8-23-2020

Research on "Zero Discharge" technical route of international ship pollutants

Zilin Zhen

WORLD MARITIME UNIVERSITY

Dalian, China

RESEARCH ON "ZERO DISCHARGE" TECHNICAL ROUTE OF INTERNATIONAL SHIP POLLUTANTS

By

ZHEN ZILIN

The People's Republic of China

A dissertation submitted to the World Maritime University in partial Fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE
In

MARITIME SAFETY AND ENVIRONENT MANAGEMENT

2020

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

Signature: ……..

Date: ……..

Supervised by: ……..

Supervisor's affiliation: ……..

ACKNOWLEDGEMENT

As one of the fruits of my study in MSEM during the year 2019-2020, this work's inspiration and knowledge base come from the lecture and assignment from all Professors. So, I would like to thank them who enlightened me and aroused my interest in environment management.

I would also like to express my sincere gratitude for MSEM and the project team, Professor Cheng Dong, providing a reasonable and high-standard study system, strict management system and efficient logistics system, benefit from which I constructed a knowledge system and useful way of thinking. Those two constitute the basis of this paper.

I also appreciate the classmates, the fruitful discussions we had over many subjects, and the most beautiful time we have shard together.

To my family and friends, thank you for your patience and support. Especially my parents, if without whom I cannot be engaged in study with few distractions.

ABSTRACT

Title of Dissertation: **Research on "Zero Discharge" Technical Route of International Ship Pollutants**

Degree: **Master of Science**

With the continuous acceleration of international economic development and construction, the trend of ship enlargement and specialization is obvious, the ship capacity is greatly increased, and the ship operating density has increased several times, but the problem of receiving and handling ship pollutants has not been effectively solved at present.

Based on the advanced experience of ship pollution prevention and control at home and abroad, this paper tries to study the source of ship pollution control by taking Guangdong Province as an example, combining with the existing GPS monitoring platform, establishing on-line real-time monitoring system of sewage from ships, and effectively monitoring the production of sewage from ships. Finally, according to the reality of Guangdong, the fixed receiving and receiving facilities of ship pollutants are reasonably arranged to ensure that the receiving capacity of shore facilities is greater than the amount of ship pollutants produced, so as to explore and solve the problem of ship pollutant prevention and control in Guangdong coastal watershed. Therefore, an on-line real-time monitoring system for sewage production is designed in this paper. The operation of the system controls the direct discharge of ship pollutants from the source. Reasonable layout of fixed receiving devices and mobile receiving devices for ship pollutants to ensure that the receiving capacity is greater than the amount of ship pollutants produced, and to ensure the timely and effective discharge of ship pollutants. And through taking measures in legislation, funds, institutional mechanisms and scientific and technological innovation, we should strengthen industry supervision and ensure the smooth implementation of "zero discharge" of ship pollutants, thus further promote the establishment of the overall route of zero discharge of ship pollutants.

KEYWORDS: ship pollutants; zero discharge; route

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1 INTRODUCTION

1.1 Research background and significance

China's territorial sea is rich in resources and constitutes a good part of the international shipping network. In recent years, with the deepening of China's reform, opening-up and the rapid development of economy and society, various emerging marine tourism and entertainment industries have also risen rapidly, and the demand for sewage discharge from ships is also increasing. For the actual existence of ship owners one-sided pursuit of economic interests, weak supervision departments, the public awareness of environmental protection is not strong, and other reasons, some ships do not discharge pollutants in accordance with the regulations, discharges greatly exceed the water environment load and brings huge environmental impact to the environment of rivers and lakes (Eide M S, et al.2007).

Garbage water discharge causes serious pollution to a large amount of water bodies, which leads to the deterioration of the water environment, irreparable damage to the aquatic ecosystem. The coastal water network of Guangdong Province is developed, shipping is developing rapidly, import and export trade is frequent, and it is in close contact with international shipping. However, limited by the technical level, the problem of ship pollution still restricts the development level of environmental protection in Guangdong Province, which has a great impact on the production and life of the people.

Therefore, it is a new subject that we face to speed up the research and development of environmental protection, energy-saving ship type, guide enterprises to environmental protection, low-carbon production, strengthen the prevention and control of ship pollution, effectively enhance the awareness of environmental protection of all staff, and really solve the problem of ship pollution.

1.2 Research status and development trend at home and abroad

1.2.1 Foreign Studies

In recent years, some scholars have used geographic information systems (GIS) and ship automatic identification systems (AIS) to reduce the risk of fuel leakage, and have achieved fruitful results. Some other scholars mainly conducted research on the pollution of ship's main engine emissions: NOx, SOx, CO, HC, particles, etc. measured NOx and particulate emissions from inland ships and cruise ships at several outlets along the river. Studies have shown that the emissions of passing ships have a certain impact on the air quality along the river (Stevens L. Assessing the changing risk of oil spills and oil movements.n.d). .established a mathematical model and impact factors for pollutant discharge to study the pollution of ships in a canal in China, and pointed out that the load of the host has an important impact on pollution, and strict emission policies are needed to control the discharge status of inland river ships in China. Ellen Karoline Norlund and others introduced several ship speed optimization strategies to reduce the ship's emissions and fuel consumption by 25%. Laurie Goldsworthy et al. calculated the emissions of ship engines distributed in a 300km area of Australia through the established model. The results show that the emissions of ships account for a significant proportion of air pollution. Jingzheng Ren established a fuzzy multi-criteria decision-making model for research on the selection of emission reduction technologies for ships with many uncertainties and incomplete information, and achieved good results. Taking the port of Las Palmas as an example, Miluse Tichavska established a model of related parameters for ship emissions and external costs and ecological efficiency. This model can evaluate pollutant emission reduction equipment (Schwehr K D,&Mcgillivary P A,2017).

In summary, most of the above research focuses on the impact of ship’s main engine emissions on air pollution, as well as the control of fuel consumption and economic costs, and the ship’s domestic sewage, oil sewage and solid garbage, etc. There are few studies on the impact of the issue, and this issue is also very important for coastal

watersheds. Therefore, this paper will carry out research on the "zero discharge" technical route of ship pollutants.

1.2.2 Domestic research

Qu Baoxia studied the control of ship pollution from several dimensions: (1) Laws and regulations. At present, China's regulatory authorities do not have sufficient systems and regulations to support it, especially those related to ship anti-pollution, which makes it difficult to manage and enforce the law. (2) Anti-fouling equipment. At present, most ships in China lack supporting anti-pollution equipment, and the incomplete establishment of pollutant receiving systems on the banks of the river makes life and oil pollution increasingly serious. (3) Construction of anti-pollution teams.

Deng Jian, Cui Zhenwei, Yang Xianchao, Chen Lijia, and Chen Yaojie thought from the perspective of real-time monitoring, and developed an online monitoring pollutant discharge system based on the AIS terminal loaded on the ship. The main function of the system is to collect and discharge ship pollutant data at any time. Report to the supervisory authority (Zee S C V D, et al.2016) .

Luo Guishan, Shao Xiaohua and Chen Qing gave a detailed description of the current status of ship pollutant treatment technology, including domestic sewage treatment technology, bilge oil sewage treatment technology, solid garbage treatment technology. It also discusses the future development trends of these treatment technologies, organically combining new technologies such as green environmental protection, recycling, and integrated management (Fu M,et al.2013).

Xie Qiong started with the treatment of pollutants produced by ships, focusing on the ship pollutants onshore receiving treatment mode, and in this treatment mode exposed the status quo of the problems that hinder the operation of the shore receiving treatment system. In the end, we should comprehensively address the shortcomings of this model and propose scientific and effective improvement measures on this basis.

From a unique perspective, Zhang Zhifeng defined ship pollutants from the perspective of economics. He proposed that ship pollutants be managed from the aspects of ship pollutant management system and ship quality, and finally focused on finding countermeasures for ship pollutants from the system (Norlund E K, &Gribkovskaia I.2016).

Liu Yuanfang put forward the necessity of receiving and handling pollutants from the ship pollutant receiving unit of the port in the jurisdiction area, and the necessity of receiving and monitoring the pollutants received from the port, and based on the "Law of the People's Republic of China on Environmental Protection" and relevant laws and regulations as the standard basis , measures should be taken to strengthen supervision by the regulatory authorities(Goldsrorthy L,& Goldsrorthy B,2015).Modelling of ship engine exhaust emissions in ports and extensive coastal waters based on terrestrial AIS data—An Australian case study[M]. Elsevier Science Publishers B. V).

Sun Jianwei and Qiu Chunxia aimed at exploring whether the online monitoring of pollution source systems is suitable for China's regulatory situation, and conducted research from three aspects, including China's current pollutant receiving and processing status, relevant management regulations, and online monitoring of pollution source systems. Finally, the conclusion is made in the promotion and application of the supervision system (Ren J,&Luzon N,2015).

In order to strengthen the supervision of marine pollution by the maritime management department, Li Fang analyzed the main ways for ships to produce oil pollution, clarified the problems in preventing oil pollution from ships, and proposed countermeasures to prevent oil pollution from inland river ships. Regulatory and law enforcement departments provide a reliable response to ship oil pollution.

Starting from actual cases, Chen Junmian listed specific accidents caused by ship pollution, analyzed these accidents and related cases, and finally concluded that in order to prevent ship pollution accidents, the anti-pollution management countermeasures that should be taken are related to maritime law enforcement.

Departmental law enforcement provides technical support for effective management countermeasures (Tichavska M,&Tovar B,2015).

Liang Xianxian discovered the following problems during his visit to ports, shipping companies, and ships: First, facilities and services are inconvenient; Second, the ideology of pollution prevention is weak; Third, laws on pollution prevention and control are incomplete. It is difficult for the regulatory authorities to obtain evidence. These three major problems have caused breakthrough progress could not be made in the anti-pollution work. In order to solve these problems, his thinking is to take the right measures: First of all, to ensure the convenience of facilities and services. Secondly, to continuously strengthen the environmental awareness of personnel. Thirdly, to give full play to the management deterrent of the regulatory department, and finally to do a good job on the improvement of laws and regulations on emission and other aspects (Qu Baoxia, 2012).

Chai Qinfang explored the differences between the MARPOL 73/78 Convention and the anti-pollution management of inland river vessels in China by comparing the gaps in anti-pollution management between China and developed countries, and analyzed and prospected the future trend of China’s inland river pollution control (Zhang Zhongying,& Liu Lijun,2009).

Luo Yiqin and Sheng Ruping analyzed the existing laws and regulations from the perspective of ship safety management, and found that China's regulatory authorities have ignored the anti-pollution management of ships and attached importance to the management of ship navigation safety. On this basis, the countermeasures for the anti-fouling work of inland ships are derived (Deng jian,et al,2014).

Through the above analysis of the current research status at home and abroad, the important means to mitigate the impact of ship pollutants on the environment is the "zero discharge" of ship pollutants. Through unified pollutant reception and offshore disposal, "Zero emissions" can fundamentally solve the problem of water pollution. At the same time, the implementation of "zero emissions" requires various measures

such as legislation, institutional mechanisms, capital, and technological innovation. Only when these safeguards are effectively implemented can the "zero emissions" technical route be successfully achieved.

1.2.3 Analysis of scientific and technical problems

(1) The technical route of collection and treatment of marine pollutants is not clear

According to Article 54 of the Law of the People's Republic of China on Prevention and Control of Water Pollution," ports, wharves, loading and unloading stations and ship repair plants shall have adequate reception facilities for pollutants and garbage from ships. Units engaged in the receiving of pollutants or garbage from ships or in the cleaning of ship holds carrying oil or polluting dangerous goods shall have the receiving and handling capacity appropriate to the scale of their operations." At the same time, the Ministry of Communications and Transport," Regulations of the People's Republic of China on Environmental Management for the Prevention and Control of Ship Pollution in Inland Waters "also stipulate:" Ports and loading and unloading stations shall have the capacity to receive or dispose of pollutants appropriate to their handling and handling capacity, so as to meet the needs of ships arriving at the port. The port or loading and unloading station shall file with the maritime administrative agency the situation of receiving or handling capacity." From the actual situation of Guangdong Province, considering the huge economic cost investment, high professional requirements for pollutant disposal, and the dispersion of wharf points, the practice of each port and wharf equipped with ship pollutant receiving facilities is basically unrealistic(Luo Guishan, et al,2012). Moreover, even if each port terminal has set up the corresponding ship pollutant receiving facilities, problems like how to transfer the collected pollutants in the later stage and how to carry out harmless treatment, the transshipment collection of the land part still exsit.

Therefore, according to the action plan of the Ministry of Transport, the specific targets and management requirements have been clarified, but the specific way of receiving ship pollutants is still not clear, and the technical and technological routes in

the specific receiving process have not been unified. Whether the collection facilities of pollutants are built by the ports and terminals, or according to the unified receiving mode, the specific implementation ideas are handed over to the local governments at the national level, thus laying an inevitable disaster for the situation of different standards for receiving and handling ship pollutants in various places.

(2)There is a lack of effective supervision on the amount of pollutants produced by ships, and the phenomenon of stealing and discharging directly occurs from time to time

At present, the amount of oil pollution water, sewage and ship garbage produced by each ship is different. Due to the lack of effective means of industry supervision, the phenomenon of ship stealing and discharging directly occurs from time to time. In accordance with the Technical Rules for Statutory Inspection of Ships, most ships have installed oil-water separation facilities or tanks (cabinets) in accordance with the requirements of the Code, and treated the oil water on board as required. However, from the field investigation, it is found that the utilization rate of oil-water separator in a large number of ships is not high, because of the high maintenance cost of the equipment, the idle situation of the equipment is more serious, and the phenomenon of stealing and discharging ships during the night or in remote waters occurs from time to time. At present, a large proportion of ships (except those with more than 400 total tons of new ships or those with more than 15 passengers) do not have sewage treatment facilities, and there is direct discharge of sewage from such ships (Bao Guoling ,&Liu Jianhai,2011). At the same time, because the sewage treatment plant is mainly operated by biochemical action, it needs to be continuously turned on, and once the external cause is interrupted, the strain culture needs to be purchased again. In view of the cost factors and convenient and quick reasons, a number of ships choose to discharge sewage directly into the water body, coupled with the difficulty of on-site supervision, a large number of similar stealing and discharging behavior is common.

Because the onshore receiving and disposal system of ship garbage is not perfect,

considering the cost factor, the operation mechanism of ship garbage is charge receiving, that is, the ship needs to pay the corresponding amount of fee to deliver the garbage disposal, which leads to the low enthusiasm of the ship to deliver the garbage, and some ships have the behavior of evading payment to steal garbage on the shore or in the water body.

(3)The system of laws and regulations on preventing pollution from ships is not perfect

Although the international community is increasingly alert to the pollution and damage caused by international shipping vessels to waters, and relevant local and departmental regulations have also been introduced to prevent ship pollution, there are still a large number of problems and difficulties that can’t be solved in the actual operation process, especially in the construction of ship pollutant collection system, the lack of unified watershed planning and coordination mechanism, resulting in the effective reception and handling of ship pollutants encountered bottlenecks, frequent ship pollution chaos(Xie Qiu,2011).

(4)Public awareness of environmental protection is weak

Under the influence of the traditional production and living habits, the shipping enterprises are driven by economic interests, which leads to a very weak awareness of environmental protection among the crew and the management of the enterprises, and does not understand the harmfulness of the ship's pollutants. Even if the equipment is in use, for lack of responsibility, the daily maintenance of anti-fouling equipment is neglected to manage and maintain, resulting in the situation that even after the treatment of anti-fouling equipment, the actual situation is still. Some ship inspection and other management departments do not carry out their duties in place, pay attention to safety and ignore the responsibility of environmental protection, causing violations of the law.

CHAPTER 2 MAIN COMPOSITION TYPES AND CONTROL STATUS OF

INTERNATIONAL SHIP POLLUTANTS

2.1 Main composition types of international ship pollutants

In recent years, with the rapid development of the waterway transportation industry, the demand for all kinds of transport ships has greatly increased. Although a large number of standardized ships have been built in recent years, and a large number of old and non-standard ships have been dismantled and eliminated, due to a series of factors, such as the one-sided pursuit of immediate interests by shipowners, the demand for dismantling subsidies is high or not covered (such as engineering ships), there are still a large number of small tonnage, small loading capacity, aging, non-standard ship type, large energy consumption and serious pollution, and the design standards and construction technology of these ships in environmental protection cannot meet the requirements of new ships, and the pollutants produced by these ships have a great impact on the environment, The main performance has 3 categories: first, ship oil water; second, sewage from ships; third, ship garbage(Zhang Zhifeng,2005).

2.1.1 Ship oil water

Ship oil water is mainly bilge oil water. Engine room oily bilge sewage is from the engine room-during the operation of the main engine, auxiliary machinery, pipes, equipment leakage of lubricating oil, fuel oil, sea water or fresh water mixed together to form oil water. These oil water have the following effects on the water environment: first, the chemical toxicity of oil products will cause aquatic biological decay; second, oil cover causes aquatic biological asphyxiation and death; third, the oil-contaminated aquatic products flowing into the market have great harm to human health; and fourth, sewage completely destroy the environment of aquatic life. Usually, the discharge of oil and sewage from the engine room of a ship is about 10% of the gross tonnage every year (Liu Yuanfang,2008).

2.1.2 Sewage from ships

Sewage refers to the discharge of any form of urinal and toilet, garbage; the bath basin, sink and drain hole discharge from the infirmary (ward, pharmacy, etc.); the discharge from the premises containing living animals; or other garbage water mixed with the discharge of the above definition.

The untreated sewage of ships mainly contains the following harmful substances: first, a large number of bacteria, parasites, and even viruses that can infect aquatic organisms and people; second, organic and suspended components dissolved in water that can make oxygen in water highly biochemically needed; third, solid particles (organic or inorganic) that need oxygen to be consumed in their own biochemical decay, deposited on the sea floor (or river bottom); and fourth, plankton particles (organic or inorganic) floating on the surface of the sea water that have a serious impact on the beach, present in a single small fragment or suspension; The fifth is to saturate seawater that absorbs certain substances, mainly phosphides and nitrides, and may cause eutrophication and high concentrations of nutrients(Sun Jianwei,&Qiu Chunxia,2014). If sewage from ships is not controlled and discharged, it will not only damage the water itself, but also have a serious impact on the whole ecological environment and human health.

2.1.3 Ship garbage

Ship garbage refers to the garbage (excluding fresh fish and its parts) produced during the normal operation of the ship and requiring continuous or regular disposal of all kinds of food, daily necessities and work supplies. Ship garbage can be divided into two categories according to its source: domestic garbage and production garbage. Among them, domestic garbage mainly comes from the daily domestic garbage and various kinds of garbage of crew and passengers. It is mainly divided into three categories: first, kitchen garbage, such as food residue, bones, canned bottles and food plastic bags, mostly solid garbage; second, cabin garbage, packaging bags, boxes, garbage paper, rags, etc., also mostly solid garbage; third, sludge from sludge water, toilets, kitchens, bathrooms, laundry rooms, etc., with large water content and mostly

liquid garbage. There are two major categories of garbage produced by ship production: one is the garbage produced by the normal operation of the ship, such as oil sludge, garbage filter core, rubber, metal and other ship maintenance, garbage generated by heavy rain; the other is the garbage generated by cleaning cargo tanks, such as cushion materials, lining materials and other cargo residues and packaging residues.

Much of the garbage generated by the daily operation of ships, such as rotten food residues, paper products, plastic products, glass products, etc., will not decompose, float or sink under water, or decompose incompletely to produce pollution, or decompose oxygen consumption, which will affect water quality, environment, fishing industry and tourism, and even affect the navigation of waterways in port areas, which may hinder navigation. The deterioration and bad smell of garbage can affect the use value of water, some garbage contains toxicity, and the harm to water is greater.

2.2 Current situation and analysis of international ship pollution control

2.2.1 EU countries' handling of international ship pollution

European countries have a sound and mature ship anti-pollution legal system, scientific and effective discharge-receiving-processing industry chain, efficient and advanced inland river ship anti-pollution emergency system and adequate and reasonable sources of funding guarantee. At the same time, European countries, subject to the norms of European Union regulations, have also fully considered the formulation of their own environmental and ship pollution control supervision and management measures in accordance with international regulations, so that European countries' legal standards for pollution prevention and control not only fully reflect their own regional characteristics, but also agree with international practice, the specific characteristics are as follows:

(1) The legal system of ship pollution prevention is sound and mature

From the international point of view, the European Union through the formulation of "ship pollution management regulations" to clarify the common responsibilities and obligations of European countries(Li Fang,2016).In Europe, several important international navigable rivers have multilateral treaties on pollution prevention, and European countries have fully integrated the framework and standards of the treaties into their own regulatory provisions in the light of their actual situation; from the domestic perspective, European countries have a complete legal system for environmental protection, and on the basis of strict compliance with environmental laws, they have formulated laws and regulations on pollution prevention of ships, which fully guarantee the integration, unity and continuity of the laws and regulations, and ensure that the laws and regulations on pollution prevention of ships do not conflict with environmental laws; from the point of view of management standards, European countries' standards on pollution prevention and management of ships show the characteristics of high standards. On this basis, the European countries have achieved the treatment of pollutants "no details, classified symptomatic treatment ": sewage must be treated on board with equipment to meet the standards of discharge: ship garbage is prohibited to be discharged into water, received by shore or received by ships; residual oil and oil water discharge standards or received on shore.

(2) The discharge-receiving-processing industry chain is scientific and effective

European countries attach great importance to the construction of ship pollutant discharge system, the shore receiving system is sound, the ship pollution discharge and shore receiving point layout is reasonable, and the discharge-receiving-processing industry chain is scientific and complete. Some European countries adopt the government input construction to the ship shore receiving system, the bidding private company manages, the ship pollution discharge receives the free practice, conforms to the environmental protection industry operation rule. For example, Germany and France have set up 13 receiving stations in the Mein-Donau Canal in 400 km, and are equipped with corresponding pollutant receiving and treatment equipment, and the receipt of ship pollutants is handed over to private pollutant receiving and treatment

enterprises by way of bidding (Li Shu,et al,2012).

(3) An efficient and advanced anti-pollution emergency system for inland river ships Firstly, the emergency division of responsibilities is clear, the government is responsible, water conservancy and environmental protection management, port ship management and inland river maritime supervision and management departments division of labor and coordination, each of their responsibilities. There are clear information channels for handling and disposal after pollution accidents, the responsibilities of each unit are clear, the division of labor is clear, after the accident through professional command and technical force specific analysis of the situation on the spot, adopt different disposal methods, in order to achieve the purpose of emergency. At the same time, it also has the emergency force and guarantee of professional modernization. The construction of ship anti-pollution emergency force in European countries is a combination of national input and social input, and the emergency team is a full-time and part-time combination. Except for petrochemical enterprises with a certain amount of emergency equipment, all European countries have established emergency equipment depots, equipped with emergency ships, hoists, linoleum, oil collectors and so on, and are reasonably distributed on the route(Chen Junmian,2011). For example, on the Seine River in France, professional emergency handling boats, seashore rails, oil collectors and other equipment have been set up, in the more dense reaches of the ship equipped with a larger decontamination ship, in the ordinary reach equipped with a small oil collector, oil felt and so on: the German emergency equipment is mainly through the equipment reserves of professional decontamination companies.Through the establishment of a good contact system with professional decontamination companies, once pollution accidents occur, the government can ensure the timely disposal of decontamination equipment in place

(4) Adequate and reasonable funding. European countries have identified reasonable sources of funding for anti-fouling of ships to ensure adequate funding

European countries, through the imposition of a ship fuel tax, set aside part of the cost of handling pollutants produced by ships, and ships do not have to pay any fees

for discharging garbage. The model of "compulsory payment of tax in advance and free enjoyment afterwards" provides scientific guarantee for the source of pollution prevention funds for ships; in the aspect of emergency cost guarantee, European countries implement the principles of "who caused the accident, who is responsible" and "compulsory insurance ", for example, in the event of a pollution accident in Germany and France, the ship must bear all the losses caused by the accident, and the source of the expenses is from two sources: the owner of the ship or the insurance company. The compulsory insurance system of ship pollution accident compensation is implemented in Germany and France, which can guarantee the decontamination and compensation expenses, in order to ensure the smooth development of emergency decontamination and disposal.

(5) Sound supervision system

The maritime department shall be responsible for the daily pollution of ships and the safety supervision of dangerous goods transportation. Water sectors in Europe set up hydrological monitoring network in several major rivers. All countries have established water pollution information network, ship pollution information is also in it.

2.2.2 Anti-pollution of international ships near domestic rivers and territorial seas

2.2.2.1 Legislation on pollution prevention and control of ships

In January 1974, China promulgated the "Interim Provisions on the Prevention of Pollution from Coastal Waters ", which pioneered the legislation on the protection of water transport environment.

In August 1982, China promulgated the Law on the Protection of the Marine Environment, the first comprehensive basic law for the protection of the sea. The introduction of this law indicates that the prevention and control of ship water pollution in China has embarked on the process of legalization.

In December 1982, the Ministry of Communications promulgated the Regulations of

the Ministry of Communications on Environmental Monitoring and its implementing rules, which define and standardize the monitoring of the environment, pollution sources and pollution accidents.

In April 1983, China promulgated the national standard "Ship pollutant discharge standard ", which makes ship's pollutant discharge standard consistent with the relevant provisions of the International MARPOL Convention.

In December 1983, China promulgated the Regulations on the Prevention of Marine Pollution by Ships, further clarifying the relevant provisions on the prevention of marine pollution caused by ships, the handling of operational or accidental ship pollution.

In 1986, the Ship Inspection Bureau of the Ministry of Communications promulgated the "Ship Structure and Equipment Pollution Prevention Code" for sea and inland river vessels, which defined the setting of ship structure and the standardization of pollution prevention equipment.

In June 1990, the Ministry of Communications promulgated the Measures on Environmental Protection Management of Traffic Construction Projects, and promulgated the Code for Design of Port Environmental Protection and the Code for Management of Port Environmental Protection.

In 1993, the Ministry of Communications promulgated the Regulations on Environmental Protection Management in the Traffic Industry, which clearly defined the institutional responsibilities of environmental protection management in the transportation system.

In September 1997, the Ministry of Communications promulgated the Regulations on Administrative Penalties for Water Safety Supervision, which set out specific penalties for violations of 31 acts such as the prevention of pollution from ships.

In March 2000, the State Council promulgated the Detailed Rules for the Implementation of the Water Pollution Prevention and Control Law, further clarifying

the management of pollutant discharge from navigation ships.

In August 2005, the Ministry of Communications promulgated the Regulations on Environmental Management for the Prevention and Control of Ship Pollution in Inland Waters, further clarifying the responsibilities and powers of maritime agencies in the prevention and control of ship pollution, and clarifying the specific provisions for the prevention and control of ship pollution (Liu Xiyuan,2006).

2.2.2.2 Prevention and control of pollutants in inland water vessels

From the current situation, ship water pollution mainly involves three aspects: first, ship garbage, second, ship residual oil garbage oil, and third, sewage from ships.

(1)Ship Garbage Control Model

According to the Law of the People's Republic of China on Water Pollution Prevention and Control and relevant laws and regulations, dumping of ship refuse into water bodies is prohibited. From the current ship garbage receiving mode, usually, after the ship arrives at the port, the professional water pollutant receiving unit sends the pollutant receiving ship to collect the ship garbage on the spot, after collecting, the garbage is transported to the shore by the receiving ship uniformly, and then the garbage disposal vehicle waiting on the shore is transferred to the garbage treatment plant for centralized treatment.

(2)Control Mode of Garbage Oil from Residual Oil

All ships are equipped with tanks dedicated to the storage and collection of garbage oil from ships. For oily sewage produced by ships in the production process (mainly concentrated in the ship's engine room area), after centralized collection of all types of pipelines on board into the oil-water separator, after treatment, the dirty oil is separated from the upper part into the tank (cabinet), and the water is discharged from the lower part, if the required standard is discharged into the water, otherwise the tank needs to be re-injected for the next treatment. Finally, the remaining residual oil in the dirty oil tank (cabinet) is sent by the ship pollutant receiving unit to send the ship to receive and then disembark for disposal (Duan Suwen,2015).

(3)Sewage control model

According to the Technical Rules for Legal Inspection of Inland Water Vessels of the Maritime Bureau of the Ministry of Transport (2011), there are three types of treatment for sewage from ships (sewage from ships, sewage from infirmary, sewage from living animals and other sewage mixed with the above-mentioned discharges): first, the installation of sewage storage tanks (cabinets) for unified shore-to-shore treatment after collection; second, the installation of sewage treatment units, after treatment up to standard discharge to the waters; and third, the installation of packaging and collection facilities (free from flushing) for packaging and collection and then for shore-to-shore treatment.

2.2.3 Case analysis of ship pollution

In recent years, many major ship pollution accidents have occurred at home and abroad, especially the ship oil spill accident has the greatest impact, and its losses to the environment are irreparable.

(1)Foreign Ship Pollution Accident

In recent years, there have been many major oil spill accidents in the world, such as Torre Carneon, Exxon Valdez and Prestige.

The Torre Carneon spill. March 1967, The Liberian tanker Torre Carneon, which carries 120,000 tons of crude oil, sailed from the Persian Gulf to the port of Milford, USA. The wheel goes to the reef in the English Channel, causing damage to the hull, 100,000 tons of oil spilled over the next 10 days. There were 42 ships in Britain and France, using 10,000 tons of detergent. Britain also dispatched bombers to burn some of the spilled oil to clean up the spill but the oil spill still caused serious pollution in the surrounding waters and coastal areas, so that Britain and France suffered huge losses. After the incident, for this purpose, the International Maritime Organization (IMO) convened a special meeting to discuss technical and legal security issues, a standing "legislative council ".And in order to prevent ships from polluting the sea area, it has issued the famous international ship pollution prevention convention -- CMARP0L 73/78 pollution prevention convention(Zhu Liang, &Zhu Mingyue,2008).

Exxon Valdez oil spill. 24 March 1989, Exxon Valdez, an American tanker carrying

about 170,000 tons of oil, was en route to Los Angeles, California, in Valdez, Alaska. Sailing outside the normal course to avoid the ice, stranded on a reef in Prince William Bay, Alaska, resulting in 8 of the 11 tanks of the wheel broken. Within six hours of grounding, more than 30,000 tons of oil spilled from Exxon Valdez. Alaska's 1100- kilometer coastline is full of oil, it caused enormous ecological damage, about 4,000 sea otters death, 10-300,000 seabird deaths. Experts believe that ecosystem restoration takes more than 20 years. The total damage caused by the accident was nearly $8 billion.

The Exxon Valdez oil spill was the largest in American waters. After the accident, several major oil spills occurred in the United States, caused a strong response from all walks of life in the United States, under the strong pressure to protect the marine environment, the United States two houses passed the 1990 Oil pollution Act.It marks a shift from passive defense to active response to oil spills.

Prestige oil spill. 13th November 2002,with 77,000 tons of fuel oil, the captain of the 243-metre Bahama old single-hull tanker Prestige, a route from Latvia to Gibraltar. In a storm, colliding with an unknown object, and out of control by strong winds and waves, hull damage caused fuel oil leakage. Under wind and waves, the oil spill and the runaway tanker drifted off the coast of Galicia, Spain, and stranded nine kilometers from the coast. The bottom of the ship cracked as long as 3 to 5- meter gap. Nearly 4,000 tons of fuel from the bilge, form a 5 km wide, 37 km long oil belt. 17th November ，the Spanish government ordered the Prestige to be towed 104 kilometers south-west of the Atlantic Ocean, because of the damage to the "prestige" hull, And the storm, November 19, the hull broke, And then sank about 3,600 metres deep, about 17,000 tons of fuel oil leaked when the tanker sank. The most polluted waters, the leaking fuel is 38.1 cm thick. For a longer period, the sunken "prestige" wheel continues to spill, part of the French coastline is also polluted. The accident caused serious environmental pollution in the waters off Spain, the spill contaminated nearly 400 kilometers of Spanish coastline, and the famous tourist resort of Galicia is beyond recognition. There's a thick layer of oil on the beach, Nearshore rivers, streams and swamps are also heavily polluted. The accident caused serious environmental

pollution in the waters off Spain, The spill contaminated nearly 400 kilometers of Spanish coastline, the famous tourist resort of Galicia is beyond recognition, There's a thick layer of oil on the beach, Nearshore rivers, streams and swamps are also heavily polluted. Fisheries and aquaculture are the worst affected by the Prestige oil spill. Some wild animals are also polluted to varying degrees. Greenpeace officials warned that Prestige, which contains tens of thousands of tons of crude oil in the deep sea, is like a "time bomb" that could explode at any time. The fuel leak is one of the worst disasters in the world's history. For this purpose, the Government of Spain has submitted a huge claim of Euro2 billion to the responsible parties (Huo Yan,&Qin Qi,2013).

In view of the frequent occurrence of catastrophic pollution accidents in single-hull tankers represented by the Prestige, the International Maritime Organization has revised the relevant annex provisions of the International Convention against Pollution at Sea, greatly reducing the service life of single-hull tankers and setting a timetable for the phase-out of single-hull tankers.

(2) Domestic ship pollution accidents

The "Ambassador of the East" oil spill.25 November 1983, Captain 207 meters Panamanian "Ambassador of the East" oil tanker in Qingdao Port Huangdao oil area loading more than 43000 tons of crude oil on the way out, drive to Zhongsha Reef to run aground, causing damage to the cargo hold, leaking 3343 tons of crude oil. The oil spill reaches more than half a meter at the thickest part of the reservoir in the port. The oil spill has affected the coastlines of Jiaozhou Bay and its adjacent waters up to 230 kilometers. At the same time it caused serious pollution to more than 15000 acres of nearby aquaculture and 900,000 square meters of scenic tourist areas and beach, Economic losses of tens of millions, Damages 17.75 million. Although the government organizes a lot of manpower and material resources for decontamination, its impact remains long-lasting.

.

Oil spill accident of "min burn supply 2". 24 March 1999,Fujian Xiamen port oil tanker "min burn supply 2"(captain 59 meters) loaded 1032 tons of heavy oil from

Xiamen to Dongguan. On the way from Guangzhou Humen Power Plant Terminal to Shanghai Port, Taizhou Port, Zhejiang Province ," East China Sea 209"(captain 99 meters), Collision at the Lingding waterway at the Pearl River Estuary, "East China Sea 209" ship first insert" Min Huo 2" starboard 2,3 cabin, the bottom of the damaged hull sank, overflow of 589.7 tons of heavy oil, Zhuhai, Shenzhen, Zhongshan, Jinxingmen, Qi'ao Island and more than 300 square kilometers of sea and 55 kilometers of shoreline pollution. The average thickness of the contaminated beach is over 10 centimeters, 20-30 cm. in some areas Zhuhai famous tourist scenic spot, beach, lovers north road shoreline, Grease everywhere, 70 hectares of rare plants - mangroves contaminated, the ecological environment has been severely damaged. Despite local government organize more than 1,000 people. For more than 20 days, some of the pollution is still hard to clean, Oil spill accident to the local direct economic loss of more than 40 million yuan.

"Modern Promotion" and "Mediterranean Elena" wheel collision oil spill accident.7 December 2004, Captain of the 182m Panamanian container ship "Modern Promotion" from Shenzhen Yantian Port on the way to Singapore, Colliding with the 300m German container ship "Irenna Mediterranean" from Shenzhen Chwan to Shanghai, The "Irena Mediterranean" fuel tank is damaged, Over 1,200 tons of ship fuel spilled, To form a 9- nautical - mile (16.5- kilometer) oil belt at sea, To be the biggest oil spill in China, Contamination of the Pearl River Estuary, All losses amounted to 68 million yuan. Fortunately, after the incident, The Ministry of Communications and the Guangdong Provincial Government organize the relevant units,take positive action, effective control and removal of leaking fuel at sea, No more shoreline pollution, protecting sensitive resources in the waters of the Pearl River Estuary, so that the loss is not further expanded(Zhu Liang, &Zhu Mingyue,2008).

CHAPTER3 RESEARCH ON THE "ZERO DISCHARGE" TECHNICAL ROUTE OF INTERNATIONAL SHIP POLLUTANTS

3.1 General framework

Combined with the advanced experience of ship pollution prevention and control at home and abroad, the serious problems existing in the current ship pollution prevention and control work, the most effective measures to solve the ship pollution control are not "zero discharge ".

For the specific "zero discharge" management measures of ship pollutants, firstly, it is necessary to install a monitoring device for the production of all ship pollutant collection and storage devices, and to carry out on-line real-time monitoring of the production of ship pollutants from the source(Liu Yuanfang,2008)). Thirdly, the maritime department makes comprehensive use of the on-line real-time monitoring system and the comparison information of the receiving situation of ship pollutants, makes clear the suspected stolen ship object and carries out on-site law enforcement verification, carries out punishment and strengthens supervision for verifying the existence of illegal acts such as stealing and discharging, so as to realize "zero discharge ".

3.1.1 The implementation of real-time on-line monitoring of ship pollutant production, ensure "zero discharges" from the source

The "zero discharge" of ship pollutants needs the supervision department to monitor the sewage, the ship oil pollution water, the ship produces the garbage quantity in real time, if the ship oil pollution water, the sewage and the ship garbage production quantity is not clear, we cannot really realize the "zero discharge" control(Huo Yan,&Qin Qi,2013). Therefore, it is necessary to establish a real-time monitoring system for the production of ship pollutants, to monitor the production of oil pollution water and sewage in real time, and to ensure that the receiving capacity is greater than the production capacity by perfecting the receiving facilities and capabilities of oil water and sewage.

3.1.2 Rational layout and unified construction of convenient and fast reception facilities for ship pollutants with sufficient reception capacity

Combined with the construction of water emergency system in Guangdong Province, the reasonable layout of ship pollutant receiving facilities in Guangdong Province area is carried out, which not only saves investment, but also facilitates management. The layout of water emergency system in Guangdong province takes into account the outstanding characteristics of more concentrated ship operation, large water transportation demand and high risk, and the layout of emergency station also takes into account the equipment and emergency function requirements of water pollution prevention and control related emergency facilities.

3.1.3 Government-led establishment of a unified system for receiving and handling marine pollutants

Legislative norms. The core of carrying out "zero discharge" of pollutants in ships lies in the unified receiving and treatment of pollutants, while the premise of unified receiving and treatment of pollutants is legislative guarantee, which focuses on clarifying the receiving and handling mode, clear supervision requirements and punishment standards and so on.

Firstly, the legal principle of unified reception and treatment of ship pollutants should be clarified. All ship pollutants, such as ship refuse, sewage and oil water, should be uniformly received and transferred to shore for treatment, and the current regulations on the management of sewage and oil water discharge up to standard should be abolished. The state and local governments shall legislate to prohibit the direct discharge of ship pollutants into the water in any form, and the sewage outlets of the ship side shall be completely closed except for the necessary emergency exits. Secondly, it is necessary to clarify the operation mode of receiving and handling of ship pollutants. In view of the comprehensive ability of pollutant disposal only in local municipal sanitation systems at present, the administrative jurisdiction can be considered as the management unit, and the receiving link of ship pollutants in the unit can be used as market-oriented operation, according to the qualification

requirements of municipal administration departments and the filing system of maritime departments to participate in the receipt of ship pollutants. After receiving, it should be handed over to the municipal sanitation system for centralized shore-based disposal. Third, the management requirements of the pollutant receiving link of the ship should be clearly defined. After the collection of pollutants by the ship's pollutant receiving unit, the receiving certificate shall be issued to the ship and confirmed by the signature of both parties, and the ship shall exchange the receiving certificate of the maritime department with the receiving document, which is consistent with the current practice. For ships that refuse to perform the delivery of pollutants,direct discharge secretly or cannot prove the destination of pollutants, they should be clearly and severely punished by the maritime department according to law.

All - line linkage. Ship is dynamic operation, it is not enough to carry out the unified reception of ship pollutants only in a certain area and section, so it is necessary to establish a basin-based receiving system of ship pollutants. At the national level, we should draw up a unified plan for the pollutant receiving project of river basin ships. Taking the Yangtze River as an example, we should set up several receiving stations along the route according to the factors of ship density and total pollutant quantity calculation, in order to effectively cover the receiving service objects in the area. All provinces and cities along the Yangtze River should establish and perfect the layout plan of the ship pollutant receiving station in the jurisdiction, which can not only set up a number of fixed receiving stations to be delivered voluntarily by the ship side, but also rely on the dynamic collection of the receiving ship. The state and provincial and municipal local governments shall support the corresponding construction funds to ensure the financial support of receiving stations, receiving equipment facilities and receiving service operation.

3.1.4 Increase investment and implement free reception of ship pollutants

Because the ship oil pollution water can be recycled after secondary treatment, refined oil has a certain economic value, so the receiving unit is willing to take the initiative to collect free oil pollution water from the ship. The ship is also willing to take the

initiative to deliver to the receiving unit, taking into account the free access to oil water treatment services (Chen Junmian,2011). This kind of treatment method can continue to be used, the receiving unit unified collection after landing centralized disposal, into economic value. The free receiving of sewage can not only protect the environment, promote the recycling of comprehensive resources, but also make the large amount of sewage can be recovered and disposed, greatly reduce pollution, but also save the cost of treatment for shipping companies and ship owners.

In terms of sewage, because of the large number of small and medium-sized ships and old ships in the ship, the unified installation of sewage treatment devices will cause a greater economic burden to the ship side, and will also cause the hidden danger that even the installation facilities will not be used. At the same time, considering that it is difficult for some small ships to install treatment devices, the principle of "classification, grading and gradual implementation" can be implemented. Firstly, priority should be given to installing sewage storage facilities for ships with large discharge volume and high pollution hazard, and a dynamic receiving and transshipment mechanism should be implemented to gradually extend to other types of ships and small ships. As for the cost, we can draw on the way that the municipal sewage treatment fee is attached to the water charge item, consider the cost expenditure from the fuel tax, or collect a certain proportion of the fee according to the principle of "who pollutes, who governs ", so as to ensure the normal operation of the receiving unit (Stevens L,n.d.).

For ship garbage, the current relevant national laws and regulations require that the discharge of ship garbage to the water area is prohibited, but must be accepted by qualified units to deal with it (Tichavska M,&Tovar B,2015). However, there are some serious problems in the way of paid charge under this kind of market operation mode, one is the problem of stealing garbage from individual ships in order to escape the cost, the other is because of the thin profit, even if individual receiving units and individuals are willing to undertake receiving business, it may also form secondary pollution secretly due to excessive cost, so it should be accepted free of charge to ensure the effective disposal of pollutants. In terms of cost, the cost can be considered

from the fuel tax, and a certain proportion of the garbage disposal fee can be charged according to the mode of municipal garbage charge disposal.

3.1.5 Scientific and technological innovation to provide technical support for the unified reception of ship pollutants

The first is the construction of the pollutant storage device of the ship. From the existing shipbuilding technology and ship inspection technology, it is feasible to set up a special storage tank (cabinet) in the cabin, but the key problem is the need to design and build a large volume of storage devices to meet the operational requirements. The solution of this problem can only be obtained by the calculation of the maximum amount of pollutants produced by the ship side, and should be considered comprehensively and properly in combination with the reasonable layout of the receiving stations along the river. Second, the construction of pollutant receiving ships. At present, the Yangtze River and other contents have been built specialized garbage receiving, oil pollution receiving, sewage recovery and cleaning and other types of pollutant receiving ship type, but considering the principle of flexibility, such receiving ships are often mainly small ships, in the future should be based on the discharge volume and receiving capacity and other comprehensive factors, the construction of appropriate large and medium-sized receiving ships to meet the needs of receiving work. The third is to consider the design and construction of pollutant transfer stations (Qu Baoxia,2012). After receiving the pollutants uniformly, how to transfer to shore is a key issue for us. Combined with the construction of fixed receiving point of ship pollutants, we should select the special transfer wharf near the shore garbage treatment station to realize the seamless connection of pollutant collection and transportation, reduce the secondary transportation link, reduce the risk of secondary pollution, and dispose effectively at once.

3.2 Design of international real-time monitoring system for marine sewage output

3.2.1 Real-time online monitoring principle

Sewage from ships production monitoring device, is suitable for sewage from ships production monitoring terminal. The sewage of the ship is fed into the treatment box by the inlet pump through the inlet pipe, and the production of sewage in the tank is monitored and recorded in real time, and the real time monitoring is carried out (Goldsrorthy L,&Goldsrorthy B.,2015).

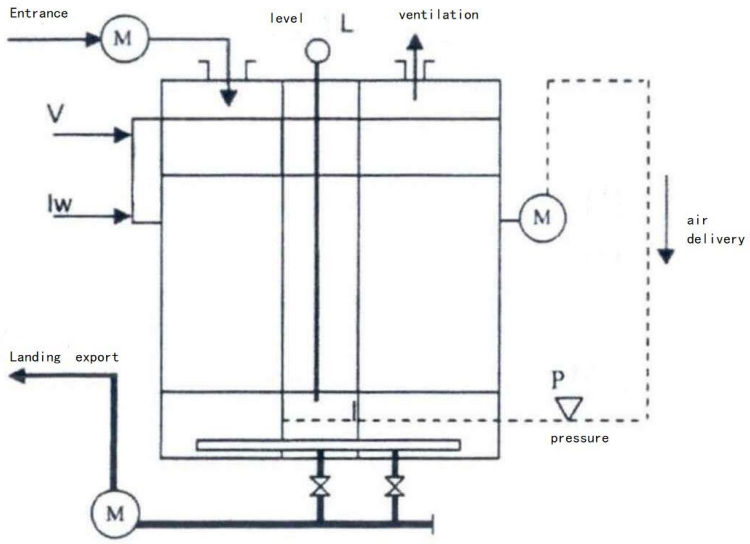

Figure 1-ship production monitoring device

3.2.2 Research plan

Through the analysis of the current situation of ship pollutant management in Guangdong Province, using advanced technologies such as GIS technology and computer information technology, and combining with the existing ship GPS monitoring platform, this paper establishes an on-line real-time monitoring system for the production of sewage from ships, continuously strengthens the supervision of the operation of ship pollutants, and carries out "zero discharge" of ship pollutants(Schwehr K D,& Mcgillivary P A,2017). According to the above technical requirements, the 32-bit embedded processor LPC2136 is taken as the core, which is specifically composed of unit circuits such as power management, sensing monitoring, real-time clock, data storage, transmission interface and man-machine interface.

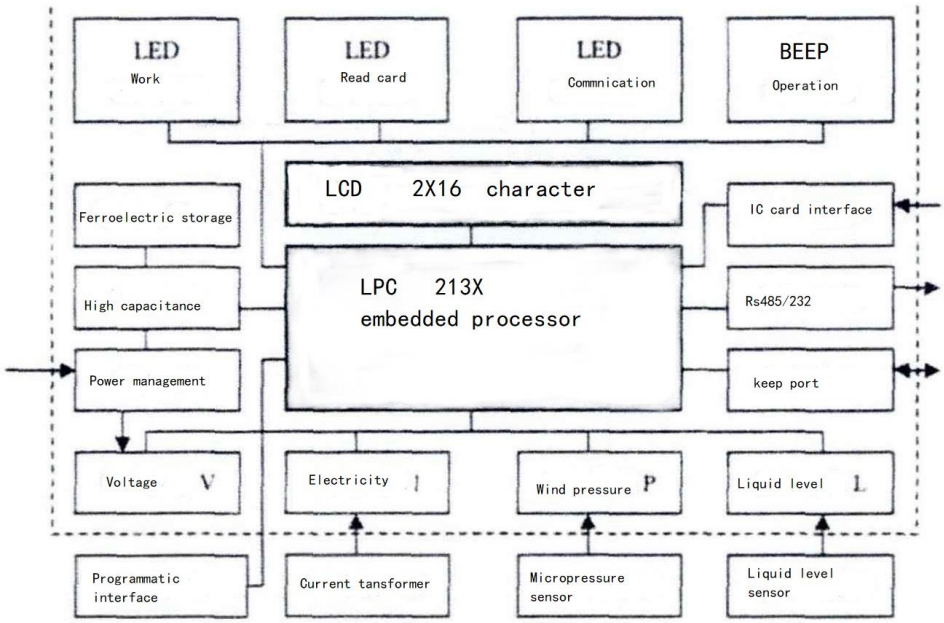

Figure 2-LPC2136

(1)Power management

From the analysis of technical requirements, it can be seen that the real-time on-line monitor is supplied by the ship's power supply, and it also requires 24 hours of continuous monitoring and recording of the operation of the device, including, in particular, the monitoring record of the power supply of the instrument in the event of interruption due to human factors and the detection of power failure. Therefore, in addition to considering the three-phase four-wire, three-phase three-wire power supply and the influence of power fluctuation factors, the power supply part of the on-line monitor should also guarantee the battery power supply in the sudden situation of the ship power supply interruption, identify the ship power failure or the cheating behavior of the man-made power cut, and record the cheating behavior, so as to avoid the human factors interfering with the monitoring and recording of the instrument, so as to avoid the monitoring and punishment of the management department(Qu Baoxia,2012).

(2)Sensor monitoring

By V、I、P、L four analog sensing and signal conditioning modules, A 12-bit A/D was used to monitor the supply voltage, load current, supply pressure and water level in

real time(Liu Xiyuan,2006). Among them V monitoring monitor the low voltage through the power management part to monitor whether the ship's staff supply power to the object device; I use current transformer monitoring to monitor the actual load current of the object device to find out if the device is properly loaded, prevent no-load operation or detect device failure; L use direct insertion water level sensor monitoring to monitor the object device water, displacement; P use10 KPa micro pressure sensors to monitor whether the object device is fed enough oxygen for the presence of bacteria. And when the online monitor MPU monitors the state parameter changes, the parameters and real time are recorded at the same time.

① On/off monitoring and recording

If the main power supply is powered on, the MPU automatically enters the reset power-on state. The MPU samples 3 monitoring parameters and records the time, writes the record to the memory, and writes the record according to the FIFO principle;

If the main power supply is powered off, the MPU automatically responds to the power-off interruption, immediately samples the main power supply voltage, monitors the sampling parameters after power-off, writes records to the memory, and automatically waits for power-off and shutdown.

② Current monitoring and recording

The minimum current of the target device for normal operation is 4A, so the online monitor should determine how to record the state change of the current parameter according to the minimum operating current:

If the current changes from 0 to non-zero, then record;

If the current changes from 0 to 0, record it;

If the current changes from less than 4A to more than 4A, then record;

If the current changes from more than 4A to less than 4A, record.

③ Pressure monitoring and recording

Pressure monitoring is performed by micro-pressure GEMS PS31 pressure switch, the sensor outputs 0/5V

Switch sensor signal. This signal is monitored by the external DI interrupt of the MPU through photoelectric isolation:

If the switch changes from 0-1, then record;

If the switch changes from 1-0, then record.

④ Liquid level monitoring and recording

Liquid level monitoring is carried out through the liquid level sensor of the device itself. The signal output by the sensor is 0-15V, which is used to represent the water level in three different states of super high, high and low. This signal is sampled after A/D conversion, and the water level in the device can be monitored.

⑤ Self-inspection monitoring and recording

In order to improve the supervision and use efficiency of the online monitor and improve its maintainability, the online monitor monitors and records its own sensors and operation usage:

If the operation of setting function is selected at the same time as the operation button, record;

If you read and write IC card, record;

If the sensor is found to be faulty or the memory has abnormal reading and writing during the self-test, record it.

(3)Real-time clock

High precision clock chip is used to timing the time unit of year, month, day, time, minute and second. In order to prevent the timing from stopping after power down, high energy lithium battery is required to provide backup power supply guarantee, to ensure the clock chip reliable timing for a long time, and to maintain high precision and low energy consumption.

(4)Data storage

Data storage is mainly used to store monitoring and recording data. Due to theexistence of power outages and repeated erasure, ferroelectric memory is used to achieve large capacity, long life data storage, the memory can keep 10 years of data without loss in the case of wire fall, and the number of repeated erasure can be as high as 1018 times.

The production of sewage is the key to ensure the implementation of "zero discharge" of ship pollutants, and it is also an important data source for the field law enforcement and supervision of the competent authorities. Considering that the data is not lost and the memory repeated erasure performance is required under the condition of power down, this product cannot choose the FLASH memory, and the ferroelectric memory with read and write life up to 1018 must be selected to support the repeated erasure of the storage area by the online monitor for many years. In addition, the depth of the storage area is also a key point in the design requirements of the online monitor, which requires a storage depth of 12 months, so it is necessary to determine the storage space according to the record size (0.

① Record information and format

YY	**MM**	**DD**	**hh**	**mm**	**ss**	**S**	**A**	**P**

Figure 3-Record information and format

The online monitor mainly monitors and records the current, water level, wind pressure, power supply and working status, from which we can calculate the record length and design it as the following record storage format:

Among them: YY-year (BCD code, l Byte)

MM-month (BCD code, l Byte)

DD-S (BCD code, l Byte)

hhmmss-hour, minute and second (BCD code, 3Bytes)

S-state: shutdown, power on, card reading, setting (HEX, l Byte)

A-current (0-25. 5A, l Byte)

P-pressure (0/l, l Byte)

L-level (0-2.55m, I Byte)

Record length: l0 Bytes

②Capacity calculation

According to the actual ship test, only when the status changes of shutdown, start-up, water intake, drainage, air supply and other faults occur, the operating characteristic status parameters of the target device need to be recorded. The actual ship test shows that under normal circumstances, about 100 records per month; under abnormal conditions, assuming that the device has a maximum of 50 state changes per day (an average of 2 changes per hour), then a maximum of 50 records per day:

Every day: 50xlO=500Bytes~ 0.5KB

Monthly: 31x0.5KB=15KB

Every year: 12xl5KB=18OKB=18000 records

The record uses 24C512 ferroelectric memory, each piece can store 64KB, then we only need up to 3 pieces of 24C512 ferroelectric memory using I2C bus cascade, we can store 12 months deep data records, and do not lose data in case of power failure.

③ Record organization storage

The monitoring records are organized using FIFO queue storage to organize data. The records that occur first are written at the head of the queue, and the records that occur last are written at the end of the queue. If the record exceeds the storage depth, the new record is written to the tail of the queue, the head record is pushed out of the queue, and the memory maintains a fixed depth of record storage. Each time data is read, the IC card reads the last 100 records starting at the end of the line; RS485 and RS232 can read all records in the memory.

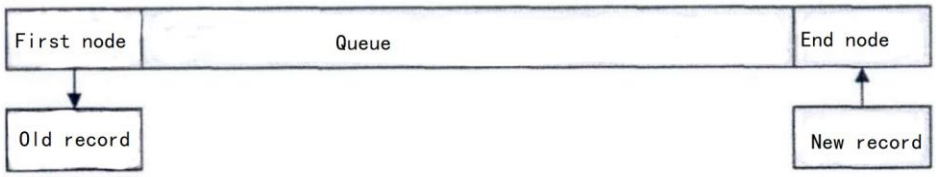

Figure 4-FIFO queue storage

(3) Transport interface

Mainly includes IC card interface, RS485 interface and RS232 interface, among which IC card interface is mainly data transfer mode, exchange data through 1 card, exchange mode is two-way; RS485 interface is to provide long distance data transmission based on RS485 bus, mainly monitor record to other data terminal of ship network transmission; RS232 interface supports field handheld device to collect monitoring record or on-line maintenance management device.

①IC card interface

The on-line monitor product adopts contact 1 C card interface that meets 7816 standard, and supports all contact 1 C card electrical and mechanical interfaces that meet the IS07816. Considering that the ship environment is relatively wet, the card reader interface of this project adopts a closed 1 C card mechanical interface which is dustproof and moisture-proof.

②RS485 interface

RS485 interface supports long distance data transmission, mainly provides on-line monitoring of the on-line monitor instrument to other ship supervision data terminals, and also supports on-line monitoring of field handheld devices. The RS485 interface adopts the MAX485 integrated chip interface with lightning protection and anti-static interference, which supports sending data from master-slave query or active report. Communication protocol adopts MODEBUS protocol, package format refers to protocol custom command, and provides protocol text for PC system developer application. In order to prevent the artificial destruction of the communication interface, the AC isolation is used to communicate.

③RS232 interface

RS232 interface mainly supports the management of on-site monitoring of handheld devices, reading records and setting date, time and working parameters to the on-line monitor, and extension support and software upgrade.

④Keep port

The data interface supporting DDZ-III instrument signal acquisition, RS485 interface, RS232 interface and water quality on-line monitor is reserved considering the possible need to increase the monitoring of oxygen demand, solid suspended matter and PH value of sewage treatment plant discharge water quality in the future. When water quality monitoring is expanded in the future, it is only necessary to expand the on-line monitoring instrument of water sanctions, so that the on-line monitoring instrument can obtain discharge water quality parameters through A/D、 or RS485、 or RS232 interface(Eide M S, et al,2007).

(5)HMI

It is composed of LED indicator, LCD screen, buzzer and buttons. It mainly supports human-computer interaction such as configuration, maintenance, management and alarm. The LCD adopts FM1602 liquid crystal module with 2 lines and 16 characters.

①Work instructions

Indicated by red LED. It is always on when the external power supply is on, and goes off when the external power is off.

②Communication instructions

Indicated by blue LED. When RS485XRS232 communication, the LED flashes to indicate the communication status.

③IC card instructions

Indicated by green LED. When an IC card is inserted into the read and write data, the LED is on until the end of reading and writing off.

④Sound prompt

Prompted by buzzer. When you press the keyboard, you will be prompted; when the IC card reads and writes normally, it will make a short sound; when the IC card reads

and writes abnormally, it will emit a long prompt sound.

⑤LCD display

The display is provided by a 16-character LCD with 2 lines of characters: system date, time, parameters and card status. Mainly used for on-site audit data, on-site time synchronization settings and status provision.

⑥Operation keyboard

It consists of 4 membrane buttons: mode, plus, minus, and confirm; the mode button is used to select different query and set operation modes; plus/minus is used for parameter setting; and confirm is used to confirm the setting parameters.

3.2.3 Design of Software Framework for Operation Supervision Analysis Tool of Ship Domestic Sewage Production Monitoring Device

3.2.3.1 Overall demand

The software is mainly used for on-site inspection of boarding based on the operating status data of monitoring records and crew IC card visa records. The overall application requirements are:

1. Enforcement registration

When the law enforcement personnel use this software to board the ship, they need to log in to the system with the law enforcement management IC card, automatically read the law enforcement personnel code in the IC card, and require the law enforcement personnel to enter the password to enter the system. The system automatically records the login time in order to record which ships conducted law enforcement inspections.

2. Visa check

Law enforcement personnel may request the crew member IC card to read the visa port, time, visa personnel and visa time recorded in the card in order to confirm that the ship has carried out visa management according to law. At the same time, it can also decide whether to conduct on-site law enforcement inspections on the ship.

3. On-site inspection

Law enforcement personnel use the law enforcement management IC card to read the last 100 data records in the online monitor (Schwehr K D,&Mcgillivary P A,2017). The software system automatically analyzes the operating status of these records, and provides charts to display the operating status. At the same time, it provides an operating operating status description: inspection period, Downtime period and running time period, in order to assist law enforcement personnel to carry out corresponding law enforcement inquiry and inspection on site.

4. Instrument management

Law enforcement personnel can use the law enforcement management IC card to set parameters such as the time of the online monitor and ship login code through the software system, so as to correct the clock and set management (Qu Baoxia, 2012).

5. Accident forensics

Law enforcement personnel can use this software system to connect the RS485 interface to the online monitor, and read all the records in the online monitor, so as to obtain all the data in the online monitor for detailed investigation and evidence collection of pollution accidents for specific ships.

3.2.3.2 Overall plan

Considering that this software system is mainly used for mobile laptop computers to board the ship for on-site law enforcement, this software system is developed based on the HNDOWS platform using VS.NET technology, and the calculation mode is C/S, which is convenient for law enforcement personnel to install and operate. The software is mainly composed of several modules: law enforcement login, visa inspection, on-site inspection, instrument maintenance and accident forensics (Ren J,&Luzon N,2015).

①Enforcement login

The law enforcement login module mainly provides law enforcement personnel with IC card identification and system login, so as to know who entered the system to prepare for corresponding law enforcement management. Main identification and records: law enforcement personnel code, law enforcement login time.

②Visa check

After requesting the crew’s IC card, the law enforcement personnel read the information in the crew’s IC card through a IC card reader to obtain the time of the vessel’s most recent visa, visa port, visa personnel, and visa confirmation period, and can decide whether to proceed with the vessel. Further law enforcement inspections.

③On-site inspection

Law enforcement personnel use the law enforcement management IC card to read the latest 100 records inside the online monitor, and read the records through the card reader to analyze the operating status. Based on the analysis results, the law enforcement personnel can inquire about the ship's operation and visa situation on site. The shutdown or other violations can be handled by administrative law enforcement.

④Instrument maintenance

The real-time clock inside the online monitor is estimated according to its error, and the deviation is about 4 minutes per year. When the working time is long, the clock correction needs to be performed about every 2 years. Law enforcement personnel can hold the management IC card to check the settings of the instrument (Norlund E K,& Gribkovskaia I,2016). The online monitor also records the operation and time of the clock modification. At the same time, if there are duplicates or other problems in the ship registration number in the online monitor, the law enforcement personnel can reset this code.

⑤Accident evidence collection

If a major pollution accident occurs on the ship, the operation records inside the online monitor will provide important evidence for the accident investigation and evidence collection. In order to facilitate law enforcement personnel to read and collect evidence from a large amount of recorded data, the software supports connection with records through the RS485 interface, and allows the online monitor to quickly output all data records through command control, so that the law enforcement person is to quickly obtain evidence on board.

1. Analysis algorithm

①Research on Artificial Intelligence Information Processing Algorithm

This paper mainly studies how to mine the valuable characteristic information according to the monitoring record data and use this information to analyze the artificial intelligence in the time domain space to accurately identify the various running states of the object device. The on-line monitoring instrument mainly monitors and records the working current, wind pressure and liquid level parameters of the monitoring device for the production of oil water and sewage.

At the same time, the on-line monitoring instrument also monitors and records the diagnostic information of its working status, operation setting, on-site verification and sensors. This record also records the real-time date and time of occurrence of this event, in many cases it is more difficult to accurately identify and distinguish whether the object device belongs to normal start, whether stop, whether effective operation, whether artificial cheating, whether sensor failure and so on, it is impossible to directly identify and distinguish by parameters alone. For example, whether to stop depends on whether the downtime is more than 4 hours; whether to run effectively depends on whether the continuous boot time is more than 15 days; whether to cheat artificially depends on whether there is a sensor anomaly in the period before and after, and must distinguish the sensor fault and avoid misreading the state (Schwehr K D,&Mcgillivary P A,2017).

In summary, the operating state of the object device is divided into several cases, such as shutdown, start-up, invalid operation, effective operation, sensor fault, on-line monitor fault, artificial cheating and so on. Moreover, it is a typical multi-classification pattern recognition problem that all parameters need to be normalized to multi-class classification recognition in time domain space. According to the current similar research situation, the main methods to solve the multi-classification pattern recognition are artificial intelligence information processing such as support vector machine.

② SVM Algorithm Model

For boot monitoring, the object device state classification process of this algorithm model is: input running state characteristic parameter vector xi (t) to root node SVM1

classifier. If state 0 is sorted out yi =0 the classification stops. Not classified yi =- l,. Continue input to SVM2 classifier; If the state is sorted out yi =l the classification stops, yi =-1, otherwise Continue input to SVM3 classifier; When classified as state yi =2 by SVM3, Otherwise yi =-l, Continue input to SVM4 classifier; SVM4 classified as state yi =3, Otherwise yi =-1, Continue input to SVM5 classifier; When classified as state yi =4 by SVM5, otherwise classified as 5(Goldsrorthy L,&Goldsrorthy B.,2015).

As can be seen from the above classification process :6 classification equipment status problem only needs 5 dichotomies SVM, and the classification process is suspended when it is classified, which has good calculation efficiency.

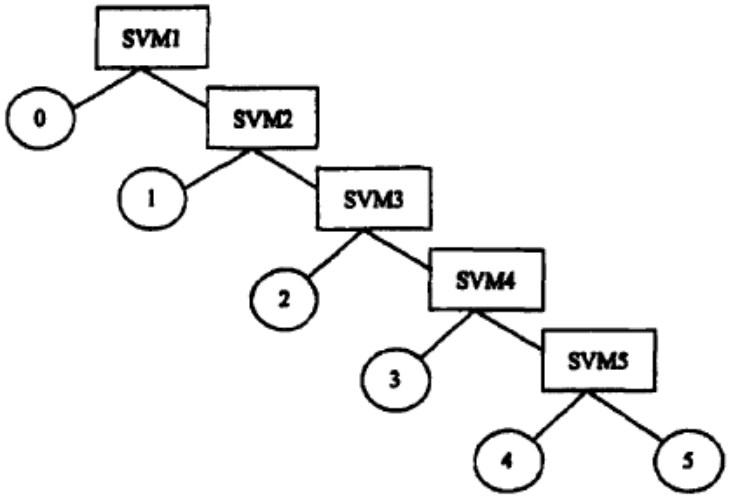

Figure 5-SVM Algorithm Model

SVM algorithm

According to the support vector machine theory, the classical dichotomy SVM is to find an optimal function in vector space and satisfy:

$$y_i(wx+b)\geq 1;/ = 1,2,\ldots,m$$

Figure 6-SVM algorithm

In the formula: w is the weight vector; b is the offset scalar coefficient.

By introducing the Lagrange multiplier% and solving in the dual space, the optimal classification function is obtained:

$$f(x) = sign(\sum_{i=1}^{SV} \alpha_i y_i x^T x + b)$$

Figure 7-SVM algorithm (2)

In the formula: SV is the set of all support vectors (ie, the samples corresponding to %>0).

For non-linear classification problems, SVM can map a non-linear sample & linear sample 0) (X), the original space, map to a high-dimensional feature space Q, and then find the optimal classification function in the high-dimensional feature space Q:

$$f(x) = sign[\sum_{i=1}^{SV} \alpha_i y_i K(x, x_i) + b]$$

Figure 8-Feature space Q

The introduction of kernel functions enables the operation to be carried out directly in the input space without having to be carried out in the potential high-dimensional feature space. This way can avoid dimensionality disaster.

CHAPTER4 STUDY ON "ZERO DISCHARGE" CONTROL STRATEGY OF SHIP POLLUTANTS

4.1 Control strategy and management mode

4.1.1Control strategy

The real-time monitoring device for domestic sewage production of ships mainly monitors and records the characteristic state according to the basic working principle of the monitoring object device and the necessary and sufficient of effective operation.

(1) Identification Strategy for Effective Operation of Monitoring Equipment

In order to ensure that the domestic sewage production of ships can be monitored in real time, it is required that the device must ensure that it does not stop working, otherwise it is regarded as invalid operation.

(2) Environmental Protection Institutionalized Visa Regulatory Strategy

With the help of the real-time on-line monitoring and recording function of the on-line monitoring instrument, the maritime department can establish the network ship environmental protection visa management system based on the maritime special network, and implement the institutionalized visa management for the operation supervision of the on-line monitoring device for ship sewage(Huo Yan,&Qin Qi,2013). Ship environmental protection institutionalized visa management requires ships to carry out navigation visas at the same time holding a ship pollution source control C card at the same time to carry out environmental protection visa, before the visa, the ship needs to hold C card to read the voyage operation monitoring records; the port visa office computer deployment of environmental visa monitoring system, can read 1 card records to achieve the network of records transmission and supervision.

(3) Assaulted regulatory strategy

The environmental supervision department of the maritime bureau may issue the law

enforcement inspection card to the law enforcement personnel, according to the environmental supervision visa system summary data and the analysis statistics situation, may carry on the surprise boarding inspection to the frequent downtime situation pertinence. Law enforcement personnel can install a laptop to run the monitoring tool software on board the ship to check the monitoring records and check the log of navigation, you can find the ship malicious cheating to escape supervision behavior.

(4)Enforcement Regulatory Strategy

Both on-site inspection and law enforcement actions of law enforcement personnel are written into the law enforcement C card by running an online monitor or law enforcement tool software, which can facilitate the maritime supervision department to carry out post-supervision and inspection of the implementation of arranged law enforcement inspection, and avoid the weak or improper law enforcement by law enforcement personnel. When law enforcement personnel return to the network monitoring system with a law enforcement card, they can automatically complete the law enforcement registration, so that regulators can keep abreast of the implementation of law enforcement and make more timely regulatory decisions.

(5)Pollution Accident Forensics Strategy

If there is a major pollution accident in the ship, it is necessary to carry out an ex post investigation and evidence collection on the ship's sewage treatment plant. The law enforcement personnel can use the software of the supervision tool used in the notebook computer to read all the monitoring records through the RS485 interface, and the record time is about one year, so as to make a comprehensive analysis of the monitoring records within a long time range and prove the evidence for the accident investigation.

4.1.2 Management model

In order to carry out the supervision strategy of "zero discharge" of ship pollutants,

combine with the maritime supervision policy, regulation and management needs,we should deeply study and fill the actual demand of ship liquidity pollution source control supervision, establish an information visa supervision platform suitable for ship environmental protection supervision, so as to effectively carry out the supervision of ship liquidity pollution source control.

4.2 Safeguard measures

4.2.1 Legislative guarantee

Firstly, combined with the implementation of the special action plan for pollution prevention and control of ship terminals of the Ministry of Transport, the national level should uniformly promulgate the upper legal basis for the unified reception and treatment of ship pollutants. To adopt the method of "year-by-year classification implementation, step-by-step comprehensive promotion ", to clarify the provisions of the unified reception and transfer of all pollutants produced by ships. We should urge the relevant departments of the Central Committee to formulate a unified long-term plan for the reception and treatment of ship pollutants, take the river basin as a unit, fully consider the factors such as the amount of pollutants produced and the density of ships, and unify the planning and layout, supporting construction funds, and carrying out the construction of the ship pollutant receiving project.

Secondly, with reference to the practices of ship pollution prevention and control in Shanghai Port, the regulations on environmental sanitation management in Shanghai waters and the measures for prevention and control of ship pollution in Shanghai Port, Guangdong Province has issued corresponding local regulations or regulations to improve policy guidance and system requirements, with emphasis on the following core contents: first, the prohibition of platoon. It is prohibited for ships to discharge oily sewage into water bodies. It is prohibited for ships to discharge domestic sewage, oily sewage and ballast water to areas such as water source protection areas, quasi-water source protection areas and nature reserves. Second, regulatory aspects.

The maritime administrative agency may take lead-sealing measures for vessels sailing, berthing or operating for more than 30 days in the port, as well as for sewage equipment of ships repaired in the dock. If a ship needs to unseal the sewage discharge equipment, it shall report to the maritime administrative agency in advance and explain the reasons; if it is necessary to unseal the sewage discharge equipment in case of an emergency that endangers the safety of the ship, the ship shall report to the maritime administrative agency as soon as possible after the unsealing. The unsealing shall be recorded in the engine log. Third, operational costs. can be classified and distributed to implement, for small ships under 400 tons free of garbage, sewage receiving treatment fees, for ships above 400 tons by the receiving unit according to the number of ships and tonnage charges, to supplement the pollutant receiving unit operating costs.

(1) The State Council's "Ten Water Rules"

In February 2015, the State Council issued the Action Plan for Water Pollution Prevention and Control, defining the objectives of water pollution prevention and control, and putting forward specific requirements for water pollution prevention and control in water transportation industry.

Target: By 2020, The quality of the national water environment has been improved periodically, the pollution of serious water bodies has been greatly reduced. The level of drinking water security continues to improve, Groundwater overexploitation is strictly controlled. The rising trend of groundwater pollution has been initially restrained, environmental quality in coastal waters is steadily improving, the water ecological environment in Beijing, Tianjin and Hebei, Yangtze River Delta and Pearl River Delta has improved. By 2030, Strive to improve the overall quality of the national water environment, initial restoration of water ecosystem function. By the middle of this century, the overall improvement of ecological quality, ecosystem to achieve a virtuous cycle. Key indicators: by 2020, the water quality of the seven key watersheds, such as Yangtze River, Yellow River, Pearl River, Songhua River, Huaihe River, Haihe River and Liaohe River, has reached more than 70% (reaching or exceeding H categories). The black and smelly water bodies in the urban built-up

areas at the prefectural level and above are controlled within 10%. At the prefectural level and above, the water quality of centralized drinking water sources in cities is higher than 93% , The proportion of extremely poor groundwater quality in the country is controlled at about 15%, the proportion of water quality in coastal waters is about 70%. About 15 percent of water sections in Beijing-Tianjin-Hebei region lost their use function (inferior to V). The Yangtze River Delta and the Pearl River Delta region strive to eliminate the loss of water use function.

By 2030, The overall quality of the seven major watersheds in China is over 75%, The black and smelly water bodies in urban built-up areas have been eliminated.For urban centralized drinking water sources, the proportion of water quality reaching or exceeding IE categories is about 95%. The measures to strengthen the pollution control of ship ports are put forward. Actively control ship pollution. Compulsory scrapping of ships beyond the useful life in accordance with the law. Classification and grading revision of the ship and its facilities, equipment related environmental standards. The new standards are implemented for coastal vessels in use since 2018 and inland river vessels in use since 2021; Other ships will be renovated by 2020. If the modification fails to meet the requirements, they will be eliminated within a time limit. On an international route to our waters. On an international route to our waters, to implement ballast water exchange or install ballast water inactivation treatment system. Regulate shipbreaking, No beach dismantling.

Enhance the capacity of port wharf pollution prevention and control. To formulate and implement a national pollution prevention and control program for ports, wharves and loading stations. We will speed up the construction of garbage reception, transfer and disposal facilities, and improve the capacity of receiving and disposal of oily sewage, chemical tank washing water and emergency response to pollution accidents. Ports, wharves, loading and unloading stations and ship repair plants located in coastal and inland rivers meet the construction requirements by the end of 2017 and 2020, respectively. Operators of ports, wharves and loading and unloading stations shall formulate emergency plans to prevent and control pollution of the water environment by ships and their related activities.

It can be seen from the above that the specific indicators of water pollution prevention and control are clearly defined at the national level, and the requirements for the revision of ship environmental protection standards and the implementation of ship transformation are put forward, and the requirements for the construction of garbage and sewage receiving and transshipment facilities are clearly defined.

(2)Ministry of Transport ,implements the "Water Ten" implementation plan

In August 2015, the Ministry of Transport issued the "Implementation Plan for the Special Action on Pollution Prevention and Control of Ships and Ports (2015-2020)", which defined the pollution prevention and control objectives of the water transport industry.

By 2020, the ship and port pollution control policies, regulations and standards system will be further improved, ships and ports air pollutants and water pollutants will be effectively controlled and scientifically controlled, discharge intensity will be significantly reduced, clean energy will be popularized and applied, and the level of ship and port pollution control will be in line with the goal of building ecological civilization and building a well-off society in an all-round way.

Target: By 2020, ship sulphur oxides, nitrogen oxides and particulate matter in the Pearl River Delta, Yangtze River Delta and Bohai Rim (Beijing-Tianjin-Hebei) waters will decrease by 65%,20% and 30% respectively compared with 2015;90% of the major ports will use shore power for ships and official ships, and 50% of the container, passenger roll and cruise specialized terminals will have the capacity to supply shore power to ships.The main port 100% of large coal, ore terminal yard to build wind and dust suppression facilities or achieve closed storage. Coastal and inland river ports, wharves, loading and unloading stations (hereinafter referred to as ports) and ship repair plants have the receiving capacity of ship oily sewage, chemical cabin washing water, domestic sewage and garbage before the end of 2017 and 2020 respectively, and do a good job of linking up with municipal public treatment facilities to fully realize the disposal of ship pollutants according to regulations. In accordance with the newly revised standards for the discharge of pollutants from ships, the renovation of existing ships shall be completed by the end of 2020. If the renovation still fails to

meet the requirements, it shall be eliminated within a time limit.

At the same time, the project puts forward the requirements of promoting the construction of the pollutant receiving and disposal facilities for ships. Strengthen the port, ship repair plant sanitation facilities, sewage treatment facilities construction planning and local urban facilities construction planning link(Luo Guishan,et al,2012). In conjunction with the Ministry of Industry and Information Technology, the Ministry of Environmental Protection and the Ministry of Housing and Construction will explore the establishment of a new mechanism for the reception and disposal of pollutants from ships, promote the construction of reception facilities for pollutants from ships such as oily sewage, chemical bilge water, domestic sewage and garbage, do a good job of linking up the facilities for the transfer and disposal of pollutants between ship ports and between ports and cities, improve the capacity of receiving and disposing of pollutants, and meet the demand for receiving and disposing of pollutants from ships arriving at port.

By the end of 2016, the administrative department of transportation (port) in the place where the port and ship repair plant is located, together with the departments of industry, environmental protection, housing construction and maritime affairs, has completed the assessment of the capacity of receiving, transshipment and disposal of pollutants from ships in the region, and formulated plans to improve the construction of reception, transshipment and disposal facilities. By the end of 2017, coastal ports and ship repair plants meet the construction requirements. By the end of 2020, the inland river ports and ship repair plants have met the construction requirements, and the international navigation ships entering the waters of our country will install the ballast water management system in accordance with the requirements of the international conventions to which they are party.

It can be seen from the above that the transportation department has included the receiving treatment of ship garbage, domestic sewage and oily water into the implementation plan, and put forward the construction requirements of the receiving and disposal facilities.

4.2.2 Institutional mechanism

(1)Relying on the disposal capacity of the state-owned municipal sanitation system.

As far as the receiving and handling of marine pollutants in Guangdong Province is concerned, the receiving units with high degree of specialization, advanced equipment and complete equipment, and sound organization team are only one of the municipal sanitation groups, and at the same time, only the sanitation group has the capacity of centralized disposal of marine pollutants on the shore base(Ren J,&Luzon N,2015). Therefore, it is necessary to rely on the treatment system of the state-owned municipal sanitation department, the ship's garbage is received by the special ship and then transported to the garbage disposal site through the transfer of shore to the vehicle for disposal, the ship's domestic sewage is received by the special ship and then transported to the municipal drainage network for free discharge, and the ship's oily wastewater is received by the special ship and sent to the qualified treatment unit for recycling to avoid the secondary pollution of the water area by garbage and sewage.

(2)Implement in batches.

In the process of concrete implementation, we can also consider starting with large passenger ships and catering and entertainment grottoes ships according to the principle of "priority ", and gradually include cargo ships, engineering ships and other small ships in the later stage, so as to facilitate the smooth progress of the work.

(3)Speed up the improvement of receiving and disposal capacity.

Although the ship pollutant receiving units in Guangdong province have a certain scale in equipment, technology and team, the implementation of "zero discharge" work is bound to pose a serious challenge to the connection of pollutants. Therefore, it is necessary to further increase investment in the construction of pollutant collection equipment（Norlund E K,&Gribkovskaia I,2016）.

(4)Implementation of free pollutant reception.

In order to improve the enthusiasm of the ship to deliver pollutants and avoid the behavior of discharging in private directly from the system, only the free receiving mechanism of pollutants is implemented. The government finance should guarantee

the operating cost of the receiving unit, subsidize the public welfare project reasonably, and ensure the effective implementation of the receiving and disposal project of ship pollutants.

(5)Broaden the means of regulation.

In order to prevent ship pollution and investigate and deal with ship pollution accidents, the legal effect of evidence is an important constraint to the effective punishment of the perpetrators. When testing results of contaminants are required as evidence, the qualification of the laboratory unit and its level of testing are crucial, and we are not ideal in this respect. Lack of laboratory equipment, low level of laboratory tests and insufficient qualifications of units have become the key problems in the investigation and handling work. And the lack of oil pollution monitoring equipment in the port also makes some ships leave the port waters to remain in the vacuum of supervision power, in the case of poor self-supervision, greatly increased the possibility of escape after pollution and even the risk of releasing pollutants without fear(Norlund E K,&Gribkovskaia I,2016). Therefore, it is the key to do a good job of anti-pollution management to configure certain laboratory equipment and monitoring equipment for the port side and the maritime supervision side, to play the cooperative management role of pollutant supervision and inspection.

(6)Implement the compulsory insurance system for compensation for ship pollution accidents

Referring to the mode of "traffic insurance" of land vehicles, urging the ship to purchase pollution accident insurance by force can greatly crack down on the behavior of escaping or even discharging pollutants without fear after the pollution accident, which not only guarantees the decontamination and compensation expenses, but also ensures the smooth progress of emergency decontamination and disposal.

(7)Speed up the construction of ship pollution emergency system

We should take the lead of local government and combine national and social input to establish and improve the ship pollution emergency system with special and part-time work. It is necessary to establish a complete anti-pollution emergency plan for ships,

make clear the specific measures to deal with water pollution emergencies, clarify the information communication channels, and strengthen emergency equipment and emergency drills for wharves with high pollution hazard risk such as oil and chemical wharves. The maritime department should further strengthen the construction of emergency equipment and the exercise of emergency linkage mechanism to ensure the effective implementation of the plan.

(8)Enhance the sense of corporate responsibility

In order to reduce the environmental harm to human inland rivers, we should make great efforts to develop economized ships(Liu Yuanfang,2008). At present, we should set up the concept of clean production of shipping enterprises, that is, by saving energy and resources, eliminating harmful raw materials, reducing the generation and discharge of waste and harmful substances, and effectively managing all kinds of pollutants according to the principles of reduction, reuse and recycling of energy sources and water resources for daily use, so as to achieve sustainable development. They must also enjoy the benefits of redistribution.

(9)Strengthen environmental publicity

Although the public's awareness of environmental protection and the level of environmental protection knowledge have been improved to a certain extent, but the ability to participate in environmental protection is poor, we should increase publicity and investment, vigorously carry out environmental protection publicity and education, comprehensively improve citizens' awareness of environmental protection, and make environmental protection become the conscious behavior of every citizen(Li Fang,2016). At the same time, the managers and supervisors of ship pollution should also be allowed to strengthen training, business learning and communication, broaden their horizons, let the concept of environmental protection take root in the mind, know the law and abide by the law, and strengthen the supervision of public opinion, endow and guarantee the right to report malicious illegal acts such as sewage discharge, and encourage the public to actively participate in the supervision of environmental illegal acts.

CONCLUSIONS AND PROSPECTS

With the deepening of China's reform and opening-up, Guangdong Province's economy and society develop rapidly.The rapid development of water transportation, ship sewage demand also increased. At present, inland river ships in Guangdong Province still take measures to prohibit garbage discharge, oily water and domestic sewage discharge up to standard. However, driven by economic interests and other factors,pollutant receiving and disposal system is not perfect, the phenomenon of ship pollutants secretly discharge, direct discharge still exists, these behaviors have bad influence and great harm.

Based on the advanced experience of ship pollution prevention and control at home and abroad, combined with much first-hand field investigation data and practical problems of field feedback, this paper analyzes and studies from the perspective of location in Guangdong Province, and obtains the following results:

(1) At present, with the rapid development of shipping, the pollution of ships has a great impact on the environment, and Guangdong Province has carried out various effective pollution prevention work of ships, but its impact and harm to the environment can not be ignored.

(2) With the introduction of the "Ten Water Articles" of the State Council, there are clear indicators and requirements for the prevention and control of marine pollutants, but from the point of view of measurement and evaluation, there are still a large number of marine pollutants that have not been effectively received and disposed of and become a major hazard of environmental pollution.

(3) In order to effectively rid itself of the environmental impact of ship pollutants, we should strengthen industry supervision and ensure the smooth implementation of "zero discharge" of ship pollutants by taking measures in the areas of legislative norms, funds, institutions, mechanisms and scientific and technological innovation

In this paper, an on-line real-time monitoring system for domestic sewage production is designed. The operation of the system controls the direct discharge of pollutants from ships from the source. Through the rational layout of fixed receiving devices and

mobile receiving devices for ship pollutants, the receiving capacity is greater than the amount of ship pollutants produced, and the timely and effective discharge of ship pollutants is ensured.

Expectation

Due to the limitation of time and ability, this research has only made a preliminary study and analysis on the technical route of "zero discharge" of pollutants from ships. Ship domestic sewage is an important and main pollutant to water pollution. This paper mainly studies the real-time monitoring system scheme of ship domestic sewage production and the rational layout of receiving facilities. Ship pollutants can truly achieve "zero discharges ". Therefore, whether in the human, material and financial input, or in the ship pollution prevention science and technology innovation, there is still a lot of research work to be completed.

REFERENCE

Bao Guoling ,&Liu Jianhai.(2011).*Discussion on supervision of pollutant from loose liquid vessels in inland waters*[J].China water transport.44-45.

Chen Junmian.(2011).*Ship pollution accident and prevention of pollution management countermeasures*[[J]].China marine.18-21.

Deng jian,et al.(2014).*On-line monitoring system for pollutant discharge from inland water vessels*[J].China sailing.293-96.

Duan Suwen.(2015).*Study on the problems and countermeasures faced by inland water vessels in preventing pollution*[[J]]. Transportation energy saving and environmental protection.47–52.

Eide M S, et al.(2007).*Intelligent ship traffic monitoring for oil spill prevention: Risk based decision support building on AIS* [J]. Marine Pollution Bulletin.

E. Merico,A. Donateo,A. Gambaro,D. Cesari,E. Gregoris,E. Barbaro,A. Dinoi,G. Giovanelli,S. Masieri,D. Contini(2016). *Influence of in-port ships emissions to gaseous atmospheric pollutants and to particulate matter of different sizes in a Mediterranean harbour in Italy*[J]. Atmospheric Environment,139.

Fu M,et al.(2013). *Real-world emissions of inland ships on the Grand Canal, China[J]. Atmospheric Environment*. 222-229.

Goldsrorthy L,&Goldsrorthy B. (2015).*Modelling of ship engine exhaust emissions in ports and extensive coastal waters based on terrestrial AIS data—An australian case study*[M]. Elsevier Science Publishers B. V.

Huo Yan,&Qin Qi.(2013.2)*"Z." emission ship design.*China Ship Survey.

Li Fang.(2016).*Strengthen oversight over oil pollution from inland ships*[[J]].China water transport.40-41.

Li Shu,et al.(2012).*The influence of pretreatment* on *membrane pollution in ship sewage treatment preparation*[[J]] .The ship sea engineering.63-66.

Liu Xiyuan.(2006).*Technical proposal of the ship sewage treatment system* [[J]].China ship research.54-56.

Liu Yuanfang.(2008).*Strengthen supervision over the receipt of pollutants from ships at ports*[[J]]. China water transport.20–21.

Luo Guishan,et al.(2012).*Current status and development trend of pollutant treatment technology for ships*[J]. Ship standardization engineer.48-51.

Norlund E K,&Gribkovskaia I.(2016). *Redlueing emissions through speed optimization in supply vesseloperations* [J] Transportation Research Part D ,Transport&Environment.105-113.

Qu Baoxia.(2012).*Discussion on the anti-pollution management of inland waterway*

vessels[J].Management informatization in China. p100.

Ren J,&Luzon N.(2015). *Fuzzy multi-criteria decision-making method for technology selection for emissions reduction from shipping under uncertainties*[[J].Transportation Research Part D.43–60.

Schwehr K D,&Mcgillivary P A.(2017). *Marine Ship Automatic Identification System(AIS)for Enhanced Coastal Security Capabilities*: An 0il Spill Tracking Application[C]//Oceans.

Stevens L. *Assessing the changing risk of oil spills and oil movements*.n.d.

Sun Jianwei,&Qiu Chunxia.(2014).T*he application of on-line monitoring system of pollution source in the supervision of inland water vessel pollution*[[J]].China sailing.47-49.

Tichavska M,&Tovar B.(2015). E*nvironmental cost and eco-efficiency frogm vessel enissions in Las Almas Port*[[J] Transportation Research Part E.126-140.

Xie Qiu.(2011).*Analysis on the shore receiving mode of pollutants from inland water vessels*[J]. Technology information.p360.

Zee S C V D, et al.(2016) .*The impact of inland ships and recreational boats on measured NO x, and ultrafine particle concentrations along the waterways*[J]. Atmospheric Environment.368-376.

Zhang Zhongying,&Liu Lijun.(2009).*A brief analysis of ship antifouling*[J].China water transport monthly.42-43.

Zhang Zhifeng.(2005).*Pollution control measures for ships*. Water management.24–25.

Zhu Liang, &Zhu Mingyue.(2008). *Prevention and control of water pollution caused by inland water vessels*[J].China shipping.289–292.