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WAREHOUSE WINTER COMFORT

The HTHV Solution





on the cover

HTHV systems for warehouses and distribution centers assure good building ventilation and improved winter comfort while reducing the cost of heating.



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HIGH-EFFICIENCY HEATING FOR WAREHOUSES AND DISTRIBUTION CENTERS

HTHV Systems Can Dramatically Lower Costs

A NEWER HEATING TECHNOLOGY DOCUMENTED AS EFFECTIVE BY A RECENT U.S. DOE STUDY can reduce the cost of heating facilities such as warehouses, shipping docks, and distribution centers, while providing greater comfort and less temperature stratification. These high temperature heat and ventilation (HTHV) systems offer savings of 20% and more over the traditional use of unit heaters, plus they allow facilities to meet current standards for ventilation. HTHV systems are increasingly being deployed in a range of building types.

Heating a Challenge for High Spaces

Certain building types like warehouses, distribution centers and even some manufacturing spaces have high ceilings – often 24 feet or more. This is to accommodate efficient storage and the use of lift trucks and manufacturing equipment. Often these buildings also have overhead doors that are regularly opened for vehicle loading and unloading. As a result, these spaces can be difficult to heat.

Such areas are usually not air-conditioned, and the heating system frequently used is gas-fired unit heaters, normally located near the ceiling. Often these unit heaters are externally vented, with combustion air being taken from the heated space. As a result, the building is at a slight negative pressure and outside air seeps into the building from seams and open doors. With the high ceilings, temperature stratification can be considerable. It's not unusual to have ceiling-level temperatures in the 80s or higher while it is chilly at floor level.

Stratification Issues

Air stratification is a problem because it means floor level – where people are usually working – is uncomfortable. It also means that significantly excessive energy is being used in the attempt to achieve comfort. A possible third concern is that the upper storage spaces in the warehouse are warmer than might be desired for storage of certain materials. Reducing stratification has multiple benefits.

A solution sometimes taken is to install so-called “air turnover units” or “air rotation units.” These floor-mounted units move warm overhead air back down to floor level, and sometimes are



The high ceilings of many warehouses and distribution centers make them a challenge for efficient heating. The HTHV unit brings the heat down to floor-level. Photo courtesy Cambridge Engineering.

also equipped with auxiliary heating or cooling modules. Their shortcomings are that they use additional energy, they take up valuable floor space, and they do nothing to meet building ventilation requirements.

According to the DOE, unit heaters account for almost 18% of heating energy use in commercial buildings, especially in areas like warehouses, loading docks and production areas. How-

ever, the long term expense of heating with unit heaters is usually higher than with other natural gas-fired alternatives. An attractive alternative is the high-temperature heating and ventilation system – HTHV – offered by Cambridge Engineering. These meet the air stratification challenge.

DOE Study Confirms Efficacy

The U.S. DOE's Better Buildings Alliance recently funded a study to compare Cambridge Engineering's HTHV system with standard unit heaters. The study, "Field Demonstration of High-Efficiency Gas Heaters," analyzed HTHV heaters under normal use conditions at a 41,000 sq. ft. warehouse outside of St. Louis. The study compared the performance of four new Cambridge HTHV direct gas-fired heaters with six existing unit heaters.

the ceiling, or is placed along an outside wall. Sidewall units are available for installation either inside or outside the wall. The unit uses an outside air intake which supplies building ventilation air plus combustion air for direct-firing in the unit. The heated ventilation air output is directed downward at approximately 45 degrees by a high-velocity blower. The heated air output is discharged at 150° F or higher, and the high-velocity air stream punches down through the upper air layer and pushes warm air down to floor level.

As this heated air spreads out at floor level and mixes with room air, it reduces the amount of stratification. This also acts to slightly pressurize the space, reducing cold air leaking in from building seams and shipping doors. The volume of air provided by the HTHV units nor-

ate on heating demand only, or to operate continuously, with heat being added to the airflow as needed. The continuous-operation mode does the most to de-stratify air in the space and provide abundant ventilation. During times of the year when heating is not required, it can be operated in a ventilation-only mode.

According to Dave Binz from Cambridge Engineering, this unit simplifies building comfort systems. "It actually replaces three classes of equipment: other heating devices, building ventilation equipment, and air turnover equipment. It is a logical solution." Binz points out that the units are customizable for most applications, depending on air volume needed, heating requirements, supply gas pressures and physical installation requirements.

The units are offered in sizes from inputs of 250 MBtuh to 3200 MBtuh. He indicates, "Our normal manufacturing lead time is three to four weeks, and typically installation can be accomplished in a few days, with minimum structural modification needed." He points out that for situations such as older buildings where the load-carrying potential of the roof or ceiling is limited, the company can provide stands to support the equipment in the upper spaces of the building.

Binz indicates that the very large volume of air dilutes any combustion by-products, which normally are water vapor and CO₂. The blow-thru unit design allows a small fraction of the incoming air to be directed to the combustion area, then remixed with the ventilation air.

Summary of Demonstration Results				
	Units	New, High Efficiency Gas Heaters	Existing Gas Heaters	% Savings
Gas Consumption	Therm/HDD	1.67	2.10	20%
Source Energy Consumption	MBtu/HDD	0.19	0.22	15%
Seasonal Utility Costs	\$/Year	\$4,955	\$6,227	15%

The report indicates that the HTHV units operated at a seasonal efficiency of 90% compared to 78%-82% with unit heaters, and significantly reduced the temperature stratification between the floor and ceiling, thus improving comfort. The report documented that the HTHV units provided a 20% reduction in the amount of natural gas used compared with the unit heaters. In addition, by bringing in 100% outside air, this technology can also satisfy minimum ventilation standards for most buildings.

mally eliminates the need for additional building ventilation. It also eliminates the need for air-turnover equipment throughout the building, thus saving expense, energy and floor space.

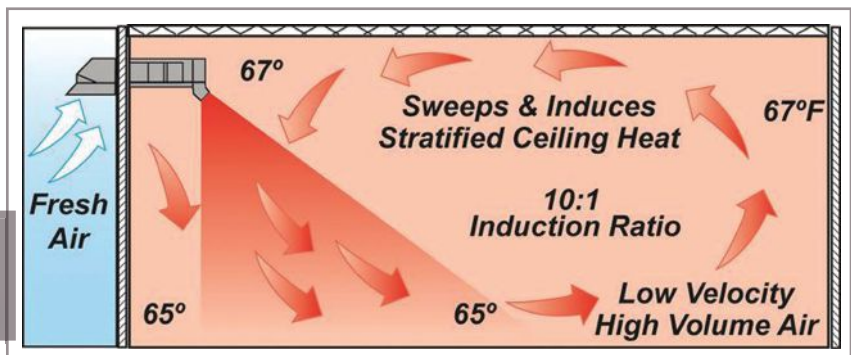
Continuous Ventilation

The unit is equipped with a fully modulating gas burner, and can be set to oper-

Unit Uses Outside Air

The HTHV unit is located externally on the building rooftop, is suspended from

HTHV units use a powerful blower to break through stratified temperature layers and achieve floor-level comfort. Illustration courtesy Cambridge Engineering.



Rooftop HTHV units save floor space and efficiently bring heated outside air into the working space. Photo courtesy Cambridge Engineering.

He indicates the two keys to this application are the high temperature air and the high velocity fan, which accomplishes the breakup of stratified layers.

Improving Comfort and Saving Dollars

An example of the benefits of the system can be found in a building operated by CJ Automotive in Butler, Indiana. According to Ron Lanning, Plant Manager at this manufacturing facility, the 154,000 sq. ft. building was built in 1954. He explains, "Our heating plant was two old boilers, quite outdated, which served radiators around the building. The system was inefficient, and there was great variation in comfort levels through the building." Another problem was that the boilers were used for heating only so we would shut them down in the summer.

He tells, "Because of our state boiler codes, we would need to do a boiler

overhaul each time we started them up in the fall at a cost of \$4,000 to \$6,000. We had to find a better system." They learned about the HTHV system and their engineer designed an installation with one large HTHV unit and two smaller ones, located outside the building along the exterior walls. The airflow was directed downward to the floor level.

Improvement in Temperature Uniformity

The installation took place in November, 2015. Lanning says, "It only took a few days, and the units were operating just when the weather got cold." Lanning is pleased with the results. "We think we're getting about a 20% reduction in energy costs, and just as importantly, the building is a lot more uniform in temperature and comfort levels now." He also is pleased that it is no longer necessary to have an employee come in to operate the boiler before work starts, and to be in attendance as required by code. "The new system operates completely unat-

tended." Lanning also points out that the company received an Indiana Green Award for taking this energy-saving step.

HTHV units have been installed in hundreds of installations in cold-weather regions of North America, and the technology is proven to reduce energy use and increase comfort. If your high-bay buildings have some of the problems indicated here – high energy bills and complaints about uneven or poor comfort levels – the solution may now be available in the form of HTHV units. **GT**



MORE info

CAMBRIDGE ENGINEERING
www.cambridge-eng.com/hthv-energy-efficient-heating

DOE FIELD DEMONSTRATION
http://energy.gov/sites/prod/files/2014/11/f19/gas_heater_demo_report_2.pdf

Improving Water Heating for the Food Industry

Direct-Contact Systems Offer Major Savings

THE TERM “FOOD INDUSTRY” COVERS A BROAD SPECTRUM, FROM CHEESE FACTORIES TO VEGETABLE CANNERIES, from snack food manufacturers to frozen fruit and vegetable packagers. What these diverse industries have in common is the need for hot water in large volumes, at high quality levels and at dependable temperatures. Thus, when an opportunity comes to improve delivery and reduce the cost of hot water, the food industry is interested. Today's direct-contact water heating systems are such a solution.

Need Lots of Hot Water

Food processing plants are found throughout North America, from fish processors in the Northwest to citrus juice plants near the Gulf. These facilities need hot water for many process purposes, and for plant

sanitation and equipment washdown. Traditionally the hot water requirement has been met by either storage water heating systems, or even more commonly, by steam water heating units. Because of the volume of hot water used, it is worthwhile to look for alternative methods that are more efficient and can produce larger volumes of hot water in a shorter timeframe.

Limitations of Storage Systems

Storage water heating systems need to hold a large supply of water for periodic use, leading to storage energy losses and burner cycling while the water is being held. Further, there are energy losses at the burner, meaning that a part of the energy goes out the flue or into the surrounding spaces. Storage systems can also occupy a significant amount of floor space. Some processes may require thousands of gallons of hot water. This means a lot of storage.

Inefficiencies of Steam Water Heating

Steam water heating systems can be no more efficient than the boilers that supply the steam. They may require a large boiler to be available at times when it is otherwise unnecessary. If the boiler load is low, the unit may be operating in the least efficient part of its range. Add to this the expense of boiler maintenance, and inconvenience from periodic boiler maintenance shutdowns.

A promising opportunity for greater efficiency and a greater volume of hot water is the direct-contact water heater. Much of the technology involved in direct-contact water heaters was developed in the 1970s and 1980s. These sys-

tems are especially attractive for industrial users because they reliably generate large volumes of hot water at nearly 100% efficiency.

Flue Gas Heats Water Directly

Direct-contact systems are usually natural gas-fired and typically drive the hot flue gases from the burner up through a vessel filled with heat exchange elements – metal rings, balls, or other elements with high surface content. The water to be heated is sprayed downward through this vessel and the heated water accumulates in a collection area in the bottom, from which it is pumped to the point of use.

Usually there is no direct contact between the combustion flame and the water. Individual units can range in size from 50 gallons of hot water per minute to several thousand. Of course, multiple units can be installed for operations needing more hot water.

Owners Often Surprised

Armstrong International is one of the major manufacturers of direct-contact water heaters. Cam Spence, from Armstrong, points out that the food industry is a major potential beneficiary of these systems. Spence notes, “The majority of food industry customers requiring large volumes of hot water will use steam to meet that requirement. Depending on the type of food they process, and the hot water volume required for process and sanitation loads, the customer is often shocked to find out that 35% or more of the steam they produce goes to generate hot water. In some food industry segments, up to 80% of steam usage is dedicated to this.”

Spence explains that depending on the age of the boiler and the condition and type of heat transfer equipment, the fuel to hot water efficiency can be low. “Efficiency of 50-60% is common with even the best maintained steam boiler systems. The reason is the inherent energy losses in these



This direct-contact water heating unit is installed on the floor of a bottling plant, the type of industry that needs plenty of hot water for washdown and sanitation. Photo courtesy Armstrong International.

ARMSTRONG INTERNATIONAL
www.armstronginternational.com

CANADIAN FOOD INSPECTION AGENCY
www.inspection.gc.ca

KEMCO SYSTEMS
www.kemcosystems.com

NSF INTERNATIONAL
www.nsf.org

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SOFAME TECHNOLOGIES
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systems.” He contrasts this with direct contact systems with 99.7% efficiency, because these units have no stack heat losses, no lost condensate, no idle run time and no radiant loss while delivering hot water on demand.

Fuel Energy Savings of 20% and More

Spence indicates that by changing to a direct-contact system, a customer can achieve 20-30% fuel energy savings. “The customer also sees reduced emissions due to the combustion efficiency of a direct-contact system.” Spence adds that by eliminating boiler use for water heating, the customer can reduce boiler load swings during plant cleanup and sanitation cycles. This also means improved boiler efficiency.

Another prominent manufacturer of direct-contact systems is Kemco Systems, which offers direct-contact units ranging in

output from 65 gpm to 850 gpm. According to Kemco Systems Vice President and spokesperson John Pabalan, direct-contact systems are not only far more efficient, but they also are not as complex as traditional boiler water heating systems. He adds that because the units operate at atmospheric pressure, the requirements of boiler codes for inspection, overhauls, and attended operation usually do not apply.

Can Supply Large Volumes

Pabalan points out that in a typical food plant where USDA sanitation requirements must be met, sanitation is commonly completed in an off-shift from production, usually third shift. He notes, “When facilities are

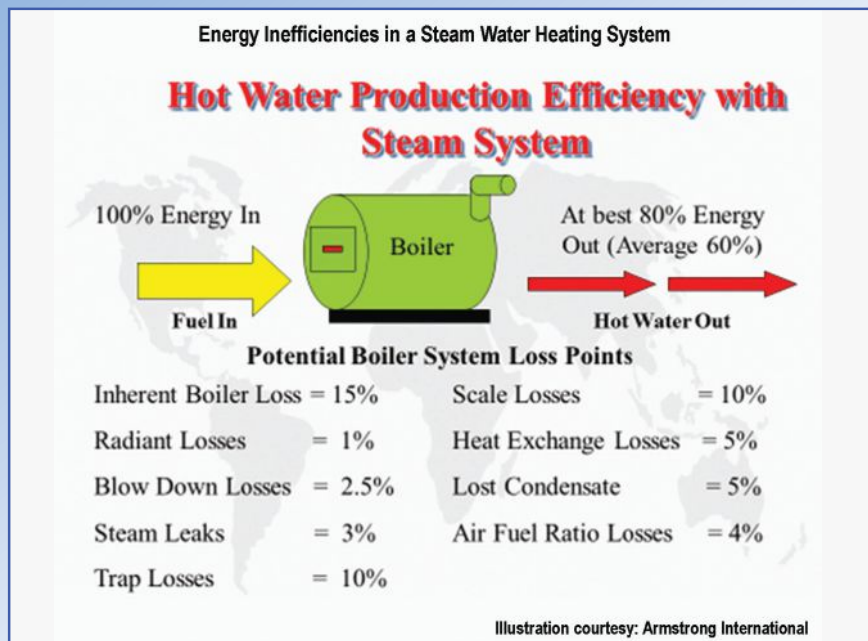
set up to operate like this, the direct-contact water heater can be sized to provide the high volumes of water needed for this single shift.” This allows for potentially downsizing the steam boiler to a size that will not short-cycle when steam demands are low. He adds, “It will also allow for down time for the boiler for potential maintenance.”

In some food processing plants, partially preheated water may be available from boiler and thermal oil heating system flues or other sources. This water can also be used in the direct-contact system to be heated to the necessary final temperature. Commonly, direct-contact water heaters are sized for either a 100 degree or 130 degree temperature rise.

Help for Selecting Systems

An owner interested in evaluating direct-contact systems should seek guidance from an engineer or consultant familiar with these system. Pabalan from Kemco and representatives of other companies state that their firms can also provide guidance on sizing, system configurations, and can help calculate potential savings from converting to this technology.

Food processors in the U.S. and Canada must adhere to USDA, CFIA or NSF International (formerly National Sanitation Foundation) codes and practices for assuring quality of water used in both plant sanitation and in food processes. Most manufacturers can provide information and verification of suitability for all of their direct-contact water heaters under the applicable codes. Owners should verify this information before installing a system. **GT**



For installations requiring very large volumes of hot water, multiple units can be installed. Photo courtesy Kemco Systems.

Gas Cooling Makes More Sense than Ever

Time to Take Another Look

NATURAL GAS POWERED COOLING IS MAKING A NAME FOR ITSELF.

Advantages include high reliability, elimination of costly electric demand and energy charges, and an opportunity to use the byproduct heat for a variety of applications. Owners who considered the natural gas option ten or fifteen years ago are advised to take another look. Today's low and stable natural gas prices make it an attractive option in many ways.

Shortcomings of Electric Systems

The traditional technology for cooling large industrial and institutional spaces has long been electric compression technology, often using chillers or rooftop air conditioning units. Such systems use large, usually three-phase motors to power refrigerant compressors – centrifugal, screw, scroll or reciprocating types. Of concern is the steadily increasing expense of electric utility energy and demand charges. Many utilities have higher demand charges during peak air conditioning seasons.

On the other hand, new technologies for natural gas production and extended pipeline capabilities have led to comparatively low and stable prices for natural gas for more customers than ever before. As a result, building owners should be asking about the natural gas cooling option, particularly for large facilities.

The Absorption Solution

One approach is absorption chillers supplied with hot water or steam produced by natural gas. Many institutional and industrial sites have extensive boiler capacity. Often there is considerable excess capacity during months when cooling is needed. An example might be a healthcare facility or university that has a boiler plant primarily for space heat during the winter months, but boilers are running at low and often uneconomical rates during the cooling season. It makes good sense to direct this steam or hot water capacity to appropriately sized absorption chillers.

Absorption chillers can supplement or

even replace electric chillers at significantly lower operating costs. Costs for boiler capacity and annual boiler maintenance may be the same or lower than before because the boilers are running at steadier and more economical load levels. Industrial plants may also be able to capture otherwise-unused byproduct heat from industrial processes. This also can be directed to single-effect absorption chillers to supply some or all of the cooling for the site.

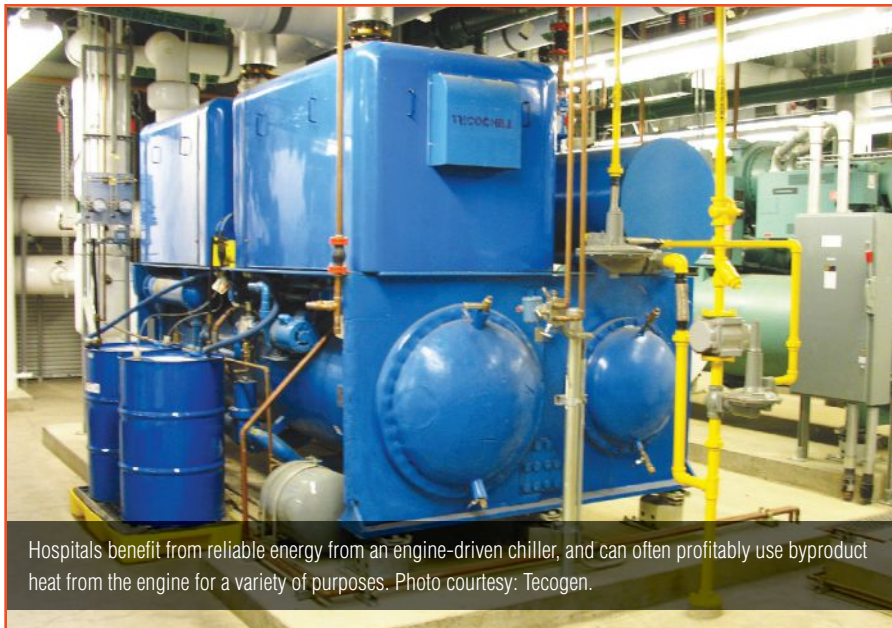
Engine-Driven Chillers

Another approach is to use a natural gas-fired engine-driven chiller to produce chilled water for building or campus cooling. These usually take the form of a packaged unit with a rugged reciprocating engine driving a reciprocating or screw-type refrigeration compressor that feeds refrigerant-to-water heat exchangers for chilled water supply. One of the leaders in this market is Tecogen, a U.S. company that serves a global market for packaged engine-driven chillers. Tecogen offers water-cooled TECOCHILL® engine-driven chillers in sizes from 150 to 400 tons, and air-cooled TECOCHILL chillers in sizes of 25 and 50 tons.

Jeffrey Glick is the Vice President of Sales for Tecogen, and he points out some of the desirable features of these products. "Many owners are concerned about the high and rising levels of electric energy and demand charges. A good part of the site electric use is for cooling. By going to an engine-driven chiller, that expense is dramatically reduced." He points out that many areas in the Northeast and on the West Coast face very high rates, and these are ideal regions for water-cooled engine-driven chillers.

Byproduct Heat a Bonus

Glick adds, "Ours is the only packaged engine-driven chiller with full maintenance support around the world." He notes that the water-cooled units have great potential for recovery of engine heat for other uses



Hospitals benefit from reliable energy from an engine-driven chiller, and can often profitably use byproduct heat from the engine for a variety of purposes. Photo courtesy: Tecogen.



Direct-fired absorption chillers are an ideal solution for many industrial and institutional applications. This series of direct-fired chillers from Broad U.S.A. is available in sizes from 40 to 3,300 tons and also provides heating and hot water. Photo courtesy: Broad U.S.A.

in the manufacturing plant or institutional facility, making energy efficiency even more dramatic. "These units can produce hot water at temperatures as high as 230° F, making them ideal sources of hot water for laundry systems, food processing and cleanup, dormitories and hotels, and other institutional uses. That hot water can also be used in many industrial applications." Glick notes that industries such as plastics, pharmaceuticals, dairy processors, and many others are successfully using hot water provided by their engine-driven chiller plant.

The smaller air-cooled chillers meet several special needs. Glick explains, "I call them 'problem solvers.' He points out that many sites do not have access to three-phase electric power in the levels needed to drive electric chillers, and the cost to develop this service is very high. "The solution in many cases is to install one of the air-cooled engine chillers. You can add major chiller capacity to a site without the need to install or upgrade a costly three-phase service, or pay increased electric energy and demand charges."

On-site Generation

A third potential solution is to power existing electric cooling equipment with your own on-site generation. A growing number of industrial and large commercial customers are taking this route, often with natural gas-fired engines or microturbines. An additional benefit is again the ability to use the byproduct heat from generation to supply other essential site operations including process hot water or steam, domestic hot water, or even an absorption chiller. Because you own the system, those

high summer demand charges will be vastly reduced or eliminated.

The Hybrid Solution

A recent presenter at a Technology & Market Assessment Forum (TMAF) sponsored by the Energy Solutions Center was Doug Davis, Marketing Director for Broad U.S.A., Inc., a major manufacturer for absorption chillers. Broad offers single-effect, double-effect and direct-fired absorption chillers in the North American market. Davis emphasized the growing interest in what is sometime called CCHP (combined cooling heating and power), or tri-generation. In these applications, an engine or turbine drives a generator and the byproduct engine or turbine exhaust heat is used for building heat, domestic hot water, and is also directed to an absorption chiller for chilled water cooling.

Davis noted the resurgence of interest in CCHP applications beginning in about 2010

because of the attractive price of natural gas, along with the development of advanced absorption chiller designs with higher efficiencies and sophisticated digital controls. He gave numerous examples of universities, data centers, retail centers, hotels and industrial campuses. He noted that single-effect absorbers are usually chosen for low-grade heat sources such as engine generators,



In areas where central station power is unreliable or very expensive, facilities such as this manufacturing plant benefit from cooling from multiple engine-driven chillers on site. Photo courtesy: Tecogen.

while double-effect machines are commonly used with gas turbine exhausts.

Selection Based on Heat Grade

He also noted that a lower-grade heat source can also pre-heat incoming flows for a direct-fired chiller, thus reducing chiller fuel costs. Another attractive feature is that the low electric energy requirement for an absorption chiller is ideal for applications that might need a black-start capability.

Owners with major cooling loads, whether for comfort or process applications, today have a range of choices for natural gas-fired sources. Engine-driven chillers, steam or hot water absorption, tri-generation, or other sophisticated hybrid systems offer a range of alternatives to electric cooling. Ask your consulting engineer for an up-to-date review of the possibilities. **GT**

MORE info

ENERGY SOLUTIONS CENTER LINKS TO GAS COOLING OPTIONS
www.gasairconditioning.com

BROAD U.S.A.
www.broadusa.com

U.S. DOE INFORMATION ON ABSORPTION COOLING
<http://energy.gov/eere/energybasics/articles/absorption-cooling-basics>

TECOGEN
www.tecogen.com

NATURAL GAS SUPPORTS PLASTICS INDUSTRIES

Significant
Growth for Next
Decade

THE PLASTICS INDUSTRIES IN NORTH AMERICA DEPEND ON A RELIABLE AND ECONOMICAL STREAM OF NATURAL GAS AND NATURAL GAS LIQUIDS, both for feedstock, and as an energy source to operate plastics plants. As a result of the growing domestic production of natural gas from shale-gas areas and other sources, this economical feedstock is assured well into the future. That expansion means jobs and export markets for U.S. and Canadian plastics industries.

Demand Continues to Expand

Though plastics have been manufactured for more than 100 years, the truly significant expansion of the industry took place after World War II. Today plastics are widely used for packaging, housewares, home construction, plumbing, toys, and in a growing number of applications, in automobiles. They touch everything we

do, and have often replaced many other materials. This widespread usage is possible because of the vast range of properties that can be developed in plastics, including heat resistance, thermal insulation, rigidity, flexibility, and the ability to be formed into a wide variety of shapes and textures.

In North America, the primary feedstocks for most plastics are petrochemicals made from natural gas liquids. Natural gas liquids are refined from raw natural gas. Some of the most important ones are propane and ethane. In other parts of the world, petroleum is the major feedstock. Increasing production of natural gas with newer technologies including directional drilling and fracking means supplies of natural gas liquids are increasingly available and affordable. The beneficiaries include our plastics industries.

A Two-Stage Industry

The American Chemistry Council recently published a report titled “The Rising Competitive Advantage of U.S. Plastics.” The report points out that generally there are two phases to plastic manufacturing, plastic resin production, and plastic product fabrication. In the first stage, building block chemicals like propane and ethane are used to produce propylene- and ethylene-based plastic resins. These are used to form long chemical chains called polymers. Each

polymer has unique performance characteristics – strength, permeability, thermal resistance, etc.

One of the most widely used intermediate chemicals in resin production is ethylene, which is used to create polymer resins such as polyethylene and polyvinyl chloride (PVC). In 2014 the U.S. produced nearly 25 million metric tons of ethylene and the number is expected to grow in coming years. The report states, “The reason is simple: because of shale gas, it is more cost effective to produce ethylene in the U.S. than just about anywhere else in the world.”

Lower Resin Costs Favor Domestic Production

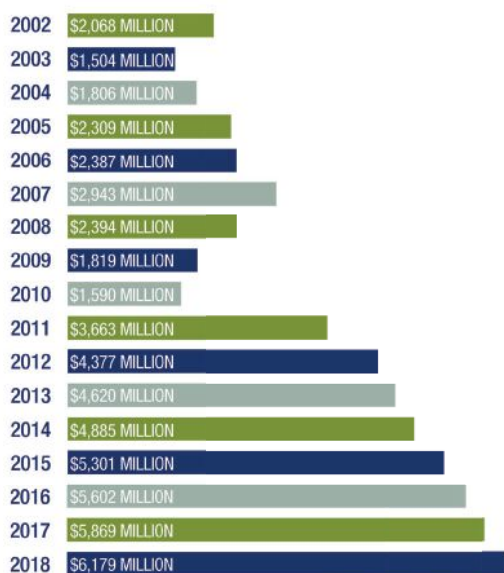
Typically, the polymer resins are shipped to domestic plastic fabrication companies that further manipulate the resins to form specific plastics and plastic products. Because the feedstocks are widely available and favorably priced, these companies often have a competitive advantage over offshore competitors. In addition to these domestic plastic product producers, the resins are also shipped to plastics manufacturers around the world.

In a recent presentation at a Technology & Market Assessment Forum (TMAF) sponsored by the Energy Solutions Center, Harry Moser, from ReShoring Initiative, gave a presentation on companies choosing to bring offshore manufacturing back to North America. One of the examples he cited was the decision by The Dow Chemical Company to restart a plant in St. Charles, Louisiana, and to build a new facility in Freeport, Texas.

Plants Return to North America

The plants will be used to manufacture ethylene and propylene for plastics feedstocks and other uses. These production facilities had previously been in Saudi Arabia, and the return to North America

Growing Capital Investment in U.S. Manufacturing



Source: Census Bureau, ACC

Used by permission of the American Chemistry Council

could result in as many as 35,000 new jobs. He indicated that a primary reason for the move is the availability of low cost and abundant natural gas. Moser indicated that chemical and plastics industries are today among the primary targets for reshoring initiatives. According to Moser, the peak years for chemical industry domestic capital investment will be 2017 and 2018, with continued major new investment for the decade beyond.

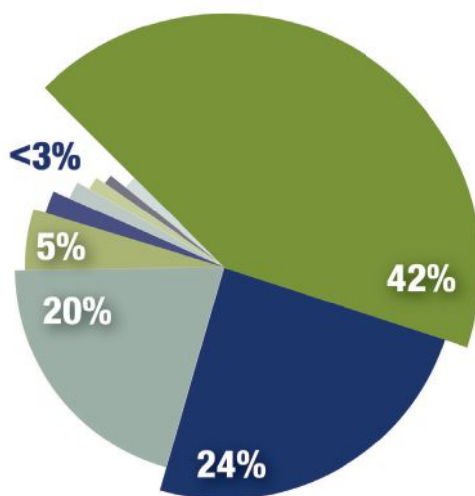
The American Chemistry Council report notes that the plastics industry has announced or anticipates nearly \$47 billion in total U.S. investments to come on-line by 2020. This includes an estimated \$25 billion in new capacity to produce plastics resins, and \$19 billion in increased capacity to process plastics materials. More than 460 plastics processing projects have been announced so far in 40 states, with numerous projects in Indiana, Michigan, Ohio, Wisconsin, Texas and Illinois.

Related Industries Thrive, Too

The ACC report points out that since this growing stream of resins must be processed, they also expect growth in industries that produce plastics additives, colorants as well as plastics-making machinery, injection molds and related products. The



Key End Use Markets for U.S. Thermoplastic Resins



Note: Excludes Exports

Used by permission of the American Chemistry Council

report summarizes, "All told, the effects of the manufacturing renaissance on the U.S. plastics industry will be substantial and far-reaching."

Plastics processors place very high priority on a totally reliable supply of electric power for machinery for rolling, forming, extruding, and expanding plastic materials. Even a short power interruption will cause waste of production material and problems with materials already in process. For this reason, most facilities have standby generation, usually natural gas-fired engines or microturbines.

Opportunity for CHP

In addition to standby generation, there is growing interest in the concept of combined heat and power (CHP). Here the onsite generation is the primary electric source, and the system captures the byproduct heat from natural gas engines or turbines for use in the manufacturing stage, or to supply absorption cooling for the plant. In this way the overall efficiency of the fuel use is dramatically increased. Today the primary fuel for CHP is natural gas.

Huge Export Potential Cited

The plastics industry is an underappreciated success story in the United States. The American Chemistry Council report indicates that plastics are expected to become a major U.S. export driver in the coming decades, with net exports expected to triple by 2030, growing from \$6.5 billion in 2014 to \$21.5 billion by 2030. Plastics: They're part of our future, and natural gas is making it possible. **GT**

MORE info

AMERICAN CHEMISTRY COUNCIL
www.americanchemistry.com

CANADIAN PLASTICS INDUSTRY ASSOCIATION
www.plastics.ca

RESHORING INITIATIVE
www.resshorennow.org

FULL REPORT ON THE RISING COMPETITIVE ADVANTAGE OF U.S. PLASTICS

<http://plastics.americanchemistry.com/Education-Resources/Publications/The-Rising-Competitive-Advantage-of-US-Plastics.pdf>

Lower Your Operating & Maintenance Costs



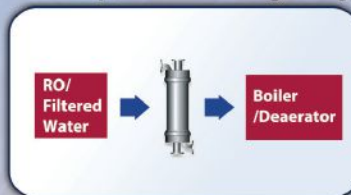
Compact, Modular Design
14-inch Industrial Deaeration System

Liqui-Cel® Membrane Contactors are used around the world to remove dissolved gases from water. They are capable of achieving $< 1 \text{ ppb O}_2$ and $< 1 \text{ ppm CO}_2$. Removing the oxygen and carbon dioxide can reduce deterioration of boilers and piping due to corrosion. Chemical usage may also be reduced which can decrease the blow down frequency due to scaling from chemical deposits. Carbon dioxide removal can improve efficiency and reduces chemical consumption in mixed bed or EDI technologies.

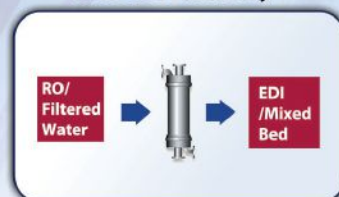
Deoxygenating HRSG feedwater during layup & start-up can prevent costly maintenance and downtime.

- **Quick start-Up**
- **Deoxygenation at ambient temperature - Energy Savings**

Chemical Free Make-up/Feedwater Degassing



Increase Efficiency



- **Alleviate Pitting and Corrosion**
 O_2 removal in feedwater and make-up loops
- **Improve Ion Exchange Efficiency**
 CO_2 removal to reduce mixed bed regeneration frequency
- **Minimize Chemical Use**
Reduce employee exposure and lower disposal costs



Rokeby Generating Station Saves 50% in Capital Expense by Using Liqui-Cel® 14x28 Membrane Contactors to Remove CO₂ to Extend Mixed Bed Resin Life

THE ROKEBY GENERATING STATION IS LES' PRIMARY PEAKING POWER STATION, totaling 255 MW and consisting of 3 dual fuel combustion turbines. The existing DI water system consisted of two single-pass, two-stage RO skids followed by a 31 ft³ (0.87 m³) mixed bed deionizer and two 250,000-gallon (943 m³) storage tanks.

LES determined that the mixed bed unit was producing only 30% of its expected capacity (90,000 gallons actual vs. 300,000 gallons expected or 341 m³ actual vs. 1136 m³ expected). It was determined that the cause of the decreased capacity was due to dissolved CO₂ in the water, which was overloading the anion resin. As the power capacity demand increased, LES had to act quickly to update their winter contingency plans.

System Design

In 2005, LES began engineering a membrane decarbonation system using Liqui-Cel® 14x28 Membrane Degasifiers. The system was designed to treat the combined water flow from both RO skids, approximately 150 GPM (0.6 m³). The

goal was to achieve approximately 90% reduction of dissolved CO₂. Additionally, the system was designed to operate with vacuum assisted air sweep, using a liquid ring vacuum pump to draw atmospheric air through the Liqui-Cel Membrane Contactors.

Since the LES staff was able to design, fabricate, and install the Liqui-Cel degassing system, the total capital cost was approximately 50% less than the cost of a forced draft degasifier. The compact design also allowed LES to build the system inside of an existing building with minimal modification. The low system pressure drop through a Liqui-Cel Membrane Contactor system also eliminated the need for a re-pressurization pump further lowering operating costs for LES.

Test Set Up

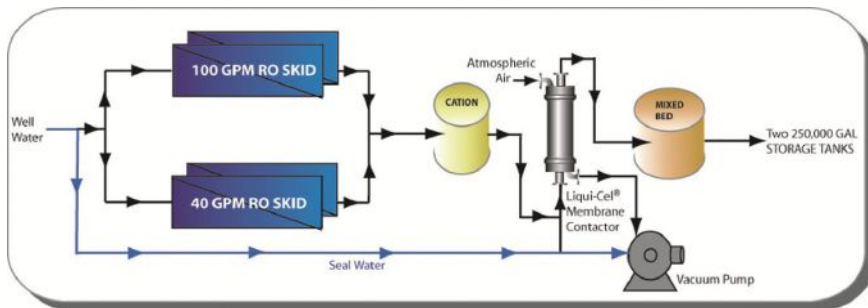
LES expected to achieve 138,000 to 168,000 gallons (522 m³ – 636 m³) throughput with this design. They actually achieved 191,000 gallons (725 m³). Specific conductivity was 0.5 µS/cm and



silica was 7.5 ppb. LES estimates the full-scale capacity will be approximately 617,000 gallons [(32 ft³ / 9.9 ft³) * 191,000 = 617,374 gallons (2337 m³)]. This represents an increase in the total capacity of the system by a factor of 5.9.

Summary

Liqui-Cel Membrane Contactors offer a cost-effective, efficient option for removal of carbon dioxide from process water. Removal of carbon dioxide prior to the mixed bed resins significantly improves regeneration times, thereby reducing operating costs and improving overall efficiency by minimizing downtime.



DISTRICT ENERGY BRINGS OPPORTUNITIES

Shared Savings for Building Owners

DISTRICT ENERGY IS NOT A NEW IDEA. BY CENTRALIZING THE HEATING AND COOLING FUNCTIONS FOR MULTIPLE BUILDINGS IN A SINGLE PLANT, owners can take advantage of larger and more efficient generation equipment, and can eliminate the need for heating and cooling plants in each building. According to the International District Energy Association, one of the first district heating systems in North America was a multi-building steam system installed at the U.S. Naval Academy in Annapolis in 1853. The concept of district heating, and eventually district cooling, spread around the world in the 20th century.

Central Plant Efficiencies

District systems are widely used in many countries for colleges and universities, for medical and industrial campuses, and for multi-unit residential or commercial developments. This approach is taken to benefit from larger, more efficient boilers and chillers, and for increased reliability by virtue of having multiple heating and cooling units available. Owners like not having to commit building space to boiler rooms and chill-

er plants. In earlier years, there were occasional problems with steam pipe leaks from concrete and rusting iron pipes. Today's insulated plastic and high strength steel pipes virtually eliminate that problem and are resistant to problems from aging, frost and even earthquakes.

An example of a successful mid-sized district energy system is at Utah State University, installed in 2004. Here a single Solar gas turbine rated at 4.5 MWe supplies half of the energy for the entire campus, and reduces the campus energy demand by one-third. The system was described by Charles Darnell of the University at a recent Technology & Market Assessment (TMAF) sponsored by the Energy Solutions Center.

Darnell explained that the turbine exhaust goes to a heat recovery steam generator (HRSG) and provides steam heat for most of the school's main campus, and overall meets 40% of the total thermal requirements. Darnell indicates that the University continues to look at possible campus cooling applications using byproduct heat as well. Another article in this issue discusses gas cooling

options and many of these fit well with a district energy system.

Making CHP Practical

Combined heat and power (CHP), the useful application of byproduct heat from on-site electric generation, is an important national energy goal and is seen as an important strategy for reducing greenhouse gas emissions. The more efficient the energy use, the fewer emissions are created. Hundreds of new CHP projects are commissioned every year.

Yet in many cases, a roadblock to a successful CHP project is that individual sites may not have a simultaneous need for electric power and the heated water it can create. A valuable solution is to broaden the number of facilities served, so opportunities for using the heat and power simultaneously are expanded.

An example might be a college dormitory that needs both electric power and space heating. But during summer months, there is no need for much of the heat produced.

Steel casing was hammered through the ground to create a tunnel for running the district heating pipeline under the Canadian National Railway yard. Courtesy: FVB Energy Inc. Photo: Sean Casey, scasey@fvbenergy.com



District energy piping was installed under the Canadian National rail yard in a 36-inch steel casing pipe. Specially designed casing spacers were used to carry and guide the two supply and return pipes, allowing each to thermally expand. Communication conduit was also run through the casing. Courtesy: FVB Energy Inc. Photo: Sean Casey, scasey@fvbenergy.com

Installed with the CHP upgrade, Texas A&M's steam turbine generator 2 (STG2) is an 11 MW unit with 600 psi inlet and 20 psi exhaust.

Courtesy: Jacobs®Thomas McConnell.

Permission contact: Kevin Fox, Jacobs, Kevin.Fox@jacobs.com

However, if the system is expanded to the entire campus, the byproduct heat might also be used for laundries, laboratories, absorption chillers for cooling, food preparation, gymnasium showers, swimming pool heat and janitorial needs. The heat usage curve is smoothed and CHP becomes more practical.

Multi-Owner Markets

An area of increasing interest for district energy is urban and suburban multi-owner markets. This is not a new idea. For example, the City of New York steam network serves hundreds of owners. Although there are many examples of successful urban district energy systems, this has been a challenging market for developing new district systems. Multiple owners have differing project payback requirements, and there are situations where the party that owns the building doesn't pay the utility bills, so there is less incentive to

join a new district system. Yet the advantages become clearer each year.

In addition to the dollar savings from larger, more efficient units and more complete utilization of the energy used, the district approach can also mean significantly lower carbon emissions and other atmospheric emissions. Many of the successful new district energy systems are in urban redevelopment projects, where all the owners are occupying new or remodeled facilities, and as a group are committed to energy efficiency. Building certification programs such as the LEED program from the U.S. Green Building Council give special credits to owners for participating in district energy projects.

Getting Started with District Energy

Whether you are a single entity that operates a multi-building campus or a single building owner looking for ways to

increase your building energy efficiency, a district energy approach may be attractive. The International District Energy Association recently merged with the Canadian District Energy Association, and is a tireless advocate for these technologies. The association offers training programs, public speakers, and a wealth of knowledge and experience with district energy programs around the world. It's a good source for help in getting started. **GT**

A backup low-pressure boiler was installed to provide 60 psi steam for campus distribution and 20 psi steam for campus heating as backup for high-pressure (600 psi) boilers.

Courtesy: Jacobs®Thomas McConnell.

Permission contact: Kevin Fox, Jacobs, Kevin.Fox@jacobs.com



MORE info

ENERGY SOLUTIONS CENTER
INFORMATION ON ENERGY RESOURCES
www.energysolutionscenter.org

INTERNATIONAL DISTRICT ENERGY
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Recirculation (80/20 — pressurization)	20% to 50%

**Some building studies show more energy savings than listed above*

