

8th International Cold Climate HVAC 2015 Conference, CCHVAC 2015

## Modeling and performance analysis of the condenser using untreated sewage heat energy

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### Abstract

Sewage condenser is the critical component which affects the performance of the direct sewage source heat pump unit. The sewage directly flows into the condenser and transfers heat with the refrigerant. The performance of sewage condenser is different from the general water source heat pump units because of the characteristic of sewage. This paper developed a theoretical model with distribution parameters based on some reasonable simplification, and this model was applied to predict the performance of some sewage condenser and the effects of different tubes and pass arrangements on condenser performance were analyzed. The results show that there is little effect on the sewage condenser performance with different pass arrangement. The condenser heat exchange increases linearly with the rise of sewage inlet temperature when the sewage flux and refrigerant inlet conditions are fixed. The condenser heat exchange and flow resistance increase with the sewage flux raises when the sewage inlet temperature and refrigerant inlet conditions are constant. In addition, the change extent of heat exchange is similar with that of the flux change.

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

*Keywords: Sewage, Condenser, inlet temperature; flux, heat transfer;*

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### 1. INTRODUCTION

In the sewage condenser, sewage flows in the tube, refrigerant condensation heat release out-side of tube bundle[Deng et al.2006].The shell of condensation heat transfer mechanism is complex, both home and abroad are

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on the outside of the horizontal tube refrigerant vapor condensation enhancement to the experimental research, making all kinds of test tube to comprehensive evaluation on heat transfer performance. To improve its performance, some scholars will focus on increasing the heat transfer coefficient, increasing the heat transfer area [Luo et al. 2015], some scholars found that changing the flow process can improve the con-denser performance [Sun et al. 2014]. Because of the particularity quality of untreated sew-age, the condenser is composed of smooth inner wall heat pipe, sewage side without any heat transfer enhancement measures, only by increasing the number of tube to improve the sewage side velocity to enhance the heat exchanging effect of the condenser. This paper is on sewage condenser along the axial direction and the tube direction to establish two-dimensional grid unit, used distribution parameters to calculate the thermal, horizontally and the upper and lower arrangement of four flow tube of wastewater of condense (sewage import and export is upper lower, lower upper) to simulate and analysis .

**2. Mathematical Modeling of sewage condenser**

*2.1 Model Overview*

In sewage condenser, the sewage flows in the heat exchange tube, refrigerant is condensed and cooled out of tubes . Because of the particularity of sewage heat, in order to ensure the effect of heat transfer, multi-process design method must be adopted (the general design di-vided into 4 tube) [Zhuang 2012]. After the sewage source heat pump operates normally in summer, the super-heated refrigerant is cooled to the saturated liquid state by the sewage and then left the condenser. According to the state of refrigerant it can be divided into two phas-es: overheating and two-phase. And it is the same as sewage flooded evaporator [Zhuang and Pang 2013], temperature of sewage in the heat exchanger along the axial direction changes, the temperature of refrigerant along the tube row direction changes. Aiming at the sewage heat exchanger tube condenser will be along the axial direction and the tube row up a two-dimensional grid unit, the establishment of the flow and heat transfer model of every unit, the heat transfer performance of the heat exchanger is calculated and analyzed.

*2.2 The Establishment of Unit Model*

The graph is grid condenser schematic diagram of sewage. Along the axial direction a process is divided into grid, to heat exchanger haven process and a horizontal arrangement, the number of grid in total length direction is . Along the tube row direction is divided into grid. Therefore, there is process and horizontal layout exchanger ,for number of total grid is . Figure 4 indicate the heat exchange tube axial and tube row direction grid number.

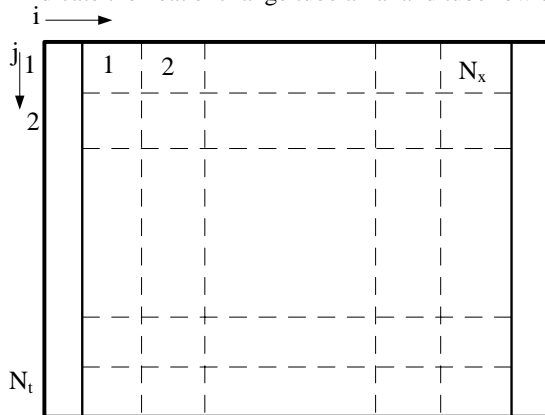


Fig.1 Grid distribution of sewage condenser

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