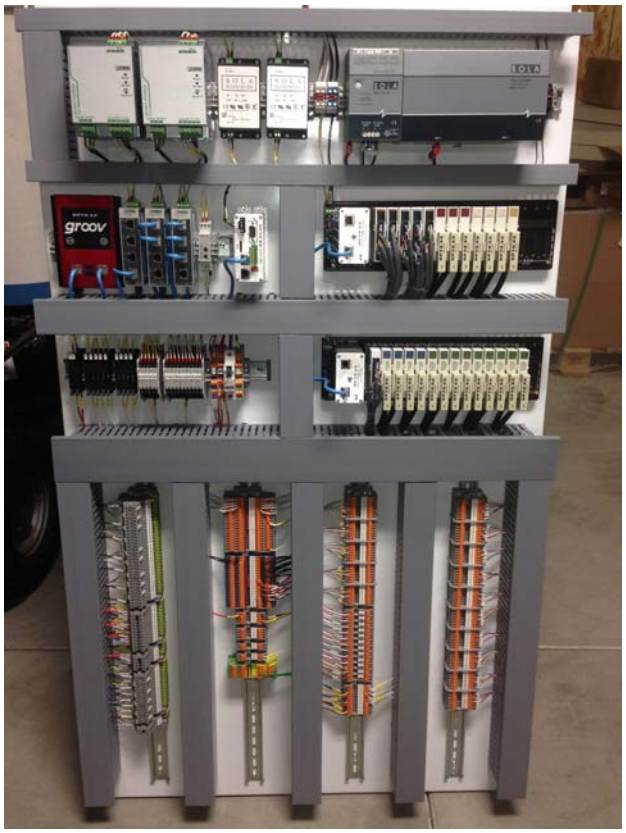
These modules are ideal for OEMs and others whose applications involve high point counts and less available space. The high-density configuration also reduces the per-point cost of I/O.

"In research, we're always changing things in the process," says Bill Jacob, Group Leader at ARi. "We need a control system with a lot of flexibility.

"Developing and fine tuning our processes takes experimentation. We may need to move a valve or a flow meter to a different area of the machine or change its place and control setting in the process. The distributed I/O architecture of the SNAP PAC System lets us quickly install or remove a module where we need to, wire it up, and get back to developing our process."

As a chemist, Jacob had virtually no prior experience developing control programs. However, he quickly picked up the ins and outs of the PAC Control programming

SMB chromatography system for fructose purification



Opto 22 PACs and I/O provide control and monitoring capabilities for ARi systems. Opto 22's *groov* provides remote monitoring and control, a common customer request.

software used to develop control programs for the SNAP PAC System.

Some ARi processes are very complex and include up to 8000 numeric variables to complete the process. To handle complex math functions, Jacob turned to the script programming capabilities of PAC Control.

Part of the PAC Project Software Suite, PAC Control is a flowchart-based tool used for programming industrial automation, process control, building automation, remote monitoring, data acquisition, and Industrial Internet of Things (IIoT) applications. Using PAC Control, anyone can create and debug control programs and then download and run them on a SNAP PAC industrial controller.

Today Jacob manages all programming, integration, and instrumentation for developing separation process systems.

The SNAP-PAC-S2 programmable automation controller (PAC) can store hundreds of control flowcharts in its non-volatile memory, allowing Jacob to develop and load up to 60 different control flowcharts on a single hardware controller. This way operators can easily switch between control programs for a given process or test without having to flash the controller with a new control flowchart.

LOOKING AHEAD

Recently ARi decided to add remote monitoring and control capabilities to their separation systems.

"Remote monitoring and control has become a pretty common request from our customer base," says Jacob.

ARi didn't have to look far to provide the functionality their customers want. Opto 22's *groov* mobile operator interface product works with the SNAP PAC System to securely bring operators data and control wherever required.

"We added *groov* from Opto 22 to one of our installations. That single *groov* Box currently allows remote monitoring and control capabilities for seven different systems, all from a single interface," says Jacob.

"Operators can use their desktop PC, mobile phone, or tablet to keep an eye on process status. With *groov,* operators can start, stop, monitor, and adjust processes from anywhere they have cellular or network connectivity.

"In the future we expect most systems will be shipped with a *groov* system installed to meet customer demand."

ABOUT AMALGAMATED RESEARCH LLC

ARI is a wholly owned subsidiary of Amalgamated Sugar LLC. ARi operates as an independent company while being backed by one of the largest and most experienced sugar processors in the United States, Amalgamated Sugar. The company is headquartered in Twin Falls, Idaho.

ABOUT OPTO 22

Opto 22 was started in 1974 by a co-inventor of the solid-state relay (SSR), who discovered a way to make SSRs more reliable.

Opto 22 has consistently built products on open standards rather than on proprietary technologies. The company developed the red-white-yellow-black color-coding

system for input/output (I/O) modules and the open Optomux® protocol, and pioneered Ethernet-based I/O.

In early 2013 Opto 22 introduced *groov*, an easy-to-use IoT tool for developing and viewing mobile operator interfaces—mobile apps to securely monitor and control virtually any automation system or equipment.

In addition to SSRs and *groov,* Opto 22 is best known for its high-quality I/O and SNAP PAC programmable automation controllers, which include a RESTful API.

All Opto 22 products are manufactured and supported in the U.S.A.

Because the company builds and tests its own products, most solid-state SSRs and I/O modules are guaranteed for life.

The company is especially trusted for its continuing policy of providing free product support, free training, and free pre-sales engineering assistance.

For **more** information, visit opto22.com and groov.com or contact **Opto 22 Pre-Sales Engineering**:

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