

Application and Analysis for Reclaimed Water System of a University in Tianjin

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Abstract. With the increasing scarcity of water resources, water utilization has become an important way to solve the crisis of water resources. Whether the water system can bring better economic benefits and environmental benefits has become a concern of the people. Based on the analysis of the water system in a university in Tianjin, this paper studies the economic and environmental benefits of the reclaimed water system. The results show that the water system has good economic benefits and environmental benefits.

Introduction

With the rapid development of social economy, the pressure of the supply of water resources is increasing. At the same time, the phenomenon of waste water in all walks of life is very serious, which is exacerbated by the shortage of water resources [1]. Therefore, how to maximize the use of existing water resources, improve water use efficiency, increase water reuse rate, has become the subject of active exploration and research in each country [2,3].

Colleges are major urban water users where students living together, due to various reasons, the waste of water resources is serious. Therefore, setting up water saving consciousness and starting the water reuse system is an effective way to solve the problem of water resources shortage [4].

Reclaimed Water System

The reclaimed water system is a water supply system which can be used for the purification of domestic sewage or waste water in the residential area, which is suitable for the serious water shortage of city and the lack of fresh water resources [5]. The system is generally consisted of three parts of the water system, water treatment system and water supply system. The methods of purification usually include physical, chemical, biochemical or membrane separation [6,7]. The source of the reclaimed water are mainly rain, cooling water, toilet water, bath water, laundry water, kitchen drainage, flushing drainage; Commonly used in the agriculture, forestry, fisheries, animal husbandry, urban miscellaneous, reuse of industrial, landscape recreational use and natural water supplement. The system presented in this paper is a system for residential building group which daily purification ability of water is less than 1500 m³/d.

The original water system is mainly refers to the collection of the original water system, whose task is to take the sewage away from the produced place (such as student dormitory, bathrooms, etc.) are collected, transported to the campus water treatment station, including indoor and outdoor drainage channel and its corresponding collection facilities. The water treatment system of university is a sewage treatment facility, which is mainly to achieve the water quality standards, including a series of treatment facilities, pumping station and its subsidiary structures. Water supply system is mainly to send water to the campus of the various water points, meeting the requirements of water, through the campus indoor and outdoor water distribution and water distribution network, Meeting the requirement of water pressure. This part generally contains the campus indoor and outdoor water pipeline system, pumping station and related facilities [8].

Application Case

Introduction of an Actual Project. Located in Tianjin, the university is divided into the teaching area, living area, sports area, leisure area and apartment area. The total number of people is about 4200, the total land area is about 450 thousand m². It is about 1200 m³ of sewage is treated everyday by the system. There is a lake landscape, used for water storage. The storage capacity is 60 thousand m³. The sewage treatment station adopts a new technology named Speed Division Biological Treatment technology(SDBT). This technique combines immobilized microorganism and biological membrane techniques. SDBT pool makes a use of gas, solid and liquid three-phase movement to separate suspended particles carried in sewage, which to achieve the separation of SRT and HRT. The core technology is the "biochemical ball filler". It can be used for 30 years without changing, saving a lot of replacement and maintenance costs than the traditional biological packing.

Technological Advantages. This process has characteristics of no sludge, no smell, simple maintenance and modular construction, which perfectly solves the problems of conventional sewage treatment process problem.

In the process, the pool of biological form a complete food chain and the higher organisms feed on lower organisms, the amount of sludge produced is very small, the amount of sludge can be reduced to the extent that the sludge cannot be discharged. The biofilm anaerobic layer is in the aerobic layer, and the peculiar smell gas produced by the anaerobic decomposition is absorbed and utilized by the aerobic bacteria in the aerobic biological layer. Sulfide is fixed in aerobic bacteria body, methane and other organic gases are further decomposed into a tasteless inorganic gas and water, so the system has no bad odor generation; The system process is simple, less equipment, easy operation and management, which can achieve real unmanned. In addition, there are other advantages such as advanced technology, high treatment, water quality, long service life, low operating costs, fast start and so on.

Economic Benefit Analysis. From the actual operation of the water system in some colleges and universities which have been implemented in China, the economic benefit is considerable [8].The cost of reclaimed water system includes depreciation cost of fixed assets and operation cost. Fixed assets investment mainly includes: pipe network, processing equipment and structures. It can be divided into the sewage collection, sewage treatment, lake ecological design and geological survey and water conservancy etc. Operating costs include electricity, chemical processing and maintenance costs, labor costs, overhaul costs etc.The costs of fixed assets are shown in Table 1. The operating costs are shown in Table 2.

Table 1 Cost of fixed assets

Item	Scale	Cost[1000 ¥]	Remarks
Sewage treatment station	1200Tons / day	6000	Equipment and civil engineering (buried)
Fee of Landscape lake water quality	Area: 40 thousand m ²	2000	Impermeable membrane treatment
	Volume: 60 thousand m ³	1000	The quality of water
Total		9000	

Table 2 Operating costs

Item	Annual operating cost[1000 ¥]	Remarks
Sewage treatment station	242.4	electricity, labor costs etc
Fee of Landscape lake water quality	200	The quality of water
Total	442.4	

After calculation, tons of water cost of electricity is about 0.4 yuan, artificial fee is about 0.5 yuan, equipment cost is about 0.5 yuan, so the sewage treatment operation with a total cost is about 1.4 yuan, net operating cost is about 0.9 yuan. The project of sewage recovery rate of 100%. The current water price in Tianjin is 4.9 yuan / ton. The system annual saves 462 thousand tons of tap water, That is to say it saves about 1821.4 thousand yuan per year. After deducting operating costs 442.4 thousand yuan, The project annual income is 1379 thousand yuan. The project total investment of 9 million yuan, the payback period is about 6.5 years. Overall, the system is of good economic benefit, and the higher the price of water for the area, the more obvious the economic benefit is.

Conclusion

The reclaimed water system to make their own sewage has been fully utilized and also make the green vegetation in school get plenty of water resources, which achieves zero discharge of sewage. In addition, there is plenty of water in the landscape lake, which effectively avoid water shortages caused by times such as school holiday. The system is a feasible and effective water-saving technology. It can save precious water resources, ease the contradiction between supply and demand of urban water, reduce the burden of urban drainage system, water pollution control, protection of the ecological environment, and has good social benefits, environmental benefits and significant economic benefits.

Reclaimed water system can not only meet the requirements of various types of water, save investment, reduce costs, but also to save the quality of drinking water, ease the contradictions of urban water resources, the construction of a large investment in the long distance water diversion project. This is a practical way to solve the contradiction between the increasing amount of water consumption and the relative shortage of construction funds in many cities of our country, and it is significant to the economic construction of our country.

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