ASHRAE La Crosse Area Chapter

"We shape our buildings; thereafter they shape us."
-Winston Churchill.

2015-2016 Officers:

President
Eric Sturm
Trane
3600 Pammel Creek Road
La Crosse, WI 54601
PH (608) 787-3736

Secretary
Kit Fransen
Trane
3600 Pammel Creek Road
La Crosse, WI 54601
PH (608) 787-2724

Treasurer
Nick Cavitt
Trane
3600 Pammel Creek Road
La Crosse, WI 54601
PH (608) 787-2715

Board of Governors
Jake Beran
HSR Associates, Inc.
100 Milwaukee Street
La Crosse, WI 54603
PH (608) 785-4709

Austin Kaiser
Trane
3600 Pammel Creek Road
La Crosse, WI 54601
PH (608) 787-3709

Charles Jelen
Trane
3600 Pammel Creek Road
La Crosse, WI 54601
PH (608) 787-3238

April 28, 2016
Sherm Sweeney
ASHRAE Region VI Regional Historian

Dear Mr. Sweeney,

I am enclosing the La Crosse Area Chapter's 34th entry for the Gold Ribbon and Lou Flagg award. The La Crosse Area Chapter, 115, is pleased to present the history of absorption chiller manufacturing in La Crosse, WI.

Almost 60 years ago, the Trane Company began manufacturing absorption chillers in La Crosse, Wisconsin. The product was one of the flagship products in La Crosse manufacturing until 2008, when production stopped. At that time, La Crosse had shipped over 10,000 absorbers for commercial, industrial and process applications worldwide.

I would like to thank all the people who helped me with researching and writing this history article. In particular, I would like to acknowledge Jerry Qualman, Andy Nordeen, Dennis Justin, John Szymanski, and Eric Sturm. Their expertise has been invaluable in forming this history submission.

John L. Sustar
Historian
La Crosse Area Chapter

ASHRAE History of a System:
Absorption Chiller Manufacturing in La Crosse, WI

Almost 60 years ago, the Trane Company began manufacturing absorption chillers in La Crosse, Wisconsin. The product was one of the flagship products in La Crosse manufacturing until 2008, when production stopped. At that time, La Crosse had shipped over 10,000 absorbers for commercial, industrial and process applications worldwide. These chillers are more expensive, heavier, less efficient, and require more experienced service personnel as compared to conventional electric chillers, which begs the question: why would anyone purchase an absorption chiller? The answer is that given the right application, absorption chillers make economic sense.

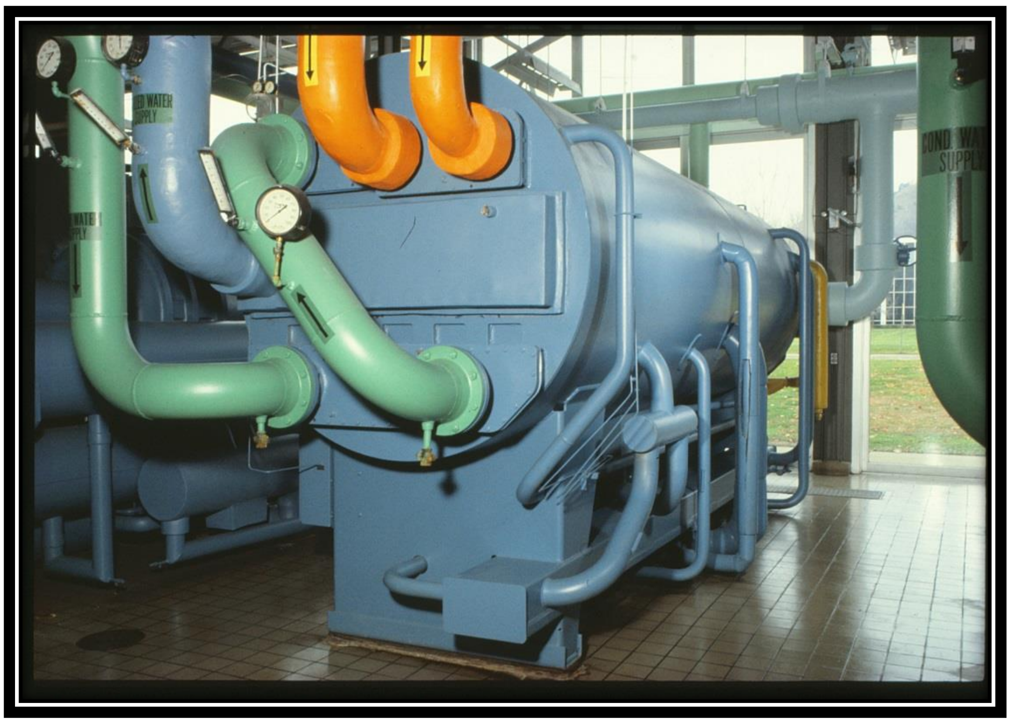

Figure 1. Absorption chiller providing chilled water in the Rueben Trane Building

How is it possible that absorption chillers make chilled water with hot steam? Contrary to theories that absorption chillers work on magic, absorption chillers make use of a liquid desiccant, a pump and a vacuum to make chilled water from hot steam, waste heat, or heat via combustion of fossil fuels. Compared to the vapor compression cycle found in direct expansion and electric chiller equipment, there are two major differences with the absorption cycle. First, the electric compressor is replaced by an absorber, pump, and generator. The pump is the only mechanical component in the absorption chiller, which means it offers great reliability. Second, in addition to the refrigerant, there is an absorbent that carries the refrigerant from the low pressure side (evaporator) to the high pressure side (condenser) of the absorption chiller. The refrigerant commonly found in large commercial chillers is water and the absorbent is lithium bromide salt.

Figure 2 shows the refrigeration cycle for absorption chillers. Refrigerant enters the evaporator in the form of a cool, low-pressure mixture of liquid and vapor (see point A). Heat is transferred from the evaporator entering water to the refrigerant, causing the refrigerant to boil. The absorber acts like the suction side of a compressor. It draws in the refrigerant vapor (B) to mix with the liquid absorbent (lithium bromide). Acting like a compressor, the pump displaces the mixture of refrigerant and absorbent from the low pressure side to the high pressure side of the chiller. The mixture goes to the generator, which is heated by gas combustion or steam, where the water refrigerant is driven out of the absorbent. The refrigerant moves to the condenser to be cooled back down and condense into a liquid, typically using cooling tower water, while the absorbent returns to the absorber (C). This liquid refrigerant (D) then flows to the expansion device, which creates a pressure drop that reduces the pressure of the refrigerant. The resulting mixture of liquid and vapor refrigerant returns to the evaporator to repeat the refrigeration cycle.

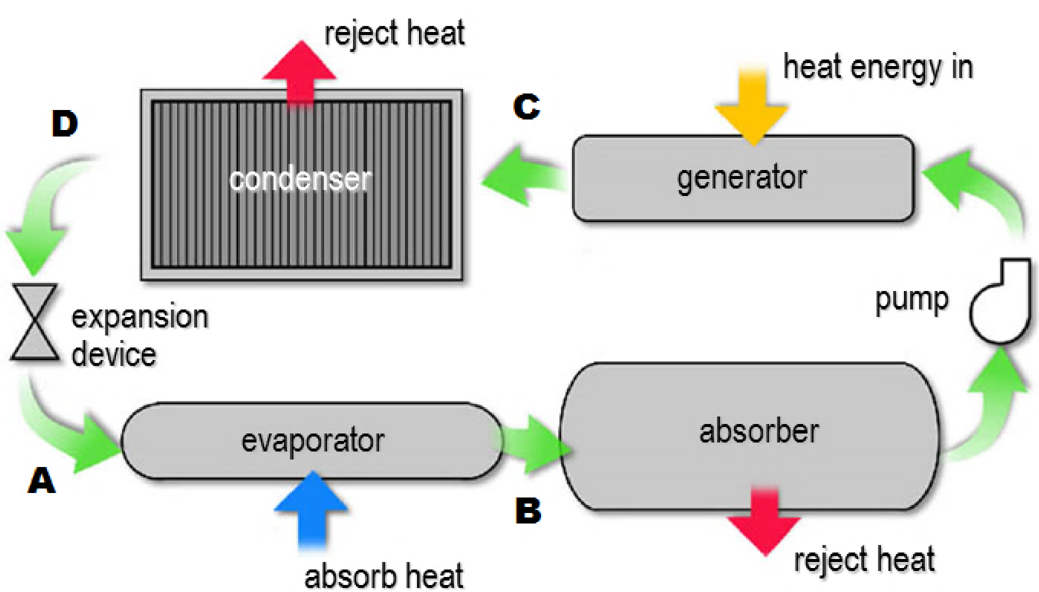

Figure 2.Refrigeration cycle for absorption chillers (©2016 Trane a business of Ingersoll Rand).

Absorption refrigeration was first discovered over 150 years ago by two French brothers, Ferdinand and Edmond Carre. Shortly after their discovery, Carre received the first U.S. patent for a commercial absorption refrigerator. Their design patent specified a mixture of water and sulfuric acid as the unit's refrigerant. In the early 20th century, absorption refrigeration machines were being designed with a mixture of water and ammonia as the refrigerant. In the 1920s, Baltzar von Platen and Carl Munters, two Swedish engineering students, invented the first gas-fired absorption refrigerator. In 1925, their design was purchased by Electrolux, an appliance manufacturer, and made commercially available as a residential appliance from 1926 through the 1950s.

In air conditioning applications, Carrier was the first to commercialize the absorption chiller in the 1940s. During the 1950s, single stage absorption chillers for air conditioning were becoming more popular. With the increase in demand, the Trane Company began developing an absorption chiller in the mid-1950s. In 1959, Trane manufactured its first single stage absorption chiller, dubbed the Trane Absorption Cold Generator, in La Crosse, WI. In the 1960s, new absorption cold generators as large as 1,500 tons were manufactured.

In 1973, at the February Air-Conditioning, Heating, and Refrigerating Exposition in Chicago, Trane announced a two-stage absorption cold generator that was 40 percent more efficient than the single stage unit. At this time, absorption comprised close to 30% of the total large chiller market. Incidentally, 1973 was the same year when the world experienced an energy crisis with the Organization of the Petroleum Exporting Countries (OPEC) imposing an oil embargo. Following the embargo, fossil fuels were no longer the energy source of choice to power chillers. Throughout the 1970s, Trane was the only U.S. manufacturer to remain in the absorption market. All other U.S. manufacturers ceased production due to the decreased market demand.

During the 1970s and early 1980s, the Japanese market for absorption increased, and Japanese manufacturers began to heavily invest in the technology. By the late 1980s, Japanese absorber exports were reaching the United States. Trane noticed the value in sourcing Japanese products and brand-named a Kawasaki Thermal Engineering direct-fired absorption chiller in 1991 that could do heating, cooling, or simultaneous heating and cooling with an auxiliary bundle. According to Andy Nordeen, Product Support Engineer at Trane, one of the biggest problems with Kawasaki chillers was that they had a 20 to 30 week ship cycle because they were imported from Japan. At the same time, several other domestic chiller manufacturers began partnering with Japanese manufacturers to produce absorbers.

Direct digital controls (DDC) systems began to gain traction in the early 1990s. In 1992, Trane applied its UCP2 microcontrollers on absorption chillers, which led to greater absorption performance and reliability versus the previous pneumatic controls. According to Dennis Justin, Trane Technical

Service Engineer, the first Trane absorption chiller controlled with the UCP2 microcontroller went to a Fruit of the Loom plant in Atlanta, Georgia.

One local installation of the Trane-branded Kawasaki direct fired absorption chiller occurred at Viterbo College in its Fine Arts building in 1993. This direct-fired, double-effect absorption chiller, branded as the Trane Thermachill absorption chiller, replaced a 20 year old single stage steam absorption chiller. The two motivating factors for the customer in selecting absorption were energy cost savings, which yielded a three year payback, and the avoidance of using a chiller with CFCs as its refrigerant, which were phased out in the mid-1990s as part of the Montreal Protocol.

Several years after the Kawasaki partnership, Trane made the decision to redesign its entire product line of absorption chillers to include single stage, direct fired and two-stage steam units built in La Crosse. "In the early 1990s, it was recognized that [Trane] needed to redo the absorption product line. There were a lot of advances in technology that had taken place over the years," said Bill Plzak, Manager of Thermal Systems in Applied Systems Engineering. This redesigned product, dubbed Horizon, was introduced in 1995. According to Nordeen, "Introducing a product that was U.S. designed and built was a big differentiator with Horizon." At their largest, a 1650 ton Horizon absorption unit reached 34 feet long and weighed over 50 tons. The average absorption chiller manufactured in La Crosse weighed approximately 30 tons. Due to their size, the Horizon units arrived disassembled at the customer site, which offered a substantial advantage over other absorption machines.

In the late 1990s, two U.S. manufacturers— Trane Company and York International— participated in research and design programs aimed at producing the first triple-effect absorption chiller. The goal of this research was to produce a triple-effect chiller that improved cooling efficiency by 30 to 50 percent, compared to double-effect absorption chillers currently on the market. The research proved that they could be produced but the 25 percent price premium inhibited it from market acceptance.

In May 2008, Trane announced that the absorption manufacturing would be discontinued due to reduced demand for absorption chillers. The final unit manufactured in La Crosse was a single-stage 800 ton unit shipped to Kingston General Hospital in Kingston, Ontario.

Today, with the volatility of fossil fuel pricing, absorption chiller installations are becoming less common in North America, but may make economic sense in applications where waste heat is available or in a cogeneration system. Additionally, absorption chillers may be found in locations where it’s economical to burn fuel in a boiler, such as the Asia-Pacific region, in areas with poor electricity grid reliability, or in applications where surplus heat from solar collectors can generate sufficient heat for the absorption generator process.

Respectfully Submitted,

John Sustar
Historian Chair
La Crosse Area Chapter

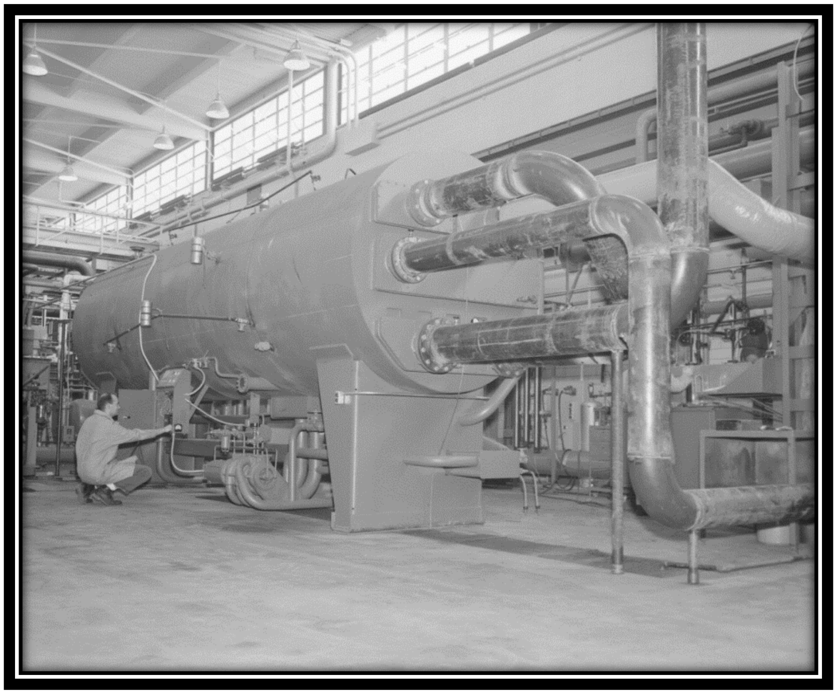

Figure 3. Trane lab employee inspects absorption chiller (December 1, 1966)

Figure 4. Trane employees tour factory (April 24, 1968)

Figure 5. Factory worker welding vessel

Figure 6. Absorption unit shipping to job site