New type solar energy micro-polluted water purification technology and device

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Abstract. The "new micro-polluted water purification device" is mainly used to deal with the micro-pollution of some water bodies. The purpose is to purify micro-polluted water through this device to provide necessary domestic water for human life. This project designed a simple, economical and environmentally friendly sewage treatment system in order to solve the water problem in water-scarce regions such as Africa. By simulating the process of natural water cycle, using solar energy as the power source, the micro-polluted water is purified into potable water. And store it in a water tank. The device flexibly utilizes clean energy such as heat energy and wind energy to meet the demand for water extraction in different situations. The device realizes the purification treatment of micro-polluted water body under the condition of low cost and low energy consumption.

1. Introduction
Due to unreasonable human economic activities, the shortage of fresh water resources has now become a worldwide problem. Some remote and backward areas have a certain amount of surface water resources. These are affected by pollutants caused by large cycles and surface runoff. Multi-chemically polluted water is generally called micro-polluted water; micro-polluted water cannot be used as a stable and reliable source of fresh water, and at the same time, limited by geographical location, human management and other factors, it is impossible to use existing treatment technologies in the local area [1]. Taking Northwest China as an example, there are droughts and less rainfall, lack of drinking water sources, slight excesses of permanganate index and ammonia nitrogen water quality indicators in rural water sources, and micro-pollution of drinking water sources is more common. The water treatment technology commonly used in cities cannot meet the actual situation of micro-polluted water source water treatment in rural areas. Aiming at the problem that the permanganate index and the ammonia nitrogen water quality index of the northwest rural water source slightly exceed the standard, it is of important practical significance to study the small, simple and easy-to-manage treatment technology suitable for use in the northwest rural area [2]. This research focuses on the purification of micro-polluted water and proposes to adopt a new micro-polluted water purification device to provide necessary drinking water for human activities.

At present, the purification treatment of micro-polluted water is basically based on biochemical methods[3]. Wang Chenxi and others have proved through experiments that it is a feasible solution to use air to solve part of the drinking water problem in deserts and other dry areas lacking water resources[4], the new micro-polluted water purification device does not rely on electricity at all.

Existing air water intake devices have two main problems: the conversion efficiency is too low to meet the most basic water demand [5], and the use of electricity as the main driving force for the
operation of the device [6] causes great limitations in the application scenarios. It is difficult to obtain a better purification effect and the cost is high.

We plan to use the existing micro-sewage treatment technology to build a micro-polluted water treatment device that is not restricted by the geographical environment, has a relatively low cost, and has a strong processing capacity. This device can achieve completely autonomous operation without excessive manual input, and is suitable for drinking Water-poor areas provide drinking water necessary for human activities. This system mainly uses solar energy as the power source. In addition, the overall structure and principle of the device are simple, and large-scale installation has advantages in scale and cost, which can make up for the problem of insufficient purification efficiency of the monomer device. At present, there are a large amount of research data on air water extraction, which provides theoretical support for the device.

The innovations of this project are as follows: First, only use clean energy such as radiant energy, wind energy, and geothermal energy to purify water; second, it has low cost, high efficiency, wide applicability, and does not require excessive manual intervention. Features: Third, it can be used to purify seawater, or for air intake in areas where water resources are relatively scarce [7].

2. Micro-polluted water purification device

Micro-polluted water purification devices include water evaporation and collection systems, condensation filtration systems, air extraction systems and water extraction systems, and only use solar energy as a power source. The black body heats up and accelerates the evaporation of the water body. The water vapor is collected by the glass gas collecting hood. Under the action of the air extraction system, the directional flow is realized, and it is liquefied through the spiral condenser tube and becomes liquid water. After the liquid water is deeply processed by the activated carbon filter, it is stored in the water tank; the purified water is taken through the water pumping system.

2.1. Water evaporation and collection system

The water evaporation and collection system includes sewage tanks, black bodies and glass hoods. The black body is the black carbon paper wrapped in the water outlet head of the steel rod. The black carbon paper has a grid porous structure, and water molecules can flow upwards through the capillary ducts in it [8]. The steel rod is fixed in the sewage tank, and the lower end of the carbon paper is immersed in the water.

2.2. Condensation filter system

The condensate filter system includes a buried spiral condenser tube, an activated carbon filter and a
water tank. The larger surface area and longer contact time of the spiral condenser tube are conducive to the condensation of water vapor [9]. Activated carbon is used for simple and advanced treatment of liquid water, and a water tank buried in the ground is used for temporary storage of condensed water.

2.3. Air extraction system
The air extraction system includes fan blades, two-color vacuum glass tubes and air circulation tubes. The fan blades are composed of wind-receiving blades in the vertical direction and suction blades in the horizontal direction. The double-layer vacuum glass tube is divided into an outer layer and an inner layer, the outer layer is transparent glass, and the inner layer is black glass.

2.4. Water pumping system
This device uses a pressure well device to take water. In the upper part of the inside of the water pressure well, there is a piston connected to the pump rod, and a bottom valve is also arranged below. Both the piston valve and the bottom valve are one-way valves, so that the air can only circulate from bottom to top.

3. The control method

Figure 2. Micro-polluted water purification device
In the first step, the staff makes suitable devices according to factors such as topography, climatic environment and soil composition [10], and bury the devices in the required scenes.

In the second step, under the action of solar energy, the black carbon paper black body buried in the water absorbs heat and heats up. On the one hand, it accelerates the evaporation of water from the water body to its own surface, and on the other hand, it transfers heat to the water body indirectly through steel rods. Warming up accelerates evaporation. The slightly polluted water vaporizes and changes from liquid to gas. The water vapor is collected through the glass gas hood and enters the device through the connecting pipe above the gas hood.

In the third step, the water vapor entering the device is mostly condensed into droplets after passing through a spiral condenser tube buried in the ground. The droplets flow into the underground water
storage tank along the pipe wall under the action of gravity, and enter the water flow of the water storage tank. After being filtered by activated carbon, it flows along the slope to the side of the water tank close to the water pumping device.

In the fourth step, while the water evaporation and collection system and the condensation filtration system are working, the air extraction system is also working simultaneously. Under the action of wind energy, the wind blade rotates, and the end gear drives the suction blade to rotate, thereby pumping the gas in the pipeline to the outside. Under the action of radiant energy, sunlight shines on the inner black glass through the outer glass, the black glass absorbs heat and heats up, and through heat transfer, the temperature of the enclosed air section rises, the gas expands, and the pressure drops, which promotes the pipeline. The water vapor flows directionally. Under the action of radiant energy and wind energy, the air in the device realizes an effective flow, which ensures the normal operation of the device.

In the fifth step, when it needs to be taken, the water in the water tank is taken through the pressure well device in the water pumping system. When the piston moves upwards, the bottom valve opens, the piston valve closes, and the air in the lower water pipe is drawn into the cavity; when the piston moves downwards, the bottom valve closes, the piston valve opens, and the air is discharged to the outside through the piston valve. Repeatedly, when the air in the water pipe is exhausted, the water in the water tank is drawn out under the action of the pressure difference. Take out the water and use a customized filter kettle for secondary filtration.

4. Economic analysis
Due to unreasonable human economic activities and climate variability, the shortage of freshwater resources has become a worldwide problem. Approximately 500 million people live in extreme water shortages, especially in Africa, where water resources are severely lacking, sewage treatment rates are low, and government support funds are insufficient; secondly, there are a large number of rural areas in my country that are not suitable for scientific treatment of micro-polluted water bodies. Under this social background, an energy-saving, environmentally friendly, low-consumption and high-efficiency water purification equipment has broad market prospects; it can not only meet the daily needs of many people, solve the drinking and water difficulties in daily life, but also alleviate politics in many areas. Problems and social pressure. The production cost of this product is low, and the device structure can be flexibly changed according to the climatic and landform of the buried site, purifying the micro-polluted water, achieving low cost and high return, and bringing huge economic benefits.

5. Conclusion
Compared with the existing technology, this project provides a set of equipment that integrates purification, collection, storage and fetching. It has the characteristics of simple structure, easy operation, clean and efficient, adaptable to a variety of topography and landforms, and provides a new solution for the purification of micro-polluted water. And it does not use electricity as a power source to drive the device to operate, achieving completely autonomous operation without excessive manual input. At the same time, it can greatly improve the overall purification efficiency through large-scale installation, which has the value of promotion and application.

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