SPRING/15

VOLUME 28 / ISSUE 1

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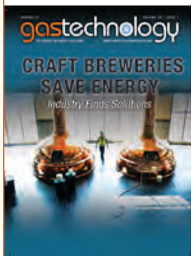
CRAFT BREWERIES SAVE ENERGY

Industry Finds Solutions



on the cover

The craft brewing industry is growing up. Today operators are looking for ways to stay competitive by reducing energy costs. Solutions include heat recovery, renewable energy sources, and more efficient process equipment.

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Gas Technology is an educational supplement from:
Energy Solutions Center Inc.
400 N. Capitol St., N.W.
Washington, DC 20001
• (202) 824-7150
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1111 W. 22nd Street, Ste. 250
Oak Brook, IL 60523
• (630) 571-4070
Printed in the USA

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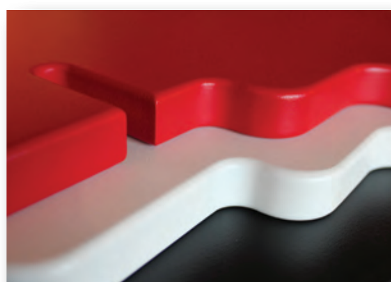


CRAFT BREWERS WATCH ENERGY DOLLARS

New Products, New Challenges

The new Sierra Nevada brewery will increase the brewer's output by a third. It was designed from the beginning to conserve energy and take advantage of renewable sources. Photo courtesy: Sierra Nevada Brewing Company.

FEW INDUSTRIES HAVE SEEN AS MUCH GROWTH AND EVOLUTION IN THE PAST 30 YEARS AS CRAFT BREWERIES. This growing sector of the brewing industry has changed the purchasing and drinking habits of many beer lovers. Even the large international brewers are watching and making changes to their product offerings because of the growing craft brewing industry. Energy management has become a major priority for these brewery operators.

Explosion of Interest

In 1979, there were 89 breweries in the United States. Today, the number is closer to 2,500, despite the fact that the volume increase in beer consumption has been relatively modest. With the growth of international travel, especially on the part of younger people, questions were asked, "Why can't we have more variety in our beer, and why can't it be more of a handmade product rather than a huge industrial output?" In the 1980s, small breweries began to pop up, many of them "nanobreweries", such as brewpubs where the small production is largely consumed on the brewery premises.

Somewhat larger enterprises are classified as "microbreweries." These produce up to 15,000 barrels per year and usually rely on local distribution of bottle and keg beers, as well as on-premises retail sales. A still-larger category is "regional craft breweries" that produce 15,000 to 6 million barrels of beer annually and usually sell to a larger but generally regional market. Taken together, these comprise the craft brewing industry that today produces about 8% of U.S. beer sales. Some brewers feel that the craft beer market could represent 20% of sales by 2020.

Attitudes toward Quality and Sustainability

The growing production volume is only one accomplishment of the craft brewers. Their innovations in beer styles and flavors have enhanced the image of brewed malt beverages and have made them attractive to new customers. They have successfully promoted the concept of quality being more important than volume, in both production and consumption. As they've grown from hobbyist scale to commercial significance, craft brewers have taken a growing interest in sustainability, particularly in terms of energy use. As production has increased in scale, energy efficiency has also become a more important financial consideration.

Most microbreweries need significant amounts of both electricity and natural gas in their operations. Electricity is used for pumps, fans, lighting, packaging, refrigeration and compressed air systems. Owners are selecting adjustable frequency drives (AFDs) for pumps and fans to reduce electric usage. Lighting can be a significant expense, and where possible, owners are changing to higher efficiency choices such as T-8 fluorescents and LED systems. Electric usage can also be reduced by monitoring filters on air handlers, reducing lighting in areas not in active use, and by purchasing higher efficiency motors and controls when replacement is required.

Steam Energy for Brewing

In the typical microbrewery, natural gas is used for boilers to produce steam for heating brew kettles and to make hot water. The brew process involves cooking large vats of water with malted grain and other ingredients to begin to break down starches, then chilling the liquid to a preset brewing temperature for the long period of fermentation. Normally the brew kettle is heated with a steam coil and held at temperature before being cooled using a refrigeration system. Significant energy can be recovered from the hot liquid using plate-to-plate heat exchangers, which transfer most of the heat to water incoming for the next brew batch. Thus the amount of steam, and the required amount of natural gas, is reduced. For this type system to be effective, production needs to be scheduled to take advantage of the availability of preheated water.

Another potential application for natural gas is to fuel a combined heat and power (CHP) plant to supply the plant with both electric power and to generate hot water or steam from the byproduct heat of electric generation. Again, to take advantage of such a system, it is necessary to evaluate times of usage of both electricity and the thermal input to assure they are a match.

For many small microbreweries, an on-premises brewpub uses half or more of the brewery products. Customers see brewing activities in action, know the brewer, and have an appreciation for a local product. Photo courtesy: Rick Staszewski.

Efficiency a Priority

According to a guide produced by the American Brewing Association, the energy input per barrel of beer from a craft brewer ranges from $3.34 to $4.26 per barrel. Naturally this varies between regions and types of brewing process. It is believed that energy cost per barrel is higher for craft brewers than for larger industrial type breweries. For this reason, it is especially important for all the process energy to be used as efficiently as possible.

American Sky Brewery in Hudson, Wisconsin is a good example of this new age of brewing. Greg and Molly Harris took an interest in brewing years ago, learning about the range of styles of beer from home-brewers in their family. They started brewing beer for personal use, then a three-year stay in Europe stimulated a lasting interest in the microbrewery business. Both Greg and Molly have full-time jobs, but committed themselves to opening a microbrewery in Hudson, alongside the bluffs of the St. Croix River in Western Wisconsin. Hudson is part of the Minneapolis-St. Paul Statistical Area, and has a rapidly-growing population of 15,000 – many of them young families with professional jobs. This is a good location for a craft brewery.

Combining Brewery Operation with Retail Area

The American Sky Brewery is in its third year of commercial production, and according to Greg Harris, the demand for the product is growing at about 20% per year. The brewery and its associated pub occupy about 40,000 square feet of space in a modern building featuring an aviation and military-theme décor. The brewery operation is open to the pub area, so customers can observe where the beer is being produced, and can interact with the owners and brewery employees.

Greg Harris notes that energy is the second largest operating expense for the brewery (after labor), and that as owners, they realize the need to use energy efficiently. They receive both electric and natural gas service from Xcel Energy. "They are the people we go to when we have questions or concerns about energy use. They've given us some good ideas on how to conserve energy."

On the electric side, he indicates that lighting is a major energy use. Harris says, "We currently have incandescent lighting, but want to replace it with something better. That's something we're looking at right now." He notes that for small breweries, payback is a major issue. "We look for improvements that can pay back the cost in energy savings in a year or so. We aren't there with our lighting improvement project, but we really want to do it."

Microbreweries can reduce energy use by heat recovery from the brewing process, selecting high efficiency electrical machinery, and by use of an efficient gas-fired low pressure boiler. Photo courtesy: Rick Staszewski.

Watching Refrigeration Expense

Another major electric energy expense is refrigeration. Molly Harris indicates, "We have a large walk-in cooler for finished keg beer, as well as for bottled product. We have lines direct from the cooler to the pub. That minimizes the number of times the door has to be opened. It also makes product quality management easier." Other electric usages are fans, pumps, and the bottlers, which are old equipment but very reliable.

On the natural gas side, American Sky uses a low-pressure steam boiler to supply heat for the brew kettles. Greg says, "A lot of brewers are going away from direct-fired kettles in favor of steam, because of its better efficiency. Also, we have better control of the cooking temperatures, which is very important." He indicates that the gas boiler is attractive because of its low-pressure characteristic. "We don't need to have a boiler attendant on duty, and it can come up to provide steam very quickly."

With brewery steam systems, it is important to prevent steam traps from leaking, and to use no more steam than necessary to reach set temperature for the mash. The Harrises indicate that water treatment and usage are critical to quality beers. "We study where we're using water, and heat it only when necessary." They indicate that scheduling operations is an important step in minimizing energy usage as well.

The Sierra Nevada brewery in North Carolina uses biogas from wastewater treatment to fire these microturbines for plant power supply. Photo courtesy: Sierra Nevada Brewing Company.

Efficiency Limitations for Startups

Smaller microbreweries, especially startups, are often located in facilities that were originally designed for other purposes. These might include warehouses, factories, or store buildings. Space is often at a premium, and compromises in energy systems may be unavoidable. One small Midwestern brewer wants to add a storage tank for hot water reclaimed from the brew kettle, but simply can't find the floor space. Often these projects have to wait until the brewery is sufficiently established to build its own facility.

Toward the other end of the scale from the microbrewery in Hudson is Sierra Nevada Brewing Company, with large facilities located in Chico, California and a recently-opened brewery in Mills River, North Carolina. Sierra Nevada was a pioneer in the craft brewing movement, starting business in 1980 in Chico. Today, Sierra Nevada produces over 800,000 barrels of beer annually, with production numbers again rising with the new North Carolina facility.

Larger Breweries Mean More Opportunities for Conserving

Cheri Chastain is Sustainability Manager for Sierra Nevada. She notes, "We have worked for decades to make sure we are using our electrical and thermal energy as efficiently as possible not only out of economic necessity, but because we try to use all resources as efficiently as possible." She notes that energy conserving steps at Chico include lighting control systems and heat recovery from the boilers and brew kettles. The electric system has been upgraded and onsite electric generation has been added. Onsite generation includes a 2 MW solar installation and a 1 MW fuel cell. These provide 70% of site energy needs.

Chastain explains that the Chico facility has been growing since the first brewhouse was built in early 1982. "This has resulted in a lot of disconnected and puzzle-like infrastructure. In Mills River, we had the opportunity to build a brand-new brewery in a much more streamlined design." At that location they installed 600 kW of solar and 400 kW of biogas-fueled microturbines. She notes, "At that site we are not yet in normal operating conditions so we don't know how much electricity we will be able to generate onsite."

All Breweries See the Challenge

The craft brewing industry continues to look for opportunities for improving energy efficiency. Chastain explains, "Brewing and all the activities that accompany brewing (cleaning/sanitizing, packaging, warehousing) requires not only a tremendous amount of electric energy, but a great deal of thermal energy. Brewers large and small are not only embracing onsite electric generation systems, but are looking for ways to reduce electrical needs through efficiency, and to recover heat for thermal needs."

At the Mills River facility, not only is heat being recovered from the brew kettles, but also from air compressors and chillers, and a water storage tank has been installed to allow use of the heated water as needed. In warehousing operations, the company is investigating replacing the use of electricity with hydrogen fuels. At the present time this does not appear practical, but investigation into alternatives continues. At both plants, treatment of spent yeast and plant wastewater generates biogas, which can be used as a primary brewing fuel. Also at both plants, spent grain is sold to area farmers as a cattle feed.

Eye on the Energy Dollar

The craft brewing industry is thriving, and one key to success is keeping management's eyes on energy usage and watching for ways to recover energy wherever possible. As with many industries, prudent use of energy is a high management priority. Important sources for guidance in conserving both electric and gas energy are local utilities. These have teams who can suggest methods for reducing energy usage. Another important source is the Brewers Association, which is focused on the needs of craft brewers. The association offers handbooks and training sessions on many brewing concerns, with a special emphasis on energy efficiency. **GT**

MORE info

AMERICAN SKY BREWERY
www.americanskybeer.com

BREWERS ASSOCIATION
www.brewersassociation.org

ENERGY STAR GUIDE FOR BREWERIES
www.energystar.gov/ia/business/industry/LBNL-50934.pdf

SIERRA NEVADA BREWING COMPANY
www.sierranevada.com

Doors Opening for NGV Trucking

More Fueling Points, New Vehicles

IT HAS LONG BEEN RECOGNIZED that over-the-road (OTR) trucking represents a major opportunity to replace petroleum fuels with natural gas. This market segment also has great potential for reduced emissions and lower fuel costs. A decade ago the obstacles were large and included a severe lack of fueling points, unavailability of heavy-duty NGV powered road tractors, and long payback times for adopters of the natural gas option. Today, many of those obstacles have been overcome, and the benefits are more obvious than ever.

A suitable fueling site for OTR truckers requires adequate space for vehicles. Often such facilities are co-located with other truck stop amenities such as restaurants, showers, convenience stores, and other outlets. Photo courtesy: Questar Fueling.

Getting the Process Started

In some ways it has been a chicken-and-egg dilemma. Operators were reluctant to switch to NGV road tractors because of the lack of refueling infrastructure. Fuel providers were reluctant to build NGV fueling points suitable for OTR truckers because of the limited demand for this service. But change was coming. OEM truck manufacturers first began offering NGV engines in sizes suitable for refuse trucks, ready-mix concrete trucks, delivery vans and transit buses. In many cases these were intended more for customers who had time-refueling systems on their own premises. But these introductions jump-started truck manufacturers and began demonstrating to others the many benefits of NGV fueling.

Several companies have supported this transition for NGV trucking. Questar Fueling, a subsidiary of Questar Corporation in Utah, has initiated an extensive program of building OTR truck fueling stations in Utah and stretching out into Kansas, Oklahoma, Colorado and Texas. Currently the company has five of these dedicated NG truck fueling stations operating, and three more near opening. Many more are in the planning or construction stages.

Another important provider is Clean Energy Fuels Corp., headquartered in Newport Beach, California. This company has developed more than 500 public and private fueling points across the United States and Canada. Of these, nearly 250 are suitable for fueling tractor-trailer units and many are along major Interstate Highway routes. Other regional and national fuel providers continue to build fueling stations that close the gaps in the North American "natural gas highway."

Large Engines Now Available

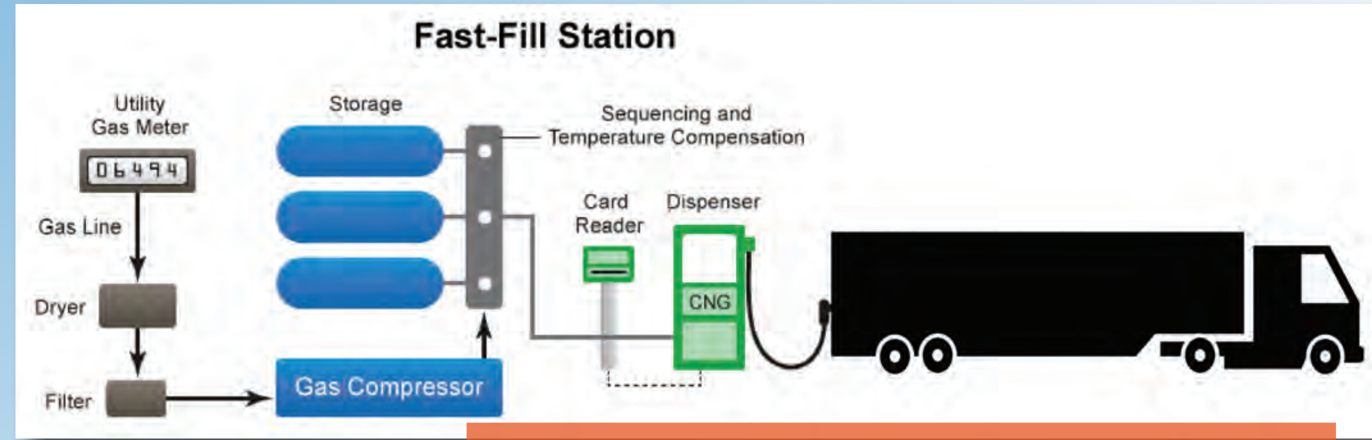
Another important force has been Cummins-Westport, a joint venture between Cummins Engines and Westport Innovations, a company specializing in technology for NGV engines. This Cummins Westport team has delivered over 50,000 NGV engines worldwide. An important milestone was Cummins Westport's introduction of an 8.9 liter truck engine in 2007 and more recently a 12.0 liter model in 2012. These two engines are now offered as options by major truck manufacturers such as Kenworth, Peterbilt, Mack, Navistar, Freightliner and Volvo.

In particular, the availability of the 12.0 liter engine has been an important spur for NGV trucking growth. This engine can provide adequate power for large OTR units. NGV engines have spark ignition systems rather than compression ignition as in diesel units, and require a completely different engine design. Of great interest is the fact that natural gas is a very clean engine fuel, so many of the complexities involved in emission reduction with diesel fuel are not required. The Cummins Westport engine employs a Three-Way Catalyst (TWC) technology that allows the engines to meet strict EPA 2010 emissions standards. The TWC device is installed in the engine muffler and requires no maintenance.

12 Liter Engine Important Development

According to Judd Cook, Director of Business Development for Questar Fueling, the availability of the 12 liter engine has done much to make OTR trucking with natural gas feasible. Cook notes, "For many OTR applications, the 8.9 liter engine was not powerful enough. The 12 liter has caught a lot of people's attention. And from what I've heard, it has been trouble-free and reliable."

Because of the growing number of NGV engines being used in commercial vehicles of all kinds, the price premium for the technology is steadily reducing. According to Chad Lindholm, the head of the trucking group at Clean Energy Fuels, several years ago a trucker would pay a premium of nearly $100,000 for a natural gas-powered road tractor. Today that premium is down to $30,000 to $45,000. He expects it will continue to go down as the volume of sales of these tractors increases.



Rapid refueling, whether LNG or CNG is a requirement for a successful OTR natural gas fueling site. More of these facilities are being installed across the U.S. and Canada. Many offer a choice between CNG and LNG. Illustration courtesy: U.S. Department of Energy.

CNG and LNG Advantages and Disadvantages

At fueling points, natural gas may be dispensed as compressed natural gas (CNG) or liquid natural gas (LNG). Lindholm indicates that there are advantages for each fuel type. CNG is a pressurized fuel and requires heavier tanks and has a lower energy density than LNG, thus more frequent refills are sometimes required. However for trucks that return to base daily, it may be the best choice, particularly if the base has a slow-fill or fast-fill refueling station on site. Long-term storage in the vehicle tank is possible with no loss of fuel.

LNG may be a better choice if the vehicle is operated over the road for longer distances and in some cases the refueling time is shorter, thus operators spend less time refueling. LNG is held at a temperature of -260°F and if the tank is not emptied, it begins venting to the atmosphere in about five days, so there is an energy loss. Vehicle LNG fuel tanks are lighter than those for CNG for the same capacity. Generally LNG is most advantageous for long-distance truckers that don't frequently return to base.

A Fraction of the Price of Diesel

CNG is usually compressed at the delivery site from pipeline-delivered natural gas, while LNG is more commonly delivered by tanker to the refueling point. Delivered cost of either natural gas fuel is typically one-half to two-thirds the price of the equivalent gallons of diesel fuel. Fuel costs are generally cited as gallons-of-diesel-equivalent (GDE). Because it needs to be trucked to the dispensing site, and because of the energy cost of the liquefaction process, LNG is typically slightly more expensive than CNG. Estimates of the cost differential range from 25 cents to as much as 75 cents GDE.

Payback for the higher cost of a natural gas tractor can range from one to three years, depending on local fuel costs and miles driven. If, as Lindholm projects, natural gas vehicle costs continue to decline proportionate to diesel vehicles, the paybacks could be even shorter. Currently the price of diesel fuel is somewhat depressed because of lower crude oil prices. How long this will continue is debatable. Judd Cook from Questar Fueling indicates that the fuel price differential is a major driver in the decision to switch to natural gas, and some truckers are watching trends. At the current time, he feels the typical paybacks are 18 to 24 months, which is enough to continue to stimulate interest.

Environmental Benefits As Well

In addition to fuel and dollar savings with OTR vehicles fueled by natural gas, there are environmental benefits. According to the California Air Resources Board, CNG-powered vehicle emit 20% to 29% lower greenhouse gas emissions. It is estimated that new natural gas vehicles offer a 40% reduction in NO_x emissions compared to new diesel vehicles, and a 95% reduction compared to the current entire fleet of gasoline and diesel vehicles. Particulate emissions are reduced 98% compared to the current fleet.

A recent example of the transition to natural gas vehicles is the announcement by Fred Meyer Stores, a division of the Kroger Company, that they were replacing 40 diesel road tractors with LNG-fueled tractors to be based out of their distribution center in Clackamas, Oregon. As an integral part of this project they worked with Clean Energy Fuels to build a private fueling station on the site. The trucks will be part of the fleet that delivers product to 123 multi-department stores in the Northwest. As part of this project, the company received a $490,000 grant from the Federal Highway Administration through the Oregon Department of Transportation.

MORE info

CLEAN ENERGY FUELS CORP.
www.cleanenergyfuels.com

CUMMINS-WESTPORT
www.cumminswestport.com

NATURAL GAS VEHICLES FOR AMERICA
www.ngvamerica.org

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Owners Testing NGV

Many other national and regional truckers are placing their first orders for natural gas vehicles for the purpose of watching trends and observing the operation of these units first-hand. Many believe we are in the opening years of a major transition to natural gas-fueled highway trucking. More infrastructure is needed, and the vehicle numbers are still relatively small, though growing rapidly. But the chicken-egg dilemma has been largely resolved and growth is underway. **GT**

Capturing the heat

Making CHP Pay with Efficient Heat Recovery

COMBINED HEAT AND POWER – CHP – IS NO LONGER A SECRET. Energy users have found the benefits of generating their own electricity on-site, and using the byproduct heat for a wide range of applications. CHP has been shown to provide significant reductions in operating costs, while increasing energy supply security. In some cases, owners even successfully sell surplus electric energy back to the grid.

CHP Increasing in Importance

According to a report by the Combined Heat and Power Partnership of the U.S. EPA, "The existing 82 GWe of CHP capacity at almost 3,600 industrial and commercial facilities represents approximately 8% of current U.S. generating capacity and over 12% of total electricity generated. The report indicates that a reasonable goal would be to meet 20% of the country's electric needs at CHP facilities.

Benefit the Community and the Planet

CHP systems fired on natural gas help the country reduce dependence on overseas oil, and lower the environmental impact of central-station electric generation. Further, because of the high overall efficiency of CHP systems, they reduce total levels of greenhouse gases emitted. On a local level, CHP reduces the need for new power plants, large transmission lines and substations for electric grid utilities. To the extent that CHP systems sell excess capacity into the grid, they can also improve local power supply reliability.

Equipment Selection is Critical

Key to a successful CHP installation is selecting equipment for optimum heat recovery. Natural gas is widely used as a primary fuel for CHP. The most common gas technologies are reciprocating engines and gas turbines or microturbines. Other potential applications for on-site power include steam turbines and fuel cell systems. All these options have potential for byproduct heat recovery.

Multiple Heat Sources from Engines

Reciprocating engine generators are often chosen for their rapid startup times, high electrical efficiencies, ability to respond to changing load patterns, and proven reliability, especially with multiple units. Byproduct heat from an engine-generator set comes from several sources. These include engine jacket cooling water and heat recovered from exhaust gases. In some cases there are additional streams of heated water from the engine oil cooler or from other minor engine cooling systems. These minor streams are typically combined with the jacket cooling water stream.

This large gas turbine application is located outdoors, with exhaust directed to a waste heat steam generator in the building. Gas turbines are ideal for applications where large volumes of high-temperature heat or steam is required. Photo courtesy: Solar Turbines.

The jacket stream is typically 200°F to 250°F. In a typical CHP engine installation, this stream goes to a heat exchanger to heat water to between 180°F to 220°F. This level of hot water can be used for a wide variety of process purposes, can provide building heat, or with the use of a single-stage absorption chiller, can provide chilled water for building cooling or process purposes.

Capturing the Exhaust Heat

The other major source of heat from engine generation is the exhaust stream. Although the exhaust gases may be as hot as 500°F, not all of this heat can be captured. Some exhaust heat should remain to prevent stack condensation or other exhaust discharge problems. Typically the exhaust stream passes over a heat exchanger to produces low-pressure hot water in the range of 230 to 260°F. Alternatively it can be used to produce steam from 120 to 150 psig. This steam can be used for a variety of plant purposes, or again it could go to an absorption chiller.

General Electric offers both its Waukesha line of engines, and the Jenbacher series, for global markets. According to GE spokesperson Gina DeRossi, with new technologies, the efficiencies of engines are increasing. As an example, she points to the introduction of two-stage turbocharger technology for engines. The Jenbacher J624 engine, when fitted with the new turbocharger, goes from 4.0 to 4.4 MWe capacity, with an efficiency increase of 1% to reach 46.5%. She notes, "This engine is particularly well-suited for operation in hot environments and CHP applications."

DeRossi states that engine CHP is particularly attractive for district heating and cooling, commercial buildings, critical care facilities, airports, industrial buildings and parks, and greenhouses for the horticultural industry. The greenhouse applications can also use exhaust CO_2 to support plant growth.

This GE Jenbacher engine, rated at 9.2 MWe, provides 40% of the electricity and 20% of the heating requirement for a municipality. The unit can achieve overall efficiencies as high as 89.1%.

Gas Turbine Systems

An alternative to CHP engine generation is the gas turbine. These can range from systems as small as a single 30 kW microturbine to large combustion turbines sized in the tens of megawatts. Larger gas turbines are a good choice for CHP installations where a large volume of higher-temperature water or steam can be used, including in combination with an absorption cooling plant.

Microturbines

Microturbines such as the Capstone Microturbine are increasingly popular, especially in multiple unit configurations. The Capstone machines are available in sizes of 30, 60 and 200 kW, with control arrangements available for multiple units. Microturbine byproduct heat is widely used for comfort and process applications.

Larger Units

Solar Turbines is a Caterpillar Company, and manufactures a broad line of gas turbine-generator sets ranging in size from 1.1 MW to 22.4 MW. Solar spokesman Chris Lyons points out that the electric generation efficiency increases as one goes up in size, typically from 25% for the smaller machines to 39% for the larger units. He adds, "In combined heat and power operations, these same units range in total efficiency from 70% to 90%.

Various Factors in Sizing Units

He notes, "Most applications in the larger size ranges are for hospitals, pharmaceuticals, breweries, and university and college campuses. They also serve a variety of other industries that have thermal or chilling loads for process needs." He indicates that in selecting equipment, most size for the necessary thermal load. But, he adds, "It is also very dependent upon overall electric rates and factors such as plant reliability."

Lyons cites a large paper company that uses a 5.7 MWe Solar turbine for plant electric service, and uses the byproduct heat for a dryer for tissue paper. Another example is a ceramic plant that uses the heat from a 7.5 MWe unit to dry the slurries used to make ceramics. In yet another application at Cal State Fullerton, a 4.5 MWe unit supplies campus power, and the exhaust heat supplies a Thermax absorption chiller for cooling a data center.

Lyons notes that the food and dairy industries also are using gas turbines for plant power, and using the byproduct heat to generate steam for sterilization and other plant purposes. He says, "With the introduction of Boiler MACT (maximum available control technology), we have seen many applications of replacing older coal boilers with steam from exhaust heat from gas turbines." He explains, "The most common industrial steam use is in the range of 120 to 250 psig saturated steam, with some applications of 50° to 100° F of superheat."

The technology for gas turbines has become very reliable, and service intervals have been extended for today's gas turbines. Lyons explains, "Most of our turbines are designed for 30,000 hours between overhauls. However some of the smaller units go well beyond 40,000 hours before being overhauled."

Selecting a System

In making the decision to go with CHP, and in choosing the right sizes of units, it is essential that owners accurately characterize their current energy usage patterns, both for heat and electricity. Remember to consider potential reductions in electrical demand charges as well as energy charges. Sometimes operating a unit for relatively few hours per day can have a major impact on electric demand charges.

Include in your considerations potential future changes in operations that might necessitate more capacity. Get help from an engineer with experience in onsite power systems who is also familiar with local energy suppliers and their tariffs. Then evaluate potential thermal contributions from a CHP system, keeping in mind that not effectively using the thermal energy can dramatically affect the overall system efficiency.

Looking Ahead

Your electric supplier may also offer attractive buyback payments for unused electric production. This might support installation of a system with higher electrical output than for site use alone. CHP will continue to be an important energy option for the future. Making the right decisions now could have a major effect on your bottom line in the future. **GT**

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www.understandingchp.com

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POWDER COATING APPLICATIONS GROWING

New Methods — New Markets

ADVANTAGES OF POWDER COATING include thicker coatings without running or sagging, faster production cycles, and much lower emissions of volatile organic compounds (VOC). In most cases, key elements of powder paint systems are natural gas-fired convection ovens, or gas-fired catalytic infrared systems. The use of powder coatings for product finishing is expanding into new markets. These finishes are expanding from metallic products only to other surfaces, notably medium-density fiberboard (MDF).

Most commonly,MDF power coating systems use conveyor designs to move panels through pre-heat, powder application, curing and cooling stages. Photo courtesy: Heraeus-Vulcan.

Growing in Market Penetration

Powder paint systems were introduced more than 30 years ago. Since then, a growing number of product manufacturers have taken the step away from spraying liquid paint. Liquid has inherent challenges, including the need for very expert application in order to get a uniform coating without sagging or thin spots. Another is the ever-tightening requirements to reduce and capture volatile organic compound emissions from solvent carriers to comply with strict VOC air emission and occupational health rules.

Early adopters of the powder coating technique included manufacturers of appliances, HVAC equipment, lawn and garden equipment, metal furnishings, agricultural machinery and tools. Today, an estimated 15% of industrial coating is done with powder, and that number is growing rapidly. Expansion into new applications is feeding that growth.

Curing is the Key

The method involves the application of coating powders through either a hand-held or robotic nozzle. The coating itself is a very fine and uniform powder made up of polymer resins, pigments, flow control agents and other additives. Powder is electrically charged as it exits the spray gun. The target object is electrically grounded, causing the charged powder to adhere evenly to the surface. Painted products are then placed in a batch oven, or carried through a conveyor oven that melts the powder and fuses it to the product.

Powder coatings are extremely variable in their requirements for heating the coated surface at a prescribed temperature for a specific period of time. Often controlled cooling at the end of the oven cycle completes the curing of the surface. Various resin types require different thermal treatments. Many newer powder products are designed for lower cure temperatures.

Less Material Waste

Importantly, powder coating virtually eliminates the huge evaporative losses experienced with liquid spray coating. With liquid spray, up to 80% of the volume of paint is lost to evaporation in the curing process, and to overspray in the booth. With powder coating, more than 80% of the powder adheres to the target, and even the overspray can often be collected and reused, assuming there is not a mixture of pigments used in the spray booth.

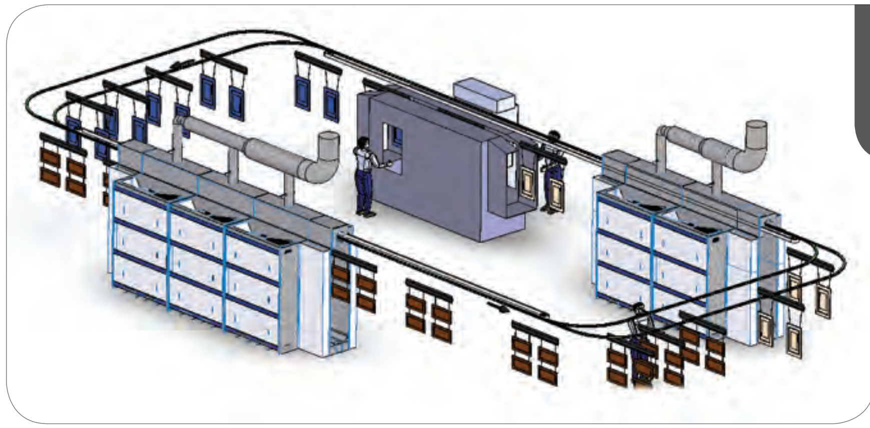
Infrared Gaining in Popularity

Curing systems using gas-fired catalytic infrared panels are gaining in popularity for parts or all of the process. These panels can be placed along the conveyor line, either in an open configuration or in an enclosed tunnel. Infrared curing is faster than convection ovens and can be closely adjusted to the size and shapes of the target objects being coated. In some cases, infrared is used to gel the paint on the objects before they enter a conventional convection oven. This shortens the bake time, allowing more production throughput.

Although powder coating was initially used only on metallic objects, techniques have been perfected for powder coating other materials, including plastic, wood, and especially medium density fiberboard (MDF). The MDF opportunity is important because this material is widely used in furniture, cabinets, recreational items, paneling, containers and shelving. The key to successfully powder coating MDF is to preheat the material, which increases its electrical conductivity, allowing it to be effectively grounded to cause the powder to adhere. Here again, the use of catalytic infrared panels makes this process effective.

Infrared Designed for Powder

One of the major providers of catalytic infrared heating systems is Heraeus-Vulcan. This company offers natural gas-fired systems specifically designed for the powder coating industry. According to company spokesman Mike Chapman, infrared systems offer design flexibility, allowing a thermal treatment area to be adapted for various coatings and product types. Chapman also notes the short cure times for infrared versus convection oven systems. Infrared systems can also be created to allow for product pretreatment before a convection oven, and controlled cooling at the other end of the process.



Conveyor MDF powder coating systems are flexible and can be adjusted in line speed and treatment temperature for various types of panels and types of powder resins. Illustration courtesy: Heraeus-Vulcan.

Chapman stresses that powder coatings for MDF products is an important trend. He explains, "The first part of the process is to heat the MDF to around 50° C (122° F) to draw moisture to the surface. This makes it conductive. So it is very important to use MDF that has a moisture content between 5% and 8%. The other issue with powder coating MDF is the need for quality. It needs to be dense with a strong internal bond so it can withstand the rapid heating and cooling that it will undergo in the powder coating process. Poor quality MDF will split and crack on the edges where there are cut surfaces when it is powder coated."

Single Coat Process Possible

He points out that until recently MDF has required two coats, a primer and a top coat. "This system has been adequate for most applications, except for products used in high humidity environments." He states that powder coating resin manufacturer DSM has worked with Heraeus-Vulcan to develop a single-coat system which is non-porous and completely seals the MDF product.

Chapman offers Ekoltech in Slovakia as an example of an industrial user that has changed from liquid to powder coating with catalytic infrared systems. The company is a major supplier to global household products retailer IKEA. He says, "They are in the process of moving from liquid to powder for a number of their products. They have two separate gas catalytic IR oven systems which have very high output capacity. Their measured cost of poor quality (COPR) has dropped dramatically." In addition to MDF, Chapman indicates that other non-metallic products being powder coated now also include certain fiber-reinforced plastic (FRP) products, and plywood and engineered wood products such as oriented-strand board (OSB). For the wood products, pre-heating is required.

With powder coating, MDF panels achieve a hard, durable finish, even on edges and complex curves. It is important to use high-quality MDF board, to pretreat with heat, and to control cure times precisely. Photo courtesy: Heraeus-Vulcan.

Method of the Future

Users of these systems are motivated by a desire to reduce emissions and waste, improve finished product quality, and shorten production cycles. All of these results are being achieved with powdered coatings applied with natural gas-fired catalytic infrared systems. If you are currently using a liquid paint coating system, powder represents a major potential saving in production time, improvement in product quality, and a reduction in emissions. It's worth considering. **GT**

MORE info

HERAEUS-VULCAN
http://vulcan-catalytic.com

POWDER COATING INSTITUTE
www.powdercoating.org

UPCOMING POWDER COATING SHOW
www.powdercoatingshow.com

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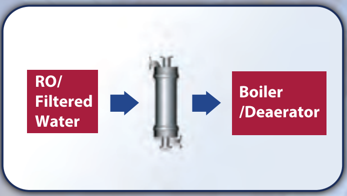

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- **Improve Ion Exchange Efficiency**
  CO_2 removal to reduce mixed bed regeneration frequency
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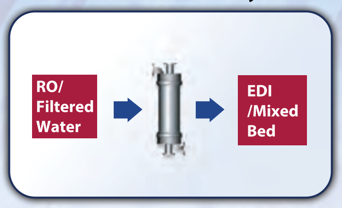
Increase Efficiency



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