

FDE 447

COLD PRESERVATION TECHNOLOGY

Content

- *Insulation and
- *Defrosting in cold stores

Insulation in cold stores

Insulation in cold stores is the process of protecting the environment against heat and vapour transfer by using an insulating material.

Purpose:

To avoid

- * heat gain and reduced efficiency of cooling systems
- * condensation of water on surfaces and potential corrosion problems

2



1) Thermal insulation

3

- Thermal insulation is the most efficient way to maintain cold temperatures. Technically speaking, it consists of minimising the transmission of heat energy between adjacent spaces.

Which materials are thermal insulators?

4

Insulating materials

Thermal conductivity (W/mK)

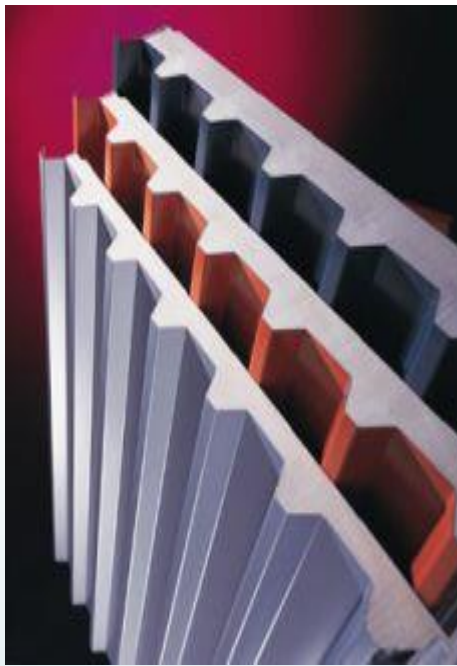
- Glass wool 0.040
- Fiberglass 0.040
- Stone (mineral) wool 0.036
- Cellulose 0.040
- Polyurethane 0.025
- Polystyrene 0.032
- VIP (vacuum insulation panels) 0.003

Insulating material should have the following properties:

- It should have high thermal resistance,
- It should be reasonably fire proof
- It should be insect proof
- It should be durable
- It should be non-absorbent of moisture
- It should be cheaper
- It should be readily available



Polyurethane foam



Stone wool

Insulation materials



Mineral wool



Glass wool blanket



Glass wool



Pre-moulded rockwool pipe insulation in 1992 WH fire test. For small pipes, the insulation is in one piece and "snaps on". For larger pipes, the insulation is in two halves that are pressed together.

Insulators used in cold stores

- Sandwich panels have used for industrial refrigeration chambers.
- Panels bring together a number of advantages within the same product, among those that stand out are:
 - Modularity: they are easy to transport and assemble.
 - They offer a broad range of core thicknesses and sheet metal cladding for facades. Their characteristics depend on the panel usage.
 - Excellent mechanical properties.
 - Superb vapour barrier.
 - Highly heat resistant.
 - Hygienic, sanitary finishes. Easy to clean and germ-resistant.
 - Manageable cost.

2) Moisture insulation

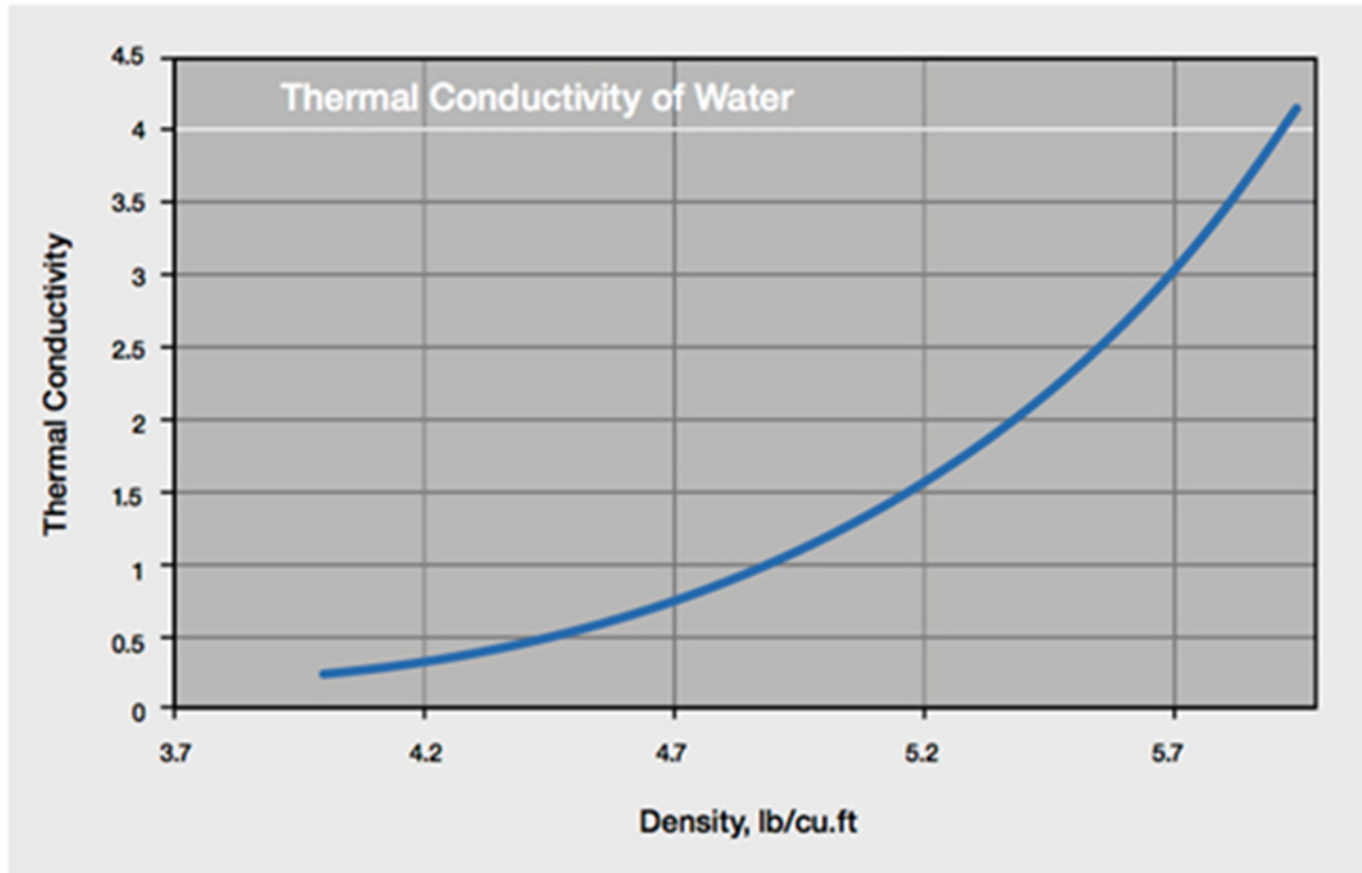
9

- A place where the cooling process is carried out (warehouse, operating area etc.) is usually colder than the outside environment.
- In this case, the water vapor pressure of the outdoor environment is higher than the water vapor pressure of the indoor environment.
- Water vapor moves from high pressure to low pressure. For this reason, moisture leaks from the outside to the inside, and as the

Moisture Control Is Critical to Thermal Efficiency

- ▶ If moisture intrudes the insulating material, thermal efficiency is lost.
- ▶ For every 1% in moisture gain, there is a 7.5% loss in thermal efficiency. In other words, a single percent increase in moisture equates to a 7.5% increase in thermal conductivity (Thermal k) — or the transference of heat from one surface to another.
- ▶ This condition leads to energy loss and higher operating costs.

Effect of Water Vapor Intrusion on Thermal K



Frosting of low temperature coils

12

- It is inevitable that refrigeration systems operating with saturated suction temperatures below freezing will eventually experience an accumulation of frost on the evaporator tubes and fins.
- When the surfaces of evaporator coils operate at temperatures below 0°C and also below the dewpoint temperature of the air, frost will form on the coil.
- In certain special situations, icing can occur where moisture from the air first condenses to liquid water, then freezes to ice.
- After accepting that we must live with frost when cooling air to subfreezing temperatures, the approach is to lessen its penalty and to remove it periodically.
- The two detrimental effects of frost cited most often are:
 - (1) resistance to heat transfer; and
 - (2) restriction of air- flow.

Purpose of defrosting:

- 1. Improve system cooling efficiency,
- 2. Guarantee the quality of frozen products in the warehouse,
- 3. Save electricity,
- 4. Extend the service life of the cold storage system.

Methods of defrosting

The most widely used methods of defrosting industrial refrigeration coils are using:

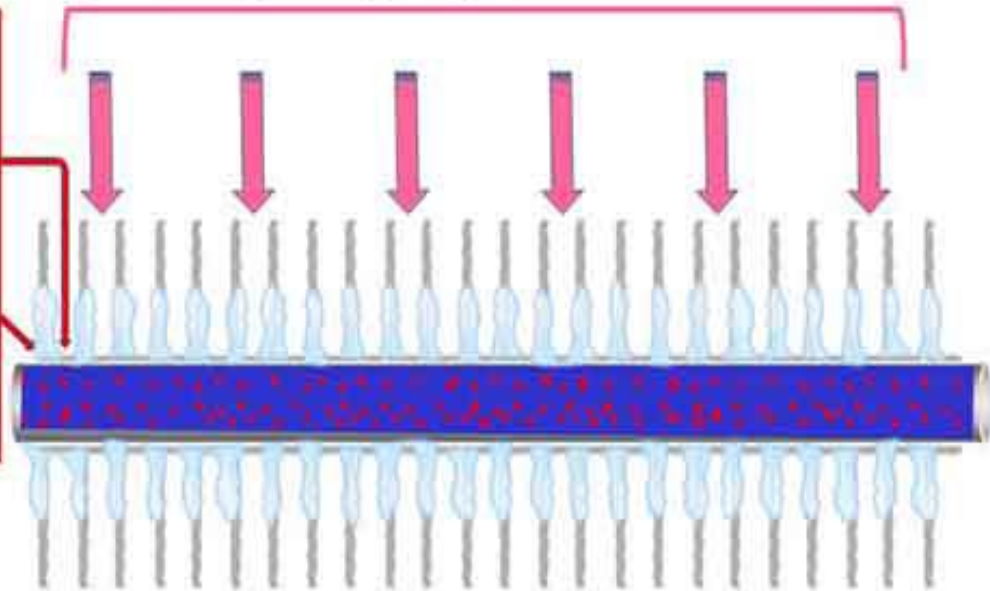
- air,
- electric,
- water, and
- hot gas
- Anti-freeze sprayed defrost

Air defrost

- ▶ An extremely long period is required unless the fan continues to operate, forcing air through the coil. Even so, the process may be slow, so the designer must insure that the capacity of operating coils is adequate to meet the refrigeration load.

Warm air from refrigerated space
Flowing through evaporator fin-tube bundle

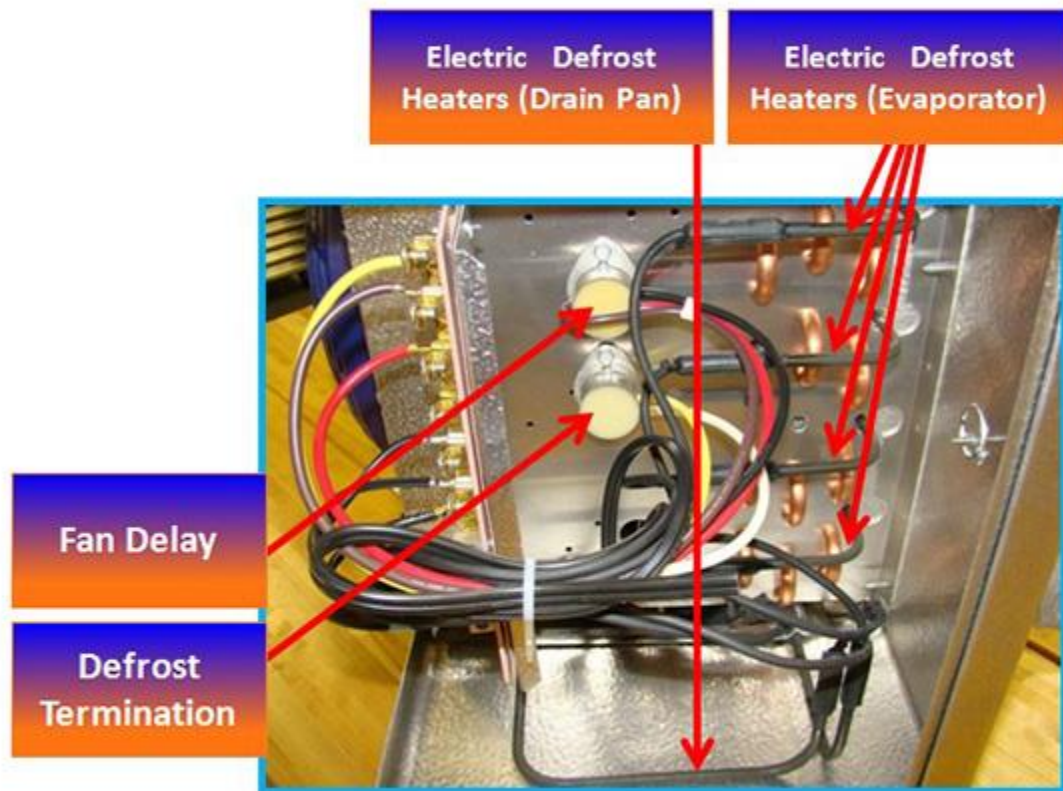
Frost/Ice buildup acts as an insulator between air from the refrigerated space and the liquid refrigerant flowing in the evaporator tubes, resulting in reduced heat transfer capacity.



Electric defrost

17

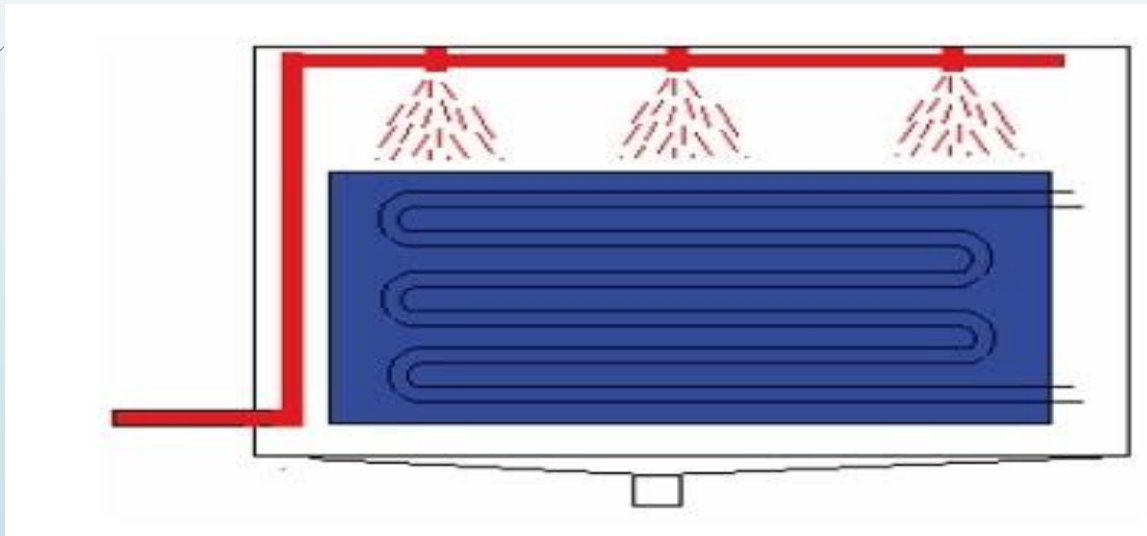
- For defrosting electrically, an electric resistance heater is mounted in good thermal contact to the coil.



Water defrost

19

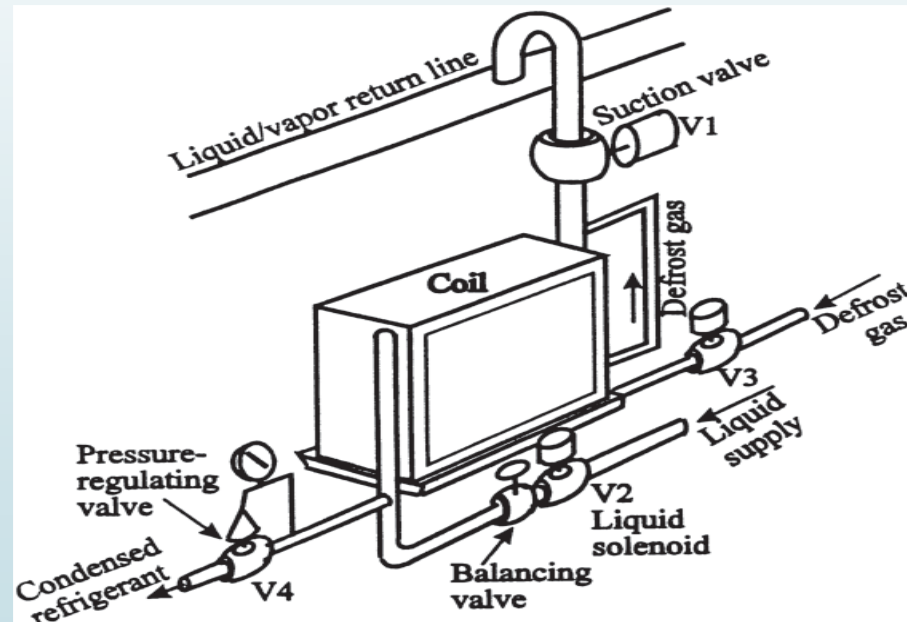
Water is sprayed over the coil and the mixture of water and melted frost is collected by the drain pan and passed outside the refrigerated space.



Hot-gas defrost

20 ■

When defrosting an air coil using hot gas, the basic procedure is to interrupt the supply of liquid refrigerant to the evaporator, restrict the outlet of the coil, then supply high-pressure vapor.



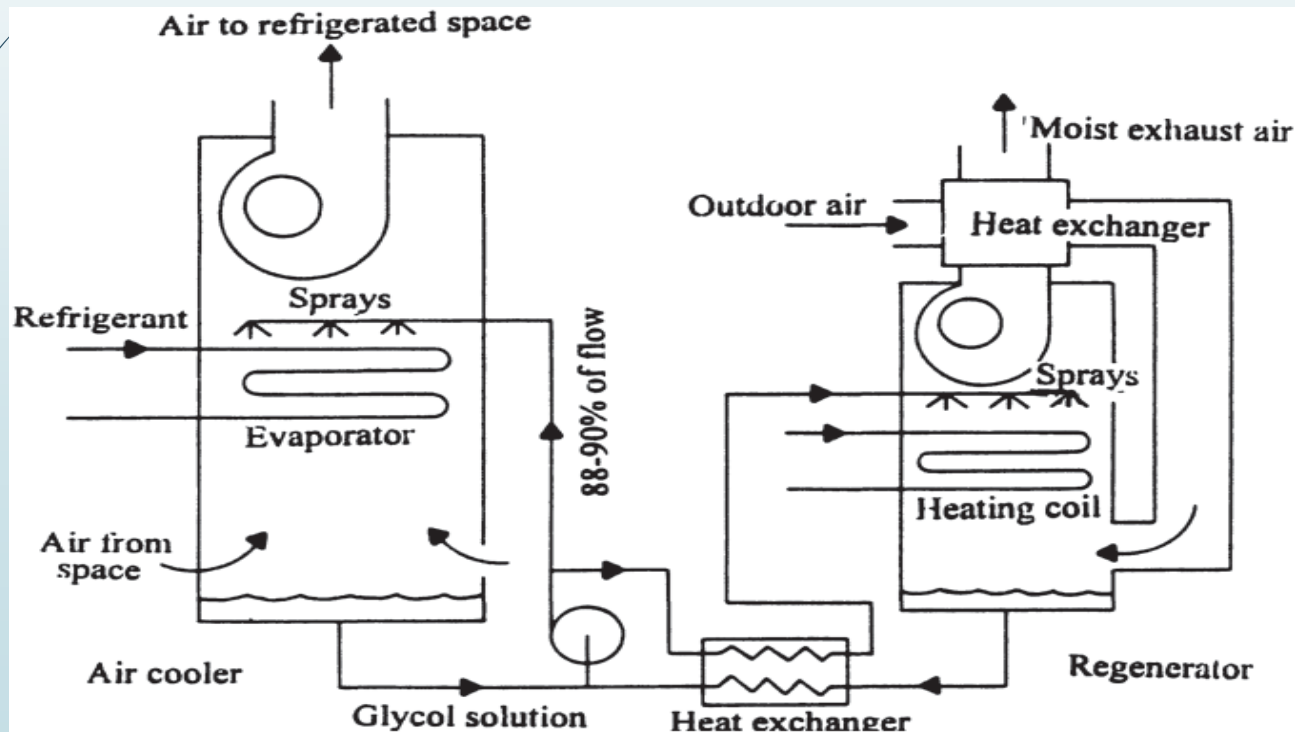
Several advantages of water defrost in comparison to hot-gas defrost are:

- (1) inexpensive source of defrost medium,
- (2) short defrost time, and
- (3) provides a cleaning action on the coil.

Antifreeze-sprayed coils

22

- An approach to controlling frost on low-temperature coils is to spray the coil with an antifreeze, such as ethylene glycol or propylene glycol.
- A characteristic of this equipment is that it generally provides a higher ratio of latent-to-sensible heat removal from the air than is true of a nonsprayed coil.



- ▶ The glycol solution is sprayed on the surfaces of the evaporator to keep the coil free of frost.
- ▶ The air passing in contact with both the sprays and the evaporator surfaces is cooled and dehumidified.
- ▶ The glycol solution absorbs water, so a fraction of it is circulated to the regenerator to drive off the moisture.