An Examination on Uses of Heat Exchangers in Industries.

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ABSTRACT: A heat exchanger is a mechanical device that transfers or exchanges heat energy between different types of heat transmission for a variety of applications. Heat exchangers are highly helpful and significant in the industrial arena for transferring thermal energy between two fluids at different temperature levels. Concentric tube (double pipe), shell and tube, and plate heat exchangers are the most popular types of heat exchangers. Heat exchangers are devices that allow heat to be transferred from one medium to another. Depending on the industry and process, these media might be a gas, a liquid, or a combination of both. For example, waste heat from a thermal power plant's gas turbine can be transported to a boiler to convert water to steam, which can then be used to drive a steam turbine to generate additional electricity. As a result, heat exchangers are used to enhance not just the amount of heat transfer but also the overall efficiency of the current system. This study is conducted to cover various types of heat exchangers which are in the use in different type of industries, which will in turn help in finding other industrial uses of heat exchangers.

***KEYWORDS:** Colling Tower, Electronic Devices, Heat exchangers, Heat transfer, Heat sink.*

1. INTRODUCTION

Heat exchanger is a mechanical system that transfers heat between two or more fluids that are typically in motion, such as a heat exchanger. Heating and cooling may be accomplished with the use of heat exchangers. Alternatively, the heat-transfer fluids may be in direct touch or separated by a solid wall to avoid mixing. Thermal power stations, chemical manufacturing facilities and petroleum refineries, natural gas processing plants and sewage treatment all utilize heat exchangers [1].In internal combustion engines, a fluid called engine coolant circulates in a closed loop via coils and air flows through the coils, cooling the coolant and heating the incoming air, which is the basic application of a heat exchanger. It is also possible to think of a passive heat exchanger, such as a cooling fluid medium, such as air or a liquid coolant, which transfers heat created by an electrical or mechanical device[2] . In order to manage the temperature of a system, heat exchangers supply or remove thermal energy heat sink.. Although there are many types of heat exchangers based on different sizes, levels of sophistication, no. of tubes and basic of heat transfer. Most heat exchangers used in practical applications may be categorized into one of the four main kinds described below based on flow direction and route design [3]. Though there are a number of prominent renewable energy technologies, such as solar and wind power, there are also simple daily resources that are renewable. In certain ways, the term "renewable energy" is frequently associated only with pictures of solar panels and wind turbines, but in truth, renewables encompass much more than these two items[4]. Renewable energy may be thought of in terms of the many natural occurrences that produce it, as well as the shared beneficial outputs (renewable commodities) that are only possible due of renewables. Subsidies are especially crucial for new energy sources in the early phases of development, and the oil and gas sectors have traditionally received far greater subsidies than renewable energy alternatives. Between 1918 and 2009, the oil and gas sector in the United States received an average of $4.86 billion in tax expenditures every year. Between 1994 and 2009, the renewable resources business generated only $0.37 billion per year on average. The good news is that these figures are beginning to shift. Annual subsidies for renewable energy are currently larger than subsidies for fossil fuels: according to the Congressional Budget Office, renewable energy and energy efficiency received nearly three-quarters of all energy tax preferences in 2015. The essential thing is to keep the renewable energy trend going. The majority of tax breaks connected to fossil fuels are permanent provisions in the tax code. Many preferences for renewable resources, on the other hand, are only transitory and must be extended. Heat exchangers are intended to improve efficiency by optimizing the surface area of the wall between two fluids while decreasing resistance to fluid flow via the exchangers while staying within material cost constraints. Corrugations or fins in the heat exchanger might improve the performance of heat exchanging surfaces by increasing surface area and channeling fluid flow or inducing turbulence. The total heat transfer coefficient, which tends to drop over time owing to fouling, may be tracked live to assess the efficiency of industrial heat exchangers.

1.1.Concurrent, or parallel-flow heat exchangers:

Fluids from two streams enter together at one end, flow in the same direction, and exit together at the other end of concurrent, or parallel-flow heat exchangers. This is the most basic type of heat exchanger in use. Figure 1, Illustrates the parallel flow heat exchanger in which the direction of the hot fluid and cold fluid is same.

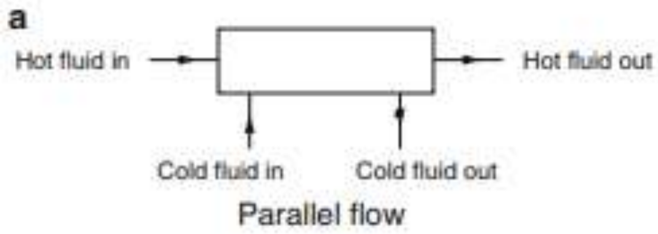

Figure 1: Illustrates the parallel flow heat exchanger in which the direction of the hot fluid and cold fluid is same [5]**.**

1.2.Countercurrent, or counter-flow heat exchangers:

Fluids from two streams enter in opposing directions, flow in opposite directions, then emerge together at the other end units. Costs of additional fuel required if fouling causes additional fuel to be burned in heat-exchanging equipment to counteract the fouling effect. Plant shutdowns, whether scheduled or unexpected, caused by fouling in heat exchangers can result in significant production losses. These losses are frequently regarded as the primary cost of fouling and are notoriously difficult to assess

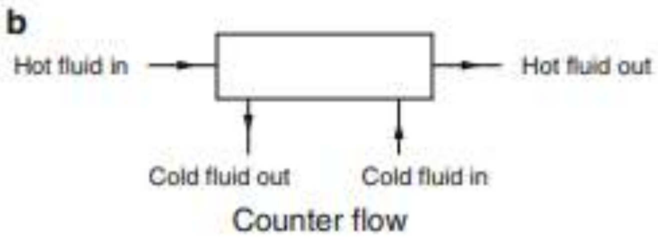

Figure 2: Illustrates the counter flow heat exchanger in which the direction of the hot fluid and cold fluid is opposite to each other [6]**.**

2. LITERATURE REVIEW

Heat exchangers are frequently categorized according to their application, with certain unique names being used for key application kinds. Boiler, steam generator, radiator, condenser, cooling tower, evaporator, regenerator, recuperate, heater, and cooler are examples of these kinds. The development of heat exchangers based on diverse uses resulted in a variety of constructions, some of which are designed to perform specific tasks. A heat exchanger may also be used as a heat pipe, which is a device that permits very high heat transfer rates over medium to short distances with low thermal resistance and low temperature gaps[7]. Heat pipe has several advantages over traditional heat exchangers, including a cheaper initial cost, high efficiency, minimal air-side pressure drop, low maintenance costs due to the lack of moving components, and lower operational expenses. According to the American Society of Heating in Operating Hospitals, the room air must be changed at least 16 times per hour, and heat exchangers are employed in hospitals to accomplish this goal. Due to global warming and environmental concerns, there is a growing demand for energy-saving technologies in buildings [8]. As a reaction of this, energy-efficient technologies are becoming increasingly popular amongst academics and designers. In this context, researchers have concentrated on the development of advanced heat or energy recovery systems with energy-efficient ventilation systems in order to meet energy conservation demands. The purpose of this article is to examine heat or energy recovery methods for use in buildings. Environmental deterioration has become a major problem in recent years as a result of large-scale fossil fuel use. It is a good idea to switch from fossil fuels to non-conventional energy sources such as geothermal energy to solve this problem. An overview of geothermal energy in Europe during the previous decade is provided, as well as the usage of heat exchangers in geothermal energy generation[9]. An industrial heat exchanger is a piece of heat transfer equipment that uses a thermal energy exchange method to transport heat between two or more mediums of varying temperatures. Industrial heat exchangers are used in a variety of sectors, including power generation, oil and gas production, chemical processing, transportation, alternative fuels, cryogenics, air conditioning and refrigeration, heat recovery, and others. Furthermore, heat exchangers, such as evaporators, air preheaters, vehicle radiators, condensers, and oil coolers, are always directly connected to our daily lives.

2.1.Discussion On Diverse Uses of Heat Exchangers:

Heat exchangers are used in a variety of fields and applications, ranging from thermal power plants to tiny electronics such as laptops and smartphones. Figure 3, depicts the many applications of heat exchangers in industrial and real-world situations. Due to the wide range of applications, it is difficult to describe all of the practical uses of heat exchangers; nevertheless, by examining heat exchanger applications in many engineering domains, a general conclusion may be reached.

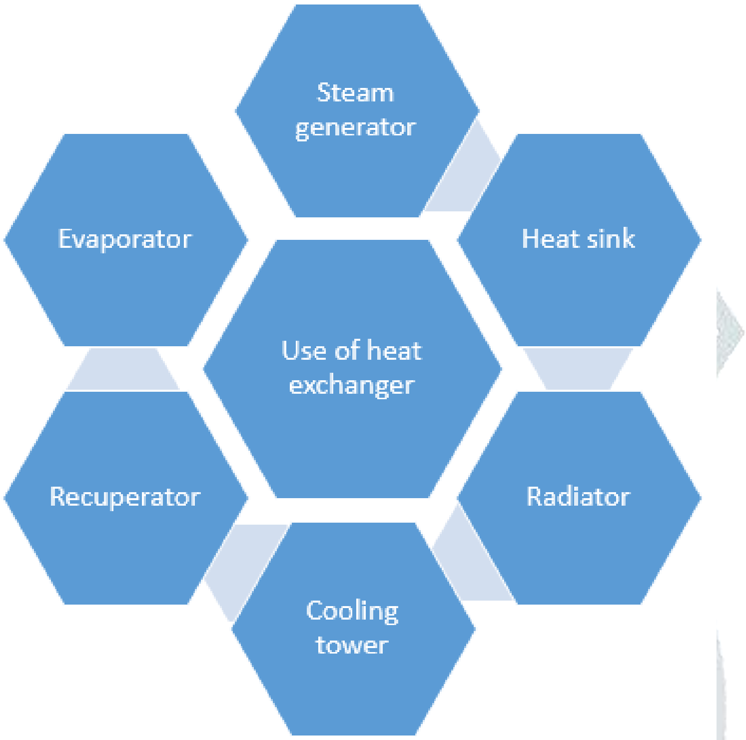

Figure 3: Illustrates the diverse use of heat exchanger in various field of engineering application like cooling tower and many more.

Heat exchangers are used in a variety of fields and applications, ranging from thermal power plants to tiny electronics such as laptops and smartphones. Figure 5 depicts the many applications of heat exchangers in industrial and real-world situations. Due to the wide range of applications, it is difficult to describe all of the practical uses of heat exchangers; nevertheless, by examining heat exchanger applications in many engineering domains, a general conclusion may be reached. The water will then be pumped back to the cooling tower to finish the cooling cycle. Thermal power plants, building management systems, petroleum refineries, petrochemical facilities, and natural gas processing plants all utilize cooling towers. Radiators are a good example of heat exchangers utilized in the automotive sector. In the age of fast-moving automobiles, it is also critical to extract additional heat from the engine cylinder via improving heat transfer. Radiators are devices that improve the rate of heat transmission in cars. A radiator is always a source of heat to its surroundings, whether for the purpose of heating or cooling the fluid or coolant provided to it, as is the case with automobile engine cooling and HVAC dry cooling towers. In comparison to other modes of heat transmission such as radiation, most radiators use convection as a mechanism of heat transfer. With the fast advancement of technology in the electronic industry and industrialization, small electronic gadgets are becoming more popular. These electrical gadgets create a significant amount of heat, which must be evacuated in order for the device to work properly.

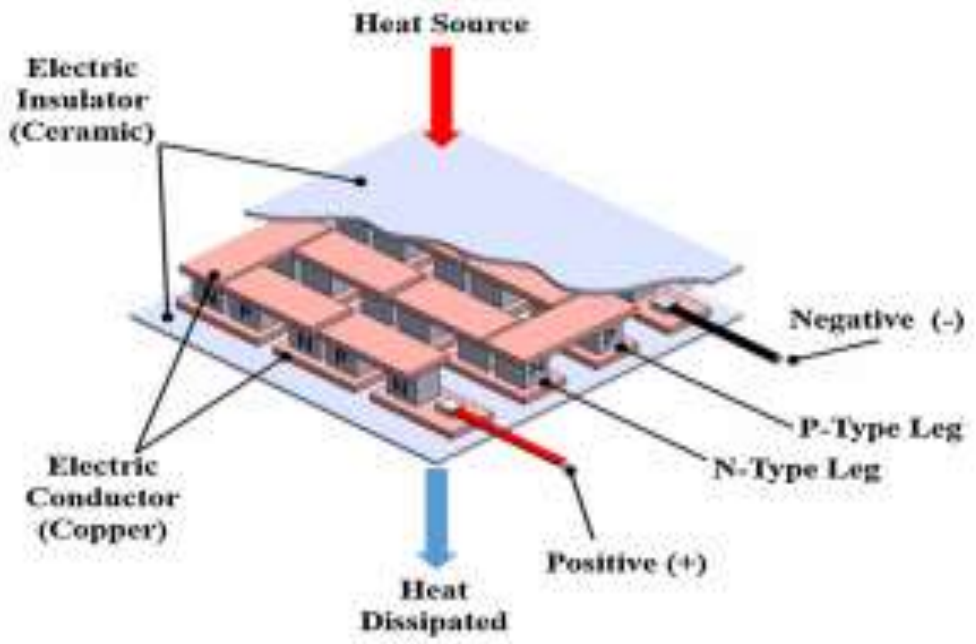

Figure 4: Illustrates the heat sink used in electronic devices to extract excess heat from the electronic chips [10]**.**

If processed water is not properly treated, the potential damage to equipment caused by the growth of scale can be quite costly. Chemicals are often employed in the industry to treat water. Every year, 7.3 billion dollars' worth of chemicals are discharged into the air, thrown in streams, and buried in landfills in the United States. Industry purchases 40% of these chemicals for scale control in cooling towers, boilers, and other heat transfer equipment. This proportion also represents over 2 billion dollars in hazardous waste, which contributes to trillions of gallons of polluted water disposed of annually into the ground, which belongs to us all. Acid cleaning, sandblasting, high-pressure water jet, bullet cleaning, and drill rods are all options for maintaining clogged tubular heat exchangers. Water treatment, such as filtration, chemical addition, catalytic approach, and other methods, are used in large-scale cooling water systems for heat exchangers to reduce fouling of the heat exchangers. In steam systems for power plants, additional water treatment procedures are utilized to reduce fouling and corrosion of the heat exchanger and other equipment. The majority of the chemicals and additives used to prevent fouling and corrosion are harmful to the environment. Heat exchanger design concepts must fulfil standard process requirements stated by service conditions for uncorded and corroded conditions, as well as clean and fouling situations. One of the most important considerations in heat exchanger design is ease of maintenance, which generally entails cleaning or replacing parts, tubes, fittings, and other components that have been damaged by ageing, vibration, corrosion, or erosion over time. As a result, if severe fouling is predicted, a heat exchanger design should be as basic as feasible. The occurrence of potential fouling can be reduced by lowering the temperature in combination with the choice of fluid velocity and lowering the concentration of foul ant precursors. Furthermore, within the restrictions of pressure drop and flow erosion, the greatest flowing velocity should be permitted. Furthermore, material selection within a cost constraint slows the formation of deposits and allows for a shorter residence period. It should also be compatible in terms of pH, corrosion, and not just heat exchangers, but also heat equipment and heat exchanger transfer lines. The development and buildup of undesirable materials deposit onto the processing equipment surfaces is always described as fouling. These materials, which have a low thermal conductivity, form an insulator on the surface, reducing the surface's ability to transmit heat under the temperature difference for which it was developed. Furthermore, fouling increases fluid flow resistance, resulting in a greater pressure drop across the heat exchanger. Crystallization fouling, particle fouling, corrosion fouling, chemical reaction fouling, biological fouling, and solidification fouling are all forms of fouling that may occur on heat transfer surfaces. Fouling has a high cost in the industry, since it increases fuel consumption, disrupts operations, causes output losses, and raises maintenance expenses. Initiation of fouling, transit to the surface, attachment to the surface, removal from the surface, and ageing at the surface are the five steps of fouling formation. The overall fouling process is typically seen to be the product of two concurrent sub processes: a deposition and a removal process. The heat transmission performance of the heat exchanger degrades over time as these deposits develop. Because of the heat exchange, this problem impacts the energy consumption of industrial operations and finally leads to industrial failure. Soil, atmosphere, water, and aqueous solutions are all frequent enemies of ordinary metals and alloys. Corrosion is the term for the degradation of these metals. It is understandable that corrosion occurs as a result of electrochemical mechanisms. Corrosion causes premature equipment failures in most commercial processes and engineering activities, resulting in unwelcome consequences. This involves costly breakdowns, unplanned shutdowns, and higher maintenance costs.

3. CONCLUSION

The heat exchanger has been utilized in a variety of applications, including mechanical, rocket, and electrical systems, as well as robotics. These heat exchangers were originally created to transfer heat in mechanical systems such as turbines, boilers, condensers, and other massive machines that disperse heat on a huge scale. Heat exchangers were widely employed in electronic devices when the age of power electronics began to increase the rate of heat dissipation from integrated circuits in order to attain maximum efficiency. As a result of continuing research and development, the size of heat exchangers has shrunk and become more compact. The major goal of this review article was to provide an up-to-date assessment of many applications of heat exchangers in various fields of engineering and research. With the creation of more and more gadgets whose efficiency is negatively affected by the heat lost by electronic chips, the demand for a smaller and more effective heat exchanger is increasing day by day. Although a significant amount of study has been done on heat exchangers, more research is needed to fully harness their potential in comparison to the degree of its usefulness.

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