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EFFECTIVITY OF HEAT EXCHANGER USING COOLANT FLUID

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Abstract

In industry, heat exchanger usually used in the manufacturing process. This research will use shell and tube heat exchanger (STHC) with coolant fluid and water. Experimental data for analysis are temperature of the fluid and flowrate. Purpose of this research to analyze the effectivity of the heat exchanger and convection heat transfer coefficient in the system. Theoretical and experimental method are used in this research. The result show the best effectivity is 80% at shell flowrate of 2 L/min and tube flowrate of 5 L/min.

Keywords: coolant, temperature, effectivity, convection heat transfer coefficient

INTRODUCTION

Heat exchanger is equipment to transfer heat between one or more type of fluid in the different temperature. The type fluids that can be used in the heat exchanger are gas or liquid. In industrial, heat exchanger usually is used in the manufacturing process, refrigeration, air conditioning, power station, chemical plant, and petrochemical plant. The simple sample of the heat exchanger contribution is found in the radiator coils at automobile and condenser/evaporator air conditioning at the home appliances.

There are many type of the heat exchanger. In industry application usually are used the double pipe heat exchanger, shell and tube heat exchanger, and plate heat exchanger. The double pipe heat exchanger is the simplest one. The shell and tube heat exchanger consist of series of tubes. Usually shell and tube heat exchanger is used for high pressure application in industry with pressure and temperature more than 30 bar and 260 ^{0}C respectively.

Effectiveness of heat exchanger is depend on the surface area effective heat transfer, pressure drop, number of tubes, pipe length, pipe diameter, and number of baffles. This research will use shell and tube heat exchanger using cooling fluid. Many researchers have been studied to increase the effectiveness of the heat exchanger. Simin Wang, etc (2008) has been modified a baffle seal in the shell side to increase the performance of the heat exchanger of 25%. Other researchers have also been examined the shell and tube heat exchanger with spiral tube modification to decrease the pressure drop (Xuesheng Wang, etc, 2004).

In this study, the effectiveness of the heat exchanger will be calculated and analyzed with experimental testing. The results can be used as a reference to design the heat exchanger with a larger scale. The purpose of the research are calculate the convection heat transfer coefficient, area of heat transfer, and effectiveness of the heat exchanger.

MATERIAL AND METHOD

Heat exchanger type shell and tube is used in this experimental research, using coolant and water fluids. The experiment is conducted in the heat and mass transfer's laboratory located in the Mechanical Engineering Department, Tarumanagara University.

Diameter of the shell is 110 mm using flexiglass (acrylic) material. Inner and outer diameter of tube are 12.7 mm and 10.9 mm, respectively. Tubes consist of 20 tubes with total length of 700 mm. Type of the baffle using single segmental with 8 baffles and 20%

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cutting. The type of the pump using 2 centrifugal pump to circulate the coolant and water fluid.

The experiment is investigated with flowrate variation of 2, 3, and 4 L/min respectively for both fluid. The properties of the fluids as shown in table 1.

Table 1. Properties of coolant and water

Fluid	Specific heat (kJ/kg.C)	Density (kg/m^3)
Water (32-49^{0}C)	4174	1000
Coolant	3818	1040

A installation diagram of the system is shown in Figure 1.

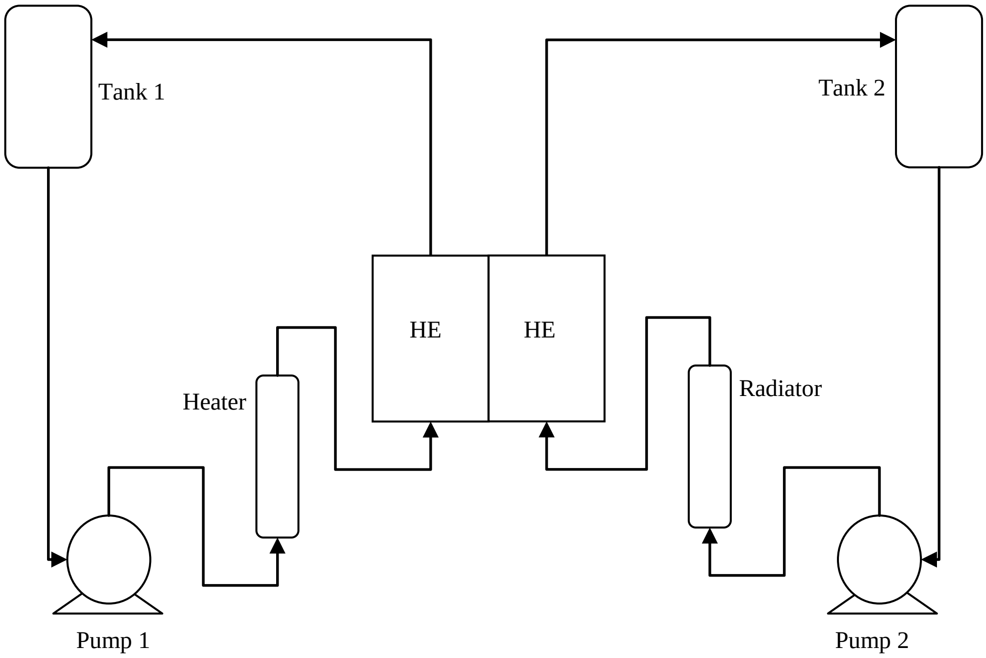

Figure 1. Installation Diagram of Heat Exchanger System

RESULTS AND DISCUSSION

In this experiment, we investigate the effectiveness of the heat exchanger. Temperature, convection heat transfer coefficient, and effectiveness of each condition are record and evaluation. Results of the experimental can be shown at the below figure.

Figure 2 show the graph of overall convection of heat transfer coefficient (U). The graph shows that the highest U is shown at the hot and cold fluid of 4 and 5 L/min, respectively. The highest and lowest U are 1270 W/m^2 ^{0}C and 743 W/m^2 ^{0}C, respectively.

Figure 3 show the graph of effectiveness and NTU of the system. The highest and lowest effectiveness are 80% and 60%, respectively.

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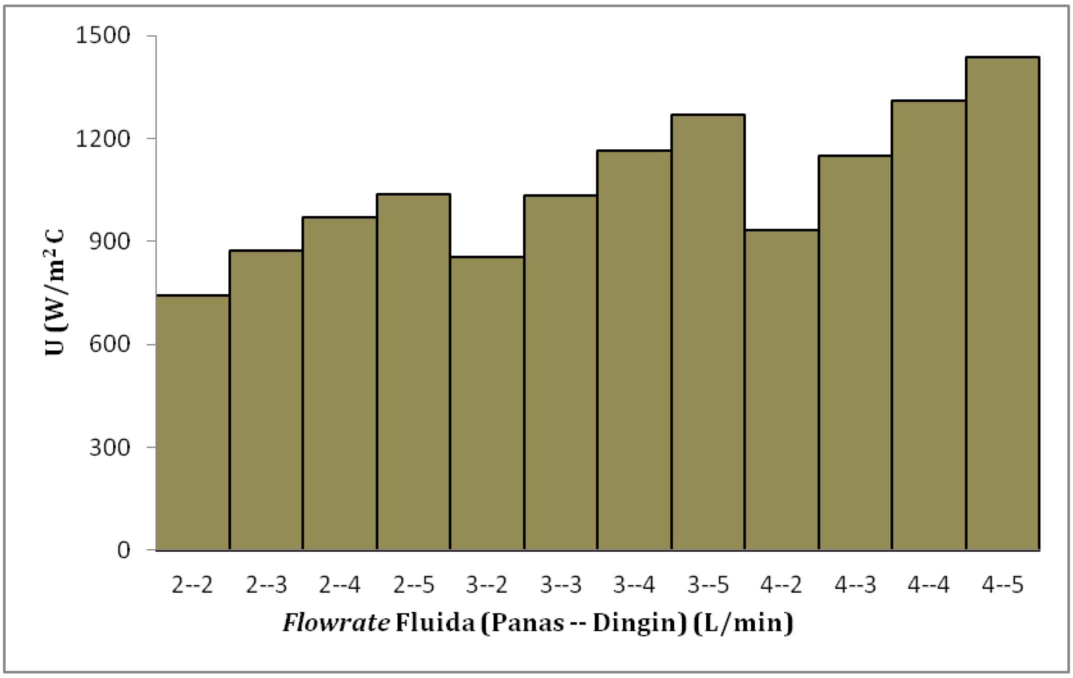

Figure 2. Over All Heat Transfer Coeficient

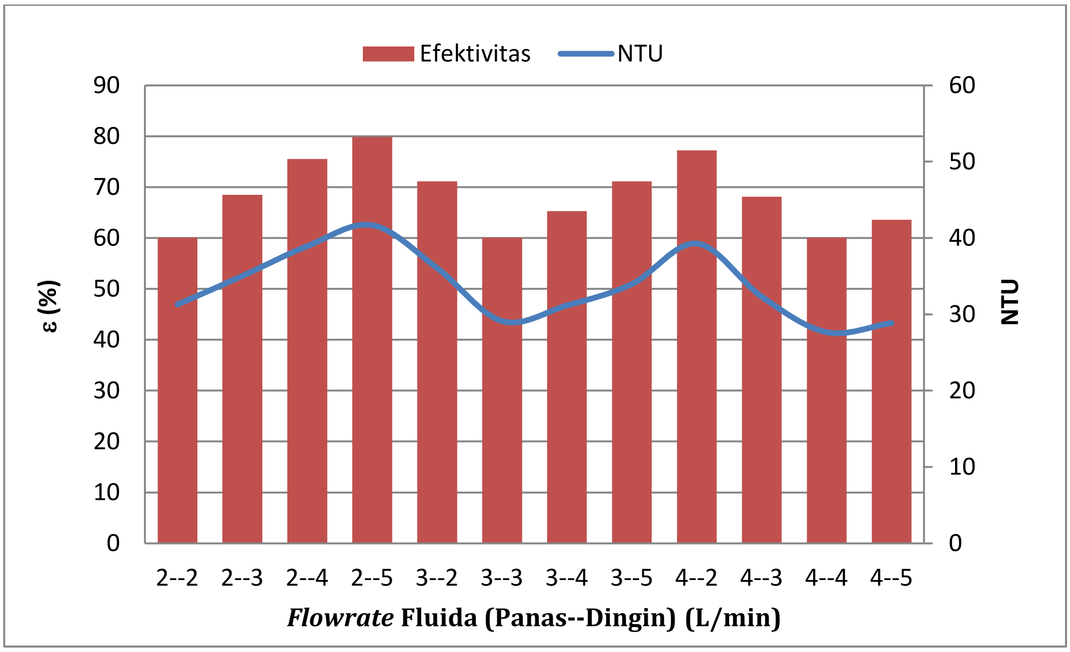

Figure 3. Efectiveness and NTU

CONCLUSIONS

The highest U for the hot and cold fluid are 4 and 5 L/min, respectively. The highest and lowest U are 1270 W/m^2 ^{0}C and 743 W/m^2 ^{0}C,The highest effectiveness is occurred at 80% at the flowrate hot and cold of 2 and 5 L/min. The lowest effectiveness is occurred at 60% at the flowrate hot and cold of 3 and 4 L/min.

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