



# Refrigeration & Air conditioning


Presented by

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# OBJECTIVES:-

1. Introduction to refrigeration.
  2. History of refrigeration.
  3. Principle of refrigeration.
  4. Application of refrigeration.
  5. Capacity of refrigeration.
  6. Introduction of air conditioning.
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# REFRIGERATION:-

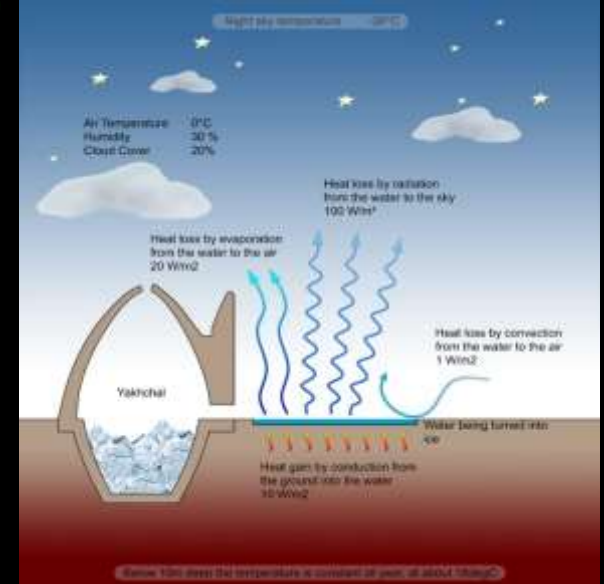
It is the process of removing heat from a space or substance to reduce its temperature and transfer that heat to another space or substance.

The ASHRAE's (**American Society of Heating, Refrigeration and Air conditioning Engineers.**) refrigeration as 'the science of providing and maintaining temperature below that of the surrounding atmosphere.

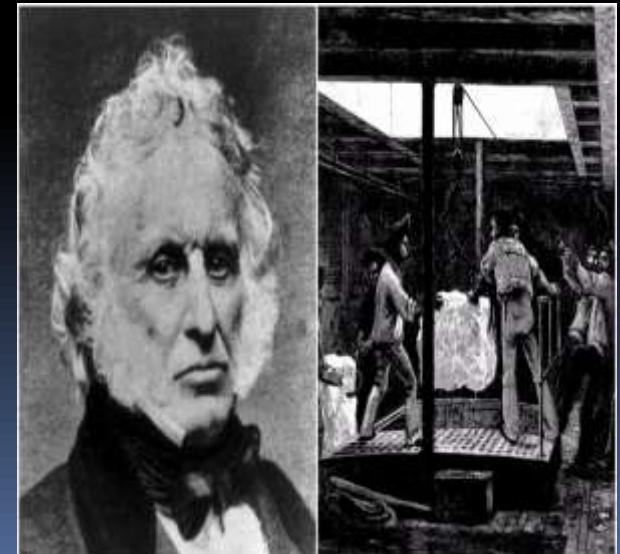
The term refrigeration means cooling a space, substance or system to lower maintaining its temperature below the ambient one (while the removed heat is rejected at a higher temperature).

# HISTORY OF REFRIGERATION:-

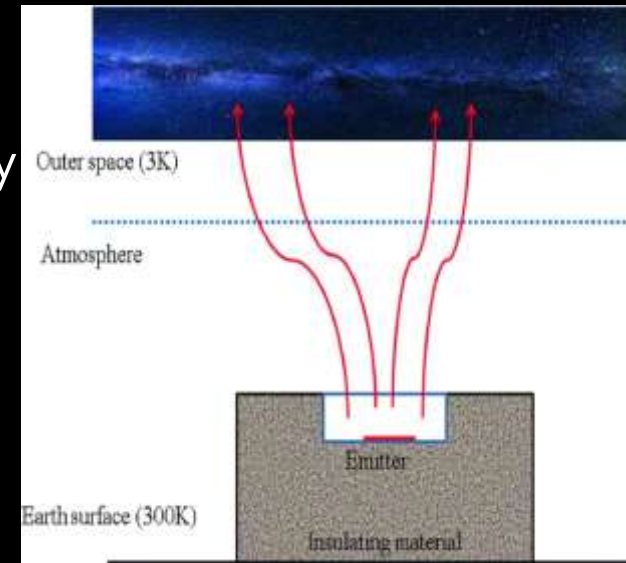
- 500 BC – the Yakhchal (meaning ice pit in Persian) is used as a refrigerator in ancient Persian. The structure was built of a resistant mortar called SAROOJ that is resistant to heat transfer in the shape of a dome above the ground. It was often used to store ice but sometimes was used to store food as well.



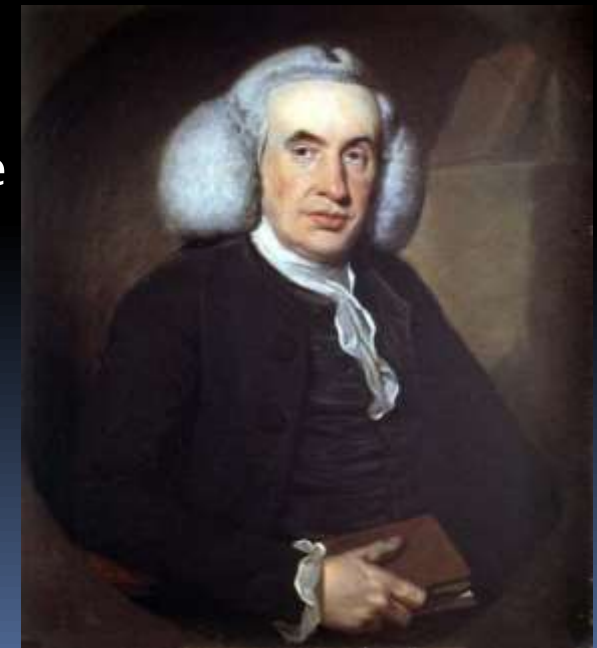
- In 1806, Fredrik Tudor, (who was later called as the "ICE KING" ) began the trade in ice by cutting it from Hudson river and exporting it to various countries including India.



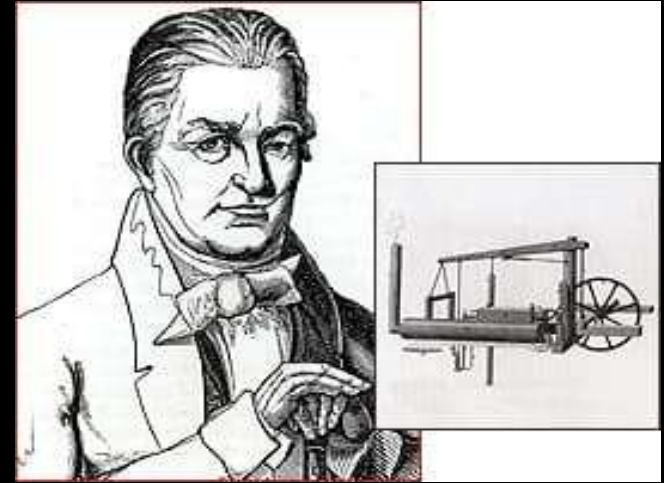
- The art of making of ice by nocturnal cooling was perfected in India. In this method ice was made by keeping a thin layer of water in a shallow earthen tray and then exposing the tray to night sky. Compacted hay of about 0.3 m thickness was used as insulation. The water loses heat by radiation to the stratosphere which is at around  $-55^{\circ}\text{C}$  and by early morning hours the water in the tray freezes to ice.



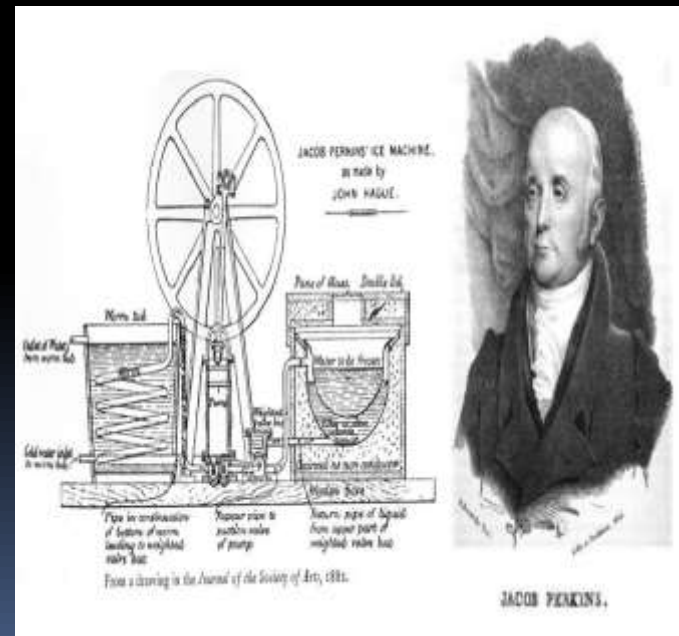
- ARTIFICIAL REFRIGERATION:** Scottish professor William Cullen designed a small refrigerating machine in 1755. He used a pump to create a partial vacuum over a container of diethyl ether, which then boiled absorbing heat from surrounding of air. He is father of Refrigeration.



- In 1805, American inventor Oliver Evans described a closed vapour compression refrigeration cycle for the production of ice by ether under vacuum.

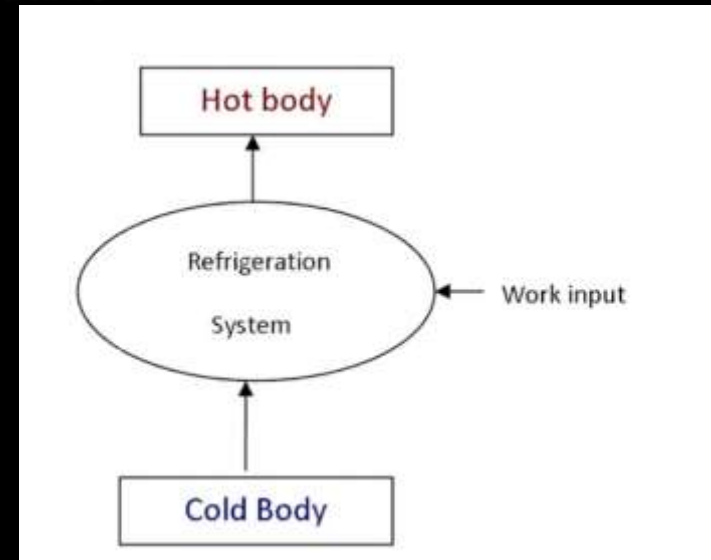


- In 1834, an American expatriate in Jacob Perkins built the first working vapour compression refrigeration system. He is known as father of Refrigerator.



# PRINCIPLE OF REFRIGERATION:

- Evaporation causes cooling.
- According to the second law of thermodynamic ( Clausius theorem) the removal of heat from low temperature in order to supply heat at a high temperature is only possible by supplying external work to the system under operation.



# APPLICATION OF REFRIGERATION: -

- Food preservation. - Milk storage, butter, dairy products, vegetables, fruits and meat and poultry products.
- Fish storage (-16) – preservation of fish from the time it is caught until the ship returns to the port requires proper attention.
- Household refrigerator
- Comfort air conditioning.
- Industrial air conditioning.
- Printing notes.
- Laboratory, textile industries
- Chemical process
- Separation of gases.
- Condensation of gases.
- Low pressure storage in liquid form.
- Cold treatment of metal
- Manufacturing of drugs.
- Ice skating rinks.
- Ice manufacturing.
- Treatment of air blast furnace



# CAPACITY OF REFRIGERATION:-

Refrigeration capacity means how much of a product can be held within a refrigeration unit.

It is equivalent to the heat supplied to the evaporator of the refrigeration cycle and may be called the “rate of refrigeration” or “refrigeration of capacity”.

It is expressed as “Ton of Refrigeration”.

## TON OF REFRIGERATION:-

Value of 1 ton Ice = 2000 lbs.

Value of latent of fusion = 144 BTU

$$2000 \times 144 = 288000 \text{ BTU/day}$$

$$288000/24 = 12000 \text{ BTU/hr.}$$

## MKS:-

Value of 1 ton Ice = 900 kg.

Latent heat of fusion = 80 kcal/kg.

$$900 \times 80 = 72000 \text{ kcal/day.}$$

$$72000/24 = 3000 \text{ kcal/hr.}$$

$$3000/60 = 50 \text{ kcal/min.}$$

## SI UNIT:-

Value of 1 ton of Ice = 907 kg.

Latent heat of fusion = 337 kJ / kg.

$$907 \times 337 = 305659 \text{ kJ/day}$$

$$305659/24 = 12735.7 \text{ kJ/hr.}$$

$$12735.7/60 = 212.2 \text{ kJ/min}$$

$$212.2/60 = 3.5 \text{ kJ/second.}$$

# AIR CONDITIONING

It is known that the physical properties of air can be controlled by cooling, heating, humidification, and dehumidification. These processes may be employed to maintain specific conditions desirable for comfort. Thus, simultaneous control of temperature, humidity, air motion, and cleanliness is known as air conditioning.

In 1901, American inventor Willis H. Carrier built what is considered the first modern electrical air conditioning unit. In 1902, he installed his first air-conditioning system, in the Sackett-Wilhelms Lithographing & Publishing Company in Brooklyn, New York; his invention controlled both the temperature and humidity which helped maintain consistent paper dimensions and ink alignment at the printing plant. Later, together with six other employees, Carrier formed The Carrier Air Conditioning Company of America.

**The four important factors for comfort conditioning are to be observed and maintained:**

- (a) Temperature
- (b) Humidity
- (c) Purity/cleanliness, and
- (d) Air motion.

### **Temperature:**

The control of temperature is necessary in air conditioning. Even though the outdoor temperature is varying, the indoor temperature is maintained to be constant which is the desired condition. The heat may be either removed or added to the conditioned space depending upon the surrounding conditions. The person may feel comfortable when the temperature is 20°C and relative humidity is 60%.

### **Humidity:**

Humidity control means an increase or a decrease in moisture content inside the space to be air-conditioned. It is necessary not only for human comfort but also to increase the working capability. In summer, the relative humidity should be 60% and in winter it should be 40%.

### **Purity/Cleanliness:**

It is one of the most important factors which affect the air conditioning. In addition to the control of temperature and humidity for human comfort, it is necessary to clean air, i.e., to make the indoor air free from dust, dirt, and odor. It is necessary that proper filtration and purification of air should be done and the supply of air free from dust and dirt should be made in air-conditioned space.

### **Air Motion:**

Air motion or proper circulation of air is also a factor affecting the human comfort. In order to maintain constant temperature throughout the conditioned space, it is necessary that there should be equal distribution of conditioned air in the space. The air movement is maintained at the desirable velocity of about 8 m/min using appropriate distribution system, grills, etc.

THANK YOU