

# Energy Tips

Tip Sheet #14 • May 2001



Steam



Motors

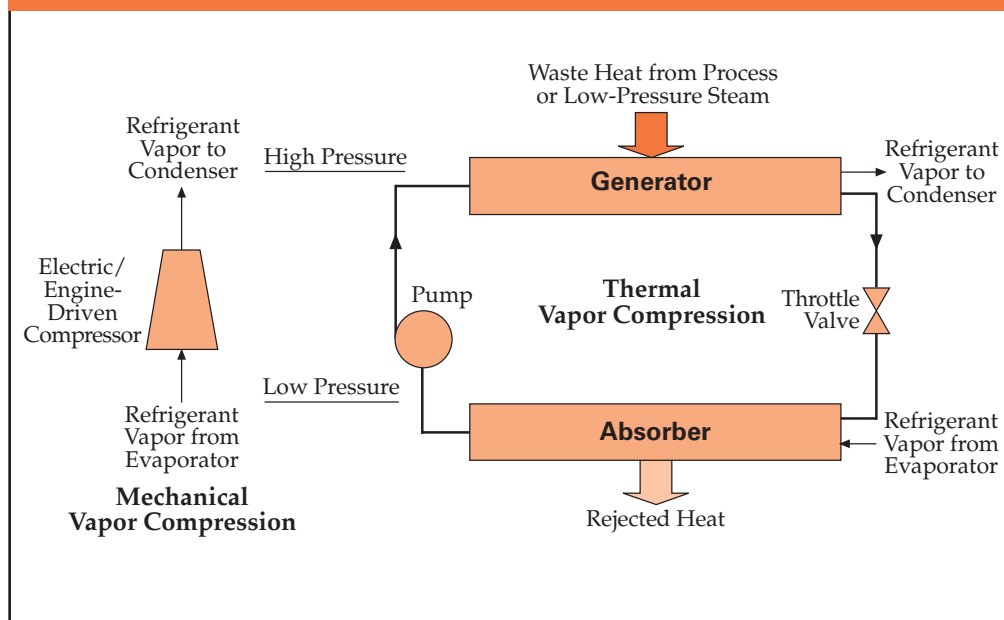


Compressed Air

## Use Low-Grade Waste Steam to Power Absorption Chillers

Absorption chillers use heat, instead of mechanical energy, to provide cooling. The mechanical vapor compressor is replaced by a thermal compressor (see figure) that consists of an absorber, a generator, a pump, and a throttling device. The refrigerant vapor from the evaporator is absorbed by a solution mixture in the absorber. This solution is then pumped to the generator where the refrigerant is revaporized using a waste steam heat source. The refrigerant-depleted solution is then returned to the absorber via a throttling device. The two most common refrigerant/absorbent mixtures used in absorption chillers are water/lithium bromide and ammonia/water.

Comparison of Mechanical and Thermal Vapor Compression Systems\*



\*The evaporator and the condenser, required for both systems, are not shown in the figure.

Compared to mechanical chillers, absorption chillers have a low coefficient of performance (COP = chiller load/heat input). Nonetheless, they can substantially reduce operating costs because they are energized by low-grade waste heat, while vapor compression chillers must be motor- or engine-driven.

Low-pressure, steam-driven absorption chillers are available in capacities ranging from 100 to 1,500 tons. Absorption chillers come in two commercially available designs: single-effect and double-effect. Single-effect machines provide a thermal COP of 0.7 and require about 18 pounds of 15-psig steam per ton-hour of cooling. Double-effect machines are about 40 percent more efficient, but require a higher grade of thermal input, using about 10 pounds of 100- to 150-psig steam per ton-hour.

### Reduce Demand Charges

Absorption chillers can reshape facility thermal and electric load profiles by shifting cooling from an electric to a thermal load. If you are served by an electric utility with a ratcheted demand charge, you may be able to reduce demand charges throughout the year by reducing your summer peak loads.

### Utility Incentives

Some gas utilities offer reduced rates during the summer. In some areas, electric utilities provide rebates or incentives to replace mechanical chillers with steam absorption units.

*Steam Tip Sheet information adapted from material provided by the Industrial Energy Extension Service of Georgia Tech and reviewed by the DOE BestPractices Steam Technical Subcommittee. For additional information on steam system efficiency measures, contact the OIT Clearinghouse at (800) 862-2086.*



## Example

In a plant where low-pressure steam is currently being exhausted to the atmosphere, a mechanical chiller with a COP of 4.0 is used 4,000 hours per year to produce an average of 300 tons of refrigeration. The cost of electricity at the plant is \$0.05 per kilowatt-hour.

An absorption unit requiring 5,400 lbs/hr of 15-psig steam could replace the mechanical chiller, providing annual electrical cost savings of:

**Annual** = 300 tons x (12,000 Btu/ton / 4.0) x 4,000 hrs/year x \$0.05/kWh x kWh/3,413 Btu  
**Savings** = \$52,740

### ***Suggested Actions***

Determine the cost-effectiveness of displacing a portion of your cooling load with a waste steam absorption chiller by taking the following steps:

- Conduct a plant survey to identify sources and availability of waste steam.
- Determine cooling load requirements and the cost of meeting those requirements with existing mechanical chillers or new installations.
- Obtain installed cost quotes for a waste steam absorption chiller.
- Conduct a life cycle cost analysis to determine if the waste steam absorption chiller meets your company's cost-effectiveness criteria.

## About DOE's Office of Industrial Technologies

The Office of Industrial Technologies (OIT), through partnerships with industry, government, and non-governmental organizations, develops and delivers advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications. OIT is part of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

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- Metal Casting
- Mining
- Petroleum
- Steel

OIT and its BestPractices program offer a wide variety of resources to industrial partners that cover motor, steam, compressed air, and process heating systems. For example, BestPractices software can help you decide whether to replace or rewind motors (MotorMaster+), assess the efficiency of pumping systems (PSAT), or determine optimal insulation thickness for pipes and pressure vessels (3E Plus). Training is available to help you or your staff learn how to use these software programs and learn more about industrial systems. Workshops are held around the country on topics such as "Capturing the Value of Steam Efficiency," "Fundamentals and Advanced Management of Compressed Air Systems," and "Motor System Management." Available technical publications range from case studies and tip sheets to sourcebooks and market assessments. The *Energy Matters* newsletter, for example, provides timely articles and information on comprehensive energy systems for industry. You can access these resources and more by visiting the BestPractices Web site at [www.oit.doe.gov/bestpractices](http://www.oit.doe.gov/bestpractices) or by contacting the OIT Clearinghouse at 800-862-2086 or via email at [clearinghouse@ee.doe.gov](mailto:clearinghouse@ee.doe.gov).



BestPractices is part of the Office of Industrial Technologies' (OIT's) Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together the best-available and emerging technologies and practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices focuses on plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small and medium-size manufacturers.

### **FOR ADDITIONAL INFORMATION, PLEASE CONTACT:**

Peter Salmon-Cox  
Office of Industrial Technologies  
Phone: (202) 586-2380  
Fax: (202) 586-6507  
[Peter.Salmon-Cox@hq.doe.gov](mailto:Peter.Salmon-Cox@hq.doe.gov)  
[www.oit.doe.gov/bestpractices](http://www.oit.doe.gov/bestpractices)

OIT Clearinghouse  
Phone: (800) 862-2086  
Fax: (360) 586-8303  
[clearinghouse@ee.doe.gov](mailto:clearinghouse@ee.doe.gov)

Please send any comments, questions, or suggestions to [webmaster.oit@ee.doe.gov](mailto:webmaster.oit@ee.doe.gov)

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Office of Industrial Technologies  
Energy Efficiency  
and Renewable Energy  
U.S. Department of Energy  
Washington, DC 20585-0121



DOE/GO-102001-1277  
May 2001  
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