Non-point source pollution comprehensive control in Tongchuan City

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Abstract. With the development of economy and the change of life-style, non-point source pollution has become one of the key points of ecological environment regulation. In order to research how to control non-point source pollution according to the specific situation of towns, this paper selected Hongshi Town, Laohu Town and Xinxing Town of Tongchuan City in Shaanxi Province as the representative residential areas for analysis. In this paper, the present situation of non-point source pollution in the three towns were analyzed, and the regulation measures were put forward according to the specific situation of each town, such as laying sewage pipes or rain trenches, adding public toilets and garbage collection points. Through the comprehensive treatment of non-point source pollution, the ecological security of cities and towns has been guaranteed, the ecological balance of regions has been maintained, and a benign ecological security pattern is forming.

1. Introduction

The General Secretary of China Xi Jinping proposed that “Mountains, rivers, forests, and lakes are a community of life” on “Decision of the Central Committee of the Communist Party of China on several major issues concerning comprehensively deepening reform” of the 3rd Plenary Session of 18th Party Central Committee [1].

In recent years, the Department of Finance, the Land Bureau and the Department of Environmental Protection of Shaanxi Province had successively formulated relevant policies and systems for the construction and management of rehabilitation projects of mountains, rivers, forests, fields and lakes. The ecological protection and restoration project of mountains, rivers, forests, farmland and lakes in Shaanxi province follows the principle of “focusing on key points, pilot first and advancing step by step”. Two pilot areas, “one south and one north”, were selected for the restoration project. The author took Tongchuan City, a pilot city in southern Shaanxi Province, as an example to introduce the design scheme of comprehensive control of non-point source pollution.

2. Basic Situation

Tongchuan City belongs to the gully region of the loess plateau. The tableland in this area is vast and flat with deep gully and soil erosion seriously. This area was an area with superior agricultural production conditions in the loess plateau with a long history of farming. The comprehensive control measures in this area mainly include the construction of the protection system of the plateau, the
protection system of the gully slope and the protection system of the gully channel. Comprehensive control of non-point source pollution is the refinement and implementation of the construction of gully protection system.

3. Basic Information before Transformation

3.1. Rainwater and Sewage Discharge

Since the non-point source pollution area were located in the old city of the urban area, the current situation in the three towns were all old residential buildings with poor supporting facilities, as shown in the Fig. 1 below.

![Figure 1. Present situation of roads in Xinxing Town](image1)

The sewage in the three towns were discharged by the cover plate or open channel. Because sewage from some channels discharged directly into the nearby river, did not connected to the municipal pipe network, the pollution was really serious. Fig. 2 (a) showed the current situation of sewage discharge on the north side of Xinxing Town. In the middle of the road, there was a flood discharge offtake with a...
width of about 2m. Below the right side of cover plate, there was a drainage ditch which collected the
domestic sewage from residents along the road. Part of the sewage ditch cover was missing, the water
flow retarding and seriously pollution. Fig. 2 (b) showed the current situation of sewage discharge on
the south side of Xinxing Town. Due to a height difference existed between the resident and road, so
the PVC pipe adopted open installation. The PVC pipe eventually drained into the underdrain.

In the three towns, the rainwater of Xinxing Town was discharged along the flood discharge offtake,
and the rainwater of Hongshi Town and Laohu Town were discharged without organization. Rainfall
form surface runoff on pavement and eventually flow into the rainwater interception ditch at the road
intersection along the road slope. (Seen in Fig. 3 and Fig. 4)

Figure 3. Present situation of non-point source pollution in Hongshi Town

Figure 4. Present situation of non-point source pollution in Laohu Town
4. The reconstruction design of non-point source pollution

4.1. Principle
The principle of non-point source pollution should follow the general dispositions and requirements of the party central committee and the state council for ecological civilization construction. To implement the spirit of General Secretary Xi Jinping’s important speeches, we should make systematic plans, whole advancement, co-governance of “beams, tableland, slopes, ditches and rivers” and “water, soil, forests, fields and people” [2-3].

4.2. The overall measures
Design rain and sewage diversion system within the project scope, and arrange rain and sewage pipe network. The setting of garbage collection points were combined with the site and municipal garbage transfer station. The garbage collection boxes were purchased for the finished product, and the service radius was not less than 70m. Remove the toilets with poor conditions and set fixed public toilets to serve surrounding residents according to the service radius.

4.3. Rainwater and sewage drainage project pipeline design
The sewage pipeline use HDPE double-wall corrugated pipe (SN≥8). The drainage pipes were slotting construction. The pipe foundation adopted 120 reinforced concrete foundation. The specific construction methods can see page 16 for “Water supply and drainage pipeline foundation and interface in collapsible loess area” (04S531-1). The pipe adopted socket type rubber ring interface. The specific construction methods can see page 24 for “Water supply and drainage pipeline foundation and interface in collapsible loess area” (04S531-1). An expansion joint was required at the concrete foundation per 25m and the interface of the first section of pipe on both sides of the inspection well. The expansion joint is 30mm wide, and the caulk material is oil-impregnated wood wool board.

The drainage pipeline construction should be strictly in accordance with the code “Code for construction and acceptance of water supply and drainage pipeline engineering” (GB50268-2008). The installation operation may refer to the “Pipeline installation instructions” formulated by the pipeline manufacturer [4].

4.4. Rainwater and sewage drainage engineering design layout
4.4.1. Hongshi Town
(1) Sewage pipe
Since there was no sewage pipe in the current ditch, the sewage pipe was added to discharge sewage. Truly achieve distribution of rain and sewage. The total length of the designed sewage pipeline was 255m, and the pipe diameter was 300mm. A total of 2 sewage inspection wells and 8 water-dropping wells were designed in the ditch. The sewage pipeline slope was 0.01. While meeting the requirements of water flow speed, try to be as close to the road slope as possible to reduce the buried depth of pipelines and the number of water-dropping wells [5].

(2) Rainwater trench
The rainwater trench was added in Hongshi Town. The rainwater trench was on the north side of the road. The new rainwater trench was based on the current sewage blind ditch. Truly achieve distribution of rain and sewage.
4.4.2. Xinxing Town

(1) Sewage pipe

Since there was no sewage pipe in the current ditch and the flood discharge offtake was wider, a closed sewage pipes were added in the current flood discharge offtake to reduce the leakage of pollutants. The sewage pipe was located in the original sewage ditch, and the profile of the designed pipe ditch was shown in Fig. 6. The part of the flood discharge offtake where there was no sewage ditch will be rebuilt brick sewage pipes in place. The total length of the trench was 560m, and the net section size of it was 500×500mm. The total length of the new reinforced concrete sewage pipeline was 560m, and the pipe diameter was 300mm. At the same time, 16 additional φ1000 brick inspection wells were added in the trench. The bottom slope of the trench was adopted the current bottom slope of the drainage ditch, and it was not less than 0.005.
(2) Rainwater trench
As the current situation of Xinxing Town has been set up rainwater trench and flood discharge offtake, rainwater can be directly discharged, so there is no need to set up rainwater pipe.

4.4.3. Laohu Town
(1) Sewage pipe
The sewage pipe was added to discharge sewage. The total length of the designed sewage pipeline was 720m, and the pipe diameter is 300mm. The sewage pipeline slope was 0.01. While meeting the requirements of water flow speed, try to be as close to the road slope as possible to reduce the buried depth of pipelines and the number of water-dropping wells. A total of 26 sewage inspection wells and 5 water-dropping wells were designed in the ditch.

(2) Rainwater trench
The new rainwater trench was added on the west side of the road. The new rainwater trench used brick trench. The total length of the rainwater trench was 726m, and the net section size of the trench was 400×600mm. Because there were already existed drainage blind ditches in some sections of the road, it can be transformed on the basis of the original blind ditches [6]. Truly achieve distribution of rain and sewage. The layout of the pipe network was shown in Fig. 7.

Figure 7. Layout of rainwater sewage pipe network in Laohu Town

5. Conclusion
The regulation of non-point source pollution not only improved the quality of the city, beautified the urban environment, improved the living environment of human settlements, but also facilitated the living and production of residents in the region. The regulation of non-point source pollution implemented the “no leakage of sewage, no pollution of air”. It played a good role in promoting urban ecological security and maintaining regional ecological balance, and constructed a benign interactive ecological security pattern.

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