

SIGNIFICANCE AND CURRENT REGULATIONS OF EXTERNAL AIRBORNE NOISE FROM SHIPS

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ABSTRACT

Pollution sources of environmental noise are most extensive in the transport sector. Unlike other transport modalities, ship noise is given marginal importance in the scientific community and the public. External airborne ship noise is not yet categorized as an entity of environmental pollution but rather as a threat to passengers and crew in navigation and industrial noise in the port. Results of the research analysis indicate that official noise regulation in the maritime sector is modest, neglected, and outdated at the international and national levels. However, professional associations and agencies recognize the external airborne noise from ships as a significant source of environmental pollution that affects health, quality of life, and economy, respectively, a socio-economic component altogether. Croatia adopted a legal frame based on the Maritime Code that, although indirectly from the safety at work perspective, also regulates noise from ships. It is the only national, official document, especially concerning airborne ship noise as a significant source of pollution. A deficiency of the legal basis for measuring, locating, and identifying noise sources in this industry's sector implicates that vessels cannot be penalized according to the polluter pays principle, nor can ships with lower noise emissions be favored. It is necessary to close this regulation gap enabling the protection measures application following the sustainability principles in maritime transport.

Keywords: airborne noise, maritime traffic, regulations, ships.

1 INTRODUCTION

Maritime transport and port activities significantly contribute to environmental degradation and thus jeopardize the socio-economic benefits of transporting services and goods [1]. Noise as an output of ship activities affects the health of passengers and crew, increases background noise onshore and in ports, and negatively influences underwater life [2]. Since 1950, maritime background noise has doubled each decade due to the growth of marine traffic and ship capacities [3]. The actual noise emission level is highly dependent on the parameter of vessel type [4], so measurement of generated noise of each single pollution source is needed. At the same time, it is an obstacle to the acceptance of efficient and comprehensive regulations. Noise protection measures in maritime transport lag behind the ones in other transportation modalities. Recent scientific literature is relatively scarce, while at the same time, the volume of marine traffic increases continuously [5].

The ship at berth in port needs energy for electricity, ventilation, air conditioning, cooling, freezing, and others, usually supplied by an auxiliary engine, marked as primary noise sources. The noise power is proportional to the vessel's deadweight [6]. The auxiliary engine power can be up to 4 MW (for the largest cruisers) [7]. Some measures to reduce noise from ships comprise different types of mufflers on the exhaust pipe of the diesel generator and other machinery while in port. There is also an onshore power supply, ventilation damping, air conditioning systems, mineral wool coating in compartments where this machinery is located, barriers, louvers, etc. [8].

Tourism activities, freight transport, and passenger traffic in port cities are burdened with their own external airborne noise, disturbing domicile residents and generating night disturbances and sleep disorders [9]. Noise sources within a port area can be classified into subcategories: road, rail, ship, port, and industrial sources. This classification can be even



more detailed based on the criteria of a specific vehicle or machine and its position within the port. Identifying the principal noise source for which complaints are filed simplifies the operation and enables targeted action [10]. Noise impact has recently become a priority as an environmental issue in seaports. Noise sources in the port are related to machinery operations, car and truck traffic, railway operations, ramps, cargo handling, and ships. The findings in the port of Stockholm, Helsinki, Tallinn, Turku, and Naantali, nominated as PENTA ports, indicated the RoPax operations as the largest identified noise source. From the perspective of noise in the port area, there is an unambiguous connection between noise pollution and urban planning [11].

Unlike other forms of pollution, the impact of noise depends not only on the physical characteristics of the sound but even more on the human reaction to it. Impacts on human health and quality of daily living are those items against which the impact of noise is measured, and to a significant extent, they are burdened with subjectivity. Some people are more disturbed by occasional noise, while others are irritated by persistent background noise. There are also differences in experiences with low and high-frequencies sounds. In overcoming subjectivity, the effects of the highest sound level should always be measured, thus eliminating noise that causes annoys [12]. Exposure to noise larger than 85 dB and more than 20 years is associated with a risk of arterial hypertension [13]. Although this claim has never been proven in the maritime sector [14], measures taken on noise pollution in marine transport should respect this cause-and-effect relationship. In a study on offshore supplying vessels, hearing impairments in the low and high frequencies scales were identified as a possible consequence of prolonged exposure and high noise levels [15]. In maritime traffic, the crew is constantly exposed to vibration, noise, and heat. When examining these factors individually onto their impact on health and quality of life, the context of simultaneous action of several factors needs to be a framework for discussion. A short-term study [16] already revealed a substantial level of stress.

For the International Maritime Organization (IMO), airborne noise pollution from ships is primarily a matter of occupational health. When the ship enters the port, port noise is classified as industrial noise. Noise emissions from maritime transport are ordinarily regulated at the national level. Due to all this, noise has not a high priority for ship-owners [11]. There is no regulation of airborne noise emission for every individual ship type. There is an initiative to mark them due to the emitted noise as Super Quiet, Quiet, Standard, Inland waterways, and Commercial [17]. Some measures to reduce port noise are convenient port location, regulation of port traffic, ramp design, speed reduction, modernization of machinery, walls, noise barriers, and measures on berths such as distance, slot use, working time restrictions, etc. Cruise and RoPax ships are paid special attention as they berth in the places closest to the city [18].

2 REGULATIONS

There is no universal protocol for measuring airborne noise emissions from ships and standardized data regarding noise and nuisance in and around the port to date. Emissions are regulated at the national level or through port environmental permits. They differ in different states and even in ports of the same ones. Airborne noise emissions are not currently on the IMO agendas, and no regulation should be expected soon [19]. Project NEPTUNE aims to classify the emitted noise from different ships according to the total noise power and the share of low-frequency noise. It also seeks to incorporate this data into the Environmental Ship Index (ESI). The first ship was already certified in September 2020 [20], [21]. For a complete picture of ambient noise, it is necessary to perform numerous measurements at many locations for at least one year [22].



Current regulations regulate exposure to noise of crew and passengers on board, but not workers and residents in port cities. The problem is exacerbated by the lack of jurisdiction over foreign-flagged ships in free zones [23], vessels used for non-commercial purposes, and in cases of innocent passage through the territorial sea [24]. Installing shore power is not only expensive, but most of all, it radically reduces only air pollution and not noise in the same way [25]. For now, it only makes sense on Ro-Ro terminals. ESI does not envisage noise limits nor a Green Award System, based on which port dues for green boats could be reduced and thus stimulate the installation of silencers [6]. Although the port is considered an “industrial plant” according to the current regulations [17], Lloyd Register noticed the significance of external airborne noise emission at the port area within the total environmental noise [26]. According to noise being a transboundary polluter, it should be regulated internationally. The ports are responsible for noise pollution but cannot affect it precisely because of the lack of international regulations [27]. The administrative framework of rules and regulations on port noise is shown in Fig. 1.

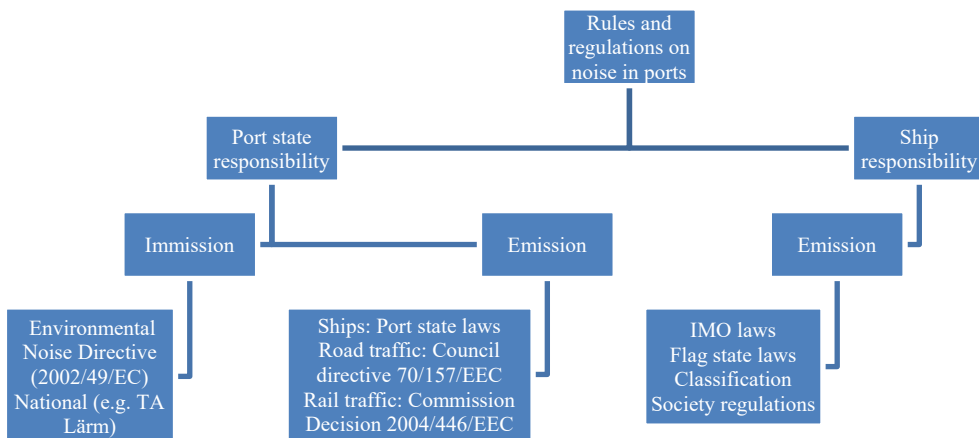


Figure 1: Rules and regulations on port noise [28].

Global cooperation on this issue is difficult to achieve. There are no international standards for port noise management. The port noise responsibility is mainly allocated to the ports and maritime industry, while the IMO is responsible for noise regulation on board. Only a few ports have implemented measures to reduce noise. Rules vary and are applied differently [29].

2.1 Regulations at the European level

The fundamental document that regulates noise on ships is IMO Resolution MSC.337 (91), “Code on noise levels on board ships” (adopted on 30 November 2012), which is in force from 1 July 2014 and is mandatory for new vessels. It is compulsory based on the International Convention for the Safety of Life at Sea (SOLAS) II-1/3-12 [30]. In Annex 1 of the IMO, Circular no. 3644 of 20 May 2016, amendments to Rule II-1/3-12 were made [31].

For ships in use before, in some segments, Resolution A.468 (XII) since 19 November 1981 has still been in force [32]. In Directive 2002/49/EC, the Commission considers noise pollution to be one of the biggest environmental problems in Europe, highlighting transport activity as one of the principal sources of environmental noise. The Directive explicitly lists all transport modes, but not maritime transport, nor even within industrial noise context [33].

At the International Labour Conference in 2006, a valuable Maritime Labour Convention was adopted, which in significant segment related to protection against noise and vibration on ships [34]. Noise is also well addressed in the European Standard laying down Technical Requirements for Inland Navigation vessels [35] but does not apply to maritime transport. In the 2018 report, the European Environment Agency (EEA) [36] emphasizes environmental pollution from the air and marine emissions, including noise pollution.

2.2 Regulations at the national level

In the Republic of Croatia, noise is regulated by the Noise Protection Act [37] and the following Ordinances: the Ordinance on maximum permissible noise levels in the environment in which people work and reside, the Ordinance on the protection of workers from noise exposure at work, the Ordinance on activities for which it is necessary to determine the implementation of noise protection measures, the Ordinance on the conditions regarding space, equipment and employees of legal entities performing professional noise protection activities, the Ordinance on noise protection measures of open-sources and the Ordinance on the preparation and content of noise maps and action plans and the method of calculating the permissible noise indicators [38].

Amendments to the Act [39] have brought alignment with the European Union (EU) *acquis* in this area, and no document mentions maritime transport. Although in the elementary text of the law, in Article 2, item 1, marine and river traffic is listed as sources that emit environmental noise, in Article 1, the same law states that this law does not apply to noise caused by maritime facilities [37]. In Articles 18 and 21 of the Ordinance on the method of production and content of noise maps and action plans and on the calculation method of permitted noise indicators, unlike other types of transport, maritime and river transport and ports are explicitly linked to industrial areas and industrial noise sources [40]. Based on the Maritime Code [41], the Ministry of the Sea, Transport, and Infrastructure has adopted Rules for the Statutory Certification of Seagoing Ships with the highest permissible noise assessed levels and within the scope of occupational safety and crew accommodation [42]. It is the only document that regulates external airborne noise from ships specifically. The Rules for Statutory Certification of Passenger Ships in National Navigation in 2017 [43] contain elementary articles on noise protection, while the current version [44] refers to EU directives and repeals specific paragraphs. In other official legal regulations of the Republic of Croatia, noise from ships has a marginal meaning.

3 DISCUSSION

Noise is recognized as environmental pollution, which sources are most extensive and most common in the transport sector. Unlike other transport modalities, noise from ships is given marginal importance in the scientific community and the public. Except for the underwater noise, external airborne ship noise is not yet accepted as an entity of environmental pollution but as a threat to passengers and crew in navigation mode and as industrial noise in the port. Based on this noise hazards understanding, legal regulations have been adopted at the European and national levels. Results of the analysis indicate that noise regulation in the maritime sector is modest, neglected, and outdated. It can be noticed that the Ordinances of

administrative bodies at the European level date from 1981, 2002, and 2012 and are still in force. External airborne noise from ships is hardly mentioned in recent regulations. However, international associations and agencies recognize the external airborne noise from ships as a significant source of environmental pollution that affects health, quality of life and economy, or socio-economic components altogether. At the national level, and especially after the acceptance and alignment with the legal regulations of the European Union, environmental pollution by noise from ships is marginalized in the Law on Noise Protection. External airborne noise from vessels is recognized in some segments of this law but is not regulated. In 2018, the Ministry of the Sea, Transport, and Infrastructure, based on the Maritime Code, adopted Rules that, although from the position of safety at work, also regulate noise from ships. In Croatia, documentation from a governing body addresses the shortcomings which the documents of non-governmental organizations and agencies fill at the European level. As long as external airborne noise from ships is not considered an environmental problem, positive measures cannot perform. Vessels cannot be sanctioned according to the polluter pays principle, nor can ships with lower noise emissions be rewarded. It is a deficiency implication of the legal basis for measuring, locating, and identifying noise sources in this segment. Sustainable development policy in the maritime transport industry dictates such a need.

There is no single standard for measuring ship noise, nor are the critical activities such as maintenance and loading and unloading included in such measurement. The night limit in cities does not exceed the value of the annual noise average of 40 dB. Above this sound power limit, sleep disturbances and annoyance can occur, and it can be assumed that this noise originates from ships in city ports as a primary source [45]. The sound power of the generator exhaust or fan wings can exceed 100 dB. In those circumstances, the calculation determined that such a ship should be moored at least 600 m from the settlement [8]. Noise maps of port terminals are a good tool for planning and predicting the impact of noise on the city and its surroundings [46].

Noise as a polluter seems underestimated in public compared to CO₂ emissions and climate change topics. The analysis shows that the implications of noise pollution in maritime transport observed ten years ago are still relevant today in the same form. Subsequent installation of silencers is quite expensive, resulting in a reduction in noise of only a few dB. Given the lifespan of commercial ships of close to 30 years, the fleet renewal will not be rapid. There is also a lack of awareness among citizens and administration and measures to reduce noise [5]. Pettersen [4] believes a good balance between efficiency and low noise can be an engineering challenge. Apart from technical improvements and advances in regulations and awareness-raising, the stakeholders' scale priorities and the scientific community is modest. Discounts on port dues and shorter berthing and dwell times are several incentives to reduce ship noise. Canadian ports offer attractive port dues for vessels that emit lower underwater noise [4] but not airborne noise emissions. Cooperation and joint action of ports are also expected to implement collective measures through environmental indices and social regulations. Best practices and experience acquired with airborne noise near airports should be exploited [47]. Noise maps help locate remediation priorities. Better cooperation between ports, shipping companies, and the city is needed, and noise management should become a part of socially responsible work. Noise management is more of an opportunity and less of a threat to the port industry [11]. In the recent report, the EEA considers that not just one but a combination of noise abatement measures is sufficient, which includes technological improvements, ambitious noise policy, better urban and infrastructural planning, and changes in human behavior [48]. EU policy for shifting road transport towards more environmentally friendly transport modes, i.e., maritime and rail transport, seems contradictory with the



sustainable development guidelines of ports and marine transport as for the increased ports and seas pollution, including noise pollution [27]. The World Health Organization (WHO) rates noise as a significant public health problem of growing concern. Recently, updated guidelines have been adopted, including new noise sources, but maritime transport is omitted again [49]. The reasons could be in comparative research with other noise sources. Industrial noise, which includes port noise, minimally contributes to harmful noise exposure as it affects only 0.15% of the urban population per day and 0.08% per night [48]. In the chronological analysis of the legal regulations of transport noise in England from medieval times until today, nothing was found relating to ships noise [50]. For now, underwater noise remains the only satisfactorily regulated segment of noise pollution in maritime transport. Despite the facts mentioned above, the American Bureau of Shipping issued a guide that equates the importance and threat of underwater and external airborne noise from ships [51]. Better education and awareness-raising on the harmfulness of noise are likely to be crucial for changing attitudes towards noise pollution in maritime transport [52].

4 CONCLUSION

Noise does not affect only health but the entire environment. It reduces the quality of life and endangers some segments of the economy. Classified as industrial noise, external airborne noise from ships in ports is only one of its components. But really, it presents an environmental noise structural element not regulated after its meaning. Non-governmental organizations and insurance companies have already recognized the problem. Ports responsible for noise pollution cannot be sanctioned or modernized due to the lack of international regulations. European regulations are flawed and outdated, dating from 2014 and 2016 for new ships and from 1981 for older ones. The only document that specially regulates external airborne ship noise at the national level is the Ordinance in the framework of occupational safety. Exposure to the noise of the crew and passengers on the ship on the one hand and workers and residents in port cities on the other is not legally equalized. The ESI and Green Awards System projects have no operational but only nominal meaning. It is necessary to close this gap enabling the protection measures application following the sustainability principles in maritime transport. The measurement of airborne noise emission from ships needs to be standardized, and the regulations at the international and national level and among ports updated and harmonized.

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