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Calcium Chloride *Market Reviews*

Industrial Uses

12 Refrigeration

Calcium chloride brines are used as refrigeration media in a broad array of industrial applications, including ice plants, ice rinks, cold storage and frozen food.

DESCRIPTION

Many industrial refrigeration applications use indirect compression systems in which a refrigerant chills a refrigerating medium (air, water or brine) that is circulated through the areas to be cooled. In direct expansion systems, by contrast, the refrigerant expands into the area cooled. Indirect systems are often used to cool large areas or when distance from the compressor is great, pressure is hard to control and vapors must be contained.

Calcium chloride brines are generally accepted as the standard refrigerating medium for industrial refrigeration.

(A brine has a of low freezing point and transfers refrigeration without a change of state.) Calcium chloride brine is a good refrigerating as:

- It remains liquid to very low temperatures
- It has little corrosive effect on metals and other structural materials
- It undergoes no serious change in character, such as precipitation, if refrigerants leak into it
- It has a high enough specific heat for economic operation so excessive amounts are not needed

Calcium chloride significantly reduces the freezing point of water. Freezing temperature depends to a great extent on brine temperature and $CaCl_2$ concentration.

END USES

Ice plants

Most ice plants use indirect refrigeration with circulating brines to make commercial ice. Calcium chloride brines are used because they give lower brine temperatures than are possible with sodium chloride brines. In low-temperature operations, $CaCl_2$ brine in contact with ice cans is 6°F.

Ice rinks

Indirect refrigeration with $CaCl_2$ brine is the most accepted way to freeze indoor and outdoor skating rinks. The amount of refrigeration needed to freeze and maintain a rink surface depends on such factors as location, type of enclosure, length of season and type of service. Indoor rinks with permanent ice may need about 0.5 tons of refrigeration capacity/100 sq. ft. of rink surface. In sports arenas where the ice floor is changed frequently, the requirement may be 0.9 ton/100 sq. ft. The refrigeration load on open air rinks may require 1.0 ton or more/100 sq. ft. When the ice is to be removed, a warm brine of 40 to 50°F is circulated to break the bond between the floor and the ice, so tractor plows can break it up for removal.

Brine temperatures of 16 to 20°F are generally satisfactory for holding ice at 26 to 28°F if ice thickness is less than 1.5 inches. This is the case in most enclosed, permanent rinks. Lower brine temperatures are often used for sports arenas and outdoor or heavy-duty rinks. The amount of CaCl2 brine circulated per minute should hold the temperature difference between the incoming and outgoing brine to within 2 to 3°F. Pumping capacities of 10 to 15 gal/min/ton of refrigeration may be needed.

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Refrigerated pipelines

Refrigerated pipelines distribute brine from a central station to various users. Brine mains vary up to 12 inches in diameter and are usually of standard wrought iron. The $CaCl_2$ brine used has a temperature of about 0F and is kept slightly alkaline.

It is sometimes treated with sodium chromate for added protection against corrosion. The return brine can be used for building air conditioning. Air conditioning can also occur via a heat exchanger on the main with a secondary cooling medium.

Cold storage

Most cold storage in the U.S. uses pipe coils with a circulating cold brine or refrigerant. A cold-air circulating system may be used to gain more uniform temperatures. Cold storage in warehouses is widely used for seasonal storage of perishable foods, frozen foods and on ships for fish, processed sea foods, perishable foods and refrigerated cargoes.

Brine circulating systems maintain a uniform temperature, usually 30 to 31°F for coolers, 0 to 10°F for carrying freezers, and 10 to 15°F for sharp freezers. Calcium chloride brine temperatures commonly are 10 to 20°F for coolers and are well below this for carrying or sharp freezers.

Sprinkler systems

Sprinklers in refrigerated spaces can be either brine or dry-pipe systems. Brine systems use an ordinary sprinkler scheme, but are filled with $CaCl_2$ brine instead of water. Brine concentration is adjusted to prevent freezing at the lowest temperature in the rooms protected. These sprinkler systems are sealed off from city water by special check valves.

Frozen foods

Brine temperatures for frozen foods vary considerably, and can be as low as -37°F for $CaCl_2$. Users of $CaCl_2$ brine systems in the frozen food industry claim greater safety, simplicity and lower peak compressor loads. After leaving the freezer, the brine is often used for other cooling purposes to level off the compressor load.

Unfrozen food processing

Calcium chloride brines frequently provide refrigeration in food processing plants, e.g., those for milk, cheese, butter, meat packing, bakery, brewery and carbonated beverages. Temperatures are generally above 32°F. Indirect systems prevent the possibility of primary refrigerant leakage, especially into processed water that may be used in the food.

Cargo refrigeration

Refrigeration for ship cargoes often uses brine as a secondary cooling medium. As temperatures trend lower and may range from subzero to ambient in any one compartment, $CaCl_2$ brine has become preferred for this use. Calcium chloride allows the primary refrigerant to be confined to the machinery room and reduces the number of units needed. This brine also has a large sensible heat capacity, absorbs abrupt temperature variations and eliminates the control sensitivity of direct expansion systems.

Construction

Refrigeration on construction sites:

- Cools concrete to prevent heat deterioration as concrete cures in large structures
- Freezes water or partially fluid soils during the construction of foundations
- Shrinks metal when members are being fitted together
- Freezes undisturbed, cohesionless soils during sampling

When brine systems are used, $CaCl_2$ is generally preferred because it provides low-temperature brines for such uses as soil solidification and shaft sinking.

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