

Refrigeration and Air condition.

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

* This simply means the cooling of or removal of heat from a system.

Brief history

Oliver Evans, an American inventor in 1805 designed a blueprint for the first refrigeration machine but it wasn't until 1834 that Jacob Perkins first built a practical refrigerating machine. The first commercial ice-making machine was invented in 1854. In 1913, refrigerators for home use were invented.

Before the advent of mechanical refrigeration, water were kept cool by ancient Iranians in yakchals a form of large evaporative cooler. {Yakchals are ancient type of ice house that functions as an evaporative cooler. The structure had a domed shape above ground and a subterranean storage space}. In modern time, before the invention of electric refrigerator, ice houses and iceboxes were used to provide cool storage for most of the year.

The Romans carried pack trains of snow from Alps to Rome for cooling the Emperor's drink. Water was also kept cool by storing it in semi-porous jugs so that the water could seep through and evaporate. These methods of cooling, all make use

of natural phenomena they were used to maintain a lower temperature in a space or product.

* The main function of the refrigeration cycle is to absorb heat from indoor air and dispel it outdoors.

Principles Of Refrigeration

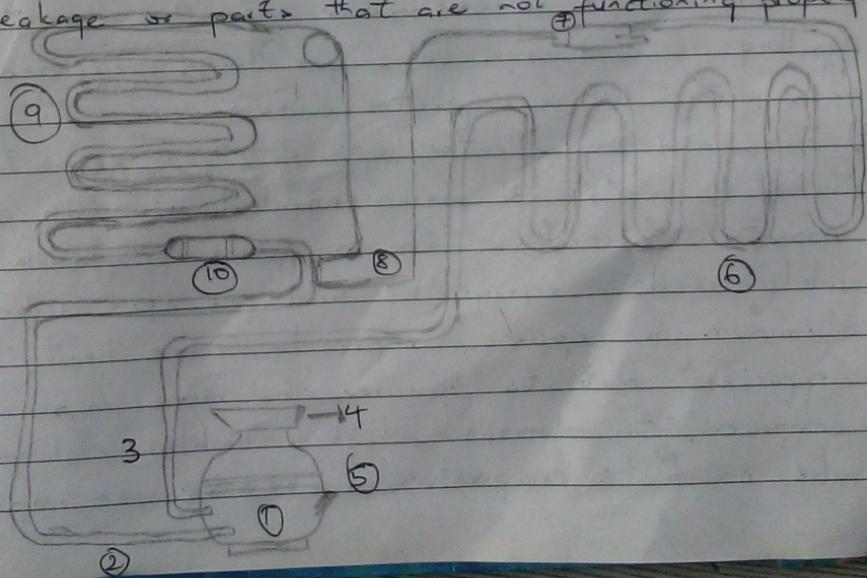
This was named after two scientists, James Prescott Joule and William Thompson and the procedure is called a throttling process or Joule-Thomson. It applies to all system whether its the smallest water cooler to largest walk-in freezer. The process where a gas or liquid change its temperature when it is forced through an expansion valve or ~~out~~ capillary tube in an insulated system where no ambient heat transfer occurs at STP (standard temperature and pressure), all gases cool up expansion by the Joule-Thomson process with the exception helium, neon and hydrogen gases.

Freon gas or the refrigerant absorbs heat inside the area to be cooled in the evaporator unit and transfers the heat to the refrigerator's condenser at exterior.

Refrigeration basic principle is that with the aid of a heat pump, the refrigerant is being compressed to the condenser and capillary tube thus increasing its temperature ($50-60^{\circ}\text{C}$) and pressure (750 kPa) in the refrigerator being cooled down by the condensing unit to 32°C depending the existing ambient temperature.

Upon entering the evaporator unit the gas expanded and vaporized due to sudden enlargement of the evaporator tube cross-section eventually dropping its pressure to almost atmospheric value (120 kPa) and temperature from 32°C to -24°C . Heat absorption takes place from the evaporator and being transformed from cool vapour to liquid state with higher temperature and pressure thus completing the heat transfer cycle.

Theoretically, after the cycle the amount of refrigerant will remain contained in the system. When leakage occurs in the closed circuit the efficiency of the refrigerator will gradually diminish till it stops cooling. By then it requires servicing to be done by a qualified technician to locate its leakage or parts that are not functioning properly.



- 1) Compressor or Heat pump
- 2) Suction pipe or low pressure side with non-return valve
- 3) Liquid exit going to condensing unit with non-return valve
- 4) Water collector during defrosting process which gradually dries out.
- 5) Freon or refrigerant charging point
- 6) Condensing unit usually in the form of serpentine tubes, with electro welded grill for effective ambient heat transfer
- 7) Vacuum application point to remove impurities and humidity prior to refrigerant charging.
- 8) Capillary tube act as an orifice where inside diameter and length is being calculated to deliver the right flow of liquid to the re-evaporator unit. An alternative for capillary is expansion valve for large refrigeration and particular refrigerator units.
- 9) Evaporator or collector unit usually in serpentine tube or plate OR fusion bonded aluminum plate evaporator. Serpentine tube or plate evaporator is widely used in refrigerator and freezer. Tube is in aluminum or copper - Copper has more heat transfer coefficient but it's heavier and more expensive compared to aluminum which is lighter. Aluminum tube or plate evaporator or absorber can improve the

A/c the process of removing heat from an enclosed space to achieve a more comfortable interior environment

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heat transfer coefficient like copper by just increasing the thickness of the aluminium plate.

10) Accumulator usually in copper & aluminium.

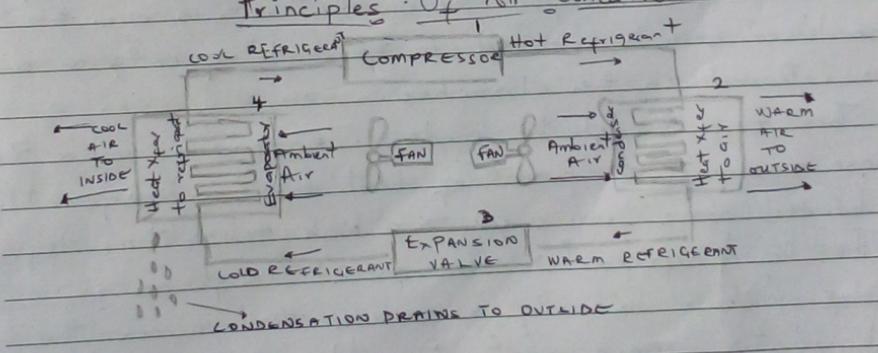
Air Conditioning

This refers to the treatment of air so as to simultaneously control its temperature, moisture content, cleanliness, odour and circulation, as required by occupants, a process or product in the space.

Brief History

Willis Haviland Carrier an American engineer invented the first electrical air conditioning unit in 1902 and the purpose was to both cool a room and reduce humidity though originally created to keep moist air in a printing plant from wrinkling magazine pages.

Principles Of Air Condition



Air-conditioning systems utilizes a specific material called refrigerant to undergo the phase conversion.

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This material is contained within tubing which runs throughout the air-conditioning system. The refrigerant is pulled into the system's compressor in the form of a warm vapor after the evaporator coil. The compressor increases the density of the incoming refrigerant vapour causing it to increase in pressure and temperature. This is normally accomplished using a centrifugal system, where a series of spinning blades rapidly forces the vapour to the outside of the compressor chamber, at which point it exits. The hot, high-pressure vapor then travels to the air conditioner's condenser where it moves through a series of coils with thin metal fins attached. A fan blows air over the fins, and heat moves from the refrigerant to the fins and into the air stream, very similar to the method a radiator uses to removes heat from the coolant circulating within in a car engine. The air that is run over the condenser coils is vented to the building exterior and is released to the atmosphere.

This trip through the condenser causes the vapor to lose a significant amount of heat and it subsequently changes phase from a gas to a high temperature liquid. The liquid refrigerant is then forced through an expansion valve which is basically a pinhole that causes the liquid to form a mist. A sudden pressure drop and material expansion when the liquid turns into a mist results in a rapid cooling of the fluid as it

throws off heat energy. This cold air travels through the evaporator coil which is located directly in the air ~~exit~~ stream of a circulation fan which pulls air from within the building. The fan pushes the air across the cold coils, which pulls heat from the air, causing the air to cool. The transfer of heat to the refrigerant causes it to change back into a warm vapor and it enters the compressor to begin the cycle again.

- * Basic definitions one should know before getting into the fundamentals of refrigeration.
- Heat : This is a form of energy transferred by virtue of a difference in temperature. It exists everywhere to a greater or lesser degree. Though as a form of energy it can be neither created or destroyed, other forms of energy may be converted into heat and vice versa. It is very important to remember that heat travels in only one direction from a warmer to a cooler object, substance or area.
- Cold : This refers to lack of heat in an object, substance or area; or a state in which all heat has been removed from a object, substance or area.
- Refrigeration : This is the removal of unwanted heat from a selected objects, substance or space and

to transfer to another substance or space. Removal of heat lowers the temperature and may be accomplished by use of ice, snow, chilled water or mechanical refrigeration.

→ Mechanical Refrigeration → This is the utilization of mechanical components arranged in a refrigeration system for the purpose of transferring heat.

Refrigerants → These are chemical compounds that are alternately compressed and condensed into a liquid and then permitted to expand into a vapour or gas. 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.

Eg → Simply wetting your finger and holding it up, it immediately begins to feel cooler than other 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.

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Trouble shooting your refrigeration system
Refrigerators has 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 problem that may occur and it may lead to all stored food to spoil and waste.

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 splashed water continuously. It can also leak when the drain hose gets clogged with food particles, vegetable leaves and other litters and 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.

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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 litter accumulating in the propeller blades and everytime it rotates, the clicking sound produced is due to litter. This can be solved by unplugging the refrigerator at first and then brushing the blades with warm water and bicarbonate solutions. This can also happen when the distance between the freezer and the wall is narrow.

Temperature not cold enough.

This happens when the condenser fan is clogged with litter, it also plays a role in inadequate cooling of the refrigerator. 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.

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 area required to be occupied and the air to read

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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 building up inside the refrigerator.

Loose door pivots and careless closure of doors, let the external air accumulate inside and cause the building of excessive ice. Ice buildup can lead to clogging inside the chamber and imbalance 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 pouring 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.
It is very accurate for pinpointing a leak.
- Fluorescent Dye / Visible method - Works with all refrigerants. The dye must be added to refrigerant ^{Used for fluid leakage} and a special UV light is required. ^(in various types of systems)
- Electronic leak detectors + Currently the most popular method in Vg. These detectors will work with all refrigerants. They can be very accurate or inaccurate depending on sensor condition. They must be checked regularly against a calibrated reference leak to ensure accuracy.
- Ultrasonic + Uses sound amplifiers. It acts on the high frequency sound pitch that occurs when gas passes through an orifice. This may not be accurate on small leaks because not enough sound is generated through a small orifice.
- Visual Inspection - If you find somewhere in the system with oil traces, probably that is the leakage point. This inspection method can't position precisely because the leakage point is usually very tiny and

many parts of the refrigeration system are barely visible. Unless it's a big leakage point due to sudden break and the leaking liquid is coloured.

→ Gas Pressure Detection : By using the pressure difference between interior and exterior of the system, the sensor will enlarge this difference and express the test results in methods like digital, voice or electronic signals. This test way is also only "qualitative" to know whether the system leaks and cannot accurately find the leakage points.

→ Halogen Lamp Detection : By holding lighted-up halogen lamp close to the system, the flame colour will turn into purple-blue when there is a leak. This method is dangerous not only with the flame but also the combination of flame and refrigerants will produce harmful gases, in addition, it is not easy to accurately locate the leak. So this method is almost out of use now.

→ Nitrogen Water Detection : Fill the system with 10-20kg/cm² pressure nitrogen and soap it in the water. The bubbling is the point of leakage. One obvious drawback of this method is that the water for leak detection can easily enter the system. This will