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# Development of new sewage treatment system

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## Abstract

**Because the traditional water treatment method is time-consuming, complicated to deal with excreta, poor purification effect and low efficiency, water treatment device is proposed to solve the above problems. Water treatment device can be installed on the mobile equipment, through the automatic control system, by the new solid-liquid separation equipment for solid liquid separation of excreta treatment, the separated sewage treatment, filtration, sterilization, disinfection, in order to meet the environmental protection of the sewage discharge standards. The experimental results show that the water treatment device can completely separate the mixture of solid and liquid, which is suitable for a variety of work sites, reduce the secondary pollution, and protect the health and safety of personnel.**

## Keywords

**Water treatment; Solid liquid separation equipment.**

## 1. Introduction

As the COVID-19 pandemic continues, non-traditional security challenges such as public health security and biosecurity have become more urgent. There are many pathogens harmful to human health in the excrement of septic tank. Harmless treatment is one of the important means to control infectious diseases at the source. Under the influence of environment, the research of water treatment device has a very good prospect. In the process of sewage treatment, the traditional way of cleaning is mainly manual cleaning. This way of effective treatment of sewage less time, low efficiency, high treatment cost, but also cause secondary pollution of the environment, affecting the health and safety of treatment personnel. The foreign treatment method has good effect and can carry out the secondary utilization of resources, but the cost is high, the processing equipment is huge, and the working place is fixed. Therefore, the research of water treatment device has certain practical significance for sewage treatment. When it is applied to the sewage treatment of intelligent public toilets, it can solve the drawbacks of pollution, difficult treatment and high energy consumption in the whole transport process of traditional public toilets, which reflects the technological innovation of harmless treatment of solid waste resources. Water treatment device treatment route: the original sewage garbage separation, separation of non-degradable substances; Then the solid-liquid separation process was carried out; Dehydration, disinfection, deodorization, liquid flocculation, decolorization, sterilization, deodorization, gas disinfection, deodorization; Finally, the treated gas and liquid are discharged, and the solid is reused.

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## 2. Mobile intelligent environmental protection sewage treatment process design

According to the requirements of intelligent sewage treatment and environmental protection, the process flow chart as shown in Figure 1 is preliminarily designed to realize the secondary utilization from the original sewage to harmless discharge and the reclaimed water.

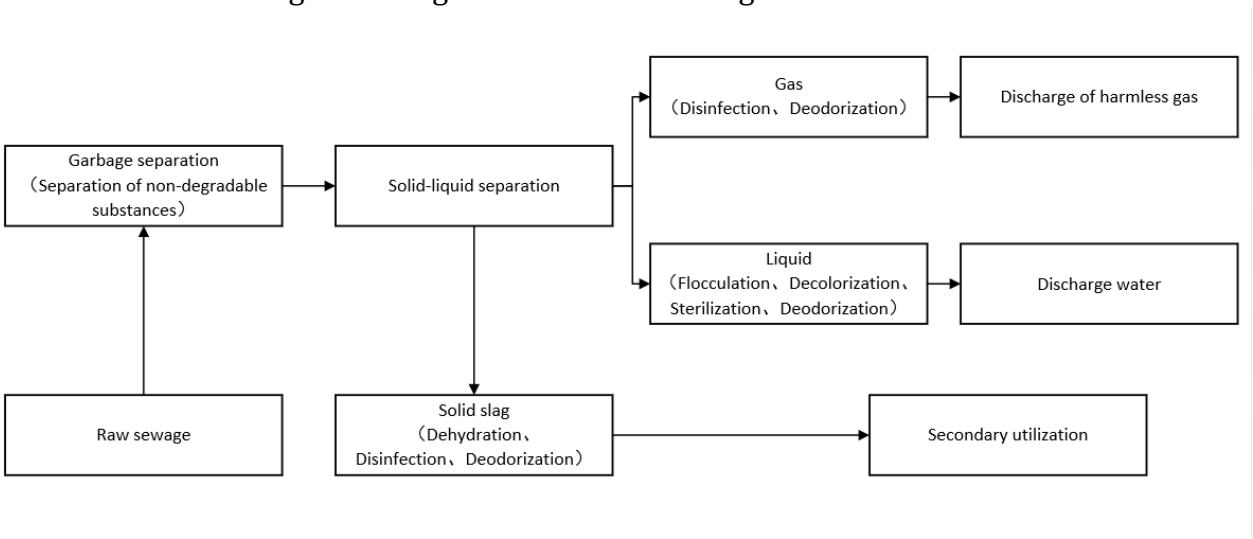


FIG. 1 Process flow chart of mobile intelligent environmental sewage treatment equipment

## 3. Overall structure design of mobile intelligent environmental protection water treatment equipment

The project plans to adopt the modular design method and preliminarily design the mobile intelligent environmental protection sewage treatment equipment as shown in Figure 2.

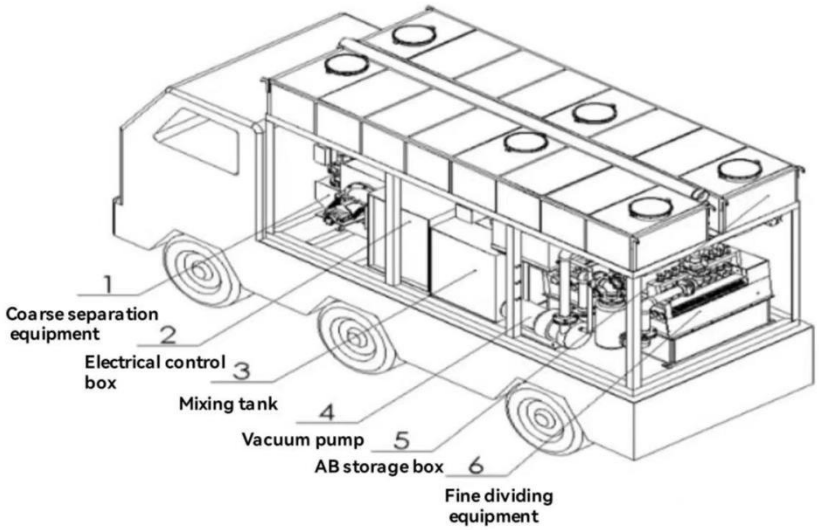


FIG. 2 Three-dimensional diagram of mobile intelligent environmental water treatment equipment

## 4. A new type of solid-liquid separation equipment

The core component of solid-liquid separation, the feeding unit, uses the principle of "Venturi" effect to realize solid-liquid separation through continuous dehydration for several times. The

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dehydration rate of solid-liquid mixture is higher than that of traditional solid-liquid separation equipment.

## 5. Design of Disinfection System

Study the nitrogen, phosphorus and COD treatment process based on biological agents for the wastewater separated from solid and liquid, to ensure that the nitrogen and phosphorus index decreases and the COD index drops below 800. Furthermore, the COD index is further reduced to the national emission standard by using nanofiltration for two stages. Finally, the pipe type ultraviolet disinfector is used for sterilization and disinfection to complete the sewage discharge in line with environmental protection.

## 6. Automatic control scheme design

According to the automatic control scheme, the system construction and electromechanical joint adjustment are planned to achieve the project research objectives. The automatic control scheme of intelligent environmental protection sewage treatment equipment is preliminarily designed as follows:

When the urinal is in use, the battery valve opens to flush water into the urinal storage box N. When the level gauge of the urinal storage tank reaches a certain value, open the solenoid valve 4-3 and input the microfiltration system R through the pump Q. After being processed by the infrared sterilization equipment s, it is imported into the central water tank.

The water from the washbasin and cleaning pool is injected into the M pool. When the liquid level meter of the M pool reaches the set value, open the solenoid valve 4-2 and input it into the micro-filtration system R through the pump Q. After passing through the infrared sterilization equipment S, it is imported into the central water tank.

Sit and stool: Open the valve 1-4, 1-8 for the clean water tank U, and water supply for the middle water tank V. Close the two valves when the level sensing reaches the set value. Start the vacuum pump C and solenoid valve 1-1 to vacuum the black tank J, open the valve 2-1-7, the toilet is in the working state, when the liquid level sensing of the black tank reaches the set value, control the solenoid valve 2-8 open to the coarse subsystem K feed. When the liquid level sensing of the coarse separator motor reaches the set value, open the valve 2-9, and make the coarse separator pump P work, so that the material in the coarse separator box is sent to the flocculation box, and the flocculation box stirring motor starts to work. When the liquid level sensor in the flocculation box reaches the set value, open the valve 3-1 to feed the fine separator L. At this time, the fine separator motor starts to work at the same time to realize the solid-liquid separation of materials. When the liquid in the fine separation box reaches the set value, open the valve 4-1 through the pipeline pump Q to transport the material to the micro-filtration system R filtration, filtered liquid through the infrared sterilization equipment S into the central water tank, open the valve 4-6, the material of the micro-filtration system R into the fine separation equipment for processing.

## 7. Experiment

### 7.1. Procedure of experiment

The solid-liquid separation equipment in the device is tested in the experiment. The solid-liquid separator shell is provided with a feed port and a discharge port at both ends of the shell. The shell is also provided with a bearing unit, a feeding unit and a pressing unit. The material on the bearing element is transferred from the feed end to the discharge end by rotating the circular rotor. The experiment was carried out with soybean milk.

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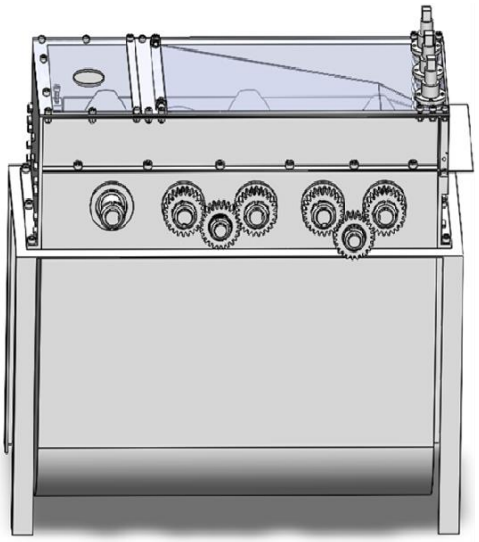

FIG. 3 Model diagram of solid-liquid separation equipment

## 7.2. Experimental results

After the mixture of soybean milk and soybean residue enters the soybean milk flows down through the process gap between the guide plate and the circular rotor. The soybean residue is constantly squeezed by the circular rotor and the water in the residue is completely discharged. The soybean residue drained of water is rotated by the circular rotor and transmitted to the discharge port, finally realizing the solid-liquid separation.

FIG. 4 Experiment of soybean milk and soybean residue

## 8. Conclusion

This paper mainly introduces the components of mobile intelligent environmental protection water treatment equipment and the function of each part, and carries out the design and experiment of solid-liquid separation equipment, and determines the feasibility of the experimental device. The research of this subject not only meets the needs of current urban environmental protection construction, but also can solve the difficult problem of harmless disposal of urban and rural feces. The product caters to a series of policies and economic development trends such as environmental protection and toilet revolution, with broad market prospects, and can produce great social and economic benefits.

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## References

[1] Lin Zengwei, Zhang Yanmin, Zhu Jia, Luan Xinyu. Mobile sewage processor's influence on shenzhen dung slag treatment process [J]. Journal of green science and technology, 2020 (10) : 79-81. The DOI: 10.16663 / j.carol carroll nki LSKJ. 2020.10.027.

[2] Chen Z L. Comparison of urban fecal treatment system models at home and abroad [J]. Journal of Wuhan University of Urban Construction,2000(01):48-51.

[3] Yu Chiming. Let "toilet revolution" become an important link of urban and rural green development [J]. Urban and Rural Construction,2022(09):5.