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Study the Effect of Add Secondary Water Pump to Air Cooler Type Bf3 on the Efficiency of Air

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ABSTRACT

An experiment was conducted in August 2011 using air cooler type BF3 size 2500 m^3/ h have motor works with two speeds. Researcher add another water pump to work with the first water pump in order to increase the amount of water drop over pads. Water consumption (liters / hour), the internal temperature°C, external temperature°C ,the temperature of the cooling water in the bottom of the cooler°C, electrical consumption (A), and cooling efficiency were studied in this experiment. The result showed that add another water pump has highly significant effect on cooling efficiency (F1, 19 =15.98, p value = 0.0018). Furthermore, add another water pump has highly significant effect on inside temperature (19, 1=58.37, P value < 0.0001) which improve the performance of air cooler. In addition, there was a highly significant effect on water consumptions (19, 1= 26.16, P value =0.0003), which is normally add another water pump mean more water will consume that because allow to the pad to become more saturation as well as don't left any dry spot in the pad. The only sources of the air that inter to the building will be through the wet pad, and any dry spot in the pad will allow to the hot air to pass through it that will add more heat to building. Just the time play an important role on water temperate there was highly significant effect (19, 4= 50.25, P value = <.0001), because temperature afternoon is higher than in the morning or at night that will causes increase water temperature of the air cooler.

Introduction

Baghdad is one of the hottest cities in the world. Even in the summer night, temperatures are seldom below 24 C° Celsius (75 °Fahrenheit). The best condition to make air cooler work well during summer, when humidity is low and temperature is high. The process of reducing temperature during hot weather called evaporative cooling

The question coming to mind of the reader why air cooler is the most common use in Iraq? It is a very common form of cooling buildings for thermal comfort since it is first, relatively cheap if we compare it with a cooling unit. Second, perform better because the higher temperature and lower humidity. Finally, requires less energy than many other forms of cooling. As we know the cooling units demand more energy to work as well as this unit don't have ability to change the air and bring fresh air to the building. However, air cooler can replace the air and bring fresh air each second. Air cooler works on cool down the temperature, remove the air inside, and replace it with cool fresh air.

An Experiment conducted by (Al-Badri S. B., 2010) to identify the impact of the pad thickness of palm fibers, the daylight hours on the efficiency of evaporative cooling and the amount of water evaporated through the pad. Fan-pad evaporative system was used. The results of the study showed that increasing of pads thickness from 5 to 9 decrease in temperature among the pad at ten Am than in the fourth PM, and the increase of pads thickness from 5-9 cm increase the cooling efficiency, as well as increasing the amount of water vaporized during the afternoon than is the case in the morning with increasing thickness of the pads from 5 to 9 cm, respectively.

The article" Does Chilling Water Increase Air Cooling Operation" by Abdul- Munaim & Al-Badri (2014), discusses adding ice to the evaporative cooling system. They added ice on the water tank, and in the upper tank before the water was dropped into pads. They recorded the data every 10 minutes from 10:10 am to 11 am. The results indicated that there is no substantial conflict between the two trials, when they added ice to the cooling system, and without adding ice on the cooling efficiency. Water temperature decreased, then became steady, but that did not indicate any significantly on the cooling efficiency (Abdul-Munaim, 2014).

The article "Evaporative Cooling Performance Resulting from Changes in Water Temperature" by (Simmons, 1996) discusses the effect of water temperature on the performance characteristics of evaporative cooling in broiler houses. Evaporative cooling is used to cool down broiler house temperatures during hot weather all over the world. They used a prototype with fan and pad system. The aim of this research was to measure the effect of water temperature on the evaporative cooling efficiency. The result showed that cooling efficiency will decrease when the water temperature increases also, when supply water temperature increases the amount of water vapor increases too.

According to (Kale, 2014) evaporative cooling is a common method which has played an important role in decrees temperature, cost and increase relative humidity. The main problem in most developed countries is the higher cost which is required to run cooling unit.

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The article "Key to Getting Good Performance from Your Evaporative Cooling System" by (Donald, 2000) discussed the key to getting success from this system to get the best cooling from the evaporative cooling system during the hot weather. Airflow is the most important thing to get adequate evaporative cooling, and we need good tunnel airflow to remove all heat from the houses and supply fresh air. Because dirty pads, shutters, and belt slippage can reduce airflow, we must keep the pads wet. Finally, in order to keep the cooling pad efficiency in a good performance.

According to (Bruno, 2009) The water consumption of evaporative air conditioners includes the water evaporated to provide the cooling effect and the water dumped off for the purpose of cleaning and avoiding high salt concentration. The amount of water evaporation is determined by the local temperature and humidity, the air delivery rate as well as the saturation effectiveness. The cooling pad materials commonly in use are Aspen wood and more commonly Celdek.

According to (Czarick, Fairchild, & Watkins, 2009) the article "The Importance of Flushing Evaporative Cooling Systems" was talked about the importance of a flushing pads system that will insure maximum pad life as well as birds, cooling. Wet pad works as a filter to prevent dust from entering the house from outside. The dust will stick in the pad, and go back with water into the tank. The pad must be wet all time that will allow for the air to enter the house through the wet pad.

Material and Methods

Air cooler type BF3 size 2500 m 3 / h have motor works with two speeds. Researcher add another water pump to work with the firsts pump to increase the amount of water drop over pads. Water consumption (liters / hour), the internal temperature°C, external temperature°C ,the temperature of the cooling water in the bottom of the cooler°C , electrical consumption (A), and cooling efficiency were studied in this experiment. The measures were taken each hour's and recorded from 12 to 4 pm, which consider the hottest part of the day during the summer. The motor was run on the first speed with one water pump, and then with two water pumps. Then the experiment repetition with second speed with one water pump, and then with two water pumps. The water consumption was calculated after full the air cooler with water and measure the amount of water in liters (L). Then add the loss water after the motor run with each speed. The result was analyses by SAS using three way ANOVA.

Air cooler model	BF 3
Motor hp	1/3 hp
Motor Voltage	220 V
Air volume	2500 M^3/h

Result and desiccation

Cooling efficiency

The GLM Procedure

Source	DF	Type II SS	Mean Square	F Value	Pr > F
Air speed	1	9.275220	9.275220	0.11	0.7407
Time	4	4767.5270	1191.881768	14.7	0.0001
Water flow	1	1292.188880	1292.188880	15.98	0.0018
Speed*flow	1	183.496820	183.496820	2.27	0.1578

The result shown that (F 19, 1 = 11.05, P value = 0.0002) there was highly significant effect of water flow VS air speed on cooling efficiency. For water flow (F1, 19 =15.98, p value = 0.0018) was highly effect on cooling efficiency. For time (F4, 19 = 14.74, P value =0.0001) the time was highly effect on cooling efficiency. Air speed (F1, 19= 0.11, P value = 0.7407) there was non-significant effect on cooling efficiency. Air speed 2 (F19, 1= 15.15, P value = 0021) was highly significant effect on cooling efficiency. For water flow Q2 (F19, 1=1.70, P value= 0.2165) has significant effect on cooling efficiency R^2 =0.865 this model was able to explain 0.865 from the result in this test.

Inside temperature

The GLM Procedure

Source	DF	Type II SS	Mean Square	F Value	Pr > F
Air speed	1	10.5125000	10.5125000	15.32	0.0021
Time	4	201.1670000	50.2917500	73.30	<.0001
Water flow	1	40.0445000	40.0445000	58.37	<.0001
Speed*flow	1	0.1125000	0.1125000	0.16	0.6926

The result showed that air speed Vs water flow (19, 1=0.16, P value= 0.6926) there was non-significant effect on inside temperature. Water flow (19, 1=58.37, P value < 0.0001) there was highly significant effect on inside temperature. Time (19, 4= 73.30 P value < 0.0001) there was highly significant effect on inside temperature. Air speed has there was highly significant effect on inside temperature (19, 1=15.32 P value= 0.0021). Air speed S2 (19, 1= 32.36, P value= 0.0001) There was highly significant effect on inside temperature. Water flow Q2 (19, 1=9.33, P value= 0.0100) There was highly significant effect on inside temperature.

Water consumption

The GLM Procedure

Source	DF	Type II SS	Mean Square	F Value	Pr > F
Air speed	1	23.32800000	23.32800000	16.99	0.0014
Time	4	27.91200000	6.97800000	5.08	0.0125
Water flow	1	35.91200000	35.91200000	26.16	0.0003
Speed*flow	1	23.32800000	23.32800000	16.99	0.0014

The result showed that air speed Vs water flow (19, 1= 16.9, P value =0.0014) there was a highly significant effect on water consumptions. Water flow (19, 1= 26.16, P value =0.0003) there was a highly significant effect on water consumptions. Time (19, 4= 5.08, P value =0.0125) there was a significant effect on water consumptions. Air speed (19, 1= 16.99, P value =0.0014) there was a highly significant effect on water consumptions. Air speed S2 (19, 1= 42.66, P value < 0.0001) there was a highly significant effect on water consumptions. Water flow Q1 (19, 1= 33.99, P value < 0.0001) there was a highly significant effect on water consumptions.

Water temperate

The GLM Procedure

Source	DF	Type II SS	Mean Square	F Value	Pr > F
Air speed	1	0.20000000	0.20000000	1.50	0.2442
Time	4	26.80000000	6.70000000	50.25	<.0001
Water flow	1	0.00000000	0.00000000	0.00	1.0000
Speed* Wflow	1	0.20000000	0.20000000	1.50	0.2442

The result show that time was highly significant effect (19, 4= 50.25, P value = <.0001) on water temperature.

Conclusion

The result showed that add another water pump has highly significant effect on cooling efficiency (F1, 19 =15.98, p value = 0.0018). Furthermore, add another water pump has highly significant effect on inside temperature (19, 1=58.37, P value < 0.0001) which improve the performance of air cooler. In addition, there was a highly significant effect on water

consumptions (19, 1= 26.16, P value =0.0003), which is normally add another water pump mean more water will consume that because allow to the pad to become more saturation as well as don't left any dry spot in the pad.

The only sources of the air that inter to the building will be through the wet pad, and any dry spot in the pad will allow to the hot air to pass through it that will add more heat to building. Just the time play an important role on water temperate there was highly significant effect (19, 4= 50.25, P value <.0001), because temperature afternoon is higher than in the morning or at night that will causes increase water temperature of the air cooler.

Recommendation

We recommended to add another water pump to air cooler that will enhance the performance of cooling efficiency of air cooler. Further study will need to conduct by using solar power as a sours of power instead of electricity.

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