Volume 11. No 2. 202-207 JUNI 2023

p-ISSN 2355-5785
e-ISSN 2550-0325
JPF (Jurnal Pendidikan Fisika)
Universitas Islam Negeri Alauddin Makassar

THE THERMODYNAMICS APPLICATION IN REFRIGERATOR

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Article Info

Article history:

Received : 2023-04-11
Revised : 2023-05-27
Accepted : 2023-06-02

Kata Kunci:

Thermodynamics
Refrigerator
Temperature
Kynematics

DOI:
10.24252/jpf.v11i2.37084

ABSTRAK

Artikel ini menjelaskan salah satu alat untuk menerapkan hukum termodinamika dalam kehidupan sehari-hari berupa lemari es. Artikel ini bertujuan untuk mendalami, memahami, dan memahami konsep termodinamika pada lemari es. Termodinamika adalah bidang fisika yang mempelajari hubungan antara panas dan kerja mekanik, temperatur dan panas, dan teori kinematika gas. Metode yang digunkan dalam penelitian ini yaitu berupa kajian pustaka. Penerapan konsep dasar termodinamika pada mesin dapat mendukung dan memudahkan pekerjaan manusia. Lemari es beroperasi sesuai dengan pernyataan fakta Clausius (hukum kedua termodinamika). Pendingin menggunakan energi listrik untuk memindahkan panas dari benda yang didinginkan ke udara luar yang panas.

ABSTRACT

This article describes one of the tools for applying the laws of thermodynamics in everyday life in the form of a refrigerator. This article aims to explore, understand, and understand the concept of thermodynamics in refrigerators. Thermodynamics is the field of physics that studies the relationship between heat and mechanical work, temperature and heat, and the kinematic theory of gases. The method used in this research is a literature review. The application of the basic concepts of thermodynamics to machines can support and facilitate human work. Refrigerators operate according to the Clausius statement of fact (second law of thermodynamics). Coolers use electrical energy to transfer heat from the object being cooled to the hot outside air.

INTRODUCTION

Thermodynamics is a branch of science, precisely in physics, where in general this science discusses the relationship between heat energy and its work. Energy and its relationship we know there are many forms of energy in this universe. Some

examples include heat, electricity, sound, chemical energy, and many other forms of energy that exist in this life. Energy is conserved, which means it cannot be created or destroyed.

The laws of thermodynamics occur naturally in everyday life [1]. Earth receives electromagnetic energy every day from the Sun. This electromagnetic energy is converted into heat energy, electricity, wind energy, ocean waves, various plant growth processes, and many other natural processes [2]–[5]. There are many applications of the principles of thermodynamics in life due to the development of the broad science of thermodynamics. The development of thermodynamics began with the invention of the steam engine in England in the 17th century, followed by many thermodynamicists such as William Rankin, Rudolf Clausius, and Sir Kelvin in the 19th century.

The study of thermodynamics is part of the study of thermophysics which is a branch of physics that examines the relationship between heat and changes in the behavior of substances. The study of thermophysics is very broad and includes the science of thermometry calorimetry, thermodynamic heat transfer, kinetic gas theory, and statistical equations [6].

Thermodynamics can be defined as the study of energy, transformations, and their relationship to the environment. Energy can be seen as the ability to cause change. Thermodynamics is always concerned with systems. A system is defined as the amount of matter in a selected space for mass study outside the boundaries of the environmental system.

The environment around the system interacts directly. Accordingly, the environment has a much stronger influence on its behavior and properties. When we study a car engine, the combustion of gasoline in the engine cylinder is a thermodynamic system [7]. The combustion system pistons, radiator exhaust system, and outside air make up the environment. The boundary then consists of the inner surface of the cylinder and the piston. For material applications, thermodynamics describes materials that accept heat energy or various forms of energy. The system usually has some interaction with its environment. Systems are divided into three categories: open systems, closed systems, and isolated systems [8]. An open system occurs when mass and energy are exchanged with the surroundings. We can observe this system in a cup of hot coffee that evaporates, material can come out in the form of steam, heat can flow around it, and heat and mass transfer occur. A closed system is a system that only exchanges energy with the surroundings. This system has several ways of exchanging time. This method uses a diathermic wall that allows heat to flow through the container or container [8]. When you pour hot water into an airtight container and close it, steam will come out but it will still feel hot against the walls because the heat has already flowed out.

An isolated system is a thermodynamic system in which the system does not experience heat, exchange of matter, or motion with the surroundings. An example of an isolated system is an insulated gas cylinder. This system cannot be completely isolated from the rest of the system or the environment. This is because some mixing needs to be done, though to some extent. The truth of the laws of thermodynamics is general and does not depend on the interactions or details of the system or the explanation being studied.

The second law of thermodynamics is concerned with entropy [9]. This law is still unclear, but there is an experimental reality statement made by Kelvin Planck which states that it is impossible for a system to operate in a thermodynamic cycle and provide a net amount of work to the surroundings while receiving heat energy from a thermal reservoir. Based on the current developments, the law of thermodynamics cannot be separated from its important role in the field of technology, especially in its application in everyday life. Examples that exist in everyday life are the refrigerator or what is commonly called a refrigerator [8]. Based on the explanation above, the laws of thermodynamics are closely related to everyday life. There are many applications of the laws of thermodynamics in technology, one of which is the refrigerator.

METHOD

The method used in this case is the literature review method. The literature review can be done by collecting data, reading, recording, and processing appropriate materials from journal articles, and other references.

RESULTS AND DISCUSSIONS

3.1. Application of the Second Law of Thermodynamics in Refrigerators

The basic abstraction of thermodynamics is to divide the world into systems surrounded by thoughts that assume reality or boundaries [10]. A system that is not included in the classification is called an environment. The splitting of a system into several sub-systems is also unexpected or can form a larger system. From the basic principles of thermodynamics, in general, we can obtain relationships between variables such as coefficient of expansion, compressibility, specific heat, heat conversion, and electrical coefficient, especially temperature-dependent properties [11].

The explanation of the second law of thermodynamics is based solely on experimental facts put forward by scientists, one of which was put forward by Clausius. Clausius said that it is impossible to operate the system in such a way that the only result of the energy transfer is heated from the system. The scientist Kelvin-Planck also contributed statements about the second law of thermodynamics. Experiments have shown that it is impossible for the system to operate in a thermodynamic cycle and release the tissue to the surrounding heat energy. The

amount of entropy that increases is generally close to the maximum value, so it is called the principle of increasing entropy [12].

There are two formulations in the second law of thermodynamics. First is the Kelvin-Planck formula, which shows that it makes no sense to build a machine that can continuously absorb heat from a reservoir and convert it into external work. The second is the Clausius formula, which shows that there is no point in building a machine that can operate in one cycle by absorbing heat from cold storage and sending it to the tendons at high temperatures without external work.

3.2. Cooling Machine Installation Procedures

The way the refrigeration machine installation works is that first, the electric compressor draws low-temperature and low-pressure refrigerant gas from the suction line and the evaporator. The compressor then compresses the refrigerant gas into steam or hot gas at high pressure, then the gas is pushed into the cold condenser by the compressor, cooled by the air outside the refrigerator, and the temperature is condensed into a thick temperature.

The refrigerant flows through the filter (filter and dryer), then enters the small and long capillary tube (pressure drop) and the liquid refrigerant (very low pressure) enters the evaporator chamber (low vacuum pressure), its boiling point becomes low and the refrigerant becomes a gas. The refrigerant needs heat to evaporate in the evaporator. The refrigerant has a large heat of vaporization, it is transferred from around the evaporator (in the refrigerator). This work is amplified by the compressor suction which accelerates the refrigerant gas molecules and travels along the evaporator, absorbing heat from the surroundings and cooling the contents of the refrigerator.

The refrigerant gas enters the accumulator and is separated from the coolant. Only refrigerant in the form of gas can enter the suction line, then return to the compressor to be compressed and then pumped back to the condenser. In addition to the cooling circuit, the refrigerator also has a support function called a defroster. Failure to defrost will form ice on the outside of the evaporator tube resulting in reduced cooling capacity. The work of defrosting from the evaporator is carried out by an electric heater (thaw heater). It is powered by small electrical components that form an electrical circuit with different circuits with the same operating principle. Based on this, set the continuous cooling and defrosting, and take time to achieve optimal cooling.

The function of the refrigerator in thermodynamics is closely related to the law of heat transfer. Heat itself is heat energy that can be received and transferred from one object to another by conduction, radiation, or convection. However, the two work differently when it comes to converting energy. The working principle of the

refrigerator is that heat energy will always move towards a cooler area. This can occur through various thermodynamic processes.

3.2.1 Process at constant pressure

In constant pressure processes, the initial pressure of the process is equal to the final pressure of the process. First, the heat energy is transferred to the refrigerator, where the energy is transferred to a cooler area of the refrigerator. In this way, the hot and cold energy of the refrigerator is constantly under pressure.

3.2.2 Process at constant volume

Furthermore, the pressure will produce a volume of each hot and cold energy.

3.2.3 Process at constant temperature

This stage is known as the isothermal process. In this process, the initial process temperature is usually the same as the final process temperature. These conditions can cause energy changes in the electronic device system. This can happen because the heat energy will always lead to a cooler area, resulting in the transfer of heat energy into cold energy.

3.2.4 Adiabatic process

This insulation process does not introduce or remove heat from the system. In a sense, converting heat energy into cold energy can change the pressure and volume of energy in the refrigerator.

CONCLUSION

Thermodynamics is the field of physics that studies the conversion of heat energy into other forms of energy. The first law of thermodynamics and the second law of thermodynamics serve as references when discussing energy changes. There are two formulas in the second law of thermodynamics, the Kelvin-Planck formula. It is impossible to make an engine that operates in a continuous cycle, receiving heat from the reservoir and converting that heat completely into external work. The Clausius formula states that it is impossible to build a machine that operates continuously without external work. Regarding the principle of operation of the refrigerator, heat energy always moves to a cooler place. This occurs through a variety of thermodynamic processes, including constant pressure processes, constant volume processes, constant temperature processes, and adiabatic processes.

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