EASY OIL?

Manufacturing Partnerships, Digital Technology Help Realize Promise of Alternative Fuels

Second-generation biofuels, such as bio-ethanol and biodiesel are produced from non-food biomass. (photos courtesy of Emerson Process Management)

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Transportation

>> According to the International Energy Agency's (IEA) World Energy Outlook 2009, global energy demand will continue to increase by 1.5% annually through 2030. China and India are the main drivers, followed by the Middle East. Oil demand is projected to grow by 1% per year on average over the projection period, from 85 million b/d in 2008 to 105 million b/d 2030. All the growth comes from countries that are not part of the Organization for Economic Cooperation and Development (OECD); OECD demand falls. The transport sector accounts for 97% of the increase. As non-OPEC (Organization of Petroleum Exporting Countries) conventional oil production peaks around 2010, most of the increase in output comes from OPEC countries, which hold the bulk of remaining recoverable resources, according to the IEA.

Second-generation biofuels: laboratory to commercialization

Second-generation biofuels, such as bio-ethanol and biodiesel, are produced from non-food biomass, including cereal straw, bagasse, forest residues, the organic portion of municipal solid wastes and energy crops such as vegetative grasses and short rotation forests. These fuels differ from first-generation biofuels, such as grain-based ethanol and vegetable oil-based biodiesel, in that they don't use food crops for feedstock.

Biochemical and thermo-chemical processes are used to produce second-generation biofuels. In the first process, enzymes and other micro-organisms convert the cellulose and hemicellulose components of the feedstocks into sugars, which are then fermented to produce ethanol. In the latter process, pyrolysis/gasification technologies are used to produce a synthesis gas from which several biofuels, including synthetic diesel and aviation fuels, are made.

In From First- to Second-Generation Biofuel Technologies, the IEA reports that several second-generation biofuels projects throughout the United States and Europe are in the planning stage, under construction or have pilot plants operating. These projects are funded through considerable public and private investments.

The industry faces complex technical and economic challenges, but the IEA projects that the first fully com-

As "easy oil" resources diminish and global energy needs continue to grow, alternative energy sources, such as second-generation biofuels and synthetic fuels, can play an important role in supplying world demand. But to take advantage of this opportunity, manufacturers in these industries must be able to shorten the time to product while reducing their risks, cutting costs and maximizing safety.

mercial-scale second-generation biofuel manufacturing could be under way as early as 2012.

Key among those challenges is the need for manufacturers to collect reliable, accurate data about the feedstocks-to-fuel conversion processes throughout their research and development (R&D). A company's data collection needs start with its initial laboratory work and expand to the demonstration plants as they are brought online. The data collected is not only critical to the operations personnel so they can safely fine-tune the processes, but also to venture capital investors and governments providing funding.

Companies must rely upon process and production data to prove their projects' progress to investors, who are concerned about the success of their project. Governments also rely on R&D data from these manufacturers to inform strategic policy decisions.

The limited technical expertise available in this field provides an additional challenge. Companies must efficiently leverage their few knowledgeable process experts across multiple plants that are dispersed geographically to be near feedstock and transportation facilities. Also, because these are often new, small companies operating on tight budgets, they usually don't have experienced project execution staff. As they work to grow their operations from the laboratory to pilot plants and on to commercial manufacturing, this leaves them open to inefficiencies, increases their risk of failure, and can affect their speed to product and result in lost funding.

Many of the challenges faced by the second-generation biofuels manufacturers are specific to that industry, but manufacturers in another alternative fuels market, synthetic fuels, or synfuels share some of those challenges.

Synfuels: automation, safety needs on a large scale

Synfuels production occurs at large industrial facilities that gasify various feedstocks to produce synthesis gas. Thermochemical processes, such as the Fischer-Tropsch process and hydrocracking, are then used to convert the syngas into liquid fuels. The feedstocks used include coal, petroleum coke, natural gas and heavy crude such as that found in the Canadian oil sands.

Compared with second-generation biofuels, synfuels manufacturing is more similar to traditional refining and chemical manufacturing in terms of its scale and the complexity of the processes used. Synfuels manufacturing operations are often an added part of an existing, large refining and chemical facility, instead of a small, stand-alone plant.

Because of the numerous, highly complex processes used to manufacture synfuels at these huge facilities, automation with accurate process control and close monitoring for efficiency and product quality are of prime importance. In addition, the operations include numerous hazardous processes, so a well-instrumented, integrated safety information system (SIS), which may have tens of thousands of monitoring points, is critical.

Project execution, engineering guidance

As second-generation biofuels companies develop their processes for commercial manufacturing and synfuels manufacturers work to operate more efficiently and safely, they can act to reduce their risk and boost their speed to product. Top among these steps is establishing early, collaborative partnerships with advisors and vendors. Experts can offer project management and engineering guidance as well as knowledgeable vendors can supply the correct automation and safety technology to meet manufacturers' needs.

Second-generation biofuels companies not only experience the usual business challenges of a venture capital - funded start-up, they endure numerous technological hurdles as well. Many of their processes have never been tried on a commercial scale. The companies risk failure and funding loss if they encounter problems or delays while moving from the laboratory, to pilot plant, to multiple commercial manufacturing facilities. Experienced advisors can help steer these companies through the development process to make the transition seamlessly and successfully while reducing their execution risk and trimming their schedule.

Advanced bio-engineering processes increase the complexity of project implementation. Synfuels manufacturers especially need expert assistance in defining the automation strategy and safety systems that will work best at their complex, multi-process facilities. Smart manufacturers will secure key advisors and suppliers the front-end of their project.

The PEpC approach – procure strategic suppliers, Engineer (by a contractor partnered with the supplier), procure commodity items and construct – when used by manufacturers from either market, can help companies in multiple ways. By choosing a main automation contractor (MAC) to procure technology before the engineering design is complete, manufacturers can reap project savings.

Automation control technology and safety systems can increase the risk for manufacturers if they are deployed incorrectly. But by developing the engineering design

around a MAC vendor's equipment through the PEpC approach, technology implementation is optimized and risk reduced.

The opportunity to keep project costs low is greater at the beginning of a project. The Construction Industry Institute found that projects undertaken with the PEpC approach could expect a 4% to 8% project cost savings and time savings of 10% to 15%. The alternative fuels industry will undoubtedly feature multiple plant networks developed by process manufacturers. Savings in cost and time will be important. Since the industry is new and emerging, one can visualize the benefits of collaboration with a MAC or main instrument vendor (MIV) and using the PEpC approach by looking at an example from an established industry, albeit in China where automation too is important to an emerging industry.

Plant-wide digital technology

Second-generation biofuels manufacturers can easily leverage their few process experts across a geographically dispersed enterprise using networked digital automation and safety technology, which uses open communications standards to link devices, systems and applications plant-wide. Operators and maintenance personnel at large synfuels facilities can use these tools to closely control multiple processes and anticipate problems before they can occur – ensuring quality control as well as asset and plant safety. Through a Web-based interface, alternative fuels production staff can monitor process and asset health data in real time, compute trends and trouble-shoot problems.

In plants that have between 3,000 and 30,000 measurement points, digital FOUNDATION fieldbus standard communications is used for its engineering and cost advantages on projects. Complementing this technology for automation agility and easy connecting of remote, hard-to-reach and often-uneconomical measurements is new proven standards-based wireless technology. Companies can save as much as 90% on installed costs over traditional wired networks for many applications. Wireless allows manufacturers to tap into data that had been prohibitively expensive to monitor and can reduce the time operators or maintenance personnel need to go into the field to gather information or take corrective action.

Intelligent field devices installed throughout a second-generation biofuels or synfuels facility can be used to better control critical plant processes, increase plant efficiencies, improve product quality, comply with environmental monitoring requirements, and realize long-term operations and maintenance savings for the manufacturers.

Temperature, vibration, level and pressure measurements are some of the data that can be collected through secure mesh networks from wireless monitors on heat exchangers, pumps, motors and tanks. These devices can also be used to track mobile assets, such as those routinely reconfigured in laboratories or pilot plants.

Synfuels projects especially favor the combined fieldbus and wireless usage because they have large, distributed facilities with multiple processing units and many data acquisition points. Other applications, such as asset tracking, safety mustering of personnel and voice over Internet protocol, in use at the plant may also employ a wireless communications backbone.

To ensure plant safety, manufacturers should seek the advice of a vendor that can identify crucial points in their integrated SIS and provide a system that is integrated with the plant's automation control, but that maintains a logical separation from it. Such a system provides safety data to operators and maintenance staff, and includes field instrumentation that constantly runs diagnostics. Second-generation biofuels processing may only need a few hundred SIS points, but synfuels facilities can require thousands.

Emerson's Smart integrated SIS has been used throughout alternative fuels manufacturing to integrate a large number of safety points around a gasifier, helping operators mange safer, more reliable and better controlled process units.

Partnerships, digital tools

Growing energy demand and future constraints on the world's conventional oil supply present opportunities for alternative fuels manufacturers to profit from the changing market. To tap into this growth potential, companies must be able to operate efficiently with low risk and reduce their time to market. Whether it's the risks encountered by second-generation biofuels manufacturers as they expand their processes from the lab to the pilot project and multiple commercial plants, or the day-to-day challenges of safely controlling multiple complex process units at huge synfuels facilities, the hurdles for this industry are many.

Data collection, whether needed for R&D or to monitor asset health and process quality, is crucial to manufacturers. Companies that utilize a plant-wide integrated digital automation network that includes wireless instruments to deliver this information can cut costs and expand data collection to areas previously economically unfeasible to monitor.

In addition, a partner who understands this industry's safety needs and can provide an integrated SIS that runs its own diagnostics as well as being accessible plant-wide to operations and maintenance personnel is critical.

By leveraging collaborative partnerships with experienced advisors and vendors as well as utilizing digital technology, including reliable wireless networks, industry leaders can reduce the risks and costs of product development and operations, and trim their schedule while maximizing safety – positioning themselves ahead of their competitors. ■

Alan Novak is Emerson's director of alternative fuels with global responsibility for project and technology within the second-generation biofuel and synfuel industry sectors. He is active in multiple industry related coalitions and is in regular discussions with many of the process licensors, developers and research centers in this emerging market.