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Discussion on the upgrading and transformation of rural domestic sewage pipe network——Taking Tong'an District of Xiamen City as an example

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Abstract: *Rural sewage treatment is an important measure to realize the strategy of rural revitalization and improve the rural living environment. Based on the field survey of the rural domestic sewage network upgrading and upgrading area in Tong 'an District, Xiamen City, this paper considers and summarizes the solutions for each stage of rural domestic sewage upgrading, and gives the countermeasures for the problems in the rural domestic sewage network upgrading project. It is hoped to provide some suggestions and guidance for the improvement and management of rural domestic sewage pipe network in the future.*

Keywords: *Countryside; Domestic sewage network; Remodel*

1. Introduction

Xiamen City will comprehensively promote the high-quality and high-standard improvement and treatment project of rural domestic sewage in 2021, and strive to use one year to combine with various work of rural revitalization to promote the improvement and treatment of rural domestic sewage according to local conditions. By the first half of 2022, the segregation of rainwater and sewage in rural domestic sewage will be basically realized, and rural domestic sewage will be fully collected and treated.[1]Rural areas are scattered, with a small population and weak economy, and it is difficult to control environmental pollution. It is difficult to copy and apply the urban governance model to meet the governance requirements of "green development" in rural areas.[2]To this end, a "one village, one policy" plan is needed to treat rural sewage.

2. Characteristics of rural domestic sewage discharge

2.1. Low domestic sewage discharge

Generally, the rural population is small, the permanent population in the village is smaller than the registered population, and most of the registered residents live in cities and towns most of the time.The economic conditions of the residents in the village are general, with only simple sanitary facilities, and the daily domestic water consumption is low, so the drainage volume is small.

2.2. Sewage discharge discontinuity

The permanent residents of the village go out early and return late, and work in the fields during the day. As a result, the rural sewage discharge is concentrated in the morning, noon and evening meals. In other time periods, the sewage discharge is less or no discharge, and the sewage discharge is discontinuous. The daily variation coefficient is generally 1.9~2.5[3].

2.3. High dispersion of domestic sewage discharge

Rural residential buildings do not have a unified layout, and the sinks, kitchens and toilets are randomly arranged. At the same time, residents in rural areas fail to develop good environmental sanitation habits. In daily life, kitchen wastewater and washing wastewater are discharged at will, resulting in high dispersion of sewage outlets in buildings.

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3. Problems Existing in Rural Domestic Sewage Discharge

3.1. The pipeline network is not perfect

The end of the rural sewage pipe network is insufficiently laid, and there are no construction sewage and wastewater connections around many households, resulting in a low household connection rate. The pipeline network is old and lacks maintenance and management, resulting in structural and functional defects in the pipeline, and the aging pipeline network can no longer meet the drainage needs. Wastewater from garbage stations and poultry farming sites inside the village cannot be collected, resulting in environmental pollution.

3.2. The pipe network is not buried deep enough

Because the villagers are worried that the construction of the sewage pipeline will cause damage to the foundation of their own buildings, the existing sewage pipelines are generally buried in shallow depths, resulting in the situation that the newly recruited households cannot access the existing sewage pipeline network.

3.3. Rain and sewage mix is serious

There is a lack of a complete rainwater drainage system in rural areas, and villagers discharge roof rainwater and indoor sewage into the sewage pipe network or roadside rainwater ditch. In addition, there are many cases of illegal construction by villagers, the drainage is not standardized, and the laundry waste water and washing waste water are discharged at will, regardless of rain and sewage.

3.4. Missing septic tank

Most of the new houses in the village have been equipped with septic tanks, but there are many septic tanks in the old houses, and the sewage is mainly discharged directly. In addition, the septic tanks set up in the village still have problems such as serious leakage, and the inspection manhole cover is sealed and cannot be removed.

4. Retrofit strategy

4.1. Collection side

The rural collection end mainly solves two kinds of drainage: general drainage and special drainage. General drainage mainly solves kitchen sewage, domestic washing sewage, toilet sewage and rainwater; Special drainage mainly solves special drainage households in rural areas (such as restaurants, public toilets, schools, barber shops, homestays, small workshops, etc.) and breeding points, garbage collection points, and waterlogging points in rural areas.

4.1.1. Data collection

Rural data is the premise to ensure the quality and duration of engineering design, and it can effectively help relevant personnel to understand the basic information, geographical distribution and planning direction of the village.

4.1.2. Status Quo

variety of sources, scattered sources, and is difficult to collect[4],In rural areas, the sewage facilities in buildings are not perfect, there are many scattered discharges, the rain and sewage are seriously mixed, and the connection of sewage facilities is unreasonable. Village-by-village and household-by-household field investigations are needed. Through household surveys, we can find out the connection of kitchens, washing pools, and toilets in the building, whether there is a mixed connection of rainwater and sewage or scattered sewage, and whether sewage pretreatment appliances such as septic tanks and grease traps are missing. Field investigation into the village can reveal the location and number of special drainage households, breeding points, garbage collection points and waterlogging points in the village, and have a basic understanding of the current drainage situation of the main and branch pipes in the village and the terminal treatment of sewage.

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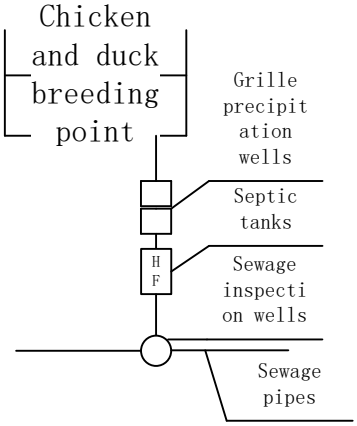
4.1.3. Pipe network investigation

The main purpose of the pipe network inspection is to check the original pipe network of the village and trace the source of the septic tanks in the village. The surveying, mapping and exploration unit shall go to the village to investigate, check the original drainage outlets, pipelines, inspection wells and pumping stations, and verify the layout of the original drainage pipe network and the elevation of control points; Find the undulating elevation of the pipeline network, wrong and missed connections, broken ends, etc., and explore the specific location and corresponding terrain elevation of the septic tank of the village. According to the investigation situation, a list of defects in the pipeline network and inspection wells will be presented.

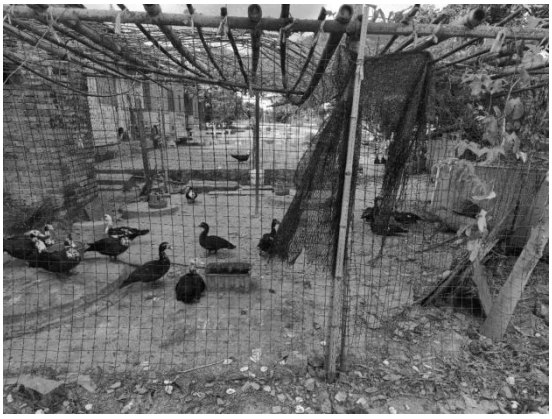
4.1.4. Renovation of breeding and garbage collection points

The aquaculture sewage produced by the villagers' small-scale farming, the garbage sewage produced by the garbage dumping in the village, and the cleaning sewage produced by the sanitation personnel cleaning the trash cans, etc., these sewage are often neglected but cause damage to the environment. In order to improve the sewage collection rate, sewage will also be collected from garbage points and breeding points during the upgrading and renovation of the sewage pipe network.

In the renovation plan of the breeding site, the ground of the breeding site is hardened, and a grid sedimentation well is set up. After interception and sedimentation, the wastewater from aquaculture is discharged into the household septic tank. Figure 1 Reconstruction scheme diagram.



a Transformation plan



b Transformation renderings

Figure 1: Breeding point transformation plan and effect drawing

Figure 2: Renderings of the garbage collection point renovation

Two stainless steel sealable and openable floor drains are set on the hardened ground of the garbage collection point, one for collecting rainwater and the other for collecting rainwater. On sunny days, the floor drain for collecting sewage is opened, and the floor drain for collecting rainwater is closed. At this

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time, the sewage discharged from the garbage point is mainly collected. When it rains, the floor drain for collecting rainwater is opened, and the floor drain for collecting sewage is closed. At this time, the main collection is the rainwater during the rainfall. The specific effect is shown in Figure 2.

4.2. Transfer terminal

4.2.1. Pipe material, pipe diameter

The household's kitchen and washing tank outlet pipes are made of UPVC pipes, and the pipe diameter is uniformly DN75; the sewage pipes from the toilet to the septic tank are DN100 UPVC sewage pipes; The diameter of the outlet pipe of the septic tank shall not be less than DN150.For households whose kitchens, sinks, and bathrooms are all connected to septic tanks, traps should be installed at each drainage point to prevent odor from returning.

When the branch line and trunk line of the drainage pipe network are reconstructed, the main drainage pipe of a household shall adopt PE pipe or HDPE winding reinforced pipe, and the pipe diameter shall not be less than DN150;The drainage pipe shared by two or more households should use PE pipe or HDPE winding reinforced pipe, and the pipe diameter should not be less than DN200.The sewage main pipe (when the pipe diameter is less than DN300) should be made of PE pipe or HDPE winding reinforced pipe, and the minimum pipe diameter should not be less than DN200.The specific pipe material and pipe diameter selection are shown in Table 1.

Table 1: Selection of pipe and pipe diameter

Retrofit Type		indoor renovation	Pipe network reconstruction
Indoor plumbing	Kitchen,sink	DN75，UPVC	-
	bathroom	DN100，UPVC	-
	Septic tank outlet pipe	DN150，PE	-
Pipe network branch	1 household separate discharge	-	DN150, PE or HDPE winding reinforcement pipe
	2 households and above shared pipe discharge	-	DN200, PE or HDPE winding reinforcement pipe
Pipe network trunk	DN＜DN300	-	PE or HDPE winding reinforcement pipe
	DN≥DN300	-	Ductile iron pipes are preferred

4.2.2. Sewage household pipe

In order to facilitate later maintenance and management and reduce disputes among villagers, each household will be set up with a household well when designing the household access pipeline.The household access well combines the sewage outlet pipes of the kitchen, toilet and washing pool into a single household sewage pipe which is connected to the sewage pipe network.The common problem for rural households is that the kitchen sink lacks filters and traps, and the kitchen waste contained in the kitchen sewage enters the pipeline and easily causes the pipeline to block.In order to prevent the pipeline from being blocked, an oil-separating and deodorizing cleaning well will be designed in the water outlet pipe of the kitchen when the rural household pipe is connected.

4.3. Processing side

There are three technical routes for rural domestic sewage treatment and treatment, namely, factory, centralized and decentralized. The acceptance of the factory is for the villages or farmers located in the towns and the surrounding areas of the park, and those who meet the conditions for acceptance will be preferentially included in the town or park sewage treatment plant for unified treatment; Concentration is for those who are far away from cities and towns and whose population is relatively concentrated, giving priority to the construction of small centralized sewage treatment facilities; Scattering means that when the population is scattered or small, a standard three-grid septic tank is constructed in combination with the renovation of household toilets, and the tail water is returned to the nearest forest and farmland through the sewage pipe network. When choosing the sewage treatment route at the treatment end, the first choice is to choose the plant, and then the choice is centralized, and the rural

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area cannot be managed and collected due to terrain and topography.

4.3.1. Urban village

A large number of migrant workers gather in urban villages[5],As a result, the resident population of urban villages is much larger than the registered population, and the discharge of sewage is large and concentrated. When calculating the amount of sewage, it is necessary to investigate the living population and the way of biochemical water use on the spot. When choosing the technical route of the treatment end, the village in the city generally gives priority to the treatment of the Nanchang, connecting the main sewage pipe in the village to the municipal sewage pipe. In view of the village in the city, the river closure system can be used to join the municipal pipeline, but effective measures should be taken to manage and prevent overflow pollution[6].

4.3.2. Ordinary natural village

Compared with urban villages, ordinary natural villages have less population and less drainage. The sewage treatment methods adopted by ordinary natural villages will also be different. First of all, we should check the village planning documents to see if there are Nanchang conditions, do not have Nanchang conditions of ordinary villages through the construction of centralized treatment station to solve, and reserve the possibility of Nanchang later. Multi-stage A/O process + constructed wetland is widely used in Xiamen rural areas. There are cases in the village where individual households are unable to access the village sewage network due to topographical reasons, sewage can be discharged or treated by setting up a small sewage pump to be lifted into the sewage pipe network or by building a three-compartment septic tank for decentralized treatment.

4.3.3. The village on the hill

The villages on the mountain are remote and scattered, the height difference of the residents in the village is large, and the construction conditions are difficult. Combined with the topography, topography and geology of the village, the sewage network should make full use of the terrain conditions, as far as possible more household sewage pipework, and at the end of the installation of centralized treatment stations to treat sewage. For households that are unable to receive pipework, sewage can be discharged or treated by setting up small sewage lift pumps to be lifted into the sewage network or by building three septic tanks for decentralized treatment.

4.4. Discharge end

The choice of the discharge end of rural domestic sewage should be determined according to the treatment mode of rural domestic sewage, the scale of sewage and the surrounding environment of rural areas. If the village sewage is treated by a holding plant, the discharge end of the rural sewage will be connected to the urban sewage pipe network, the quality of the sewage at the discharge end shall be in accordance with the national standards for sewage discharged into urban sewers GB/T31962 -2015. When a small centralized sewage treatment facility is built in the village, the sewage can be discharged to farmland, woodland, streams, lakes and so on. For decentralized treatment of villages or households, sewage can be used in three septic tanks and other ways for pre-treatment, discharge to the general woodland, farmland, etc.

4.5. Long-term mechanism

4.5.1. Strengthen publicity and guidance

It is of great significance to strengthen the propaganda of rural domestic sewage treatment so that the villagers can form the habit of building and discharging the sewage in an orderly manner.

4.5.2. Strengthening inspection

To include the treatment of rural domestic sewage in the government's annual plan for inspection and assessment, to formulate methods for the assessment of projects, to conduct assessment and inspection of rural domestic sewage upgrading and treatment projects, and to carry out assessment and inspection of projects that do not meet the requirements, supervise and urge the rectification in place.

5. Conclusion

The treatment of rural domestic sewage is very different from the treatment of urban domestic

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sewage. The water used is dispersed, the discharge is small and discontinuous, and there is no experience to be followed in the construction of the sewer, the current standard sometimes can not support the bid-raising construction of the existing sewage pipe network, so it is necessary to determine the drainage pipe material, pipe diameter and construction method according to the actual situation on the spot. Xiamen Tong'an District is a leading model city for the upgrading of rural sewage networks. In fact, the construction concept and practical experience can provide useful reference for other cities to deal with rural domestic sewage, for the construction of a beautiful countryside to provide technical support.

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