Wind Engineering Joint Usage/Research Center
FY2017 Research Result Report

Research Field: Indoor Environment
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Research Number: 172008
Research Theme: Development of improving energy efficiency of air cooling system for data center

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Budget [FY2017]: 200000JPY

*There is no limitation of the number of pages of this report.
*Figures can be included to the report and they can also be colored.
*Submitted reports will be uploaded to the JURC Homepage and etc…..

1. Research Aim

We take an IDC room of Beijing Capital International Airport T3 terminal as the research object to investigate the application of the Micro-channel heat pipe type split natural cooling system (referred as MHPTSNCS) proposed by our research team.

2. Research Method

Figure 1 is the view diagram of the IDC room in Beijing Capital International Airport T3 terminal. The total area of this IDC room is 550m^2, including 100 cabinets and 7 special air conditioners (6 of them are working at the same time and one for backup), the detail information of the air conditioners see Table 1. Indoor air temperature of this IDC room is controlled under 23℃, while the air supply mode of air conditioning is the bottom supply and upper return.

Figure 1 View diagram of the IDC room

Table 1 Detail information of the air conditioners

Air conditioning brand	Refrigerating capacity (kW)	Air flow (m^3/h)	Heat and humidity ratio
Harold Q19	69.8	16900	0.91

In order to get rid to pollute indoor environment of the IDC room, we decided use water as the refrigerant medium for the MHPTSNCS and designed the system for indirect natural air-water heat exchange cooling system. The system schematic diagram see Figure 2, the system was comprise by Indoor and outdoor Micro-channel heat pipe exchanger, outdoor and indoor ventilation system and data acquisition system.

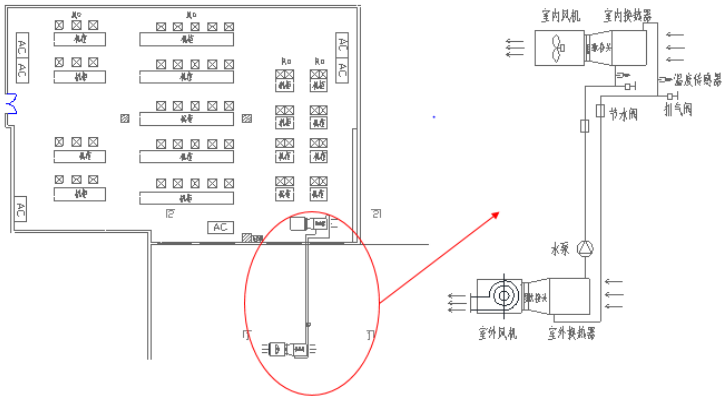

Figure 2 The system schematic diagram of MHPTSNCS

Figure 3 depicts the Indoor and outdoor micro-channel heat pipe exchanger, respectively. The micro-channel heat pipe exchanger was composed by a new type of non-contact high efficient micro heat pipe array (see Figure 4), it was made from aluminum plate and internal packaging material. The inner of the micro-channel heat pipe exchanger included the multiple micro-channels, and each channel connects outside wings. Taking indoor side as an example, indoor air driven by a fan to across the indoor heat exchanger and sent the heat to micro-channel heat pipe exchanger, meanwhile, the cooling medium (water) driven by a pump transfer the heat to the micro-channel heat pipe exchanger in outdoor side, finally, the heat was taken away by outdoor cooling air through the outside fan.

a) Indoor side heat exchanger b) Outdoor side heat exchanger

Figure 3 Heat exchangers in both indoor and outdoor side heat exchangers

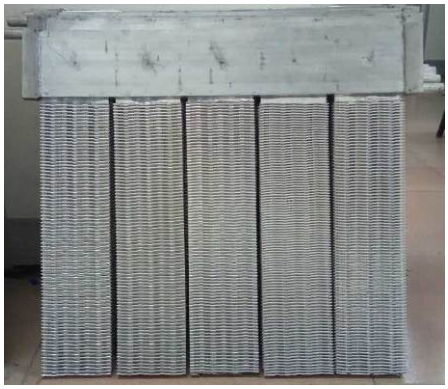

Figure 4 A new type of non-contact high efficient micro heat pipe array

3. Research Result

3.1 Inlet and outlet air temperature of the system

Figure 5 depicts the outdoor ambient air temperature, outdoor inlet air temperature and indoor side heat exchanger inlet air temperature. From Figure 5 we can see outdoor air temperature had a large fluctuation ranges during monitoring period, and all of the monitored temperature were lower than 10℃, which can met the natural cooling requirement. The indoor supply air temperature was between 16 and 22℃, which can met the standard of IDC room indoor environment. Besides, we also can find that when the outdoor temperature is low, the indoor supply air temperature will also decreased. However, the change range of indoor supply air temperature was always smaller than that of outdoor air temperature, therefore, it was reduced the possibility of indoor exposure.

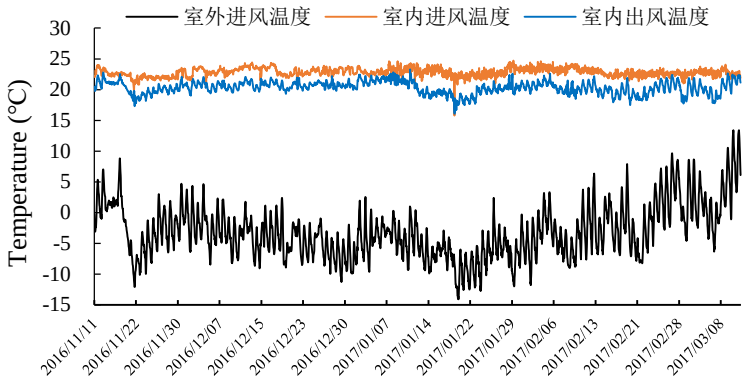

Figure 5　Outdoor ambient air temperature and indoor heat exchanger inlet and outlet air temperature

3.2 Refrigerating capacity

Figure 6 shows the unit refrigerating capacity of this system. We can see the ranges of refrigerating capacity between 1 and 7.46 kW, and the average value was 2.85 kW. The cumulative refrigerating capacity is 35458MJ during monitoring period (2016.11.11 to 2017.3.10) and saved 3517kW·h for air conditioning system.

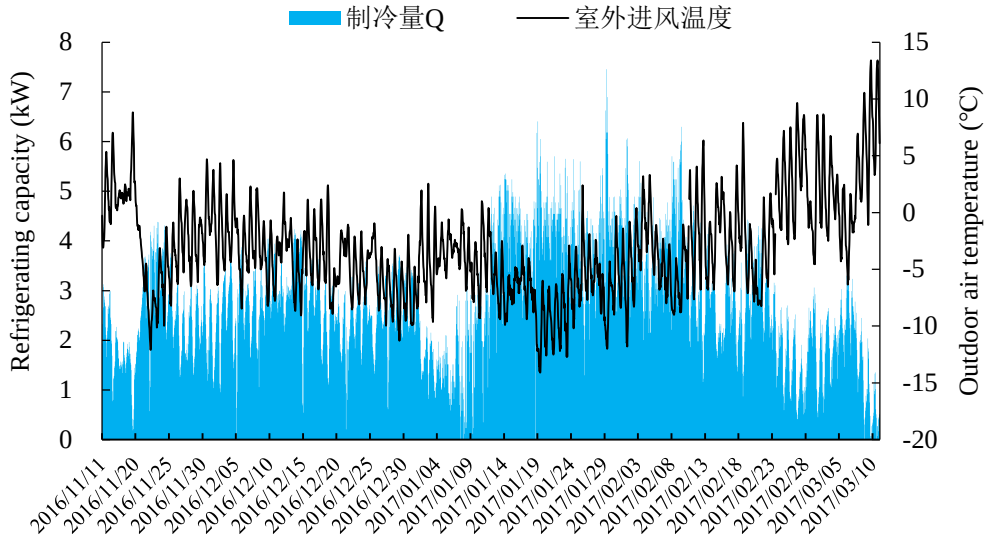

Figure 6　Refrigerating capacity and outdoor air temperature

3.3 Energy efficiency ratio (*EER*)

Figure 7 and 8 show the power consumption and energy efficiency ratio (*EER*) during monitoring period. From Figure 7, the power consumption change ranges between 0.21 and 0.97kW·h and the average value was 0.583kW·h. Figure 8 was the energy efficiency ratio (*EER*) during the monitoring period, the highest EER can be reached at 10.02 in a lower outdoor air temperature condition. The mean EER during monitoring period was 4.82, and more than 84.4% of the period when EER higher than general

precision air conditioning's rated EER (not more than 2.8).

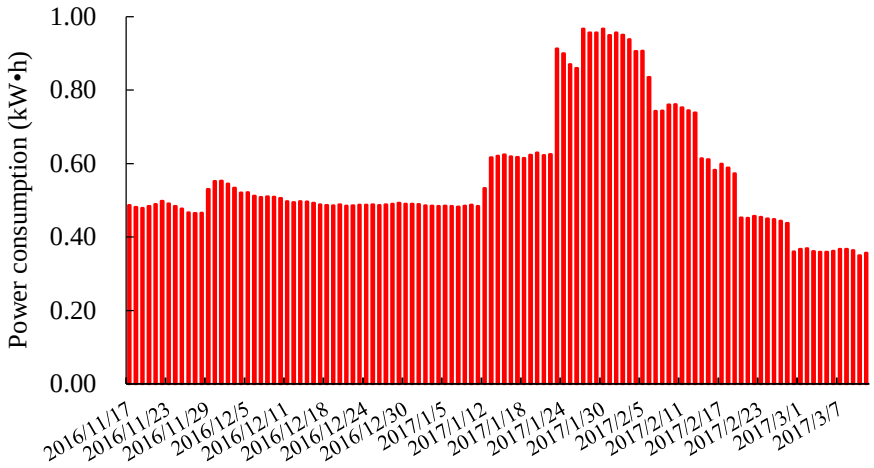

Figure 7　Power consumption of the system

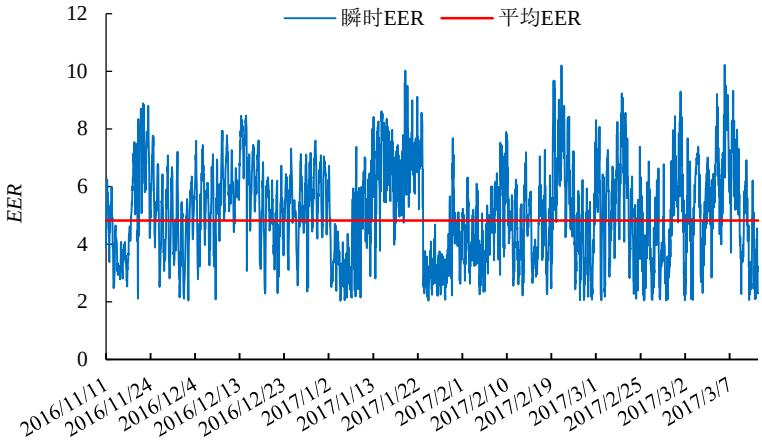

Figure 8　EER of the IDC room

4.　Published Paper etc.

[Underline the representative researcher and collaborate researchers]

[Published papers]

1.　吴玉琴，陈超，陈紫光，等. ＩＤＣ机房微热管型分体式自然冷却系统及其应用[J]暖通空调，2018，48（3）：80-84.
Wu Yuqin, Chen Chao, Chen Ziguang, et al. Micro heat pipe type split natural cooling system and its application to IDC room[J] HV&AC, 2018, 48(3): 80-84.

[Presentations at academic societies]

1. 第十三届国际绿色建筑与建筑节能大会, 2017, 北京. 《北京首都机场绿色节能技术应用研究》

5. Research Group

1. Representative Researcher
   Chen chao
2. Collaborate Researchers
1. Wu Yuqin
2. Chen Ziguang

6. Abstract (half page)

Development of improving energy efficiency of air cooling system for data center
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We take an IDC room of Beijing Capital International Airport T3 terminal as the research object to investigate the application of the Micro-channel heat pipe type split natural cooling system (referred as MHPTSNCS) proposed by our research team. The measured results showed that the average cooling capacity of the system was 2.85kW, and the maximum cooling capacity was 7.46kW while the average energy efficiency ratio (EER) was 4.82. Besides, the maximum EER can be reached at 10.02 and the accumulative cooling capacity of the IDC room is 35 458MJ.