



Prevention and control of the novel coronavirus in urban sewage treatment plants in Jiangsu

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Abstract: The 2019 novel coronavirus (COVID-19) can survive in the environment for an extended period of time, and may also linger in medical wastewater and domestic sewage. If the pollutants containing the novel coronavirus are not handled properly, a secondary of COVID-19 infection may be caused by the sewage system and sewage treatment site, and so COVID-19 may pose a serious threat to the health of sewage treatment personnel. To guide urban sewage treatment plants to standardize the implementation of novel coronavirus epidemic prevention and control measures, Jiangsu Provincial Center for Disease Control and Prevention has formulated “Technology specifications for prevention and control of the novel coronavirus pneumonia in urban sewage treatment plants” in order to protect workers from the novel coronavirus infection. This article introduces the various hazards of domestic waste and the treatment methods for different pollutants. At the same time, according to the requirements of the urban sewage treatment process and operation, this article introduces the specific requirements for the prevention and control of the novel coronavirus epidemic in urban sewage treatment plants in the specification, which is aiming to guild the city sewage treatment plant to carry out new COVID-19 prevention and control measures.

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Introduction

Urban sewage contains many pollutants. If not handled properly, these pollutants may spread further, leading to eutrophication of bodies of water and damage to the local ecology. Therefore, it is necessary to ensure that the sewage system meets the discharge standard. The 2019 novel coronavirus (COVID-19) epidemic has spread throughout the world. Its main transmission mode is through droplets, while the route of transmission through aerosols or the digestive tract still needs to be verified (1). In the process of sewage treatment, workers may come into contact with

chemical, biological, and other materials, which can be damaging to human health. Therefore, it is particularly important during pandemic times that the safety protocols meant to protect these personnel are strengthened.

Treatment of pollutants in domestic sewage

Pollutants in domestic sewage include solid pollutants, aerobic pollutants, nutritional pollutants, toxic pollutants, and biological pollutants.

The main hazards of pollutants in domestic sewage are described below.

- (I) Solid pollutants. To begin, suspended solids can make the water quality become more turbid, which makes it difficult to distinguish whether the sewage has been treated from the surface. Secondly, the accumulation of suspended solids may seriously affect any underwater equipment, causing blockage or wear, which can then affect the service lifespan of the equipment. Finally, suspended solids can also affect aquatic organisms, making some aquatic organisms have difficulty breathing and destroying the underwater ecological balance.
- (II) Aerobic pollutants. The decomposition of aerobic pollutants consumes a large amount of dissolved oxygen in the water. When these pollutants decompose, the amount of dissolved oxygen in the water decreases, making it difficult for some aquatic organisms to breathe, which can lead to ecological environmental harm in serious cases (2).
- (III) Nutrient pollutants. When the content of nutrient pollutants in the water is too high, the water may become eutrophic, promoting the proliferation of algae, which will consume a considerable amount of dissolved oxygen in the water, thus threatening the survival of other organisms in the water.
- (IV) Toxic pollutants. Toxic chemicals can cause biological poisoning in the water. If people directly drink water containing toxic pollutants or consume toxic organisms, they may be poisoned.
- (V) Biological pollutants. Bacteria and viruses can cause various diseases and impact the health of humans and animals.

The main treatment methods of pollutants in domestic sewage are described below.

- (I) Treatment of solid pollutants. To a large extent, suspended solids are treated by sedimentation, and the suspended solids can be treated intensively after being precipitated. The activated sludge suspension layer can also be used to agglomerate the suspended solids together via its adsorption net trapping effect, so as to centralize the treatment.
- (II) Treatment of aerobic pollutants. Aerobic pollutants are mainly treated by microorganisms and adsorbed metabolites. The final products of microbial metabolism are nonpolluting substances such as CO₂ and H₂O.
- (III) Treatment of nutrient pollutants. The treatment of nutrient pollutants such as nitrogen and

phosphorus usually depends on biological and chemical methods.

Prevention and control of the COVID-19 virus

Basic requirements

COVID-19 prevention and control protocols for worker safety are described below:

- (I) Responsibility for epidemic prevention and control should be clearly designated. Specialized departments and personnel should be responsible for epidemic prevention and control and worker safety.
- (II) A COVID-19 emergency plan should be developed, and relevant training; management plans for unit safety; management of returning personnel; and storage plans for epidemic prevention materials, ventilation, and disinfection should be conducted and completed to manage the occurrence of a possible virus outbreak.
- (III) Contact with the relevant departments of the local government should be established, along with an epidemic information reporting system. If an outbreak is discovered, it should be reported in timely fashion.
- (IV) Considerable importance should be attached to the safety of sampling, testing, and maintenance personnel, who should be provided the necessary safety protection equipment (gloves, goggles, and medical masks), and be given the appropriate safety knowledge and training.
- (V) During times of outbreak, the urban sewage treatment plant should ensure the safe production and operation of units according to the relevant requirements (3-5).

Material support

- (I) Equipment reserves. The reserves of protective equipment and disinfection supplies should be increased. According to the epidemic prevention material reserve plan, material manufacturers should be contacted to provision a reserve of anti-epidemic materials. The required materials mainly include protective masks, goggles, gloves, protective clothing, medical alcohol, disinfectant, and thermometers.
- (II) Use of officially recommended materials. Epidemic

prevention materials should conform to relevant national and local management requirements and technical standards, and products recommended by epidemic prevention and control departments should be selected and purchased.

- (III) Resupply and waste disposal. It is necessary to establish a standing order for purchasing and distributing epidemic prevention materials, regularly count the inventory and verify the validity period, and purchase and replenish epidemic prevention materials in timely fashion. Meanwhile, a special recycling device for waste protection articles should be acquired, and special personnel should be assigned to waste disposal duties.

Environmental management

- (I) Cleaning and disinfection. Comprehensive cleaning and disinfection should be completed to strengthen the management of the environmental sanitation of the plant area. According to the relevant requirements (6,7), all areas of the urban sewage treatment plant should be cleaned and disinfected regularly to ensure the health and safety of the staff.
- (II) Natural ventilation and mechanical ventilation. A COVID-19 management system should be implemented according to the management guidelines for epidemic prevention and control mechanisms (8).

Personnel management

- (I) Personnel health report system. A comprehensive statistical investigation on the daily health status of all employees and family members should be conducted, and employees should be urged to immediately visit the designated hospital for treatment in accordance with the provisions.
- (II) Quarantine protocol. Any personnel returning from the epidemic area should be isolated, and only permitted to return to their posts after the isolation period has elapsed. An isolation area in the facility should be designated, and any employees who feel unwell or are suspected of infection should be immediately isolated and observed.
- (III) Management of personnel access. Vehicle entry should be strictly controlled. Personnel exiting or entering the work area should have their temperature checked, and each worker should be examined to ensure that

the necessary equipment is being worn. Personnel access should be recorded and filed.

- (IV) Canteen areas. The canteen should be disinfected daily. The staff should wear protective masks, and the distance between people should be more than 1 meter; face-to-face dining should be avoided.
- (V) Meetings. Unnecessary meetings should be reduced. For centralized meetings, windows should be opened for ventilation. Participants should wear masks. The distance between the participants should be more than 1 m, and the meeting time should be made as short as possible.
- (VI) Equipment protocols. Employees should wear masks throughout the work time. Body temperature testing personnel and cleaning personnel should wear masks and gloves during their work. Hand washing facilities and disinfection supplies should be set up in work and living places.
- (VII) Health awareness. Health education should be enhanced. Relevant departments should raise awareness of epidemic prevention, protection, and control work in comprehensive fashion. All staff should be instructed to pay close attention to personal hygiene, while being encouraged to exercise and maintain a healthy diet.

Production safety

- (I) Water quality management. The detection frequency and disinfection of effluent should be increased and strictly implemented to prevent the spread of infected sewage and feces, while samples should be sent to relevant units for detection if necessary, so as to ensure the safety of the river water environment and the supply of reclaimed water. The total effluent should be sampled and tested in strict accordance with standard requirements, and indexes, such as fecal coliform group in the effluent, should be stable and meet the pollutant discharge standard of urban sewage treatment plants. For appropriate ultraviolet disinfection, it is suggested that the effluent disinfection system be supplemented with sodium hypochlorite or liquid chlorine disinfection to ensure a sufficient sterilization effect and so that effluent measures meet standards. Meanwhile, the detection of residual chlorine in effluent should be strengthened to ensure residual chlorine amounts remain lower than 0.5 mg/L, and that treatment products are safe.

- (II) Sampling and testing. The sampling and testing personnel should wear protective equipment throughout the respective process (protective clothing, protective mask, protective glasses, medical gloves etc.) to safeguard them from the corresponding occupational hazards of potential new COVID-19 cases. The skin should not be in direct contact with sewage or sludge. The testing process should be carried under a fume hood, and the fan of the fume hood should be kept on. During this process, the samples should be prevented from spillage or leaks, and the laboratory should be disinfected after testing is complete.
- (III) Maintenance and repair. During the period of epidemic prevention and control, plans for emptying and dredging should be suspended until after the epidemic is over. Other operations should be mainly mechanical and hydraulic in nature, and manual operation in wells and pools should be avoided in nonemergency situations. When dealing with emergency events such as sewage overflow, pipeline collapse, and underwater equipment maintenance, operators should ensure their own protection and safety. After finishing an operations, the staff should disinfect the personal protection equipment and wash hands with hand sanitizer or soap water as soon as possible.
- (IV) Loading, unloading, and transportation. The sludge production workshop, loading and unloading areas, and transportation vehicles should be disinfected frequently and washed timely fashion. After an operation, the operation site, loading tools, and collection and transportation vehicles should be washed and disinfected. On site handling, cleaning, disinfection, and maintenance personnel should wear protective clothing, waterproof gloves, goggles, and protective masks to avoid direct contact with grid slag and sludge. After the completion of the operation, the staff should conduct a comprehensive disinfection of personal protective equipment and wash hands with hand sanitizer or soap water as soon as possible.
- (V) Patrol inspection. During inspections, site staff should wear long sleeve work clothes, waterproof gloves, goggles, and protective masks. When entering the pump room, fan room, and other machine rooms, attention should be paid to maintaining adequate ventilation. After the entire patrol inspection work or a certain patrol inspection work is completed, hands should be washed with disinfectant or soap water.
- (VI) Cleaning and disinfection. Disinfection personnel should put on protective clothing, protective masks, goggles, and medical gloves or waterproof gloves before beginning work. For the disinfection of office areas, staggered peak disinfection should be conducted. In the process of disinfection, a distance of more than 1 m from others should be maintained. After disinfection, disinfection tools and personal protective equipment should be disinfected comprehensively, and hands should be washed with hand sanitizer or soap water.
- (VII) Office management. The office environment should be kept warm and clean each day. Gathering should be kept at a minimum, face-to-face communication should be minimized, and a distance of more than 1 m should be maintained when discussions occur. Attention should be paid to personal hygiene through separation and management of personal clothes and frequent hand washing.

Emergency response

- (I) Case determination. A suspected or confirmed COVID-19 case should be immediately transferred to the designated hospital for diagnosis and treatment, and timely reports to the relevant local departments and authorities should be made.
- (II) Close contact management. The close contacts of confirmed COVID-19 cases, along with any relevant suspected cases and asymptomatic infected persons should be identified. Quarantine observation should be conducted in a temporary single dormitory, private housing, or centralized medical observation area according to local requirements. The isolation observation period should be 14 days, and body temperature and other physical conditions should be reported twice a day. If respiratory symptoms, fever, chills, fatigue, diarrhea, conjunctival congestion, and other symptoms occur during isolation observation, these should be immediately reported to the local health department, and the infected individual should be sent to the designated medical institution for diagnosis and treatment according to regulations.
- (III) Disinfection. Under the guidance of the local center for disease control (CDC) and according to the relevant requirements (9), terminal disinfection of potentially infected areas, such as rooms and places

where the infected individual was active, should be completed; close contacts should be isolated and the corresponding areas disinfected.

Discussion

The 2019 novel coronavirus can adversely affect the human liver, kidney, brain, immune system, excretory system, and reproductive system. In the process of treatment, patients produce medical waste and medical wastewater, and pathogenic material can be discharged. Medical institutions should thus carry out treatment of urban sewage treatment systems according to the relevant requirements. Furthermore, a considerable number of infected asymptomatic cases may be hidden in the normal population. They may also produce a large amount of domestic waste and excreta, which enter the urban sewage pipe network as domestic wastewater. Urban sewage treatment plants have become potential high-risk places for COVID-19 infection. A scientific research team managed to isolate the virus from the feces and urine of patients, which may cause aerosol or contact transmission of environmental pollution (10-13). From October 2019 to February 2020, a team of water quality experts from the Italian Institute of Higher Health collected 40 samples of wastewater, and a variety of methods were used to confirm the presence of the novel coronavirus RNA in wastewater samples (14); traces of the new coronavirus were also detected in the sewage products of Spain (15), the United States (16) and the Netherlands (17). Accumulating evidence indicates that COVID-19 can be discharged through human urine or feces. Therefore, sewage protection and inspection measures for this novel coronavirus are particularly important. We have proposed strategies for urban sewage treatment which may be helpful for guiding sewage treatment procedures during the COVID-19 epidemic.

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Footnote

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