



## Research on Simple Disinfection System for Medical Wastewater of Township Hospital

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Disinfection is an important and necessary process of hospital sewage treatment, which directly affects public security and environment health. Chlorine dioxide disinfection is most effective wastewater processing method which has good disinfection effects and economic benefits through comprehensive comparisons of several kinds of disinfection methods of hospital sewage. In order to solve the difficulty of no space to construct disinfecting tank in some small hospital or township hospital, disinfecting pipelines surrounding the clinic building are applied. A new simple disinfection system for medical wastewater including three-stage filtration system and chlorine dioxide generator, which is suitable for the disinfection for medical wastewater of township hospital was adopted.

**Keywords:** Hospital wastewater, Disinfection, Disinfecting tank, Chlorine dioxide generator, Simple processing system.

### INTRODUCTION

Disinfection is an important and necessary process of hospital sewage treatment, is a public problem that often threatens the health of both doctors and patients. The disinfection effect directly affects the spread of pathogenic microorganisms, public security and environmental health. After the primary or secondary treatment, disinfection of medical wastewater was followed generally, its purpose is to kill the pathogenic microorganisms and viruses, control and decrease the appearance of hospital infection.

Both domestic and foreign scholars have been carrying out large-scale investigation and research on the current management situation, disinfection effect for medical wastewater in various hospitals and up to now, certain achievements have been made<sup>1-5</sup>. The conclusion showed that the effluent quality of medical sewage can't meet the discharge standard from most medical institutions, especially in some township hospitals. The main reason is the deficiency of investment fund, lacking the specialized managerial talent and skilled professionals of sewage treatment, sewage treatment facilities as well as construction cannot meet the actual demand<sup>6</sup>. And no space or geologic structure to construct disinfecting tank are the existing problems in some small hospital, they will directly restrict the development of the hospital. Therefore, it is urgent

to put forward disinfection method suitable for the wastewater disinfection in small hospitals. According to the current management situation of medical sewage and its pollution in township hospitals, disinfecting treatment of sewage in pipeline was proposed and a new simple disinfection system for medical wastewater including three-stage filtration system and chlorine dioxide generator has been adopted.

**Choice of disinfectants:** There are several common disinfection methods of hospital sewage, such as liquid chloride, chloride dioxide, sodium hypochlorite, bleaching powder, peroxyacetic acid, ozone and ultraviolet ray<sup>7</sup>. To screen the convenience, economic and effective disinfection method, comprehensive comparisons of several kinds of disinfection methods of hospital sewage are made<sup>8,9</sup> (Table-1).

Based on above comparative analysis, oxidized disinfectant (ozone and peroxyacetic acid, etc.)<sup>10</sup> not only can kill bacteria but also kill the virus and not easy to form disinfection by-products. However, such disinfection methods incorporate a high degree of risk, relatively immature technologies and high operation cost. Compared with oxidized disinfectant, chlorinated disinfectant is widely used for low cost and convenience. But liquid chlorine cannot be adopted in population concentration district for high storage risk; sodium hypochlorite will also gradually be eliminated in domestic, for its high equipment cost, strong corrosion due to the existence of big

TABLE-1  
COMPREHENSIVE COMPARISONS OF SEVERAL KINDS OF DISINFECTION METHODS OF HOSPITAL SEWAGE

Items	Advantages	Disadvantages	Disinfection effect
Cl <sub>2</sub>	Good continued effect; simple and mature technology; precise dosage	Produce disinfection by-products (THMs); strong corrosion; some risk for running and management	Effective sterilization, but poor effect
NaOCl	No toxicity; excellent security	Produce disinfection by-products (THMs); increase pH value	Same sterilization effect as Cl <sub>2</sub>
Peroxyacetic acid	Low concentrations of disinfectant, low toxicity, easy-prepared, no second pollution	Easy decomposition, strong corrosion, strong excitant sour, immature in treatment equipment	Poor disinfection effect
O <sub>3</sub>	Strong oxidant, short contact time, no organic chlorine; no affected by pH; can increase DO of water	Some risk for running and management; high infrastructure investment and operation cost	Good effect for bacteria and viruses
UV	Without harmful residual substances; no odour; simple operation, low costs, easy maintenance	High power consumption; high water quality; no continued sterilization effect	Good effect, high require for suspended solids
ClO <sub>2</sub>	Strong oxidant, no THMs; good germicidal efficacy, better continued effect; no toxicity; excellent security; easy maintenance	Only produce and use on the spot; complex equipment; high operating management requirements	Better sterilization effect than chlorine

volume of residual chlorine, salt, water and chemical reagent. The ozone disinfection is characterized by strong sterilization ability, fast reaction, no permanent residual<sup>11</sup>, but over-dose of ozone is easy to cause bad smell to secondary pollution and has higher investment cost and power consumption. Chlorine dioxide disinfection as a mature technology are the most widely used at present in China with a safe, reliable, stable and sustainable disinfection effect<sup>12</sup>. It will be a inevitable trend for chlorine dioxide and other efficient and economic methods gradually to replace the traditional disinfection methods<sup>13</sup>. So the chlorine dioxide generator is adopted in this paper.

#### Disinfection technological process and drawbacks:

Wastewater treatment system has anoxia pond, good oxygen pond, precipitates pond and disinfecting pond, dirty mire pond to constitute. Disinfection is a very important unit process in hospital wastewater treatment. Disinfection equipment is mainly composed of the technology and equipment of preparing medical disinfectant, the facility for storing, dosing and blending and disinfecting tank.

From Fig. 1, it can be concluded that disinfecting tank is an essential part of hospital sewage treatment system, the disinfection of hospital sewage is mainly implemented to construct disinfecting tank.

But there are some major drawbacks as follows: (1) High infrastructure investment and more complicated technological process. Main part of construction project include concrete ponds, machine rooms, disinfecting equipment, etc. (2) Poor disinfection effect. The retention time of disinfectant can't be ensured by effective volume of disinfecting tank; (3) Restricted

by space or geologic structure (such as rock), it's difficult to construct disinfecting tank in some small hospitals. Therefore, it is urgent to put forward disinfection method suitable for the wastewater disinfection in small hospitals.

**A new simple disinfection system for medical wastewater:** Hospital wastewater simple disinfection system is mainly composed of chlorine dioxide generator, control valve, the doser with water injector, mixed well, disinfecting pipeline, sampling well, including the preparation and dosing of disinfectant system, three-stage filtration system, contact disinfection system (Fig. 2).

The system of disinfectant system contains chlorine dioxide generator (1), control valve for disinfectant (2), water pipe (3), water valve (4), the doser with water injector (5), drug dosage regulator (6), Drug delivery pipeline (7). Chlorine dioxide's preparation on-site is used as disinfectant.

Hospital sewage was carried out anaerobic treatment in septic tank. The main purpose of three-stage filtration system consist of rough filter (10), second-level filter (11) and fine filter (12) is to remove suspended solids in wastewater. Contact disinfection system is composed of mixed well (14), contact disinfection pipeline (16).

Hospital sewage flows into mixed well to form vortex, to enhance the disinfecting effect. To ensure the most optimal retention time between hospital sewage and disinfectant, length of the disinfecting pipeline is designed according to maximum quantity of hospital wastewater. The disinfecting pipeline surrounding the septic tank or outpatient building can be adopted according to the actual demands and geological conditions.

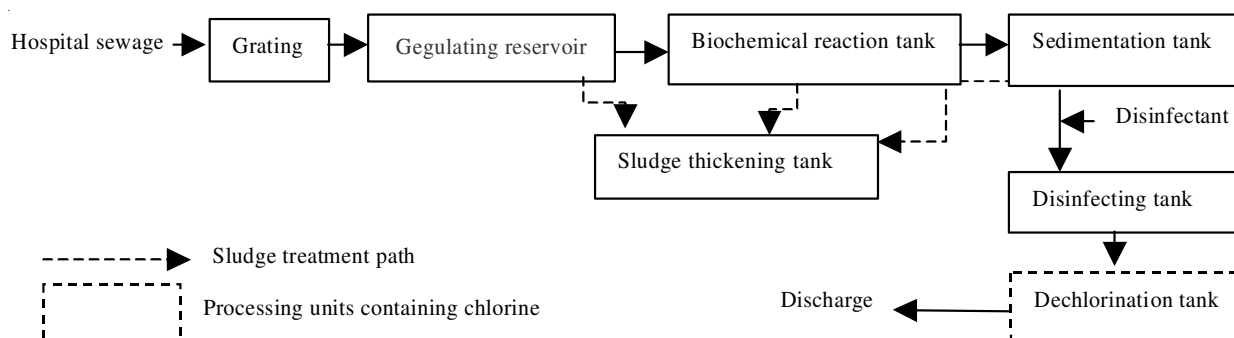


Fig. 1. Flow chart of secondary treatment process for hospital wastewater

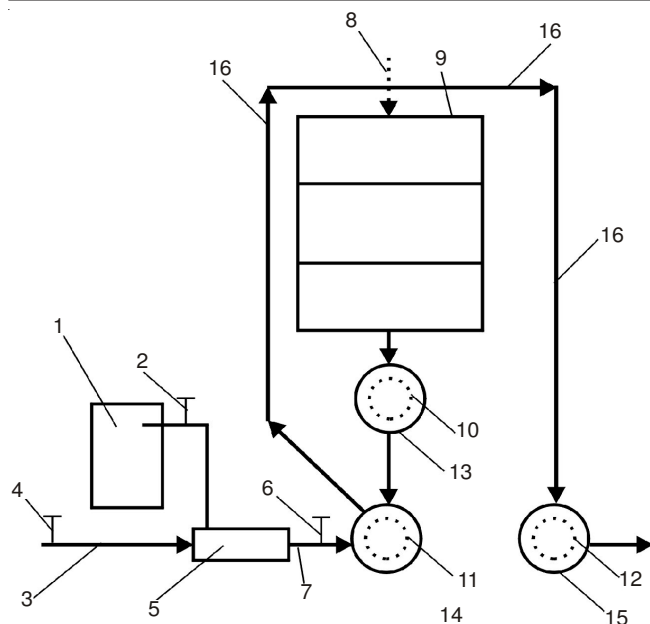


Fig. 2. Schematic diagram of simple disinfection system for hospital wastewater. Note: 1. Chlorine dioxide generator; 2. control valve for disinfectant; 3. Water pipe; 4. Water valve; 5. the doser with water injector; 6. Drug dosage regulator; 7. Drug delivery pipeline; 8. Hospital sewage; 9. Septic tank; 10. Rough filter; 11. Second-level filter; 12. Fine filter; 13. Prefiltration well; 14. Mixed well; 15. Sampling Well; 16. Disinfecting pipeline

Technological processes: (1) Hospital sewage → Septic tank → Rough filtration → Dosing and mixing → Second-level filtration → Contact disinfection → Fine filtration → Sampling → Discharge meeting standards → Municipal pipe network; (2) Chlorine dioxide generator → Chlorine dioxide's preparation on-site → the doser with water injector → Chlorine dioxide disinfectant → Regulating valve → Mixed well.

### Conclusion

In this paper, the disinfection effect and features of chlorine dioxide and ozone disinfection, oxidation and disinfection are introduced and analyzed, chlorine dioxide disinfectant is more

superior to the other disinfection methods. It will be an inevitable trend for chlorine dioxide gradually to replace the traditional disinfection methods. The three-stage filtration system can effectively remove suspended solids, COD and BOD, is suitable for the disinfection for medical wastewater of township hospital. Chlorine dioxide's preparation on site can achieve better disinfection effect, also won't produce large quantities of disinfection by-products and carcinogens (like THMs). Chlorine dioxide generator can be arbitrarily placed staircase, washing room or other spare corner in hospital, without taking up machine rooms and space. Disinfecting pipeline surrounding the septic tank or outpatient building is adopted to replace contact disinfecting tank, the practical difficulty of no space to build contact disinfecting tank is solved.

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