Refrigeration and Air condition.

Refrigeration may be defined as the process of reducing and maintaining a temperature of a space or material below that of the surroundings.

N.B Refrigeration simply means the cooling of or removal of heat from a system.

Before the advent of mechanical refrigeration water was kept cool by storing it in semi-porous jugs so that the water could seep through and evaporate. The evaporation carried away heat and cooled the water. The Romans carried pack trains of snow from Alps to Rome for cooling the Emperor's drinks. These methods of cooling all make use of natural phenomenon. They were used to maintain a lower temperature in a space or product.

The melting of ice or snow was one of the earliest methods of refrigeration and is still employed. another medium of refrigeration is solid carbon dioxide or dry ice. At atmospheric pressure CO_2 cannot exist in a liquid state and consequently, when solid CO_2 is exposed to atmosphere, it sublimates. i.e it goes directly from solid to vapour by absorbing the latent heat of sublimation (620 kJ/kg at 1 atm, −78.5°C) from the surroundings. The dry ice is suitable for low temperature refrigeration.

* One of the most important applications of refrigeration has been the preservation of perishable food products, food processing, packaging storing and transportation by storing them at low temperatures.

Effect of storage temperature on useful storage life of food products.

Food products	Average useful storage life at 0°C	at 22°C	at 38°C
Meat	5–10	1	< 1
Fish	1–7	1	< 1
Poultry	5–18	1	< 1
Dry salted fish	> 1000	> 350 & < 1000	> 100 & < 350
Fruits	2–180	1–20	1–7
Dry fruits	> 1000	> 350 & < 1000	> 100 & < 350
Leafy vegetables	3–20	1–7	1–3
Root crops	90–300	7–50	2–20
Dry seeds	> 1000	> 350 & < 100	> 100 & < 350

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Refrigerants – The are chemical compounds that are alternately compressed and condensed into a liquid and then permitted to expand into a vapor or gas as they are pumped through the mechanical refrigeration system to cycle.

The refrigeration cycle is based on the long known physical principle that a liquid expanding into a gas extracts heat from the surrounding substance or area.

A typical example of this is :- Simply wetting your finger and holding it up, it immediately begins to feel cooler than others particularly if exposed to some air movement. That's because the liquid in which you dipped it is evaporating and as it does, it extracts heat from the skin of the finger and air around it.

Refrigerants evaporate or "boil" at much lower temperatures than water, which permits them to extract heat at a more rapid rate than the water on your finger.

Principle of Refrigeration

In the process of refrigeration, the available heat with the system to be maintained at low temperature, is continuously removed and transferred to the surrounding which is at high temperature.

According to the second law of thermodynamics (Clausius theorem) the removal of heat from low temperature in order to supply heat at high temperature is only possible by supplying external work to the system under operation. Hence a refrigerator needs external power for removing heat continuously from the cabin to maintain temperature lower than the surroundings.

Basic mechanism of refrigeration is

T_1 = Maximum temperature

T_2 = Minimum temperature

R = Refrigerator

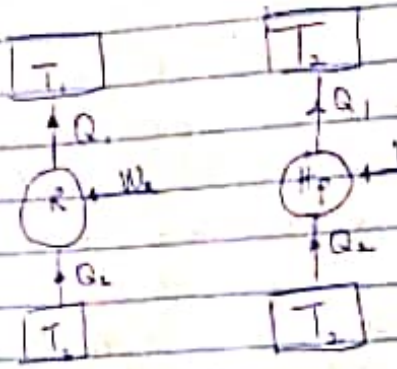
Q_1 = Heat supplied to the hot body

Q_2 = Heat removed from the low-temperature body

W_R = Work required to produce low temperature.

$$(COP)_{Rep} = \frac{Q_2}{Q_1 - Q_2} = \frac{T_2}{T_1 - T_2} \left[\frac{Q_1 = T_1}{Q_2 \quad T_2}\right]$$

mechanism of refrigerator



$$(COP)_{HP} = \frac{Q_1}{Q_1 - Q_2} = \frac{T_1}{T_1 - T_2} \left[\frac{Q_1 = T_1}{Q_2 \quad T_2}\right]$$

Basic mechanism of heat.

The job of the refrigeration cycle is to remove unwanted heat from one place and discharge it into another. To accomplish this the refrigerant is pumped through a closed refrigeration system. If the system was not closed, it would be using up the refrigerant by dissipating it into the surrounding media, because it is closed, the same refrigerant is used over and over again, as it passes through the cycle removing some heat and discharging it. The closed cycle serves other purposes as well it keeps the refrigerant from becoming contaminated and controls the flow of it is a liquid in some parts of the cycle and a gas or vapour in other phases. The basic principle of refrigeration is

- Liquid absorb heat when changed from liquid to gas
- Gases give off heat when changed from gas to liquid

For an air conditioning system to operate with the economic the refrigerant must be used repeatedly. For this reason all air conditioners use the same cycle of compression, condensation, expansion, and evaporation in a closed circuit. The same refrigerant is used to move the heat from one area

To cool the areas and to expel this heat in another area.

- The refrigerant comes into the compressor as a low-pressure gas, it is compressed and the moves out of the compressor as a high-pressure gas.
- The gas then flows to the condenser. Here the gas condenses to a liquid and gives off its heat to the outside air.
- The liquid then moves to the expansion valve under high pressure. This valve restricts the flow of the fluid and lowers its pressure as it leaves the expansion valve.
- The low-pressure liquid then moves to the evaporator, where heat from the inside air is absorbed and changes it from liquid to gas.
- As a hot low-pressure gas, the refrigerant moves to the compressor where the entire cycle is repeated.

Also Note that the latent heat of a liquid when it gets converted to a gaseous state is the basic concept behind refrigeration.

Adiabatic compression of the refrigerant gas results in a heating of the gas. Cooling of the heated gas results in liquefaction. The liquid is then allowed into the evaporator section of the refrigerator (the freezer) through a throttle valve where it is allowed into the evaporator absorb the heat from the interior of the freezer or refrigerator and gets reconverted to a gas but this section is at a lower pressure and forms the inlet side of the compressor.

The body of the refrigerator is well insulated to reduce the heat inflow from outside.

Modern refrigerators have a fan inside to force the cold or chilled air from the freezer section to the refrigerator section and a magnetic lock on the doors to keep the doors closed, automatic defrosting, collection of the defrost water and evaporation.

To put it simply, refrigerators, freezers, AC units, heat pumps all have the same basic components

1) An evaporator : The cold coil that removes heat

2 A condenser : The warm coil that rejects the heat collected by the evaporator.

3 Refrigerant (green): That runs through the entire system transporting heat

4 A compressor : Basically a pump that moves the refrigerant from place to place

N/B ⇒ All the components work together to achieve one thing, which is removal of unwanted heat from one place and deliver it to another place where it can be rejected

Trouble shooting your refrigeration system.

Refrigerators had made life so much easier than it was back when they did not exist and today, it is the most essential and used appliance in our life. Everything beneficial comes with its problems, refrigerators have a slew of miscellaneous problems that may occur and it may lead to all stored good to spoil and so on. Most times, to recover from such problem refrigerator repair is needed.

Common problems

- Continuous water leakage
- Strange noise from the refrigerator.
- Temperature not cold enough
- Freezing of food at the bottom part
- Ice building up inside the fridge.

Continuous Water leakage : A refrigerator leaks water when the water supply line freezes and splashes water continuously

It can also leak when the drain hose gets clogged with food particles, vegetable leaves and other little food scraps. A defect in the water supply line or a shut-off valve at its open state can also cause water leakage and to get rid of this, the valve behind the panel of the refrigerator should be closed clearing the blockage and checked for wear and tear.

Strange noises from the refrigerator.

This happens when the condenser motor fan stops working due to blockage. The fan gets blocked due to blockage accumulating in the propeller blades and every time it rotates, the clicking sound produced is due to litter.

This can be solved by unplugging the refrigerator at once and then brushing the blades with warm water and bicarbonate solution.

This can also happen when the distance between the freezer and the wall is narrow.

Temperature not cold enough

Clogged coils inside can add to the raised temperature inside and result in inadequate cooling. This can be solved by the removal of evaporator cabinet and replace the fan.

The condenser fan is clogged with litter also plays a role in inadequate cooling of the refrigerator.

Freezing of food at the bottom:

It is abnormal for food at the bottom part to be frosted. The food may be insufficient compared to the surface are required to be occupied and the air to cool the food. Due to inadequate food compared to the amount of the air inside, the food tends to freeze. This can also happen if the temperature regulating point are not set correctly. Too much low-temperature setting point can cause food to freeze inside the bottom part.

This can be solved by setting the regulatory points to

an optimum temperature.

Ice buildup inside the refrigerator.

Loose door pivots and careless closure of doors let the external air accumulate inside and cause the build up of excessive ice.

Ice buildup can lead to clogging inside the chambers and increase in humidity to be maintained inside. The proper preventive measure is to always tighten the door seals and check for proper closures.

It can be solved by unclogging the apertures, unplugging the refrigerator and introducing warm water to get rid of the excess buildup of ice paving out.

Attention should be given so that distance is maintained between the wall and the fridge so that it gets enough space to release the excess air.

Best methods for refrigerant leak detection

Accurate leak detection methods must be utilized to find leaks in a system and correctly address them.

Soap Bubbles / Visible method: Works with all refrigerants is very accurate for pinpointing a leak.

Flourescent Dye / Visible method: Works with all refrigerants dye must be added to refrigerant and a special UV light required

Electronic leak detectors: Currently the most popular method in use. These detectors will work with all refrigerants. They can be very accurate or inaccurate depending on sensor conditions must be checked regularly against a calibrated reference leak to ensure accuracy

Ultrasonic: Uses sound amplifiers. It acts on the high frequency sound which occurs when gas passes through an orifice. This may not be accurate on small leaks

not enough sound is generated through a small orifice.

- Corona Discharge
- Hot Diode
- Heated Electrolyte
- Ignitron