ISSN- 2394-5125 VOL 8, ISSUE 04, 2021

STUDY THE SHAPES OF EVAPORATOR COILS IN VAPOUR COMPRESSION SYSTEM

Wadnere Gopal Anil[1], Sachin Baraskar [2]

[1]Research Scholar, Department of Mechanical Engineering, Sri Satya Sai University of Technology and Medical Sciences, Sehore Bhopal-Indore Road, Madhya Pradesh, India

[2]Research Guide, Department of Mechanical Engineering, Sri Satya Sai University of Technology and Medical Sciences, Sehore Bhopal-Indore Road, Madhya Pradesh, India

Abstract

Using an appropriate working material, known as a refrigerant, a vapour compression refrigeration system is an enhanced system of air refrigeration. At atmospheric pressures and temperatures, it condenses and evaporates. Ammonia, carbon dioxide, and sulphur dioxide are the most common refrigerants used for this purpose (SO2). The refrigerant is recycled in a closed system, condensing and evaporating at different points in the system. The latent heat of the brine (salt water) used to circulate the refrigerant around the cold chamber is absorbed by the refrigerant as it evaporates. As it cools down, it releases its latent heat into the condensing system's circulating water. Since the vapour compression refrigeration system extracts latent heat from the brine and transfers it to the cooler, it functions as a latent heat pump. This paper study the shapes of evaporator coils in vapour compression system.

Introduction

From the perspectives of commercial and residential utilities, the vapour compression system is the most essential refrigeration system. It's the most realistic option for refrigeration, for sure. The system uses a vapour as the operating fluid. It may easily transition between the vapour and liquid phases, or between evaporation and condensation, within the refrigeration facility itself. It does this by soaking up the heat of the chilly body as it evaporates. To change it from a liquid to a vapour, this heat is employed as latent heat. In the process of condensation, cooling, or liquification, it rejects heat to an external body, condensing the temperature of the working fluid. By

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rejecting or delivering the latent heat from the cold body or brine to the external hot body or cooling medium, this refrigeration system functions as a latent heat pump. All vapours for which tables of Thermodynamic properties are available can be compressed using the same principle used in the vapour compression system.

Refrigeration Cycle

In refrigeration system the heat is being generally pumped from low level to higher one & rejected at that temp.

According to the second rule of thermodynamics, rejecting heat from a low- to a high-temperature level requires the input of external work. There are two components to the overall quantity of heat that the body is rejecting to the environment:-

- the heat equivalent to the mechanical work required for extracting it.
- the heat extracted from the body to be cooled .

A refrigerator is a reverse heat engine run in the reverse direction by means of external aid. Every type of refrigeration system used for producing cold must have the following four basic units:-

Low temp. thermal sink to which the heat is rejected for cooling the space.

EVAPORATORS

Evaporators are used in removal and evaporator systems to remove heat from the substance being cooled or refrigerated. The evaporator (coil or shell) is where the liquid refrigerant is vaporised to remove heat from a fluid (air, water, etc.).

Numerous types and configurations of evaporators are available on the market to meet the wide range of cooling needs. The many evaporator designs include primary surface, finned tube or extended surface, shell and tube, etc., liquid chillers.

Types of Evaporator

There are two main types of evaporators: the "dry expansion" evaporator and the "flooded" evaporator.

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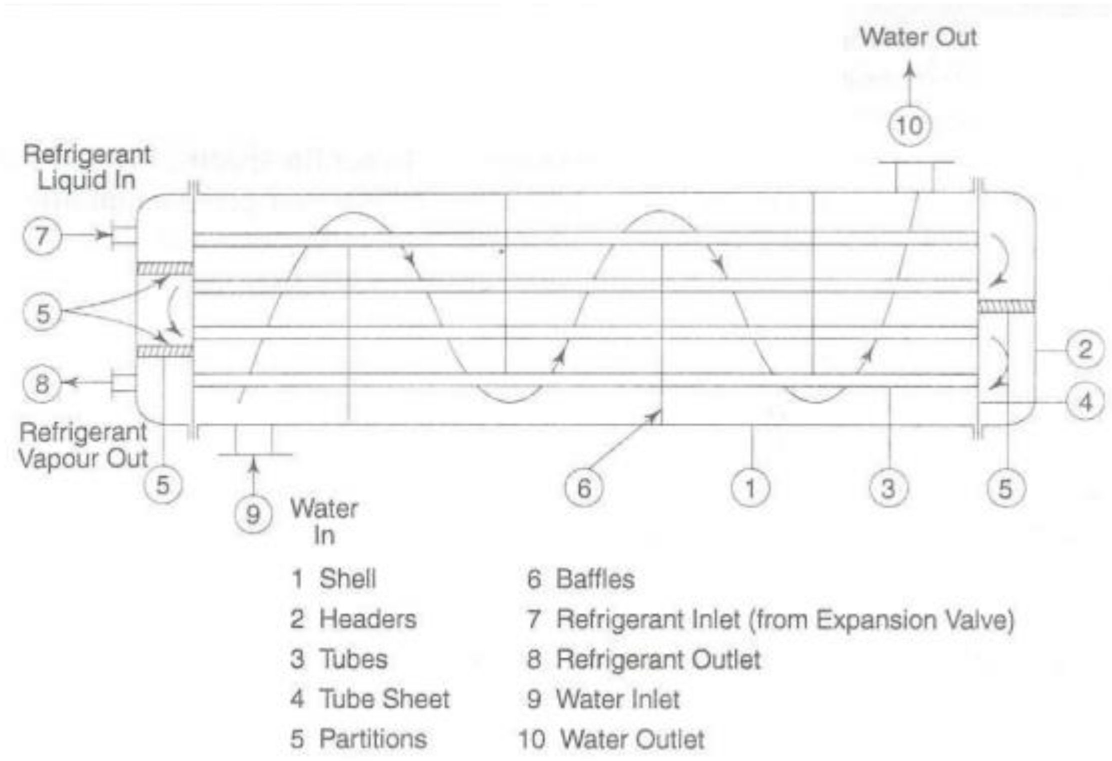
Dry Expansion Evaporator

The liquid refrigerant is typically supplied via an expansion valve in a dry-expansion evaporator. The expansion valve regulates the rate of refrigerant flow to the evaporator so that all of the liquid is vaporised and the vapour is superheated to a certain level by the time it reaches the output end.



Direct Expansion Evaporator

The refrigerant is mostly liquid, with a little quantity of vapour produced as a result of flashing at the expansion valve. The load vaporises more and more liquid as the refrigerant goes through the evaporator. By the time the refrigerant reaches the end of the evaporator, it is solely in the vapour condition, and that too superheated. As a result, the evaporator is filled with a changing proportion of liquid and vapour throughout its length. The amount of liquid in the evaporator varies with the evaporator's load. The interior of the evaporator is not 'dry,' but rather damp. Regardless, this kind is known as a 'dry-expansion' system to distinguish it from a 'flooded' system and also because by the time the refrigerant reaches the evaporator outlet, it is no longer wet (no liquid) but dry (superheated) vapour.

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Flooded Evaporator

When using a flooded evaporator, the liquid level of the refrigerant is kept at a steady state. The throttling mechanism that keeps the liquid level in the evaporator steady is a float valve. When a substance to be cooled releases heat, the liquid refrigerant in the system evaporates, causing the liquid level to decrease. The liquid level is kept constant by the float valve which allows more liquid to be added. Therefore, the evaporator is constantly wetted with liquid and filled to the level set by the float adjustment. The term "flooded evaporator" was used to describe this particular design. Since the entire flooded evaporator's surface is in touch with the liquid refrigerant, its heat-transfer efficiency is increased. However, compared to dry-expansion models, the refrigerant price is substantial. Since the evaporator is already saturated with liquid, its effluent vapour cannot be superheated. Generally, accumulators are used in tandem with flooded evaporators to avoid liquid carry over to the compressor. In addition to storing liquid, the accumulator houses the float valve. The evaporator coil is connected to the accumulator and the liquid flow from the accumulator to the evaporator coil is generally by gravity.

Because it is lighter than air, the vapour produced by the evaporation of the liquid in the coil rises to the top of the accumulator, where it is drawn into the suction line. Liquid eliminators may be installed at the top of the accumulator to filter out any droplets of liquid that may have accumulated there and be sucked into the system by the vacuum. As an added measure, the suction vapour is superheated with a liquid suction heat exchanger installed on the suction line. For some uses, a 'liquid-overfeed system' is used in which a refrigerant liquid pump is used to circulate the liquid from the accumulator to the evaporator coil. The terms "dry expansion" and "flooded" refer to the means by which liquid refrigerant is introduced to and circulated within the evaporator, while "natural convection" and "forced convection" describe the means by which fluid (air or liquid) is cooled and circulated around the evaporator, respectively.

Fluid motion is the basis for natural convection, with the heavier upper cold layer sinking while the lighter upper warm layer rises. A natural convection cooling system uses an evaporator placed in the highest point of an insulated cabin to cool the air within the cabin. A classic instance is the refrigerator in a home. With a fan or a liquid pump, the fluid is "pushed" over the evaporator in a "forced-convection" model. A

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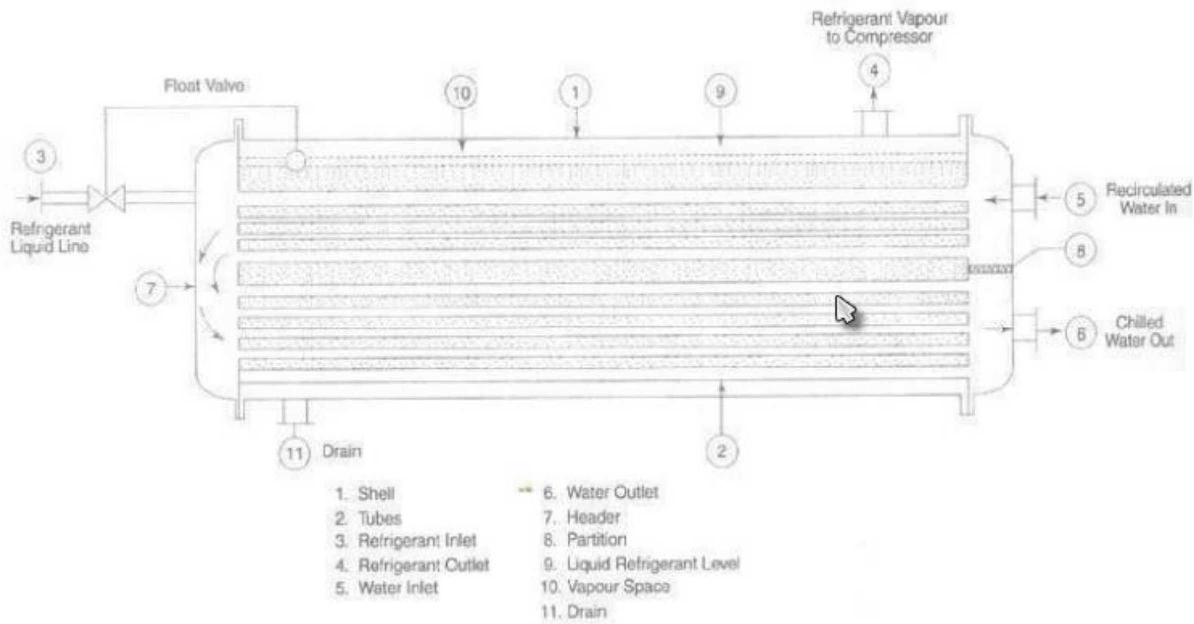
room air conditioner works by constantly recirculating the room's air over a cooling coil. A chilled-water system consists of a chiller and a set of cooling coils that are kept at a constant fluid by means of a water pump or brine pump. In a 'coil-in-tank' setup, like that used in an ice plant, the brine is pumped at a set velocity over the cooling coil.



Types of Evaporator according to their Working Principle

Falling Film Evaporator

Tubes ranging in length from 4 to 8 metres are surrounded by steam jackets to create falling film evaporators. The liquid film drips from the top of the tube wall and evaporates. Highly viscous solutions, such sugar and chemicals, can be evaporated with this type of evaporator.

Nucleate Boiling Evaporator

Wall nucleation is used to create vapour in the Nucleate Boiling Evaporator. This procedure is analogous to boiling the fluid.

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Flash Evaporator

In seawater desalination plants, flash evaporators are used to remove salt from seawater and produce distilled water. When a saturated liquid stream pressure is reduced by passing through the throttle valve, vapours are produced.

Direct Contact Evaporator

Hot gas is fed into a pool of liquid to be evaporated in direct contact evaporators. They are inexpensive and may be used to evaporate caustic and viscous liquids.

Conclusion

Evaporation is a vaporisation process in which liquid converts to gas at the liquid's surface. This process keeps the earth's water cycle running, as well as refrigeration applications and the re-vaporization of liquid gases, etc.

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