

Newsfront

MOVING TO MODULAR

Larger and more complex processes are now being offered in this unique building approach

If the word “modular” brings to mind a trailer office parked on site, it’s time to revisit modular systems. Today’s modular system go well beyond office space and tool sheds, and can contain almost anything from a skid-mounted filtration system to a cleanroom laboratory to a petroleum refinery, which is built elsewhere and delivered as a complete unit to a site, where it is then erected.

And, large modular process systems, especially, are impressive feats of engineering. For example, according to Brian Loftus, contracts manager at Koch Modular Process Systems (Paramus, N.J.; www.modularprocess.com), which designs, plans and builds large-scale modular mass-transfer systems, a typical modular process system of this type includes all of the process equipment, such as columns, reactors, heat exchangers and pumps, mounted within a structural steel frame. After the process equipment is installed within its frame in the shop, the piping components, field instrumentation and electrical wiring are completed. Items like tracing, thermal insulation, lighting, control systems, safety showers and fire protection systems may also be installed at the shop. Finally, all these components are tested and then the module is shipped and erected on site (Figure 1).

While this type of modular process unit may contain different equipment and serve a different purpose from modular refineries, water systems or smaller-scale process systems, all modular process

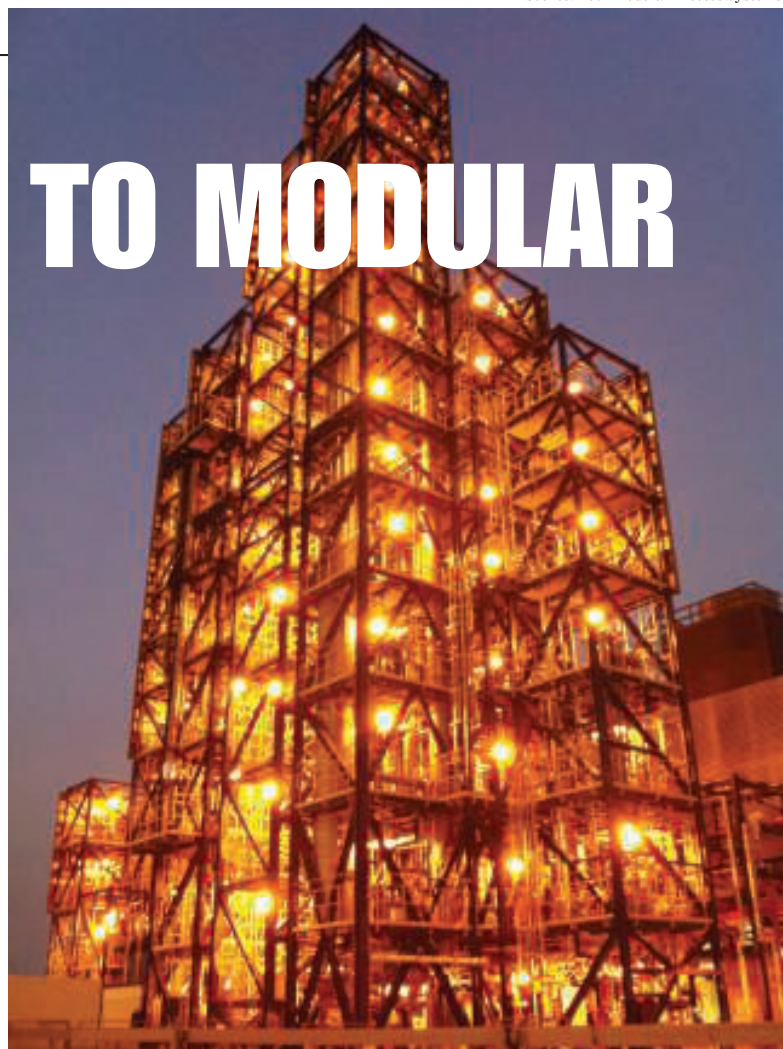


FIGURE 1. This modular system comprising three reactions steps and nine distillation steps — a complete chemical production process — was designed and constructed off-site in a controlled environment as modules

systems have one thing in common: They are pre-fabricated to the maximum extent possible in a fabrication shop that is remote from the user’s plant site. Because modular systems are typically built indoors in a controlled, assembly-line fashion, many advantages can be realized, says Loftus.

Modular benefits

“Because modular process systems are built using industrial manufacturing techniques under stringent quality controls and in a controlled environment by skilled technicians, there are plenty of advantages for the customer,” says Brad Spindler, industrial water business unit manager with Wunderlich-Malec (Minnetonka, Minn.; www.wmeng.com), which constructs electrical enclo-

tures for power distribution and control systems used in power and process plants, and modular industrial-water-process skids and systems (Figure 2) that supply makeup and process water, or clean and recycle a facility’s wastewater. “The modular approach to building at our site versus the customer’s site eliminates the inefficiencies of onsite construction, including site restraints, labor stacking and weather delays.”

Also, because construction takes place in the fabricator’s shop, building can begin before site permits are obtained, which leads to a drastically reduced construction timeline. All of these factors come together to reduce the schedule for delivery of the completed project, which arrives at the user’s site ready to be erected on a pre-laid foundation.

“Because we have a well established system of suppliers, and the process of parallel tasking and detailing allows for a very high level of efficiency during design and construction, the modular project is quite short,” explains Loftus.

He says a typical schedule, depending upon materials, level of complexity, customer specifications and number of modules being made, ranges from 9 to 12 months when starting at the process-design stage.

The time to erect modular facilities is usually reduced as well. “After the modules arrive in the field, a single module might be erected within a month, with the average multi-module system taking two to three months. Once the modules are erected, the customer would be ready to commission a water startup, followed by chemical introduction,” says Loftus.

Ken Reynaud, senior vice president with Plant Process Equipment, a subsidiary of Plant Process Group (League City, Tex.; www.plant-process.com/refining), agrees. “Our modular refineries arrive at the site like an erector set. The foundation is already poured, the trucks roll up, a crane lifts the modules off the truck, and everything is efficiently set up and ready to go. The time it takes to erect a modular refinery is dramatically less than to stick-build the same size facility.”

In addition to shortened schedules, fabricators say the quality of modular systems is often higher than conventionally built systems. “Because we are building in a controlled environment we have workers at designated stations, and those

workers are highly skilled welders, fitters [and so on],” says Reynaud. “If you work onsite, you don’t know the skill level of the workers. If the welders aren’t capable, the welds fail, and so on. But building under controlled circumstances affords the ability to control the quality of the workers and, therefore, the quality of the work.”

Spindler adds that factory fabrication also allows the use of stringent quality systems and factory testing to ensure that finished systems conform to technical requirements. “Eighty percent of the commissioning and startup is already complete on a system before it’s even shipped to the site,” he says.

Finally, there are also cost efficiencies. “Because our design is very precise and we are working within the known space of a well-defined structural frame, and because we detail every isometric, we have a fully detailed bill of materials, upon which our assembly shop can rely,” explains Loftus. “So, when they place the order for materials, our shop doesn’t order excess, which assists with cost efficiency. In traditional stick-build, extra materials are always ordered for contingency planning, which drives up costs.”

“Our clients make money by making a product, not by having us building a plant in the middle of their floor,” says Bruce Blanchard,

national sales manager with GEA Filtration (Columbia, Md.; www.geafiltration.com), which provides modular filtration skids. “Not only is modular faster because of the controlled environment, but it’s less expensive because we aren’t disrupting produc-

tion or creating downtime, which results in lost production dollars,” he emphasizes.

More and more modular

Because of the associated benefits, more operations and processes are being offered in modular form to meet a myriad of process needs. Here’s a summary of some of the modular systems currently available to processors.

Process systems. A diverse variety of process systems can be provided in modules from filtration skids to water purification to mass-transfer systems.

Membrane filtration. Crossflow filtration, microfiltration, nanofiltration, ultrafiltration and reverse-osmosis plants can all be placed on modular skids by GEA Filtration. And, there has been an increased need for these molecular-level separation plants due to a lot of activity in the nutritional market, says Blanchard. “The basic technology allows for converting a mixed nutritional stream into a very specific nutritional stream,” he says. “For example, if you take a nutritional product that has fats, proteins and carbohydrates, it can be segmented so it has more proteins and less carbohydrates, which falls into creating healthier nutritional products by manipulating food chemistry.”

What is the reason for doing this modularly? “The standardized approach to a modular format of these filtration plants results in a more compact plant that takes up less floor



Source: GEA Filtration

FIGURE 3. Crossflow filtration, microfiltration, nanofiltration, ultrafiltration and reverse osmosis plants can all be placed on modular skids



Source: Wunderlich-Malec

FIGURE 2. These complete, modular integrated water solutions are pre-assembled and factory tested to meet the client’s functional requirements

space in a facility, which is worth about \$200 to 300 per square foot," explains Blanchard. "Our standardized, modular design allows them the operations they need in a space- and money-saving package that doesn't disrupt existing production" (Figure 3).

Industrial water solutions. Due to increasingly stringent regulations regarding water, there is an increasing demand for process skids and systems that supply makeup and process water, and for units that clean and recycle wastewater streams, according to Spindler. Wunderlich-Malec's systems go through a very detailed engineering process to incorporate all the equipment, pumps, vessels and instrumentation in an optimal layout so that the equipment and components can serve as a fully functional system on a stand-alone skid.

"What that means is that if our clients have a phased facility expansion, it is very easy to add additional units when they need them, so they are able to expand the operation as their business expands or as regulations further tighten," says Spindler. "Also, if the system serves a temporary need, a modular system can be placed, started and operated and, if needed, re-located to another site in the future."

Mass transfer systems and beyond. The demand for pre-assembled, modular mass-transfer systems for distillation and liquid extraction that include not only the process equipment, but also the piping, instrumentation and electrical wiring, ranging in size from



FIGURE 4. An entire laboratory workspace is pre-engineered

WHEN TO SAY 'NO' TO MODULAR

While modular process systems offer many advantages, there are times when they may not be feasible. Dennis Euers, strategic business manager with Wunderlich-Malec, outlines some constraints that reduce the feasibility of going modular:

- Size matters. If a system is to be delivered by road, there are often restrictions on size and weight. However, it is possible to design and package equipment as multiple units that can be shipped and assembled on site. Barge shipping is also possible if there is water access
- Processes that require large tanks or vessels for storage and reaction time may not be suitable applications for a modular build
- Ideal modular process skids include some level of complexity, incorporating piping, pumps, equipment, electrical and instrumentation. Simple processes can be effectively delivered onsite without the engineering effort modular systems require
- Some site constraints, such as in installations within existing systems or system modifications at a facility, may not lend themselves to the logistics and ability to get a modular system installed. In these cases, onsite field activities are often a better choice □

semi-units to full-scale production units recently has been expanding beyond single-operation units.

One of the areas of growth for systems that go beyond single operation, according to George Schlowsky, president with Koch Modular Process Systems, is in the biofuels industry. Startup firms producing biofuels often need more than just the distillation steps, explains Loftus. "So, in addition to the mass transfer, we are more often incorporating reactors, solids handling, filtration, drying and other processes that will support their chemical process into our modular construction. Because we are not experts in these other technologies, we leverage a network of existing specialists in these industries and work to procure their units and incorporate them into our modular construction. So, in addition to our expertise in system design and modular mass-transfer systems, we have become system integrators, which is a tremendous value to startup companies that don't have the engineering expertise to manage the overall processes in house."

Refineries. Most modular refineries are usually vacuum distillation units. Therefore, the throughput of the modular refinery is dictated by the size of the vacuum distillation column, which, when part of a modular refinery, is generally about 11 or 12 ft in diameter because it must fit within the skid. And, skids typically can't

be more than 14 ft by 14 ft due to transportation limitations, Reynaud explains. With a column this size column, the largest modular refinery likely could be no more than a 20,000 barrel a day (bbl/d) facility.

The desire to go with a modular refinery is often due to the significantly reduced schedule. "Because many refineries are being built overseas, a modular approach can really shave time off the construction," he explains. "If you build on site in a foreign country, you have to ship all the raw materials, metal and pieces there. Think of it like buying a television that's already assembled versus the store shipping you a whole bunch of parts to be put together at your house. You aren't sure if all the parts arrive, the quality of your construction is probably not that of a skilled expert and it's going to take you a long time to get it right."

"Using that analogy, imagine the difference between constructing a modular refinery and a stick-built one," says Reynaud. "A modular refinery can be constructed in 12 months versus two years if built onsite."

Cleanroom laboratories. Hemco (Independence, Mo.; www.hemcocorp.com) provides an entire laboratory workspace, which is pre-engineered, including the structure, the furniture and fume hoods for the interior (Figure 4). While modular cleanroom laboratories afford many of the same time- and cost-saving opportunities as modular process systems, one of the biggest benefits of going this route versus traditional construction, according to David Campbell, vice president of sales with Hemco, is that the structure can be easily assembled, modified in the future, or disassembled and moved if needed. ■

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