

The manufacture and experiment test of newly jacket ultrasonic filtering units in sewage-source heat pumps



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ABSTRACT

In order to make direct heat-exchange system work as soon as possible, this essay mainly studies the problem of raw sewage treatment. Firstly, the paper constructs the structure of primary filters. Then it focuses on secondary filters and ultrasonic filtration system are designed and produced, which is still under experimental study. According to the experiments in early period and the design, manufacture and experiments in later period, it proves that the hydraulic power transmission and ultrasonic scrubbing are workable, which provides reliable foundation for engineering application.

Finally, the paper suggests a set of membrane treatment units should be placed behind this unit to filter sewage with granules. After part of the condenser or evaporator of heat pump system is treated with preservatives, sewage with membrane treatment can flow into heat pump system.

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1. Introduction

According to different conditions of sewage treatment, sewage-source heat pumps can be divided into two categories, including untreated-sewage or raw-sewage heat source and treated-sewage heat source [1]. If treated sewage, secondary effluent or reclaimed water, is treated as heat source [2], system only needs primary filters because of its good water quality and simple treatment process [3]. However, sewage disposal plants, generally located in urban fringe districts [4], are far away from hot consumers. If heat pump stations are placed in sewage disposal plants, relatively long heating pipes increase heat loss and investment fees of water treatment in heat pump system [5].

If heat pump stations are based on untreated sewage, they can be established in a place near sewage pump stations [6] so that the emitted heat from sewage can be delivered to the nearest heat consumers through heat pump system [7]. This means its first cost will be dramatically decreased, which leads to a bigger potential of application and generalization in untreated sewage heat pump system than in secondary sewage heat pump system [1]. Fig. 1 is the schematic diagram of raw sewage source heat-pump system [8].

Nowadays, a majority of projects adopt indirect heat-exchange system. As for direct heat-exchange system, its research challenges still are the preservative treatment of sewage and machine groups

[9]. The treatment effects of sewage are the dominated one between sewage and machine groups [10]. The components treatment of evaporators and condensers in machine groups is necessary; however, better skills sharpened by a large quantity of experiments can be applied in projects with greater confidence [11].

In order to make direct heat-exchange system work as soon as possible, this essay mainly studies the problem of raw sewage treatment, constructing the structure of primary filters. Secondary filters, ultrasonic filtration system are designed and produced, which is still under experimental study.

2. Ultrasonic scale-removing technology

In the early years of last century, former Soviet Union scientists, M.N. Chepurnoi studied the influence of ultrasonic on slowing down the formation of scale in the evaporation process of sugary fluid in sugar mills [12]. He founds that ultrasonic could reduce the ratio between the heat resistance and the total heat resistance of scale layers of scale coefficients so that tanks are not washed in entire production period. In China, seven sugar mills, such as, Zhanjiang sugar mill in Guangdong, Bayi, Haitou and Nada sugar mills in Hainan, and Dongbin, Limin and Nongzhang sugar mills in Yunan, use ultrasonic anti-scale preventers in evaporation system, which acquires satisfied anti-scale and scale-removing effects [13]. When ultrasonic technology is applied in the water circulating system of blast-furnace scrubbing tower of water supplying

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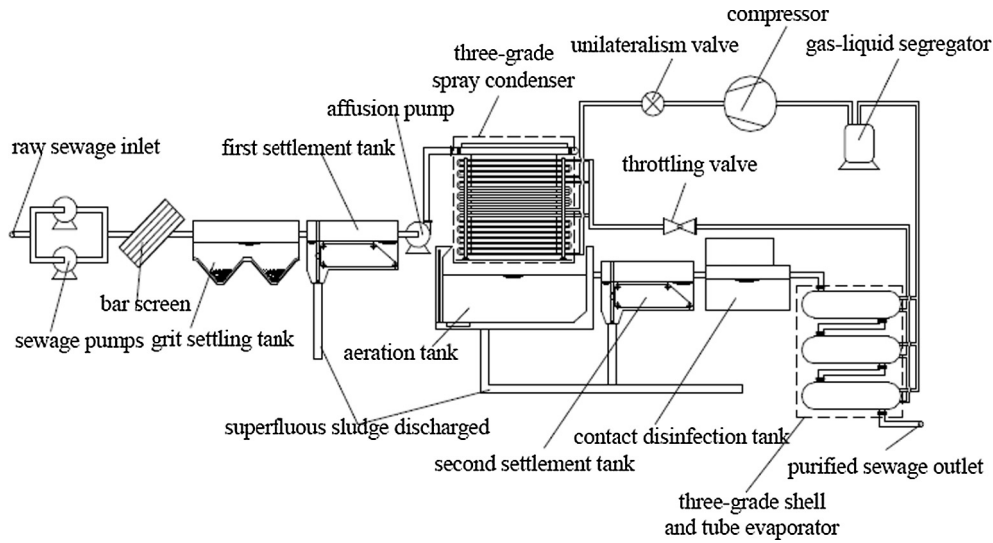


Fig. 1. The schematic diagram of raw sewage source heat-pump system.

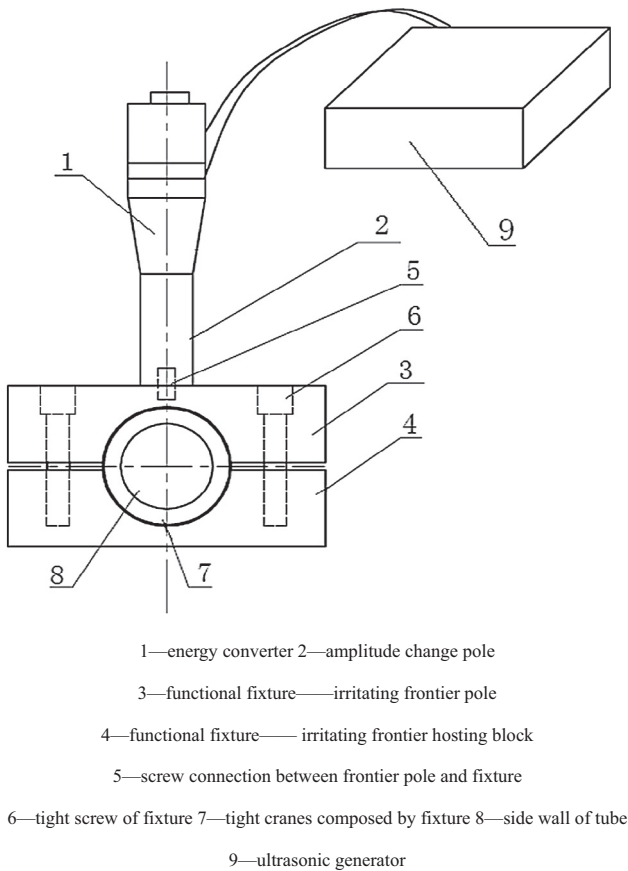


Fig. 2. The schematic diagram of jacket ultrasonic equipment.

plant in Angang Corporation, anti-scale effect is obvious and scale thickness is greatly reduced from 5 mm to 1.5 mm [14]. Ultrasonic have many advantages in anti-scale and scale-removing, including online treatment, small damage of equipment, low costs and being easily automated [15]. Therefore, it has broad development prospects and application spaces.

Ultrasonic can not only prevent scale, but also removes scale [16]. The key point is how to control ultrasonic energy, frequency

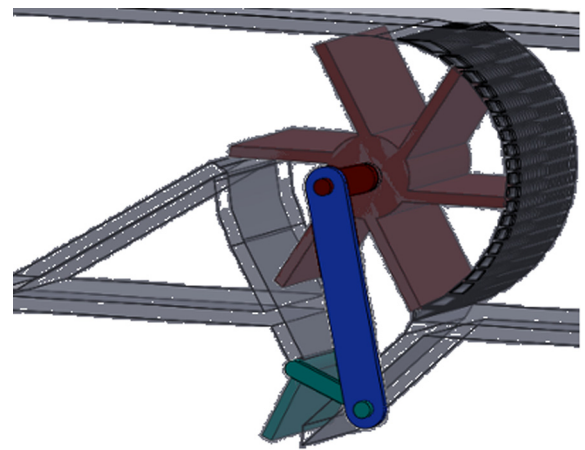


Fig. 3. The schematic diagram of water-flow filter screen.

and working time [17]. Both preventing the formation of scale and removing formed scale are beneficial to the enhanced heat transfer of production equipment [18].

In this essay, ultrasonic treatment method is applied in the early treatment process when sewage is taken, which both purifies sewage and clean mesh filtering plates [19]. When the analysis of units is done, jacket ultrasonic equipment are adopted shown in Fig. 2. Their merits are shown below [20]:

- (1) Operation is convenient. The original equipment will not be refitted when jacket ultrasonic method is applied. Therefore, objects inside are well-proportioned, which accelerates reaction speed.
- (2) As ultrasonic vibration can be transferred through jacket ultrasonic equipment, direct contacts are avoided among objects. Ultrasonic transducer system and moulds which are clamped from outside to transfer ultrasonic vibration do not need to directly contact server environment.
- (3) The number of ultrasonic clamps can be conveniently increased according to the requirements of specific powers. Thus, it can adapt to the specific situation well.
- (4) It is easy to install and repair.

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