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Energy Procedia 88 (2016) 518 – 525

Energy Procedia

CUE2015-Applied Energy Symposium and Summit 2015: Low carbon cities and urban energy systems

Economic analysis of gravity heat pipe exchanger applied in communication base station

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Abstract

This paper evaluates the economy of gravity heat pipe exchanger used for cooling communication base station to replace air conditioning in winter and transition seasons. The experimental data were analyzed, which proved that the gravity heat pipe exchanger can reduce running time and operating cost of air conditioning system. Based on the practical applications, the yearly cooling loads of a typical communication base station were calculated for five cities which represent the typical weather conditions of the five climatic zones in China. The results showed that the energy saving by using the gravity heat pipe exchanger is significant. The annual electricity-saving rate is the highest in Kunming, about 48.6%, while the annual electricity-saving rate is the lowest in Guangzhou, about 18.7% among the five climatic zones.

Peer-review under responsibility of the organizing committee of CUE 2015

Keywords:Communication base station, Gravity heat pipe exchanger, Electricity-saving rate, Economic analysis

1. Introduction

Communication base station is of large number, high heat quantity, long-time cooling season and high energy consumption. Air conditioning system is the key equipment to maintain a proper internal environment, such as the demanded temperature and humidity values. However, as shown in Fig. 1, the consumption of air conditioning system occupies about 43% of the total energy consumption in a communication base station, which is the largest part except the main equipment energy consumption [1,

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Peer-review under responsibility of the organizing committee of CUE 2015
doi:10.1016/j.egypro.2016.06.072

2]. Therefore, reducing the energy consumption of air conditioning system is an effective method to save energy for communication base station.

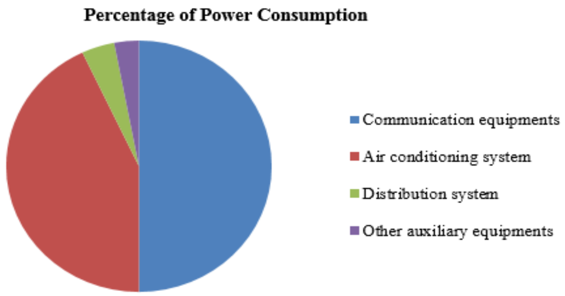

Fig. 1. The consumption of communication base station

Nomenclature

Q	cooling load (kW)
Q_1	heat transfer through building envelope (kW)
Q_2	heat release through equipment(kW)
Q_3	lighting and human body heat Dissipation (kW)
Q_c	heat release of communication cabinets (kW)
Q_t	heat release of transmission equipment (kW)
Q_s	heat release of switch power (kW)
Q_b	heat release of battery pack (kW)
Q_E	cooling capacity of heat pipe exchanger (kW)
Q_h	cooling load taken by heat pipe exchanger (kW)
Q_a	cooling load taken by air conditioning (kW)
P_f	the power of the fan (kW)
W_h	electricity consumption of heat pipe exchanger (kW · h)
W_a	electricity consumption of air conditioning (kW · h)
COP	coefficient of performance of the air conditioning
t_w	outdoor air dry bulb temperature (℃)
t_N	indoor air design temperature (℃)