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The Analysis of Control Technology of Non-point Pollution and Endogenous Pollution of the Water Environment

Xin Zhang[1], Peng Li[2], Xigang Xing[3], Zhuoran Wang[4], Xijun Gong[5]

1.2.3. Zhongke Dingshi Environmental Engineering co. LTD
4. Yanbian University
5. North Control Water (China) Investment co. LTD
E-mail: 1035852509@qq.com

Abstract: With the development of globalization, regional integration, industrialization and urbanization, the problem of water environment treatment in China has become more complex, more serious and contradictory. In order to solve the water environment problem fundamentally, the source of pollution should be cut off from the source. Non-point pollution has become one of the main sources of pollution in the basin, so blocking and treating the non-point pollution is also a test for environmental practitioners. The paper introduces the treatment technology of the non-point source pollution and the endogenous pollution from many aspects. At the same time, the paper also expounds the condition of usage and the range of application.

1. The technology of non-point source pollution treatment

1.1. The source of non-point source pollution

The main sources of non-point source pollution include the rural non-point source pollution, the runoff pollution and the dry and wet deposition pollution. The rural non-point source pollution is made up of the aquaculture pollution, the planting pollution and the rural domestic sewage. The runoff pollution is made up of the initial rainwater in the rainwater pipe network and the initial runoff in the non-rainwater control area. It also includes the dry and wet deposition pollution which is entering into rivers directly.

1.2. The integrated control technology of the non-point source .pollution

The section introduces the integrated control technology of the aquaculture pollution, the planting pollution, the rural domestic sewage and the runoff pollution.[1]

1.2.1. The integrated control technology of the aquaculture pollution. The ultimate goal of the disposal of the aquaculture pollution is to realize the efficient use and recycling of resources and the minimization of the pollution. It is usually possible to separate solids from liquids. The separated waste water is used to generate electricity and supply heating by adopting the technique of efficient anaerobic biogas production technology. The other part is treated by the high efficiency purification process. The solid aquaculture pollution can be realized ecological utilization within the range of region. The aquaculture pollution emission is strictly controlled from the source through the above integrated management measures.

1.2.2. The integrated control technology of the planting *pollution.* In order to solve the problems of excessive fertilizer application, low level of management of water fertilizer and high nitrogen and phosphorus runoff, the measures of environmentally friendly plastic, water-saving irrigation, moderate fertilization and nitrogen and phosphorus ecological interception can be used to control the disorder of non-point source pollution emissions from the source, the erosion process and the end of the link.
Take the example of rice production, applying rice slow-release fertilizer can effectively control the nutrient release speed, extend the fertilizer effect which fully meet the needs of the whole growth period and practically match the growth line, meanwhile, which can avoid the excessive application of fertilizer and improve the utilization rate of fertilizer. Besides, some simple tools such as the rice leaf ratio color card and the field water level monitoring cylinder can be used to achieve accurate fertilization and moderate irrigation and reduce the risk of nitrogen and phosphorus loss. In the end, the ecological ditch or ecological detention pond can be constructed depending on the yield of water to intercept nitrogen and phosphorus terminally in the field of returning farmland. The current common treatment methods include centralized sewage treatment and decentralized sewage treatment.

1.2.3. The integrated control technology of the rural domestic sewage. The rural domestic sewage has the characteristics of good dispersion and difficult centralized collection processing, which has become an important river pollution source [2].
Take the example of coupling treatment technology of anaerobic + multi-medium soil. Sewage goes through the septic-tank, the anaerobic bank and the artificial reinforcement multi-media soil composed of permeable layer in turn to achieve purification. The treatment technology has advantages of high hydraulic loading, excellent performance of nitrogen and phosphorus removal, low cost, free energy and strong adaptability, which has been successfully applied.

1.2.4. The integrated control technology of the runoff pollution. The early runoff pollution is high concentration and heavy load, which has a great influence on the quality of the receiving water[3]. The main measures which are used to control the runoff pollution include rainwater storage tank, high efficiency hydraulic cyclone separation device, low impact development design (LID) and ecological buffer zone and so on.
For example, the initial rainwater can be intercepted and stored by the storage tank. And when it's sunny, the initial rainwater can be transported to the sewage plant by submersible sewage pumps for treatment
The above measures can greatly reduce the discharge of initial rainwater into the river. Efficient hydraulic cyclone separation technology is based on the principle of physical separation, which can effectively separate the particles, scum and grease from rainwater runoff.. Low impact development (LID) and ecological buffer technology which are using the principle of ecological interception greatly enhance the interception effect of non-point source pollution, thus reducing runoff and improve the quality of receiving waters.

1.3. The ecological restoration of non-point source pollution
Carrying out the ecological restoration of polluted water and biodiversity restoration work is the main study direction and important engineering measures of non-point source pollution[4]. The water quality improvement and ecological restoration of polluted rivers are important measures to ensure the sustainable development of aquatic ecosystem.
According to the implementation position difference of engineering measures, the technology of water quality improvement can be divided into three categories: in situ repair, semi-in-situ repair, and heterotopic repair. In situ restoration is to set up some artificial oxygenation measures, artificial water grass and ecological gravel bed in the natural water to increase the oxygen content of water and provide sufficient habitat for aquatic organisms. Thus it can enhance the purification effect. The semi-in-situ restoration which is aimed at the river channel with smooth both or three sides is to upgrade the polluted water to the top of the revetment, then go through the high efficient purification medium laying on the bank to purify the water. Heterotopic restoration is a process that transfer the river water to other locations on the shore and discharge treated water into the river. The common

heterotopic restoration technology includes air flotation decontamination technology, super magnetic separation decontamination technology and bypass intensified wetland technology and so on.

1.3.1. The air flotation decontamination technology. The air flotation decontamination technology is a solid-liquid separation process. The water purification is a process that the hydrophobic impurities in the water collide with the water hydrophobic micro-bubbles under certain hydraulic conditions. Then the two stick together through the VDW and float to the surface of the water and remove from the water.
The air flotation decontamination devices mainly include the container system, the release gas system, the separation system and the slag discharge system. The working principle of the air flotation decontamination devices is shown as below: The air is attached to the suspended particles in highly dispersed microbubbles. The result is that the density of the suspended particles is less than the water. Then the suspended particles float on the water surface and realize solid-liquid separation by buoyant effect. The air flotation methods include bulk air flotation, dissolved air flotation and electrolytic air flotation. Compared with other solid-liquid separation devices, the air flotation decontamination devices have the advantages of low investment, small area, high automation and convenient operation management.

1.3.2. The super magnetic separation decontamination technology. The premise of the method of using the super magnetic separation decontamination technology is that the particles in sewage have certain magnetism. For the sewage with non-magnetic or weak magnetic, combing the nonmagnetic substance with magnetic seeds which are artificial additive. And purify the sewage by the super magnetic separation decontamination technology or flocculation settlement with high gradient magnetic separation decontamination technology. The technology has the advantage of good water quality, convenient operation management and low cost.

1.3.3. The bypass intensified wetland technology. The bypass intensified wetland system is a sewage treatment technology which is simulating natural wetland to achieve sewage treatment. The system is made up of packed beds, plants, aquatic animals and microorganisms.
It is widely used due to its strong processing ability, high efficiency and convenient management. The working process of the technology is to achieve to remove impurity especially organic pollutant by filtration, adsorption, precipitation, ion exchange, plant absorption and microbial decomposition.

2. The technology of endogenous pollution treatment

Endogenous pollution mainly refers to the nutriment settle down to the bottom of the lake gradually through all kinds of physical functions, chemical functions and biological functions. One the one hand, the nitrogen, phosphorus and other nutriment accumulated on the surface of the sediment can be eaten by microorganisms, then enter the food chain and participate in the circulation of aquatic ecosystems. On the other hand, the nutriment can release from the sediment and enter into the water under certain physical and chemistry conditions to become endogenous pollution.
The control and elimination of endogenous pollution is the most direct and effective way to cut down the pollution source of black and odorous water. The following is an introduction to the three control technology of endogenous pollution such as sediment pollution, aquaculture pollution and shipping pollution.

2.1. The technology of sediment pollution treatment

The study says, the amount of pollutant released by sediment is equivalent to that of external source. In addition, the algae blooms due to the large amount of nutriment in the urban river. These algae supply oxygen to the water in the early stage of growth, then resolve and mineralize to COD and NH_3-N after death, and it causes the phenomenon of the black and odorous water and produces an extremely strong odor.
The treatment techniques of sediment pollution include engineering treatment, chemical treatment, bio-ecological restoration treatment and resource utilization. The techniques of engineering treatment

include environmental dredging, mechanical dredging and solidification and stabilization. The techniques of chemical treatment include improver and inhibitor. The techniques of bio-ecological restoration treatment include plant restoration, microbial restoration and animal restoration. The resource utilization refers to land utilization, producing construction material and fill material.

2.1.1. The technology of engineering treatment

1. The environmental dredging
The environmental dredging is a method of removing endogenous pollution by combining with ecological restoration. It is achieved through environmental reamer. Dredger ships with high positioning accuracy and mining precision require that different sites have different depths and that the sediment pollution should be removed in a controlled way.
The environmental dredging machine should have the following characteristics: 1. Dredger should be with high accuracy and mining precision and avoid leakage and over excavation, and not harm the original soil. 2. Prevent disturbance and diffusion and don't cause the secondary pollution during digging. 3. Reduce the amount of water treatment by high concentration inhalation and as low as possible overflow.

2. The mechanical dredging
The mechanical dredging includes dredging rivers and lakes, dredging inland waterway and excavating lakes, channels and seaside. Its work includes dredging and filling. The filling is to carry mud to the operation surface with press pipeline to achieve the effect of dredging and strengthening.
The dredging ship is divided into mechanical, hydraulic and pneumatic three categories according to the work principle and delivery way. The main types includes grab dredger, dipper dredger, wheel dredger, pump-suction dredger, jet dredger and drag-suction dredger, in which cutter-suction dredger is the most widely used.

3. The solidification and stabilization
Dredging sediment is a kind of engineering waste soil which is high water content, small particles, high organic content, in the flow state and little intensity, and which can't be used for the project directly. The solidification and stabilization treatment is an effective resource utilization way which can turn the large amount of sediment into good engineering soil [5].. The core of the treatment is the selection and deployment of sludge stabilizer and modifier, and to realize the fast and efficient mixing reaction of sludge and modified agent. The water in the sludge is in the form of interstitial water and cellular water. The interstitial water is easy to be mixed with the modified agent. The cellular water reacts with agent after complete broken cells and micelles. The solidification and stabilization has the advantages of short period, fast effect, easy operation and low cost [6]..

2.1.2. The technology of chemical treatment
The method of chemical treatment mainly refers to add water and sediment quality modifier which is with physical or chemical activity to improve water quality and reduce the amount of harmful substances. The water and sediment quality modifier includes physical modifier, chemical modifier and micro-ecological agent.
Physical water quality modifiers generally have large specific surface area and many gaps. Poisonous and harmful substances are adsorbed to the sponge pore, so that ammonia, hydrogen sulfide and nitrite are reduced. In aquatic production, frequently used ones are zeolite powder, medical stone, activated carbon, alum and so on.
Chemical active water quality modifier are classified into oxidants, ion exchangers, heavy metal ions complexing agents, flocculants and so on. The principle of action is to oxidize ions in water, to exchange ions in water, and to degrade into compounds without secondary pollution. They are often specific and selective for other water quality substrates used in coordination.
At present, microbial ecological modifiers are the most important types of water quality modifiers [7]. They are able to break down organic ammonia in the water, such as excess organic matter, excreta,

feed, into harmless nitrogen compounds and nitrogen oxides. They can reduce the concentration of ammonia and nitrite, and promote the metabolism of anaerobic bacteria in the subsoil, such as sulfur bacteria, nitrifying bacteria and reducing bacteria. They can reduce toxic gases at the bottom of the pond, purify water and sediment, and restore microbial ecology of the aquaculture water. Commonly used microbial agents are EM bacteria, photosynthetic bacteria, Bacillus subtilis, nitrifying bacteria, denitrifying bacteria, yeast, Lactobacillus and other bacteria or mixtures[8].

2.1.3. The technology bio-ecological restoration treatment

The technology bio-ecological restoration treatment refers to reduce the concentration of poisonous and harmful substances in the environment or make it completely harmless by using the biological metabolism, so that the polluted environment can partially or fully recovered to the original state.

1. The plant restoration technology

The plant restoration technology is a kind of treatment method which is widely used in the field of environmental pollution. It reduces or eliminate the toxicity of pollutants by using the absorption, metabolism and elimination of the microorganisms of plant roots. There are three mechanisms of the plant restoration. The first is that plants absorb organic pollutants directly. The second is that the secretions and the enzyme released by plant roots resolve organic pollutants. The third is the combination of plants and root microorganisms.

A research by Anderson etc. [9] shows that plants can stimulate microorganisms to transform organic pollutants in many different ways, in which rhizosphere microorganisms play an important role. Because of plant roots, activity and quantity of microorganisms increased in soil. Microbial number and activity increased by 5~10 times in soil with plant roots some as high as 100 times, which will accelerate the degradation of many organic pesticides, trichloroethylene, petroleum hydrocarbon, methyl sulfur substances and some pesticides. Jordahl etc. [10] found that in the soil with Populus diltoides roots, the number of heterotrophic organisms, BTEX degrading microorganisms and herbicide Atrazine is higher than that without roots. Katayama etc. [11] also studied the degradation of various organic compounds such as pentachlorophenol, DDT with the fungi in the rhizosphere. They confirmed that fungi in the rhizosphere can play an important role in the degradation of organic pollutants probably because of microorganism activity is stimulated by secretions of roots.

Ma Weifang etc.[12] did an greenhouse experiment of , the specific surface area of the sediment was reduced by adding a certain amount of EDTA, citric acid and DTPA, during the Ryegrass remediation of heavy metals (Zn, Pb, Cu, Cd, Ni) - organic compound pollution of urban sewage river. It is beneficial for the release of heavy metals by sediment particles to add these, and also increases the number of microorganisms in rhizosphere and accelerates phytoremediation.

2. The microbial restoration technology

The microbial restoration technology is a kind of method that the organic pollutants are degraded into CO_2, H_2 and other harmless substances by oxygenation, reduction and hydrolysis of natural or domesticated microorganisms. The microorganisms can be made by artificial domestication, immobilized and GMO project.

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When Feng Qixiu etc. [13] are dealing with Chaoyang River in Guangzhou, without complete interception, they diluted and mixed 250kg culture solution of indigenous microorganisms (1 * 106pic/mL) and BE bio-stimulants 37.4L by the American company general with sewage dilution . Then the mixture was injected to the sediments through targeted delivery technique, in order to promote the oxidation. This process lasted for 5 days. Then 12.5L biological oxidation mixture every day was sprayed with the same method for 30 days. Then halve the dose and continually injected for 25 days. It is observed that dissolved oxygen content in water gradually increased both the upstream

and downstream, and removal rates of COD, ammonia nitrogen and total phosphorus are also improved. Organic pollutants of aerobic microorganism system had been strengthened, and the purification ability of the overlying water significantly increased.

Duque etc. [14] transferred Pseudomonas patina plasmid with toluene degradation properties to Pseudomonas sp. Clong A, so it can oxidase TNT and use it as a nitrogen source for growth. It can acquire binding energy, degrade toluene and TNT, and cause TNT fully mineralized. Yan Yanchun etc. [15] cloned the esterase gene of Culex pipes pollens and expressed it in E. coli. The engineered bacteria were immobilized to degrade organophosphorus pesticides. The results showed that the bacteria degrading efficiency of pesticide was high in a short period.

Schippers etc. [16] studied the promotion of biological surfactant Sophorolipids on microbial degradation of phenanthrene. Two kinds of culture medium were used, including liquid medium and 10% soil suspension. The study showed that the highest degradation rate of phenanthrene increased significantly with the two additions of bio surfactants. Also, the concentration of residual phenanthrene decreased significantly. Further studies showed that this promotion is not because of the number of microorganisms increased, but the solubilization of phenanthrene by biological surfactants, which results in enhanced bioavailability of phenanthrene.

Wang Xin etc. [17] degraded phenanthrene and pyrene in soil pollutants with immobilization technique of Lactobacillus. The results showed that the immobilized microorganism had an absolute advantage in degradation of pollutants, since its effect is much better than autochthonous.

2.1.4. The resource utilization

The principles of the resource utilization of dredging sediment are harmlessness, reliability and stability. Choose the resource utilization method suit locally according to the sources, the composition characteristics of the dredging sediment and the local economic and technological conditions.

1. The fill materials

Make the dredging sediment suitable for the engineering requirement after improving the quality by pretreatment. Then backfill the treated sediment as fill materials. The methods of pretreatment include physical methods, chemical methods and heat treatments. The solidified soil has the advantages of no consolidation settlement, high strength and good permeability compared with general soil.

2. The land utilization

The land utilization is to apply dredging sediment to the restoration and reconstruction of the land which are farmland, woodland, grassland, wetland, municipal greening, seeding matrix and seriously disturbed land.

3. The producing construction

The dredging sediment can be used to make building materials, concrete lightweight aggregate and silicate gel materials. The building materials include ceramicite , bricks and tiles.

2.2. The technology of aquaculture pollution treatment

The technology of aquaculture pollution treatment includes: (1) Carry out the cleaning work and remove the net breeding gradually; (2) Implement the demonstration project of pond recirculating aquaculture; (3) Ensure the fishery environment and administer according to law.

2.3. The technology of shipping pollution treatment

The technology of shipping pollution treatment includes: (1) Strengthen anti-pollution legislation; (2) Reconstruction the suspended screw river boats and accelerate the standardization project of ship type; (3) Carry out the construction of stations which place the water waste and oil wastewater.

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