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A study on the effectiveness of fresh air units in temperature and humidity independent control system

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Abstract

In the temperature and humidity independent air conditioning system, the fresh air units, in addition to bear all the new wind load, indoor wet load and part of the indoor cooling load, also need to control the temperature of supply air and prevent condensation. This paper pro-poses a new concept for the construction of fresh air units and found: the heat recovery should be carried out in different ways according to the degree of the exhaust air pollution; the use of water-cooled surface cooler with the combination of direct expansion type can improve the overall energy efficiency of the cooling dehumidification system; the reheat of condensing heat, secondary thermal recovery and the adjustment of supply air temperature can achieve through the use of double condenser and double expansion valve structure.

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Keywords: Fresh air unit, heat recovery; cooling dehumidification, control strategy

Nomenclature

W	outdoor air condition in summer
H	the state of fresh air after heat pipe heat recovery
L	the condition point of fresh air after the initial cooling of a high temperature water cooler
M	the state point with deep cooled by the heat pump evaporator

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K	the state point reheated by the first condenser
N	the interior design point
t_w	the dry bulb temperature of outdoor air, °C
η	the heat recovery efficiency
t_H	the fresh air temperature at H point, °C
t_N	the indoor temperature, generally 26°C
ρ	the air density, Kg/m ³
G	the fresh air volume, m ³ /h
h_H	the specific enthalpy of the fresh air state point H, kJ/kg
h_L	the specific enthalpy of the fresh air state point L, kJ/kg
h_M	the specific enthalpy of the point M, kJ/kg
C_p	the air specific heat capacity, kJ/(kg·°C)
t_M	the dry bulb temperature of fresh air of state point M, °C

1. Introduction

Temperature and humidity independent control air conditioning system (THIC) which has better comfort and energy saving effect is being widely used. In some areas have adopted the THIC system, such as hospital wards, hotel rooms and residential buildings, the more suitable form of indoor air conditioning is the ceiling (or ground) radiation heating with displacement ventilation [1]. Indoor radiation coil uses high temperature cold water to bear the main building sensible heat load, responsible for controlling the indoor temperature; the main equipment of humidity control system is the fresh air unit [12]. The function and operation of the fresh air unit is very important, because its burden of cooling load is too large, in addition, it should meet the requirements of indoor sanitary conditions and ensure the requirement of the supply-air temperature, the most important things are to reduce energy consumption. and make it easy to adjust and control. There are many researches about fresh air unit, Zhao et al [2] provided a building used THIC air conditioning system and the fresh air system adopted liquid desiccant fresh air unit. The results show that the system can guarantee the comfortable of indoor environment and has great energy saving potential. Ghali et al [3] established a numerical model, which consist of a rotary dehumidification system and a vapor compression refrigeration system. The results show that the system can save operating costs greatly. Liu et al [4] analyzed the principle of air volume in the fresh air system, the composition of wet load and the calculating method are studied mainly.

2. Illustrations

The THIC air conditioning system include temperature control system and humidity control system, they control and adjust the indoor temperature and humidity respectively. The temperature control system includes high temperature cold source, terminal device for eliminating residual heat, and the system uses water as transport medium. Humidity control system includes fresh air unit, air supply device, and this system uses fresh air as transport medium. The composition of the THIC air conditioning system is shown as Fig. 1[1].

The THIC air conditioning system control temperature and humidity separately, which can reduce energy consumption. But The latent heat and sensible heat of fresh air need to be dealt with, therefore, how to reduce the energy consumption of fresh air will be the focus of this study. This paper will introduce a combined multifunctional fresh air unit with high efficiency.

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