Research of The People and Livestock Drinking Water Technology with Wind and Solar Energy Mutual-complementing Power

Junfeng Zhu¹ ; Xingtian Wang¹ ; Yuewen Liu²
¹Institute of Water Resources for Pastoral Areas, Hohhot, 010010, China
²Inner Mongolia University of Technology, Hohhot, 010010, China
* Corresponding author: 81145701@qq.com

Abstract. There is a shortage of conventional energy in pastoral areas, especially due to the limitations of the power grid. But there are abundant renewable energy reserves. The northern remote pastoral areas are rich in wind energy and solar energy resources which has become the main method to solve the safety problem of drinking water in pastoral and rural areas. But the instability of wind and solar energy, and one single power can't meet the needs of the pastoral area water supply well, so high reliability water supply mode with wind and solar energy mutual-complementing power in pastoral areas has been proposed.

1. INTRODUCTION
Due to the lack of water, power grid, conventional energy, pumping power generation, backward water supply technology, remote location and other reasons, the problems of drinking water and backward methods are prominent, which seriously affect the healthy and sustainable development of animal husbandry[1]. Wind and solar energy mutual-complementing power technology which used in water pumping and supply is a effective method to solve the safety problem of drinking water in pastoral, it’s even the only way in the extreme situation. The proper wind and solar energy mutual-complementing power technology for the popularization and application of the pastoral areas has been proposed which is on the basis of past experience of pastoral area water supply project[2].Wind and solar energy mutual-complementing power technology can be used to solve the pastoral area instability and low reliability of water supply[3].

2. Tap water technology of household water supply system with wind and solar energy mutual-complementing power
It’s sparsely populated, living scattered and generally far apart between households in the pastoral areas. So there are huge social needs of household water supply system[4].

The system is mainly composed of shallow underground water, dc submersible pumps, wind and solar energy mutual-complementing power system, electric control tank, water pipeline, etc, as shown in fig 1. The water supply mode uses wind and solar energy mutual-complementing power technology, high position water reserve, the potential energy water supply. System is with power of 500-1000 w, lift of 10 to 30 m, flow of 2-3 m³ everyday. Reservoir volume of 5 m³ (two to three times daily dosage for the water supply objects ). The system can realize the tap water working which the working principle is that wind and solar energy mutual-complementing power from the controller to the submersible pumps, water pumped
into the high reservoir and the water supply system usually 7 to 10h a day's work, water delivery system with the aid of potential energy, water for 24h to the user's automatic terminal water supply.

Fig. 1. Tap water technology of household water supply system with wind and solar energy mutual-complementing power

3. Distributed water supply technology with wind and solar energy mutual-complementing power for pasture

Groundwater is the main drinking water for human and animal in arid and semi-arid pastoral areas. And the groundwater in those areas generally restored deeply, but the quality is good and the reserve is relatively abundant. So herdsmen can get water from the centralized water supply site from the deep well with abundant water resource\(^5\).

Fig. 2. Distributed water supply technology with wind and solar energy mutual-complementing power for pasture

Distributed water supply technology with wind and solar energy mutual-complementing power is composed of water source(motor-pumped well) water pumping unit with wind and solar energy mutual-complementing power, controller, water transport pipeline, pump, reservoir, as shown in fig 2.

Pumping water directly could cause the shortage of water and long time of pumping water. The method of two-level pumping water is a proper to solve the problem of water shortage. The first level pumps water into the reservoir through a submerged pump of small flow rate and high lift, the second level pumps water from the reservoir to the herdman's portable water tank with a centrifugal pump of big flow rate and low lift. The shortage of water and long time of pumping water could be solved with
the water pumping mode, and unstable energy and low water supply reliability could also be solved when the wind and solar energy mutual-complementing power technology used in the mode.

4. Cold area all-weather automatic water supply technology with wind and solar energy mutual-complementing power in winter

Cold winter brings great difficulties to distributed small water supply engineering construction in the cold area which is more than 40° north latitude. There are many water wells froze when the winter coming, so the water supply would be impossible. The set of technology demonstration can bring the safe water supply for cold area in winter which combines the thermal insulation, antifreeze, solar thermal utilization and the water supply system with wind and solar energy mutual-complementing power.

Underground reservoir is applicable for thermal insulation and antifreeze in northern cold area which Compared with the mode without anti-freezing facilities. High potential energy automatic water supply can’t be achieved due to the underground reservoir. So the terminal water pump with battery has been added in the system, as shown in fig 3.

The technology is composed of water intake structures (Wells), water pumping units with wind and solar energy mutual-complementing power, anti-freezing underground reservoir, water pump, power supply, hydrant and water transportation pipeline. Closed water pumping area which is composed of water pumping units with wind and solar energy mutual-complementing power, water well, anti-freezing underground reservoir is formed by safety fence. The control room, hydrant, water intake platform, livestock drinking water tank and water transportation pipeline are outside the fence. The underground reservoir is enclosed and commonly 3m depth, And the object's daily water consumption is water storage. The top of the water pool generally higher than the ground 0.2 ~ 0.3 m (to prevent the vehicle rolling), and the top covered with thermal insulation material and heat absorption material, in order to improve the effect of winter antifreeze.

The principle is: water pumping units with wind and solar energy mutual-complementing power works all time, generally 80% of its output power used to pump water from the well into the underground reservoir, about 20% is used for battery charging. Storage battery drive pump for water supply facilities when the water needed. Reservoir depth is 3m Generally, well depth is 20 ~ 80 m, and depth ratio of reservoir to well is equal to load ratio of battery load to wind turbine load. In order to achieve rapid loading and terminal water supply, water pump work generally in short time and high power mode.

![Fig. 3. Cold area all-weather automatic water supply technology with wind and solar energy mutual-complementing power in winter](image)
5. Conclusion
Water supply technology of wind and solar energy mutual-complementing power can reduce the damage to grasslands which caused by livestock’s centralized water supply, and the technology that plays an important role in protecting ecological security provides technical support for rotational grazing in natural pastoral areas. The goal of 500 sheep shed and 100 square kilometers natural pasture’s protection can be achieved with one unit. In consideration of energy conservation, fuel can be saved about 2500L with one unit. Consumption of fossil fuels and greenhouse gas emissions can be reduced by water supply technology of wind and solar energy mutual-complementing power. And it has great effect on energy-saving and environmental protection.

Acknowledgments
This work was supported by the National Key Research and Development Program of China (Grant No. 2018YFE0196000)

References
[1] Brian D Vick, Byron A Neal, SE, 86(2012).
[2] Ilyas Omar, Selbourne Makhlomo, JEDT, 1(2003).
[3] Wang shifeng, Hou shiwen, Cao liang, RWCHPC, 6(2016).
[4] Wang shifeng, Hou shiwen, Cao liang, RWCHPC, 11(2018).
[5] Wu yongzhong, Cha yong, Li liang, RWCHPC, 3(2014).