How refrigeration works

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Introduction

A refrigerator is used to cool products. It is a necessity nowadays as it is supplied in almost every household. It is mostly shaped like a box that has a door. In order for the process of refrigeration to work with no interruption, the box must be insulated and the door does not leak air to the outside. A refrigerator includes Ammonia gas that is vital to the process of refrigeration to reach its objective, which is cooling. Also, The refrigerator is generated electrically. Refrigerators are supplied with copper tubing. Copper tubing is mainly used because they will not burn or support combustion or decompose to toxic gases. It also has strong and leak-proof joints. Although we use it everyday, many of us don't know how the process of refrigeration works.

The process of refrigeration is as follows:

- Compression
- Condensation
- Expansion
- Evaporation

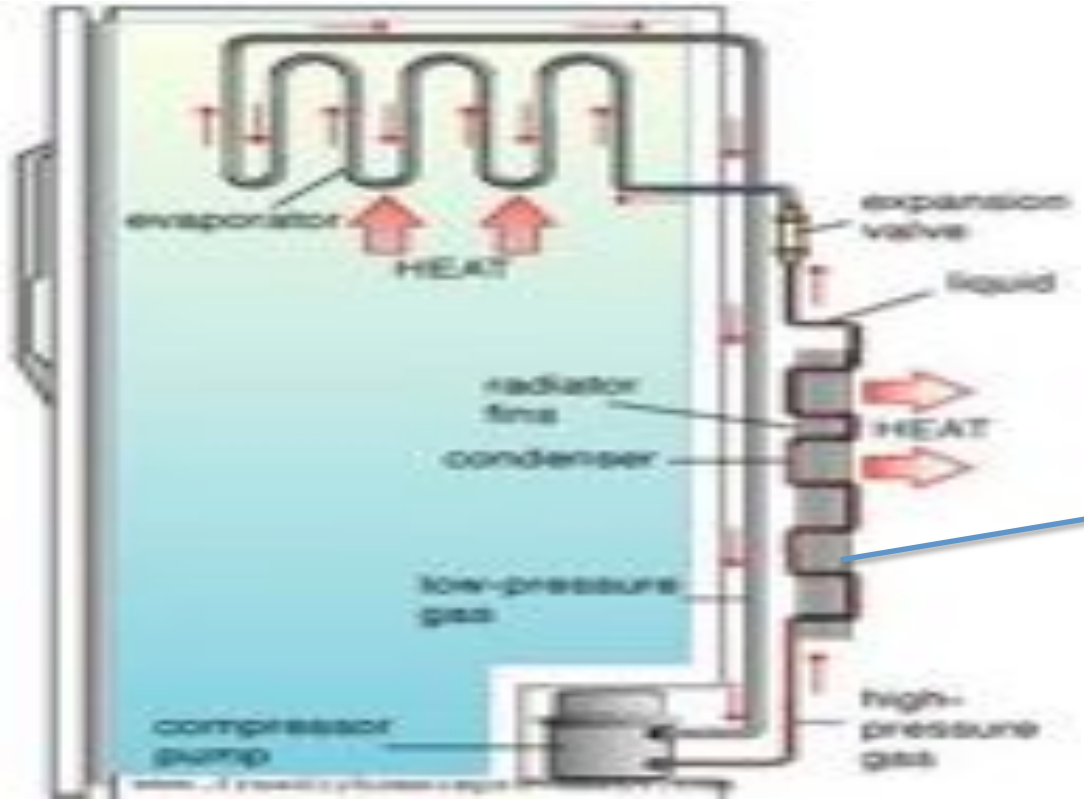


Figure 1: This diagram explains the cycle of the refrigeration (source of the picture: http://researchthetopic.wikispaces.com/How+does+a+refrigerator+work%3F+-+R)

Compression

The compressor plays a major in the process of refrigeration at the beginning and ending. At the beginning, the compressor compresses Ammonia gas by applying high pressure. The gas then heats up and vaporizes with high pressure. The temperature of the gas would be high. The purpose of applying high pressure is to increase its temperature. If the temperature of the gas is high then the performance of condensation will operate fantastically. How does this help? This will help the gas (at high temperature) to exchange heat with the surrounding of the refrigerator. If we have a high temperature that is in contact with a low temperature, the gas will easily exchange heat.

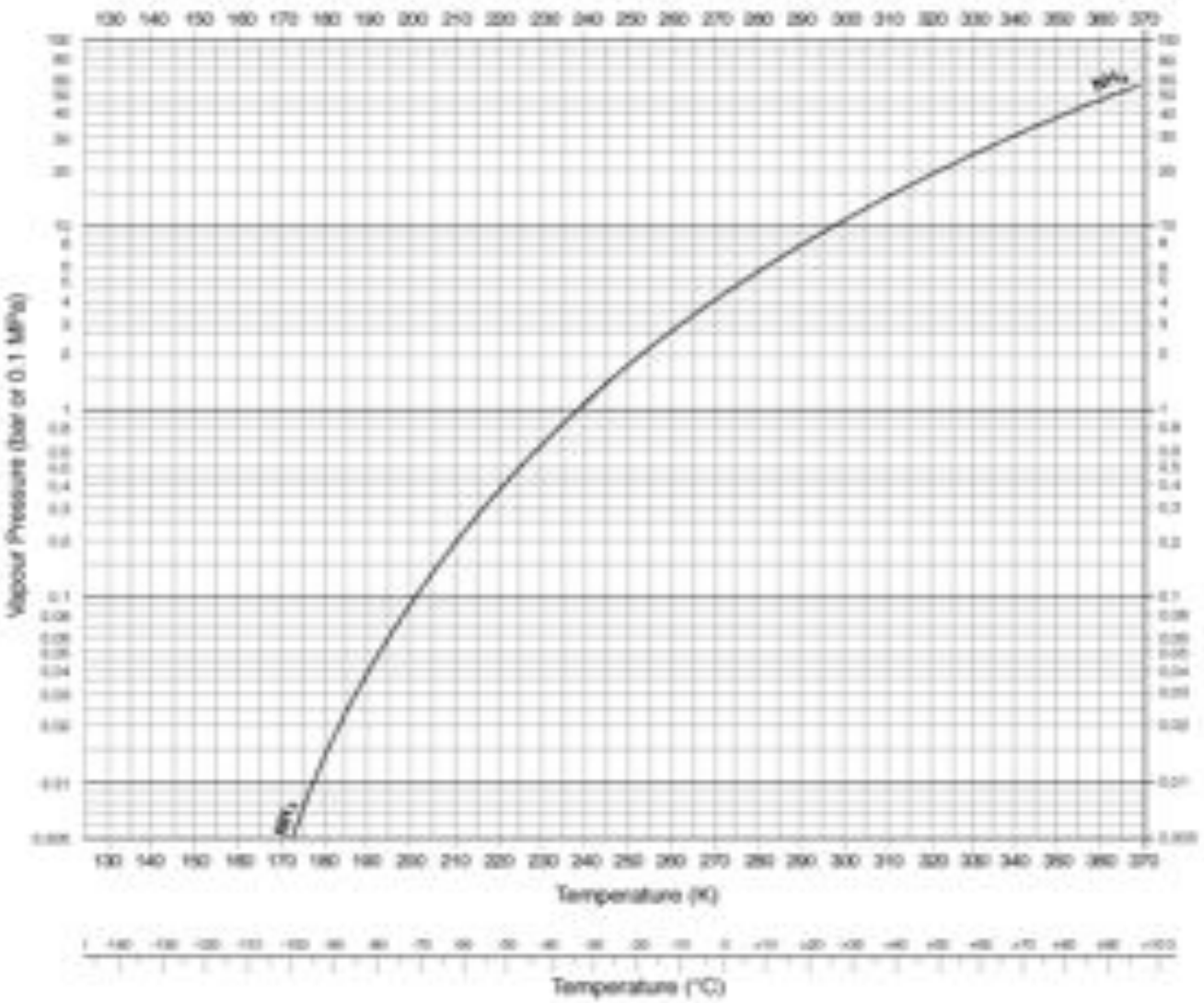


Figure 2: Ammonia temperature vs. pressure diagram (Source of the diagram: encyclopedia, http://encyclopedia.airliquide.com/Encyclopedia.asp?GasID=2)

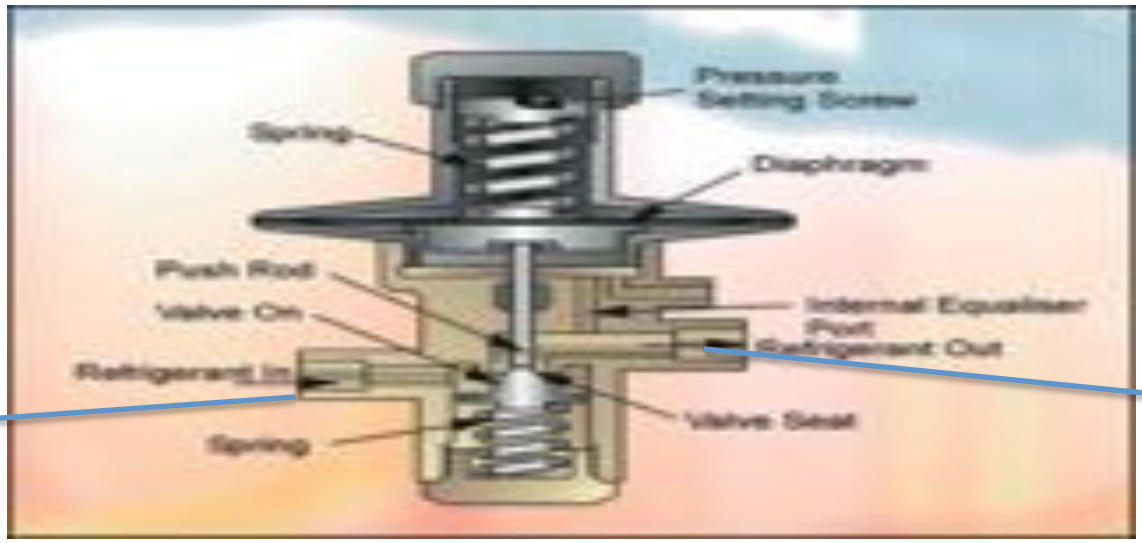
Condensation

The gas then enters phase two. The pipes in this phase are attached to coils as shown in figure.1. The coils allow the pipes to exchange heat. The gas is at a very high temperature, and the coil is exposed to the temperature of the surrounding which is cooler air. If two objects: one with a high temperature and another with cooler temperature get in contact with each other, they will exchange heat. The hot object will be cooler, and the cold object will be warmer. This is what happened to Ammonia gas when it impacted the coil. Ammonia dissipates its heat and condenses to a form a liquid at high pressure.

Expansion

The liquid at high pressure enters an expansion valve. The expansion valve is just a valve that allows the liquid to enter from a smaller pipe to a bigger pipe. A smaller pipe means a smaller area that yields higher pressure, whereas a bigger pipe means a bigger area that yields lower pressure. Because of that, the expansion valve phase forces the liquid to decrease it pressure. When the pressure decreases, the temperature decreases. (See figure.2)

The gas Entry gate



The gas Exit gate

Figure 3: Expansion Valve (source of the picture: acr news, http://www.acr-news.com/news/images/650_1.jpg)

Expansion Valve

The expansion valve (figure. 3) purpose is to increase the pressure, so that when the area of the pipe increases the temperature drops drastically. This is due to the relation of area and pressure. Pressure is force over area. If you decrease the area, the pressure would increase, assuming that force is constant. And vice versa, if you increase the area, the pressure would decrease. When the refrigerant (Ammonia) forces the Expansion valve to open, the valve springs counter force the refrigerant from entering. Until, the refrigerant reaches a high pressure that will force the valve to open. (Entry gate, figure.3) The refrigerant is then transferred to a bigger area. The expansion valve is a vital device that helps the process of cooling to increase the pressure of the gas and then decrease it by letting it get access to a larger pipe. (Exit gate, figure.3)

Evaporation

The liquid will then enter another heat exchange phase, however, this is from cold to hot. After the temperature dropped in the previous step, the liquid is vaporized. And so, we have a cold liquid that is being heated to increase its temperature. This allows the coldness of the liquid to be absorbed by the surrounding (the fridge). The fridge is then cooled and the process accomplishes its objective, which is refrigerating. After that, the

liquid at low pressure is sucked into the compressor. The compressor generates high pressure to the vapor and the cycle of this process starts again.

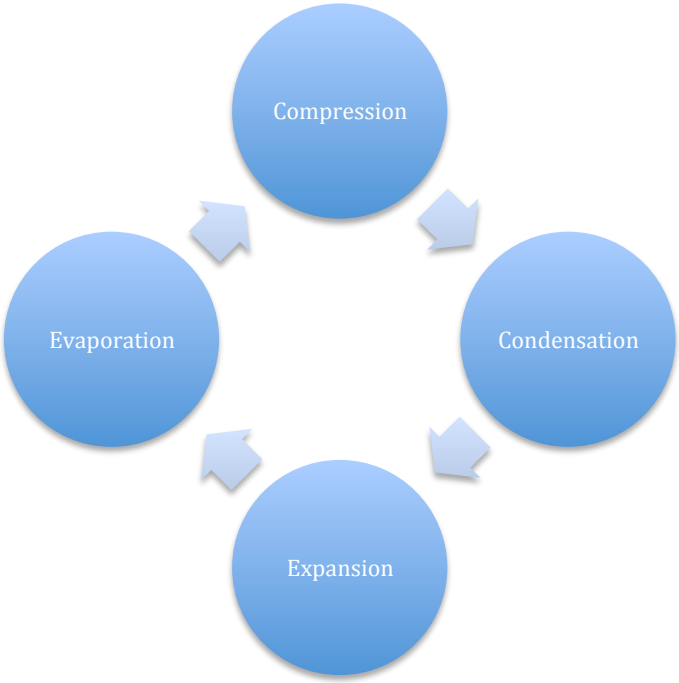


Figure 4: Conclusion of the refrigeration cycle

Conclusion

It is a simple process especially if you have thermodynamics background, since this process is one of it basics and fundamentals. It may be challenging to understand how refrigeration works, nevertheless, I think the figures provided are clear and makes the process more coherent. Ammonia is one of the great discoveries that helped human beings provide a better life. It is used mainly in refrigerators and air conditioning. It is a weird element that can be found in the decay process of nitrogen animal and vegetable matter. Also, it can be found in small quantities in rainwater. Someone could ask can water be a substitute to Ammonia? Well, the water phase diagram is not the same as Ammonia. They don't follow the same pattern. For example the water at high pressure could be either solid, water, or vapor depending on the temperature which makes it more difficult to conduct cooling. Where as the pattern of Ammonia's diagram is exponential. For instance, if you decrease the pressure, the temperature is affected exponentially (see figure.2), which makes it easy to control the temperature of the gas and conduct cooling. In conclusion, the process of Refrigeration starts with compressing Ammonia to produce high pressure on the vapor. The gas is then condensed through contacting coils that are impacted by cool air. After that, the liquid phase is formed and the expansion valve reduces its pressure. Because of that, the temperature of the liquid is forced to drop.

Subsequently, the liquid is immediately boiled which allows the fridge to absorb its coldness. The process ends at the compressor phase to start the cycle again. (See figure.4 and figure.1)