U.S. Department of Energy - Energy Efficiency and Renewable Energy

Energy Savers

Absorption Heat Pumps

Absorption heat pumps are essentially air-source heat pumps driven not by electricity, but by a heat source such as natural gas, propane, solar-heated water, or geothermal-heated water. Because natural gas is the most common heat source for absorption heat pumps, they are also referred to as gas-fired heat pumps. There are also absorption coolers available that work on the same principal, but are not reversible and cannot serve as a heat source. These are also called gas-fired coolers.

Residential absorption heat pumps use an ammonia-water absorption cycle to provide heating and cooling. As in a standard heat pump, the refrigerant (in this case, ammonia) is condensed in one coil to release its heat; its pressure is then reduced and the refrigerant is evaporated to absorb heat. If the system absorbs heat from the interior of your home, it provides cooling; if it releases heat to the interior of your home, it provides heating.

The difference in absorption heat pumps is that the evaporated ammonia is not pumped up in pressure in a compressor, but is instead absorbed into water. A relatively low-power pump can then pump the solution up to a higher pressure. The problem then is removing the ammonia from the water, and that's where the heat source comes in. The heat essentially boils the ammonia out of the water, starting the cycle again.

A key component in the units now on the market is generator absorber heat exchanger technology, or GAX, which boosts the efficiency of the unit by recovering the heat that is released when the ammonia is absorbed into the water. Other innovations include high-efficiency vapor separation, variable ammonia flow rates, and low-emissions, variable-capacity combustion of the natural gas.

Although mainly used in industrial or commercial settings, absorption coolers are now commercially available for large residential homes, and absorption heat pumps are under development. The 5-ton residential cooler systems currently available are only appropriate for homes on the scale of 4,000 square feet or more.

Absorption coolers and heat pumps usually only make sense in homes without an electricity source, but they have an added advantage in that they can make use of any heat source. Because of this, they can make use of solar energy, geothermal hot water, or other heat sources. They are also amenable to zoned systems, in which different parts of the house are kept at different temperatures.

The efficiency of air-source absorption coolers and heat pumps is indicated by their coefficient of performance (COP). COP is the ratio of either heat removed (for cooling) or heat provided (for heating) in Btu per Btu of energy input. Look for a heating efficiency of 1.2 COP or greater and a cooling efficiency of 0.7 COP or greater.

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Reading List

- Ryan, W. (April 2002). "New Developments in Gas Cooling" (PDF 561 KB). *ASHRAE Journal*. (posted on the Web site of the Energy Resources Center at the University of Illinois at Chicago)
- Ryan, W. (April 2003). "New Applications for Gas Cooling" (PDF 1.1 MB). *ASHRAE Journal*.(posted on the Web site of the Energy Resources Center at the University of Illinois at Chicago)

- "Residential Gas Absorption Chiller Heat Pump" (PDF 143 KB). (September 2004). American Council for an Energy Efficient Economy.
- Cabage, B. (1995). "New Gas-fired Heat Pump Technologies Help Chill Greenhouse Effect." *ORNL Review* Volume 28, Number 2. Oak Ridge National Laboratory.
- Babyak, R. (29 May 2003). "Technology Update: Air Conditioning & Refrigeration." *Appliance Design*.