REFRIGERATION

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Abstract Refrigeration is a process in which work is done to move heat from one location to another. The work of heat transport is traditionally driven by mechanical work, but can also be driven by heat, magnetism, electricity, laser, or other means. Refrigeration has many applications, including, but not limited to: household refrigerators, industrial freezers, cryogenics, and air conditioning. Heat pumps may use the heat output of the refrigeration process, and also may be designed to be reversible, but are otherwise similar to refrigeration units.

1BRIEF HISTORY OF REFRIGERATION

The first American patent of a cold air machine to produce ice in order to cure people suffering from high fever was obtained by Dr. John Gorrie of Florida in 1851. In 1860, instead of air or ether, Dr. James Harrison of Australia used sulfuric ether. This was the world's first installation of refrigeration machine for brewery. In 1861, Dr. Alexander Kirk of England constructed a cold air machine similar to that of Dr. Gorrie.

To meet the demand for ice during the civil war, Ferdinand Carre of the USA developed a vapor-absorption refrigeration system (Figure 1.6) using ammonia and water. Carre's system consisted of an evaporator, an absorber, a pump, a generator, a condenser and an expansion device. The evaporated vapor is absorbed by the week ammonia-water mixture in the absorber yielding strong aqua ammonia. The pump delivers this strong solution into generator where heat transfer from a burner separates ammonia vapor and the weak ammonia returns to the absorber. On the other hand the ammonia vapor condenses in the condenser before being throttled. The throttled liquid ammonia enters the evaporator resulting in completion of the cyclic process.

Until about 1920s the development in refrigeration system was restricted to the refinement in the cold-air machines and vapor-compression systems. After 1920s, there has been extensive diversification in the growth of refrigeration systems leading to new developments such as vortex tube, thermoelectric, pulse-tube, steam-jet, centrifugal compression systems, etc. The most important development can be the invention of new refrigerants which were chlorfluor hydrocarbons. This development occurred in 1930 in GE Corporation of USA at a time when Refrigeration industry had begun to stagnate on the use of NH_3 SO_2 as refrigerant. The chlorfluor carbons offered the advantages of best refrigerants and were proven non-toxic substances in comparison with NH_3 and SO_2 Other developments took place due to special requirements to utilize waste heat or low grade energy or materials of specific properties for thermoelectric effect. Owing to the likelihood of energy crisis in the future, many commercial units have been developed that utilizes waste heat or solar energy.

Literal meaning of refrigeration is the production of cold confinement relative to its surroundings. In this, temperature of the space under consideration is maintained at a temperature lower than the surrounding atmosphere. To achieve this, the mechanical device extracts heat from the space that has to be maintained at a lower temperature and rejects it to the surrounding atmosphere that is at a relatively higher temperature. Since the volume of the space which has to be maintained at a lower temperature is always much lower than the environment, the space under consideration experiences relatively higher change in temperature than the

environment where it is rejected.

2 Methods of refrigeration

2.1Non-cyclic refrigeration

In non-cyclic refrigeration, cooling is accomplished by melting ice or by subliming dry ice (frozen carbon dioxide). These methods are used for small-scale refrigeration such as in laboratories and workshops, or in portable coolers.

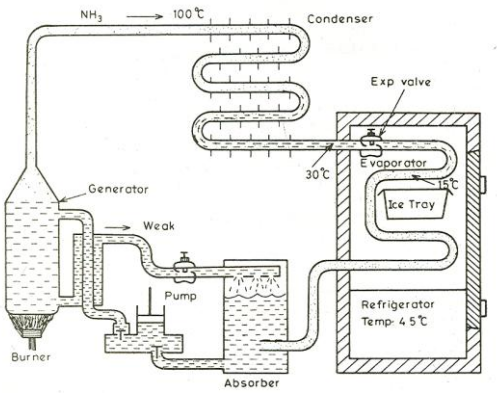
Ice owes its effectiveness as a cooling agent to its melting point of 0 °C (32 °F) at sea level. To melt, ice must absorb 333.55 kJ/kg (about 144 Btu/lb) of heat. Foodstuffs maintained near this temperature have an increased storage life.

Solid carbon dioxide has no liquid phase at normal atmospheric pressure, and sublimes directly from the solid to vapor phase at a temperature of -78.5 °C (-109.3 °F), and is effective for maintaining products at low temperatures during sublimation. Systems such as this where the refrigerant evaporates and is vented to the atmosphere are known as "total loss refrigeration".

2.2Cyclic refrigeration

This consists of a refrigeration cycle, where heat is removed from a low-temperature space or source and rejected to a high-temperature sink with the help of external work, and its inverse, the thermodynamic power cycle. In the power cycle, heat is supplied from a high-temperature source to the engine, part of the heat being used to produce work and the rest being rejected to a low-temperature sink. This satisfies the second law of thermodynamics.

A refrigeration cycle describes the changes that take place in the refrigerant as it alternately absorbs and rejects heat as it circulates through a refrigerator.



Vapor-Absorption Machine

3. Applications of Refrigeration. The largest application of refrigeration is for air conditioning. In addition, refrigeration embraces industrial refrigeration including the processing and preservation of food, removing heat from substances in chemical, petroleum and petrochemical plants, and numerous special applications such as those in the manufacturing and construction industries.
In a similar manner, air conditioning embraces more than cooling. The comfort air conditioning is the process of treating air to control simultaneously its temperature humidity, cleanliness, and distribution to meet the comfort requirements of the occupants of the conditioned space. Air conditioning, therefore, includes entire heating operation as well as regulation of velocity, thermal radiation, and quality of air, including removal of foreign particles and vapors.

3.1Air Conditioning of Residential and Official Buildings

Most of the air conditioning units are devoted for comfort air conditioning that is meant to provide comfortable conditions for people. Air conditioning of building is required in all climates. In the summer, living/working spaces have to be cooled and in the winter the same have to be heated. Even in places where temperature remains normal, cooling of the building is required to remove the heat generated internally by people, lights, mechanical and electrical equipment. Further

in these buildings, for the comfort, humidity and cleanliness of air has to be maintained. In hospitals and other medical buildings, conditions on cleanliness and humidity are more stringent. There ventilation requirements often specify the use of 100 percent outdoor air, and humidity limits.

3.2Industrial Air Conditioning

The term industrial air conditioning refers to providing at least a partial measure of comfort for workers in hostile environments and controlling air conditions so that they are favorable to processing some objects or materials. Some examples of industrial air conditioning are the following:

3.3 Spot Heating

In a cold weather it may be more practical to warm a confined zone where a worker is located. One such approach is through the use of an infrared heater. When its surfaces are heated to a high temperature by means of a burner or by electricity, they radiate heat to the affected area.

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