2원 사이클 히트펌프의 모니터링 App 개발

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Development of Monitoring App for a Two-Way Cycle Heat Pump

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Abstract

The resent work is about the design and installation of the 60 URT heat pump according to the need. This design is eco-friendly, easily available, reduces maintenance and electricity cost. The dimensions of heat pump is 1500mm x 500mm x 1940mm (i.e length 1500 mm, width 500 mm and height 1940 mm) is installed on site .It can be operated with automation (PID) and controlled by sensors. The performance of and heat pump is evaluated experimentally by the monitoring system.

1. Introduction

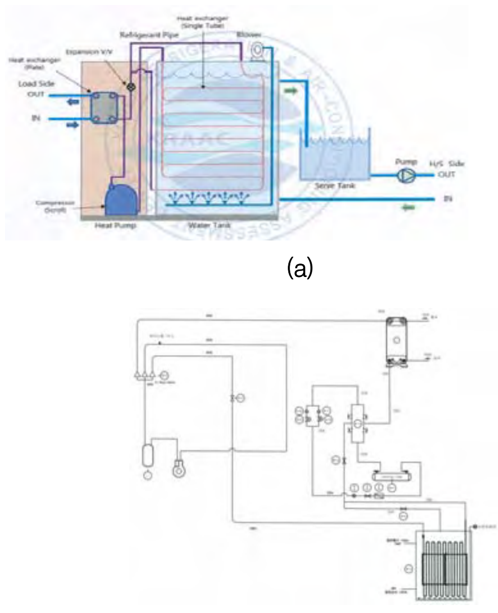
In this paper, the vertical aquarium is designed for improving the aquaculture even at freezing temperature of surroundings. Especially in the cold countries it is challenging task to protect the fish at a freezing temperature to improve the aquaculture by maintains the constant temperature of warm water inside the vertical aquarium. Thermal energy management system is a solution to utilize various energy systems more effectively without harming the environment. The heat engines in the power plants, produces largest proportions of low temperature of heat called waste heat that rejects to the sink. In power plants the cool water is circulated for condensing process. Due to the heat exchanger temperature of this cool water gradually increases and becomes hot.

In this energy management system, heat pump system plays a vital role to design the system. Heat pump systems are energy-efficient devices and it provides hot water for vertical aquarium. Commonly used heat sources and sinks are sea water, lake water, river water, ground water, earth, rock and waste water[1].

2. Design of Heat Pump

The mainly consists of Heat pump that includes condenser, compressor, expansion valve and evaporator as shown in the Figure 1. The Design specifications of Heat pump as shown in the table.1. The Energy Conversion Modeling of the Heat Pump Unit[2]. Mainly heat pump is used to maintain the warm water, and it helps in reduce the cost of electricity.

The heat flow received from the environment through the evaporator can be expressed as :



(a)

(b)

(Figure 1) (a) The Heat Pump (b) Heat pump Detail view

$$Q_{evop} = q_{air}.c_a.(T_1 - T_2)(W) \quad (1)$$

Thermal power delivered by the compressor into a refrigerant

$$Q_{comp} = q_{ref}.(s - s_{evap}).(T_c - T_{evap})(W) \quad (2)$$

The energy input of refrigerant into the expansion valve

$$Q_{cond} = q_{ref}.s_{co}.T_{co}(W) \quad (3)$$

Subsequently, it can be expressed, that the heat flux input to the storage tank is reduced of the efficiency of the heat exchanger, which is around 70 – 80% [3]. The Equation (4) is used for the calculation as implification, because the s_{ev} and T_{ev} are not known. It presumes $Q_{cond} = Q_{evap}$

$$Q_{HP} = \left(\frac{Q_{exp} + Q_{evap} + Q_{comp} - Q_{cond}}{q_{ref}\frac{S_{co} - S_c}{2}}.c.q_s \right).Q_z(W) \quad (4)$$

The calculation of mass flow of hot water into the accumulation tank is determined:[4]

$$q_s = \left(\frac{q_{ref}.\frac{S_{co} - S_c}{2}}{c} \right)(kg.s^{-1}) \quad (5)$$

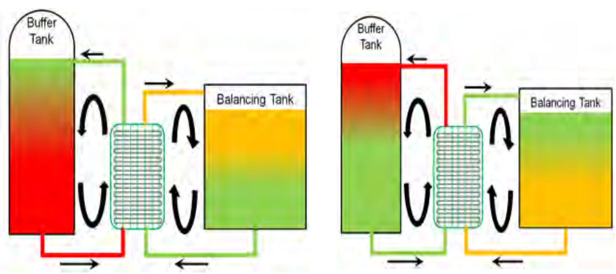
Coefficient of performance (COP) is related to the heating mode and it is determined from the energy output of the heat pump and the electrical energy[5].

$$COP = \frac{Q_{HP}}{W_c} = \frac{Q_{HP}}{\frac{Q_c}{\eta_c}} \quad (6)$$

<Table1> Experimental Design of Heat Pump

Elements		IWK-13A-54
Performance	Heating	205 Kw
	colling	155 Kw
Power Consumption	USRT	60
	Kw (heating)	28.50
Power Source		Φ3*380V*60Hz
Lay out dimensions	Length (mm)	1,500
	Height (mm)	1,940
	Width (mm)	500
Compressor	Type	Scroll
	Start-up Method	Y-△ Start-up
Refrigerant	Capacity Control	direct
	Type	R-410A
Heat Exchange (Load)	Control	Expansion Valve
	Circular Water Capacity (LPM)	700
Heat Exchange (Source)	Pipe Dimension (In/Out)	100A/150A
	Circular Water Capacity (LPM)	1200
Weight		2 ton

3. Processing of water management



(a) (b)

(Figure 2) Heat management system (a) Winter season (b) Summer Season

3.1 Hot water generation

Water in the tank flows into the condenser of heat pump via a cooling pump and gets heated. Water temperature is raised about 10°C in the condenser from 50°C to 60°C at the design flow rate. The outlet temperature is fixed at 60°C. If the inlet temperature is lower than 50°C, an internal circulation loop would be activated to heat up the water until the design temperature is obtained. The experiment setup is shown in Figure. 2(a). An insulated water tank is used to store hot water. The tank is divided with partition into four parts of identical volume. In figure 2(a) left side is called buufer tank this buffer tank is collecting the hot water and water is circulating to the balacing tank though heat exchanger [6].

3.2 Cold water generating

Water in the tank flows into the condenser of heat pump via a cooling pump and gets heated. Water temperature is drop about 35°C in the condenser from 20°C to 15°C at the design flow rate. The outlet temperature is fixed at 15°C. If the inlet temperature is lower than 25°C, an internal circulation loop would be activated to heat up the water until the design temperature is rejected. The experiment setup is shown in Figure. 2(b). An insulated water tank is used to store hot water. The tank is divided with partition into four parts of identical volume. infigure 2(b) left side is called buufer tank this buffer tank is collecting the cold water and water is circulating to the balancing tank though heat exchanger [7][8][9].

4. Result and Discussion

The main components of Heat pump consists of evaporator, compressor, condenser and expansion valve are designed for 60URT Heat pump as shown in the Figure 3. The design of the experimental heat pump set up as shown in the Figure 3. The first level performance of the heat pump has tested and the performance of the heat pump was satisfied.

<Table2> Heat Pump Parameter

S. No	Experimental Results	
	Parameter	Value
1	Heating Range	65
2	Circular Difference Pump	15oc
3	Water Capacity	6.48ton
4	Heating performance	28.50 Kw
5	Quantity of heat	60USRT
6	Power consumption	28.50 kwh
7	COP	6.68

The experimental data of the heat pump as shown in the table 2. In this table, the performance of heating is 163.14 kw and burns 140,300 kcal/h. The power consumption of the heat pump is 60 kw. The power source connected to the heat pump is 3-phase, 380v and 60Hz, and the dimensions of the heat pump is length 1700 mm, width 850 mm and height 1720 mm. The temperature of the heat pump is 65and the capacity of the water is 6.48 tons.

(Figure 3) The Experimental setup of Heat Pump and Monitoring Control System.

calculated as the ratio of output thermal energy to input electrical power consumption. The temperatures at expansion valves, evaporator, compressor and condenser were monitored as : The experimental results obtained from the monitoring of heat pump system is as follows, the working fluid ,in its vapour state, is pressurized and circulated through the system by a compressor. This low pressure liquid then enters to evaporator, in which fluid absorbs heat from the inflow as 24.5°c and outflow temperature is obtained as 28°c at a pressure of 2.5hpa.The refrigerant then returns to the compressor and cycle is repeated. The power consumption is 14.9kwh to 15 kwh is observed. Heat pump monitoring mobile app in shown in the Figure 4. The performance of the heat pump has monitoring and controlling with this app tested and the performance of the heat pump was satisfied.

(Figure 4) Heat Pump and Monitoring Control System Mobile app.

4. Conclusion

The aim of this project is to evaluate the coefficient of performance of heat pump when it is coupled with waste warm water from power plants and to observe how effectively it is recycled for improving the aquaculture. The following conclusions were made by this design of VAEMS: Vertical aquarium energy management system is designed and installed on site. Experimental results of heat pump at ambient temperatures yields better performance of heat pump.Thermal pollution in seas and oceans can be reduced.Waste water from the power plants can be recycled for improving the aqua culture.This design is mainly done for automatic operation and controlled by sensors.

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