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MEC299

HEAT TRANSFER ANALYSIS OF DIFFERENT COOLING MEDIUM ON A CONDENSER

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ABSTRACT

One of the cooling devices that can induce condensation to high-pressure refrigerants by ventilating the heat of the high-temperature refrigerant meanwhile at the same time maintain its pressure is the condenser. The cooling medium that being applied in it is vital because it will result in the effectiveness of the condenser. The most functioning cooling mediums to be used is coolant fluid. This research purpose is to analysis the performance of the condenser and to improve it by improving the heat transfer features and cooling rates of the device including coolants, the same coolant but with two different concentrations, and the mass flow rates. The working fluids that being used are water as Coolant A, and Coolant X with two different concentrations such as Coolant B with 13% of concentration and Coolant C with 15% of concentration and the mass flow rate is use at the range from 0.5 l/s until 4.0 l/s. The temperature of every coolant at the inlet initially will be constant at 26°C and when running the experiment each coolant runs through the piping system, passing through the condenser, which dissipates any unnecessary heat before exiting the pipe. Next, before and after passing through the condenser both temperatures of the coolant were measured using the thermocouple that is provided. For this study, the result that can be expected from this experiment is that Coolant C with 15% of concentration may be the best coolant for the condenser because of its heat transfer analysis and follow up with the Coolant B with 13% of concentration and the last coolant from this study is the Coolant A which is water.

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CHAPTER 1
INTRODUCTION

1.1 Background of Study

Nowadays, there is no denial that many countries in the world including Malaysia are growing and developing impetuously. For economic development, one of the backbones for it is the manufacturing sector because from that there are a lot of machines and devices that created to ease and give comfort to humankind. Air conditioner can be taken to be one of the examples of home appliances that help people. The market for air conditioner units is keep growing in numbers every year but because of the spread of the COVID-19 pandemic negatively impacted the demand for air conditioners in 2020 owing to decreased consumer spending. However, the market is expected to revive in 2021 and record a stable growth aided by the changing climate conditions and rising demand for commercial construction. (Grand View Research, 2021). Indirectly, there will also be an increment in demands of a good condenser where it is the most important parts for the air conditioning system.

Condenser is a compulsory highly efficient parts in the air conditioning system where it will move heat that is unneeded from a working fluid to the nearby environment. The coolant used is the one that really help the good condenser as it works as working medium to avoid overheating disperse the heat generated by the equipment. When something is overheated, the effect of it obviously dangerous such as damage to the system circuit components and the worse outcomes that might happened are injury, fire, or an explosion (Al-Mubarak, 2017). The damage can be reduced or avoid with having an excellent good cooling medium system with high rate of heat transfer in the system.

One way to describe heat transfer is the energy transfer occurred from the differences of the mediums' temperature (Nurni, 2014). Regardless of whether it is solids, liquids, or gases, heat can be transmitted from one medium to another (Curd, 2001). Despite of all the mediums, the most usual one that being applied in the condenser system is the liquid and gasses. For condenser the heat transfer process that happen in it because of the temperature differential between them causes them to naturally transfer into the working fluid that runs through the system (Greenspec.co.uk, 2016). There are many parameters that can affect the rate of heat transfer. Anyhow, coolant is likely to become the primary component of condenser because there are variety of coolant that are there in the manufacturing industries.

Commonly, in industries for heat transfer coolant liquid is the one that is preferable. It is being said that because of coolants that are fluid can prevent overheating through sending the heat that being produced from device to other devices that can evaporate or make use the heat. To have an ideal coolant, it must have high thermal capacity, low viscosity, low-cost, non-toxic, and did not result in the corrosion of the system and water is the usual type of coolant used because of it has good heat transfer properties between others especially with its high specific heat, 4200 J/Kg.K, and no flash point (Mohapatra, 2006). Nevertheless, water is easily influenced by freezing and boiling so it has a narrow range of operation. Consequently, to analyse the tips to enhance the heat transfer features and cooling rates of the devices using different coolants a few experiments will be made with the same coolant but two different concentrations, and different in mass flow rate.

1.2 Problem Statement

There are a lot of usual problems regarding an air conditioner (A/C) and one of them is, it does not blow cold air even it switched on and cause the uneven cooling in the room. With this problem, the manufacturers in the industries all determine to come up with excellent coolants that can be used in the condenser so it can be the leading and unmatched, importantly in the aspect of heat transfer to solve these problems. Because, when the engine cooling system and condenser are not at their best it will affect the performance of an A/C system and unsatisfactory A/C output (Rosone, 2019).

It is necessary for an ideal coolant unit to have an excellent condenser and an auspicious A/C system. Until today, one of the best cooling mediums for a condenser is water however, there still downsides of using water as coolant because water can boil faster than other coolants. Water itself seems not adequate to maintain the system cool because it is easy to evaporate. Hence, different coolants, similar coolants with varying concentrations, and varied mass flow rates will be used to analyse the heat transfer of the coolants. In every coolant in aspect of properties they all have their own differences that can affects its cooling rate. For concentration, it is better for coolant to stay its concentration level because it will result in the corrosion of the pipe or other components if the level of concentration is too low. Contrast with it that if the level of concentration is too high, the result for rate of heat transfer will be less (Mein, 2019). The rate of heat transfer for the flow rate of the coolant is directly proportional to the flow rate of the coolant. From the equation of the thermodynamics, rate of the heat