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Source / Izvornik: **Pomorski zbornik, 2021, 61, 79 - 89**

Journal article, Published version

Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

<https://doi.org/10.18048/2021.61.06>.

Permanent link / Trajna poveznica: <https://urn.nsk.hr/urn:nbn:hr:187:587750>

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Download date / Datum preuzimanja: **2024-05-23**



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Abstract

The paper presents the legislation of Croatia and the EU on the prevention of sea water pollution by wastewater from boats, yachts and other smaller vessels. The authors analyse the key legal determinants and explain their impact on the pollution caused by the discharge of wastewater from boats, yachts and other smaller vessels. The specifics of the Adriatic Sea with regard to potential pollution are determined and the previous experiences and effects on the environment are explained.

It's a fact that the national legislation is not effective enough in matters of marine environmental protection, which is why the authors propose changes and qualitative solutions. A review of previous research has shown that there are appropriate solutions and interest from boaters in terms of using appropriate receiving stations for the reception of wastewater from vessels and boats. A SWOT analysis was made where the strengths and opportunities for the establishment of an appropriate system of receiving stations were identified.

Keywords: wastewater, receiving stations, protection of the marine environment, SWOT analysis

1. Introduction

Discharge of wastewater into the sea and disruption of the purity of the sea and marine environment is a fundamental problem of modern, technologically advanced society. Recreational sailing activities can affect the environment due to regular nautical activities (anchoring, mooring, sailing) or accidents (collision, grounding, sinking ...). Operational pollution includes intentional or unintentional discharge of: oil (fuel), sewage, garbage, paint fouling, air emissions, as well as light and noise pollution. [5] Long-term wastewater discharge can have severe consequences in the form of unusability of the sea and coastal area. Destructive effects on underwater flora and

fauna, disturbance of fish stocks and biodiversity. The topic of discharging wastewater from boats, yachts and other smaller vessels has been researched and articulated by many authors. The authors (Szopinska et al, 2021) found that the special properties of wastewater generated at polar research stations can have direct consequences on the Antarctic ecosystem. [14]

Existing literature has been systematically researched to gather information and facts about the potential negative environmental impacts of nautical navigation and tourism on the marine environment. Wastewater poses a danger to public health if discharged into waters used for recreational activities such as swimming, diving and nautical tourism. Damage caused by increased illness or mortality due to ingestion or skin contact with contaminated water causes direct health care costs and indirect opportunity costs. [6] In order to achieve the goals of protection of the sea from wastewater from boats, yachts and other smaller vessels, it is necessary to enact new legislation because according to current legislation it is impossible to control their discharge into the marine environment i.e. the Adriatic Sea. We also know the capacity of each tank on the boats, so the control of unauthorized and uncontrolled discharge into the sea would be easier to implement. All this would result in a reduction in marine pollution despite the rapidly growing number of vessels in the Adriatic Sea. Unlike commercial vessels in international navigation, commercial vessels in national navigation do not have built-in purifiers but only wastewater tanks.

Also, the fact is that the design and installation of purifiers on vessels is extremely complicated, demanding and sophisticated for such small vessels. In the context of the mentioned issue, the structure and implementation of the model of receiving stations for wastewater from boats, yachts and other smaller vessels will be also argued in the economic sense. The scientific problem of the research will be defined and a solution for involving the local community in the protection of ecosystems or marinas (ports) will be offered.

2. Legislative framework

Legal acts defined the manner of discharge, technical treatment and purification of wastewater from boats, yachts and other smaller vessels. However, national regulations and regulations have not offered good enough solutions for wastewater reception. For this purpose, the paper identifies and proposes measures for the reception, transport and storage of wastewater from boats. The most important legal act in Croatia is the Ordinance on boats, vessels and yachts, which states that the discharge of sanitary wastewater into the sea is not allowed. These fluids must be retained on board. [13] Wastewater is retained on board until disposed of on land.

However, the Ordinance does not define detailed control and mechanisms for controlling the discharge of wastewater into the sea. Namely, at the moment, yachtsmen and boat owners can freely discharge wastewater into the sea because there is no real control. During 2020, due to the COVID pandemic, the number of vessels was

reduced to about 100,000, more precisely 121,536 vessels in transit. [8] In previous years, the number of vessels was continuously around 200,000. For example, in 2017 there were 202,000 vessels in transit [9], in 2018 there were 194,164 vessels in transit [10], and in 2019 there were 204,858 vessels in transit in the Adriatic Sea [11] and it is advisable to ask the question of increasing the risk of marine pollution by black wastewater from boats.

Taking into account the statistics and the fact that Croatia has over 30,000 km² of coastal sea, more than 1,200 islands, reefs and cliffs as one of the characteristics of Croatia, nautical tourism naturally imposes itself as tourism of exceptional value and guests of high purchasing power. Also, it was noticed that nautical tourism significantly prolongs the tourist season. Therefore, it is extremely important to determine the possibilities of construction and development of wastewater reception stations in such a way as to ensure that each port or marina has one. It is important to point out that there are already developed technologies in the world that convert sewage sludge as an integral part of wastewater into bio-coal, which achieves extremely high prices on the market due to the fact that it greatly increases soil fertility. According to the current capacities and operations of nautical tourism ports, it is clear that the construction of reception stations is necessary. According to the Central Bureau of Statistics in nautical tourism ports, on 31 December 2017 there were 13 thousand vessels on a permanent berth [9a], on 31 December 2018 there were 13 617 vessels on a permanent berth [10a], on 31 December 2019 on a permanent berth there were 14,249 vessels at berth [11a] and on 31 December 2020 there were 14,312 vessels at berth [8a]. At the present stage, knowing and studying the behavior and habits of boat owners speaks in favor of the fact that the landing of wastewater on land should be free of charge.

It should be emphasized that the term wastewater includes already used water that can no longer be used for other purposes during navigation. The issue of wastewater on boats has its peculiarities primarily due to the limited storage on board the vessel. Therefore, it is necessary to take care when intervening in the area of the marine environment. Also, it is important to emphasize that wastewater contains organisms that cause disease in humans and in larger quantities can negatively affect fishing.

The authors (Vodopija et al, 2001) state that marinas are the most elite part of the tourist offer. Luxury yacht owners accustomed to a high standard of living consume significant amounts of water. In our marinas, we have provided them with a connection for drinking water, which they can then freely use on their vessels. Unfortunately, the issue of removing wastewater from these boats has not been adequately addressed. [15] Definitely a step forward that is indirectly related to the construction of the infrastructure of wastewater receiving stations from boats is the simultaneous construction and change of the concept of the sewerage system of larger Croatian coastal cities. This prevented decades of discharge of wastewater directly into the sea. The most recent example is the city of Pula and the associated bay. The construction of reception stations would greatly reduce the fecal burden on the marine environment and multiply economic opportunities.



Image 1: An example of a marina

*Source: <https://croatia.hr/en-GB/experiences/nautical/aci-marina-pula>,
[Accessed on October 5th 2021].*

One of the consequences of wastewater discharge is turbidity and unpleasant smell of the sea, which negatively affects the development of the tertiary sector, i.e. tourism, aquaculture and the fishing industry, which have a significant impact on GDP. The author (Koljatić, 2001) finds that the Adriatic is threatened by many pollutants. Due to geomorphological, ecological and demographic factors, not all parts of the Adriatic Sea are equally exposed to pollution and its consequences. The most endangered area is the shallow and closed northern Adriatic, with its urbanization, tourism and maritime economy. [12] Directive 2008/56/EZ of the European Parliament and of the Council contributes to the coherence of the various policies, agreements and legal measures having an impact on the marine environment and seeks to ensure that environmental issues are included in them. [4] Regarding the correlation of national regulations (since boats, yachts and other smaller vessels are regulated by national regulations) and EU legislation, it is extremely important to know that all EU member states are obliged to comply with all EU directives, conventions and agreements, although at EU level, there is no one, sole piece of legislation on the protection of the marine environment. Certainly, the sea and the marine environment is an extremely sensitive area and potentially exposed to various pollutants and risks. The regulation that encroaches on the protection of the marine environment is also the Law on Waters, which refers to groundwater and surface waters, including coastal waters, except when otherwise regulated by this Law or a special law. Furthermore, the provisions of this Act also apply to: - territorial sea waters in terms of their chemical status. [17] The Environmental Protection Act states that the protection of the sea includes measures to protect the

marine environment including the marine ecosystem and the coastal area as indivisible units, the prevention of harmful interventions with negative consequences for the marine ecosystem. [18]

Accordingly, the analysis determined that the receiving stations are necessary in the function of protection of the marine ecosystem, in order to collect wastewater and adequately transport, treat and store it.

3. Results and discussion

The construction of wastewater reception stations from yachts, boats and other vessels in marinas and ports would largely solve one of the biggest problems facing today's society. In order to achieve a high level of protection of the marine environment from wastewater, the system should be set up in two ways. The legislation must enable the local community to establish a service with which a 'local' boat could reach each yacht or vessel, and the operator would collect wastewater at the request of boaters when docking in the marina. This service would be in the 'catalog' of free services provided by each marina or port.



Image 2: Wastewater collection vessel from nautical vessels, yachts and boats
Source: <https://www.cei-marine.com/en/products/mobile-pumping-station.html>,
[Accessed on October 5th 2021].

As an alternative model, the construction of conventional wastewater reception stations from vessels should be ensured, through which sailors would be allowed to discharge these waters on a daily basis. A definite step forward for society would be to build and ensure that each port (marina) has a wastewater catchment. The construction of wastewater collection stations would create the effect of new employment. It is necessary that each boat has, for example, a kind of control card, which we will talk more about in the following chapters of this research. Also, each local community would have its own dedicated vessel that would reach each boat that anchored and connected the associated tank and thus collected wastewater.



Image 3: Sewage pump in the marina (nautical port). Copengahen, Danska

Source: https://dbw.parks.ca.gov/?page_id=28771,

[Accessed on October 5th 2021].

Studies examining the social behavior and common habits of owners of yachts, boats, and smaller vessels in general say that it is a personal characteristic of sailors that even though they are wealthy, they do not waste money. The author Cottrel states that, for example, mobile pumping stations are relatively cheap and easy to use, which can encourage the further use of people of both sexes of old age and owners of large vessels. [3] It is assumed that the introduction of service charges would cause a counter-effect. For this reason, the effect would be greater if the reception of wastewater into the station was free of charge, i.e. included in the nautical fee. Such a design and performance would highly motivate boaters to behave even more in accordance with the preservation of the marine environment. Regarding the protection of the marine environment, the authors (Carreno et al, 2001) conclude that only a holistic approach that considers all these different actions will allow the impact of recreational navigation

in the Mediterranean and other parts of the world to be reduced. [2] There is great doubt as to how much the waste collection station will have a negative impact on the environment. For this purpose, it is necessary that the wastewater receiving stations do not have an impact on the surrounding properties and the environment. The authors (Koboević et al, 2018) state that the causes of ineffective protection and preservation of the sea are numerous and complex. Apart from economic, political and other differences between countries and the problem of limited sources of funding, environmental protection still has a low political priority in some countries and there is little public awareness of environmental issues in these countries. [7]

It has been observed that there are potential irreversible negative effects due to the action of wastewater from boats on the issue of biodiversity of living organisms of the marine ecosystem. It is necessary to point out the legal obstacle that large vessels must have built-in devices for wastewater treatment, while smaller vessels are not required to do so, and the latter are large pollutants of the marine environment. Measures and procedures need to be agreed which, depending on the circumstances, would prevent, predict or at least limit pollution of the marine environment. The author (Alvarez, 2021) notes that insurance, ship search and rescue services, lobbies, NGOs, P&I clubs, shipowners, etc. have been working together for decades to prevent marine pollution. [1] Therefore, the marine ecosystem protection model requires new options and solutions that would reduce potential pollution caused by wastewater from boats and minimize it.

4. Suggestions and measures

It is important to adopt and elaborate regulations at the state level on the prohibition of the discharge of treated and untreated wastewater into the marine environment for all boats, yachts and other smaller vessels, regardless of the number of passengers. The capacity of each wastewater tank on each boat or yacht is known and in that case it would be much easier to control the unauthorized discharge. The design of receiving stations for collecting wastewater from vessels in nautical marinas must be automated. It is necessary to provide a permanent system for monitoring wastewater discharges using a kind of control cards that would be owned by each nautical vessel. Also, a permanent tracking system could be implemented and managed from any device that has internet access, such as a computer or smartphone. However, this solution also has certain shortcomings. It was found that the proposed IT solutions have certain logical issues and conclusions. Namely, in the overall evaluation, it was noticed that the GPS tracking system does not have the ability to track people, and that data would not be realistic. It was further established that it is possible to monitor the location of an individual vessel, but it is not possible to monitor specifically how many people are on it, on which the amount of wastewater depends. Also, there are vessels that are in a permanent berth and which can be used in a permanent berth, and it is questionable how to control them in such a way as to give concrete applicable results.

Consequently, it is important that the central government, by the principle of subsidiarity, delegates powers to regional and local governments. Regional self-government and local government must address the issue of wastewater from nautical vessels. One of the reasons is that the Harbor Master's Offices do not have sufficient human capacity to supervise wastewater collection procedures. Therefore, the reorganization is proposed in such a way that in the summer period 'external' companies are hired whose engagement in the collection of wastewater from nautical vessels would be evaluated by the number of pumps performed. It is extremely important that this is a continuous process without deviating from the prescribed norms and legal acts for the protection of the marine environment. In order for the whole process to gain in importance, it is necessary to establish measures of the control system and support everything with appropriate penalties in case of deviation from the set norms. The authors (Wang et al, 2019) state that the development and use of nautical tourism resources has the potential for underdevelopment, overuse and resource depletion. [16]

Marine pollution is a big problem especially because this process has been going on for many years. A study by the author Cottrel was conducted, which shows that wastewater from boats and yachts is generally inefficiently disposed of. To the question: "what would make you use the pump station more often", only 31% of respondents answered that they use the pump station every time they return from sailing. 61% of them answered that more suitable working hours would help, and 42% think that better designed facilities would encourage greater use. 20% believe that shorter queues would improve greater use, yet 51% believe that lower pumping costs would be more beneficial, and 42% said greater availability of mobile pumping units would and increased use. [3a]

The following is a SWOT analysis where strengths and weaknesses are identified, as well as opportunities and threats to the construction of reception stations for wastewater from vessels in marinas and ports.

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Relatively high sea quality • Constant control and testing sea quality • High level of security 	<ul style="list-style-type: none"> • Unregulated national legislation • Uncontrolled discharge of wastewater into the sea • Non-use of 'raw material' of sewage sludge as an integral part of wastewater for further use in agriculture
<ul style="list-style-type: none"> • Extremely favorable positional, climatic and natural features of the Adriatic Sea 	<ul style="list-style-type: none"> • The design and construction of wastewater receiving stations from boats would lead to partial devastation of the coastal zone and the marine environment
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • Possibility of new employment • Nautical tourism is tourism of high value and guests of high paying power • Conservation of the biodiversity of the Adriatic Sea 	<ul style="list-style-type: none"> • Fast growing number of vessels in the Adriatic Sea • Ecosystem disruption • Wastewater contains organisms that cause disease in humans and in large quantities can adversely affect fishing
<ul style="list-style-type: none"> • Possibility to extend the tourist season 	<ul style="list-style-type: none"> • Pandemic, COVID-19

The fact is that if the necessary steps are not taken, the trend will continue in this decade. It is necessary to start with the preliminary phase of planning the entire system of construction of reception stations in the Croatian part of the Adriatic Sea. An extremely important step forward for society is to determine the concept where 'sucked' wastewater from boats would be stored or transferred to the city sewage system. EU funds are proposed as a financial instrument (in the context of grants) to achieve objectives in the function of protecting the marine environment.

Therefore, it is necessary to argue on the basis of facts about the exceptional importance of the construction of reception stations in order to achieve the goals of sustainable development, non-disturbance of marine ecosystems and the tertiary sector, which would increase resource valuation in addition to successful environmental protection. Also, it is necessary to model the construction of reception stations in future research.

5. Conclusion

The construction of reception stations for wastewater from vessels is a further important step in the protection of the marine environment. Any delay implies and multiplies extremely harmful consequences for the marine environment. From the point of view of marine environmental protection, the results of this paper consider two key issues. First, the main factors in the nautical sector that affect the pollution of the marine environment currently do not have an alternative option of disposal and storage of the same due to the lack of a system of receiving stations. Second, the main postulate of wastewater acceptance should be that the service is free regardless of the size of the vessel or the number of people on board the vessels.

The construction of reception stations for wastewater from vessels in marinas and ports must be primarily based on the principles and high standards of protection of the marine environment. In this way, it contributes to the evaluation of the marine environment based on the concept of sustainable development. The results of the research indicate the need to build reception stations for wastewater, which would reduce the negative impacts, in order to reduce pollution of the marine environment and contribute to the protection of the sea.

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