

A lithium bromide absorption chiller with cold storage

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Lithium Bromide Absorption Chiller: An In-Depth Guide**

Principle of Absorption Chilling

Absorption chillers utilize the principle of vapor absorption to provide cooling. A vapor absorption machine employs a refrigerant, absorbent, and a heat source to produce a cooling effect.

How Does a Lithium Bromide Absorption Chiller Work?

1. **Absorption:** Lithium bromide (LiBr) acts as the absorbent and dissolves in water. Refrigerant (usually water) is passed through the LiBr solution, where it is absorbed.
2. **Heat Addition:** The LiBr solution, now containing the refrigerant, is heated in a generator. Upon heating, the refrigerant vaporizes and separates from the absorbent.
3. **Condensation:** The refrigerant vapor travels through a condenser, where it condenses into a liquid. This process releases heat.
4. **Expansion:** The condensed refrigerant passes through an expansion valve, where it undergoes a pressure drop. As it expands, it becomes cold.

5. **Evaporation:** The cold refrigerant enters an evaporator, where it absorbs heat from the surrounding environment and turns into vapor.
6. **Absorption (Repeat):** The vaporized refrigerant is then absorbed back into the LiBr solution in the absorber, completing the cycle.

Materials Used in Lithium Bromide Refrigeration System

- **Lithium Bromide (LiBr):** Serves as the absorbent, which dissolves in water to absorb the refrigerant.
- **Water:** Acts as the refrigerant, which is absorbed and released during the process.

Temperature Range of Lithium Bromide Absorption Chiller

- Chilled water temperature: Typically in the range of 45-55°F (7-13°C)
- Condenser water temperature: 90-110°F (32-43°C)

Advantages of Lithium Bromide

- Non-flammable and non-toxic
- Compatible with water
- High latent heat of vaporization
- Low vapor pressure at low temperatures

Hazardous Nature of Lithium Bromide

Lithium bromide is not considered a hazardous material by the EPA. However, it can cause skin irritation and respiratory problems if handled improperly.

Cold Storage Chiller Temperature

For cold storage applications, chiller temperatures are typically maintained between 32-40°F (0-4°C).

Differences Between Absorption and Centrifugal Chillers

- **Cooling Method:** Absorption chillers use the principle of vapor absorption, while centrifugal chillers utilize mechanical compression.
- **Cooling Tower:** Absorption chillers do not require cooling towers, unlike centrifugal chillers.
- **Energy Efficiency:** Absorption chillers are generally less energy-efficient than centrifugal chillers.

Why Lithium Bromide is Used in Absorption Chillers

Lithium bromide is chosen for absorption chillers due to its:

- High affinity for water
- Low vapor pressure
- Suitable boiling point for the desired cooling temperatures

Calculating Absorption Chiller Capacity

Absorption chiller capacity can be calculated using the formula:

$$Q = m \cdot h \times L$$

where:

- Q = Cooling capacity in British thermal units per hour (BTUH)
- m = Mass flow rate of refrigerant in pounds per hour (lb/h)
- h = Latent heat of vaporization of refrigerant in BTUH/lb

Vapor Absorption Machine (VAM) vs. Chiller

VAMs and chillers are both used for cooling, but VAMs are designed specifically for small-scale applications, while chillers are suitable for larger systems.

How a VAM Chiller Works

VAM chillers utilize a similar principle to absorption chillers, using a refrigerant, absorbent, and heat source to produce a cooling effect. The main difference is that VAM chillers use zeolite as the absorbent instead of lithium bromide.

Absorption vs. Adsorption Chiller

- **Absorption Chillers:** Utilize liquid absorbents (e.g., LiBr) to dissolve the refrigerant.
- **Adsorption Chillers:** Employ solid adsorbents (e.g., silica gel) to adsorb the refrigerant.

How an Adsorption Chiller Works

Adsorption chillers use a solid adsorbent to adsorb refrigerant vapor. When heated, the refrigerant is desorbed and undergoes a cooling cycle similar to absorption chillers.

Other Related Chiller Types

- **Wort Chiller:** Designed to cool hot wort produced in the brewing process.
- **Refrigerator:** Employs an absorption cycle to provide cooling for food and beverages.

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