

The Problems and Countermeasures of Domestic Sewage Treatment of Coastal Ships and Ships Berthing in Port

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Abstract

The current new version of the "Ship Water Pollution Discharge Control Standard" (GB3552-2018) is higher than the requirements of the Convention in terms of domestic sewage discharge. Through research and actual investigation of current domestic and foreign relevant conventions, laws and regulations, the current coastal and harbor domestic sewage from ships For the problems of discharge, countermeasures and suggestions for the discharge and reception of domestic sewage from ships in the coastal and harbors are proposed, so as to promote the further improvement of the level of compliance and pollution prevention supervision of domestic sewage from ships in the harbor and coastal areas.

Keywords

Domestic sewage; Discharge standards; Coastal ships; Berthing in port.

1. Introduction

On July 1, 2018, the "The Standard for The Control of Water Pollution Discharge from Ships" issued by the State Ministry of Ecology and Environment, hereinafter referred to as "GB 3552-2018", came into force. Among them, the discharge standards for domestic sewage from ships are higher than the existing regulations and MARPOL73/78 convention. This standard is a mandatory standard under the law of the People's Republic of China on the prevention and control of water pollution, and has a retroactive character to the existing ships. Therefore, it is necessary to carry out a comparative study of the relevant discharge requirements of the MARPOL73/78 Convention Annex IV to the "GB3552-2018", clarify the emission control standards, and improve the ability of law enforcement to investigate violations, to avoid the pollution of port waters by the domestic sewage of foreign vessel in port and the resulting detention and administrative penalty by PSC. At the same time, we will actively solve the existing difficulties and problems, and promote the improvement of relevant infrastructure facilities and supporting laws and regulations in domestic ports, so as to meet the need of pollution prevention in the discharge control of domestic sewage under the new situation, promoting the coordination of environmental protection and port economic development.

2. Definition of " Ship Domestic Sewage" in International Conventions and Domestic Regulations

According to the Water quality, the daily life drainage of the crew can be divided into "black Water" and "Grey Water" two types. "Black Water" is the convention definition of "ship sewage" sewage.

According to MARPOL73/78 ANNEX IV: "sewage" means "(1) drainage and other wastes from any form of toilets and urinals; (2) drainage from medical premises (dispensary, sick bay, etc.) via wash basins, wash tubs and scuppers located in such premises; (3) drainage from spaces containing living animals; or (4) other waste waters when mixed with the drainages defined above". In brief, "ship living sewage" commonly known as "Black Water", is generally a higher

pollutant content of the flushing drainage, that is, fecal sewage, must be treated by domestic sewage treatment facilities before discharge. "Gray Water" is relatively "black water" to say, generally refers to the less pollution of the bath, kitchen, laundry and other waste water. Generally speaking, in the ship life waste water, the limited discharge is only "the black water", only when "the gray water" mixes has the excrement drainage to need to be treated.

The domestic regulation "GB 3552-2018" is consistent with the definition of "ship domestic sewage" in MARPOL convention.

3. Necessity of Preventing Pollution of Sewage from Ships

The harm of domestic sewage from ships to the waters in harbor has two main points:

(1) The influence to the water environment. The natural purification process of water environment is that bacteria and other microorganisms use dissolved oxygen in water to decompose organic matter into inorganic matter and carbon dioxide. Although this natural purification process is very slow, it is still an equilibrium process, and the determining factor to maintain this equilibrium is the dissolved oxygen content. If a large amount of domestic sewage from ships is discharged into the water environment without treatment, a series of biochemical actions will take place, which will reduce the dissolved oxygen content in the water and destroy the natural purification process and balance of nature of the water environment, it changes the ecological characteristics of water environment and causes the death or migration of fish and other animals in water environment. When the concentration of the nutrient salt in the ship sewage reaches 0.01 mg / l, the algae will grow and multiply excessively, the eutrophication will occur, the dissolved oxygen content in the water will be reduced, and the ANAEROBIC condition will occur, the Marine Flora and fauna in the good gas community (such as fish) by the low-level anaerobic community (MOLLUSCA) replaced. The destruction of natural purification process of water environment, together with the existence of suspended solid in domestic sewage, will also have a more serious impact on the resources of bathing beach and fishing ground.

(2) Impact on human health. Each milliliter of untreated faecal wastewater contains about one million bacteria, most of which are disease causing bacteria that can spread a variety of intestinal infections. If sewage from faeces is not sufficiently treated to kill disease-causing bacteria, it can contaminate water sources and spread such diseases, posing a threat to human health. Due to the shorter discharge cycle of the ship sanitation system, the discharged sewage is fresher and less decomposed than the urban drainage system, so the pollution load is higher. And because of the concentration of personnel, the quality and quantity of drainage water vary greatly, so it is necessary to put forward higher requirements for its discharge control.

4. Existing Convention Policies and Regulations

4.1. Regulatory Requirements to Be Met Bycoastal Vessels

On July 1, 2018, the "Discharge standards for water pollutants from Ships" (GB3552-2018) was enforced. It applies to ships of 400 gross tonnage and above; and ships of less than 400 gross tonnage which are certified to carry more than 15 persons. It is clearly definite that in the inland water and sea area within 3 nautical miles from the nearest land, if the ship needs to discharge domestic sewage, domestic sewage treatment device should be used, and the domestic sewage should be discharged when the ship is en route and proceeding after achieved the discharge standard. In addition, the GB3552-2018 national standard not only adds new water pollutant indicators such as noxious liquid substance, but also proposes stricter standards and emission requirements for water pollutant control indicators, such as the addition of total nitrogen and total phosphorus. And the limitation standards such as total suspended solids (TSS),

biochemical oxygen demand (BOD) has also raised. GB3552-2018 national standard emission index requirements are shown in Table 1.

Table 1. Requirements of the new national standard on ship domestic sewage discharge indicators

	Device installation time		
	Before 2012.1.1	2012.1.1 and after	2021.1.1 and after (passenger ship)
SS/(mg/L)	150	35	20
BOD5/(mg/L)	50	25	20
COD/(mg/L)	NR	125	60
Number of heat-resistant coliforms/(PCS/L)	2500	1000	1000
pH value/(Dimensionless)	NR	6~8.5	6~8.5
Total chlorine/(mg/L)	NR	<0.5	<0.5
Ammonia nitrogen/(mg/L)	NR	NR	15
Total nitrogen/(mg/L)	-	-	20
Total phosphorus/(mg/L)	-	-	1

According to the domestic regulations and the requirements of the "Discharge standards for water pollutants from Ships" for the ships' domestic sewage treatment systems, in the sea area within 3 nautical miles (inclusive) from the nearest land, ships' domestic sewage shall be treated in one of the following measures, and shall not be directly discharged into Environmental water body:

- Collected by ship's domestic sewage collection device and discharged into receiving facilities.
- Treated by shipboard domestic sewage treatment device, and discharged during ship is en route and proceeding after meeting the requirements of Table 2.

Therefore, according to domestic regulations and standards, the discharge standards of coastal ships within 3 nautical miles from the nearest land are higher than the requirements of the MARPOL Convention, and it is also clear that coastal ships cannot discharge domestic sewage during their berthing at berth terminals and during their anchorages. The nearest land in the standard is defined as the baseline of the territorial sea closest to the location.

4.2. Regulatory Requirements to Be Met by Foreign Ships Arriving at the Port

For China's foreign ships to port, to meet the relevant requirements of the convention, should also comply with China's legal requirements, that is, according to GB3552-2018 for domestic sewage discharge control requirements.

The scope of application of "GB3552-2018" is consistent with Annex IV to the MARPOL73/78 CONVENTION: Applies to ships of 400 gross tonnes and above, and to ships of 400 gross tonnes or less carrying 15 persons or more under an approved permit.

For the discharge control of domestic sewage, "GB3552-2018" is basically consistent with MARPOL73/78 convention in most of its discharge standards, but some of its "five-day biochemical oxygen demand, suspended solids (SS) " and other indicators are stricter than the requirements of international conventions, and even if the quality of the treated water reaches the standard through the domestic sewage treatment plant, it is only allowed to be discharged during navigation, and the route speed is not less than 4 knots.

Therefore, the most obvious thing about GB3552-2018 is that it has different requirements on emission control: for the emission control within 3 nautical miles from the nearest land, GB3552-2018 requires emissions during navigation after reaching the emission limit,

international Conventions, on the other hand, only state that no visible floating solids and no discoloration are required when the treatment reaches the discharge limit and is discharged into the surrounding waters. In fact, in many countries such as South Korea, the "prohibition of direct discharge into the sea" is also adopted for domestic sewage from ships berthed in ports, which is higher than the requirements of the convention, the ultimate goal of such "harsh" requirements is to achieve the port coastal waters of ships living sewage "zero discharge "

4.3. Difficulties Are Found for the Sewage Treatment of Coastal Ships

On July 5, 2018, the Ministry of Transport issued the "Notice on the implementation of Discharge standard for water pollutants from ships", and put forward deadlines for rectification of ships that fail to meet the standards, which should be completed by the end of 2020 at the latest. Therefore, coastal ships that currently failed to meet the standards are facing with the problems of tight time, high requirements, extensive coverage and traceability. Through the survey of relevant departments and owners such as docks, shipping companies, sewage treatment companies, the following difficulties are found for the sewage treatment of coastal ships:

4.3.1 It is difficult for existing domestic sewage equipment to meet new discharge standards

1. Because the new national standards (GB3552-2018) has a higher requirement than the MARPOL Convention in the sea areas within 3 nautical miles from the nearest land for sewage discharge, and some ships are currently equipped with domestic sewage equipment in accordance with the MARPOL Convention. Therefore, even if the equipment is in the normal service condition, it still cannot meet the new national standard requirements.

2. The quality of some coastal ships' crew is low and their awareness of anti-pollution is not strong. Many of the crew don't have the operational capabilities for domestic sewage treatment devices. Therefore, even if equipped with domestic sewage treatment devices in the ships, it has become a decoration because nobody can operate it. Illegal discharge of domestic sewage occurs from time to time during the voyage proceeding, and the discharging status cannot be accurately monitored.

3. There is no uniform standard for the records of domestic sewage disposal. At present, only the time and location of discharge are recorded in the engine log. There is no unified format standard. If illegal discharge occurs, information like the location and quantity of domestic sewage discharged or received cannot be accurately verified.

4.3.2 Difficulty in reform existing ships

1. Existing ships without any domestic sewage treatment device are restricted by the factors such as ships' age, type and tonnage etc, and there are prominent problems such as narrow engine room space, difficulty in reforming domestic sewage pipelines, and time limit, especially the small gross tonnage passenger ferries which are certified to carry more than 15 persons, the space in engine room is extremely narrow, which makes it very difficult to find enough space for a holding tank with sufficient capacity. In addition, according to the existing policy, the time for reforming is very urgent. If the standard is strictly implemented according to the requirements, then the ships must design drawings, submit drawings for review, and immediately suspend operation for actual rebuilding, which is great difficult to some ships.

2. It is difficult for some ships to reform due to insufficient capacity of sewage holding tanks. For a long time, coastal ships can discharge their sewage anytime and anywhere though sewage treatment devices while meet the standards, and because of this, most ships do not keep sewage holding tanks with sufficient capacity. But according to the requirements of new national standard (GB3552-2018), ships cannot discharge sewage while at berth and anchorage condition when in the port, and the domestic sewage treatment device is very easy to be filling up. Therefore, due to insufficient capacity, it is extremely urgent for some coastal ships to add

sewage holding tanks. However, for some existing ships with smaller scales, the layout of the ship is very compact, so it is very difficult or even impossible to find a space for the holding tank.

3. Ships owners' willingness to reform is not strong. Due to the high cost of reconstruction, after the installation of sewage collection and storage devices, the cost of disposing to the shore is high, have illusions about the policy and so on, some ship owners still maintain a wait-and-see attitude, especially for some old and small tonnage ships, Owners continue keep waiting till the last minute, and their willingness to reform is not strong.

4.3.3 Difficulty in receiving and transshipment onshore

1.Domestic sewage is different from the ship's oil residuals and oily water, there is no recycling value. The treatment also requires high costs, which severely restricts the development of professional recovery team for domestic sewage by the pollution cleaning company, resulting in the lack of ship domestic sewage receiving project.

2. For most wharves, especially faraway wharves, there is nothing domestic sewage receiving facilities at all, and cannot connect to the urban domestic sewage pipe network. Even if the ships want to pump domestic sewage to shore, they cannot do it because of the lack of receiving abilities of the wharves.

3.There is very few domestic sewage receiving ships in the port. Most domestic ports only have oily water receiving ships, but no domestic sewage receiving facilities or ships. Although a few ports have the ability for receiving sewage, normally they refuse to do that due to the poor economic benefits or the difficulties in subsequent treatment.

4.4. Difficulties Are Found for the Sewage Treatment of Foreign Ships Arriving at the Port

1 The port receiving service ability is not perfect

Generally speaking, the main problem of domestic sewage disposal in domestic and foreign ships is that it is difficult to dispose domestic sewage by domestic sewage receiving facilities.

Under the current new National Standard "GB3552-2018", berthing ships can not discharge domestic sewage into the sea. The storage capacity of the waste collection tank on the ship alone is often insufficient for the ship with a long time in port. This is especially true in shipyards that repair foreign ships. The waiting time of foreign ships at the dock is often more than half a month, and even if the dockyard has installed domestic sewage reception facilities, it is also a decoration, and there is no supporting municipal sewage pipe network, the outer ships in the dockyard face the dilemma of no one to receive them when they want to be discharged ashore.

However, the sanitary condition of the working place of the crew can not be satisfied if the waste collection tank overflows to the bottom of the tank. It is also illegal for some ships to discharge domestic sewage into the oil tank or ballast tank by pulling the pipeline without permission, which may result in the detention of PSC or even administrative penalty. Even if the PSC inspector does not treat the defect as a detention, the program will usually require a reasonable explanation from the shipowner or classification society. For example, a defect during a round of PSC inspection is stated as "Overflow pipe from sewage treatment plant flow into bilge water tank". The sewage treatment system overflows into the bilge water tank. Treatment Code 99, the correction is "Check with class to confirm retention tank" and ask the classification society to confirm the collection tank.

The domestic sewage is different from the ship residual oil matter, has no recycling value, the recycling treatment is completely the consumptive type, including the artificial, the equipment investment maintenance, the transportation and so on high processing expense. Although now under the promotion of the port government, some clean-up companies also try to start a record of domestic sewage reception business, but face many obstacles, less demand,

profitability and received domestic sewage difficult to deal with many problems. Therefore, the current port of domestic sewage reception and treatment capacity of ships is still very low.

2 New Issues in epidemic prevention

Since 2020, the prevention of new coronavirus has become a top priority. In order to prevent the disease from entering China with foreign vessels, domestic sewage from foreign vessels is strictly controlled. Because the ships living sewage and the living garbage may cause the virus transmission the shipping way. If it is necessary for a port enterprise to receive and handle it, it shall receive and transship it according to the requirements of the frontier health and quarantine law and other port health and quarantine measures, so as to avoid pollution contact. But at present only a very small number of approved with higher quality capacity of the receiving units to accept, otherwise generally not allowed to receive domestic sewage from foreign ships. In the future, the epidemic prevention and control of domestic sewage from ships will probably become the normal situation. Therefore, the problem of high receiving threshold and few receiving units will greatly increase the difficulty for the disposal of domestic sewage from foreign ships berthed in the harbor.

3 Difficulties in law enforcement of illegal discharge of domestic sewage

Emissions violations are difficult to detect. Domestic sewage directly into the port waters, it is easier to dilute desalination, unless caught on the spot, otherwise illegal discharge is difficult to be found. Law enforcement officers rarely go to the scene at night, port control facilities can not film the ship sewage outlets, some of the port berthed foreign ships in the night illegal discharge of domestic sewage. Especially, the domestic sewage discharged by the domestic sewage treatment device is more concealed and difficult to be found from the appearance of the discharged water. However, the record of domestic sewage storage and treatment on ships is not perfect. MARPOL73/78 73 / 78 Annex IV and GB3552-2018 have not put forward the uniform compulsory requirement of "domestic sewage record book" , or simply do not do continuous records, the cost of violations is very low, to law enforcement supervision caused great difficulty.

5. Countermeasures and Suggestions

5.1. Improve Port Reception Facilities as Soon as Possible

The need to rely on ports to provide adequate reception facilities is therefore an important guarantee for the effective implementation of the MARPOL73/78 convention. The "zero tolerance" policy of illegal discharge from ships can only be achieved if sufficient receiving facilities are provided in ports. The Convention requires contracting governments to ensure the provision of port reception facilities, these reception facilities are suitable for receiving residues from ships that can not be discharged into the sea and which fully meet the normal needs of arriving ships without undue delay. The For sewage from ships, the MARPOL73/78 Convention Annex IV sets out the mandatory requirement for port reception facilities, according to regulation 12.1: "The Government of each Party to the Convention, which requires ships operating in waters under its jurisdiction and visiting ships while in its waters to comply with "the requirements of regulation 11.1" (ie: the regulation on prohibition of discharge of sewage into the sea"), undertakes to ensure the provision of facilities at ports and terminals for the reception of sewage, without causing delay to ships, adequate to meet the needs of the ships using them" . Considering the current reality, compared with the scale of our country's port transportation, our country has not paid enough attention to the construction and operation of reception facilities, especially shipyards, especially some old ports, reception facilities do not have or have limited capacity to receive and treat waste.

5.2. Supporting the Construction of Port Terminal Receiving Units

The receiving unit of domestic sewage of the port terminal receives the third kind of domestic sewage which goes beyond the discharge of ships and the reception of port reception facilities, especially when the basic reception facilities of the port are insufficient, it can solve the urgent problem of foreign vessel in port quickly. It is suggested that port government departments should take into consideration such policies as perfecting laws and regulations and government subsidies to guide and support the establishment and development of port domestic sewage reception industry when the construction of port reception facilities is insufficient, it is a beneficial supplement to the port receiving facilities and an important step to gain the advantage of the port development and the ship service industry of the live port.

5.3. Push Forward the Amendment of the Convention to Establish A Unified "Record Book of Ship's Domestic Sewage Discharge" System and Make It Mandatory

Annex IV of MARPOL73/78 73 / 78 does not provide for a uniform mandatory requirement for a sewage record book. However, in the ship safety management system for foreign ships, there is a "domestic sewage record book" which stipulates that the company's ships shall use the same format and record requirements to record the amount of domestic sewage produced, treated and discharge up to the standard, this approach has been widely accepted. It is suggested that maritime affairs and other relevant authorities should make further study and write it into the amendment proposal of IMO Convention, popularize this practice and establish a scientific and unified "record book of ship domestic sewage discharge" system.

5.4. Installation of An Electronic Flowmeter in the Discharge Line

Installation of more advanced electronic flow meters at appropriate locations in the pipeline behind the sewage discharge pump to automatically record the quantity of sewage discharged overboard, and not to tamper with or stop the use without permission, so as to facilitate law enforcement officers to access the relevant discharge records, it is proposed to incorporate this measure into the requirements of Annex IV of MARPOL73/78 convention in order to realize the control of domestic sewage discharge and effectively prevent illegal discharge by vessels.

5.5. Adapt to the New Normal of Foreign Ship Epidemic Prevention, Scientifically Control and Discharge of Domestic Sewage Epidemic Prevention

The port authorities shall strictly comply with the relevant regulations and documents of the state and various localities, such as the "guidelines for the prevention and control of the importation of "new crown pneumonia" by port enterprises, the "frontier health and Quarantine Law", etc., to implement the management of the epidemic prevention measures for foreign ships and the discharge and reception of domestic sewage in ports, to vigorously develop and enhance the epidemic prevention capacity of the domestic sewage reception and treatment enterprises in ports, and to realize the rational allocation of resources, while effectively avoiding epidemic prevention and pollution, the proper reception and disposal of domestic sewage from foreign ships can be realized.

5.6. Continue to Strengthen the Publicity of Ships to Prevent Domestic Sewage Pollution

In order to completely realize the "zero discharge" of domestic sewage from ships in port, we should not only strengthen supervision and control, but also strengthen education and guidance, through publicity and education, and increase the public awareness of environmental protection.

6. Conclusion

The wastes generated during the operation of ships, if discharged directly into the sea without proper reception and treatment, will cause great damage to the marine resources and human health. Environmental protection is the need of the next transformation and upgrading of China's social economy, and the goal of water resources protection is bound to have higher requirements for the control of ship's domestic sewage discharge. I hope that the government departments of the port area will pay more attention to the research and construction work, so that the "last kilometer" of sewage collection and treatment can be guaranteed. At the same time, while strengthening law enforcement and publicity efforts, the competent port authorities should also actively provide professional advice, promote the further improvement of the convention's laws and regulations and the technical specifications for ship inspection, and strongly urge foreign ships to implement measures to prevent pollution of domestic sewage, put an end to the pollution of domestic sewage from ships at the source, and protect the "blue sky and clean sea" of Chinese ports.

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