JAEHR
Journal of Advances in Environmental Health Research
J Adv Environ Health Res. 2025;13(3):168-175. doi: 10.34172/jaehr.1400
http://jaehr.muk.ac.ir

Mini Review

Ensuring Safety and Sustainability: HSE Guidelines for Ship Breaking

Ramin Maleki[1], **Hamid Moaieri**[2*]

[1]Department of Environmental Health Engineering, School of Public Health, Iran University of Medical Sciences, Tehran, Iran
[2]Imam Khomeini Marine Science, Noshahr, Iran

Article history:
Received: October 3, 2024
Revised: December 2, 2024
Accepted: December 22, 2024
ePublished: September 27, 2025

***Corresponding author:**
Hamid Moaieri,
Email: h.moaieri@gmail.com

Abstract

Background: The ship breaking industry plays a crucial role in the global supply chain by recycling valuable materials from decommissioned vessels, yet it is fraught with significant health, safety, and environmental (HSE) challenges.

Methods: This study analyzed key HSE guidelines and presents case studies from major ship-breaking nations, focusing on minimizing environmental impact and enhancing worker safety. It provides a comprehensive overview of essential HSE frameworks to support the safe and sustainable operation of ship breaking facilities.

Results: The analysis identifies major risks in ship dismantling operations, including exposure to hazardous substances, physical injuries, and environmental contamination. It marks the importance of continuous monitoring and the dynamic adaptation of safety protocols to meet evolving industry challenges. Case studies from leading ship recycling nations illustrate the successful implementation of international HSE standards, showcasing tangible improvements in safety outcomes and environmental performance. Environmental considerations are emphasized, particularly regarding effective waste management and pollution control. The study also underlines the role of transparency and environmental reporting in aligning ship breaking practices with global compliance expectations.

Conclusion: By offering a detailed roadmap for HSE compliance and continuous improvement, this article serves as a valuable resource for industry stakeholders. It aims to elevate operational standards in ship breaking, enabling the sector to meet the demands of a growing global fleet while protecting human health and the environment.

Keywords: Ship breaking, HSE, Waste management, Health

Please cite this article as follows: Maleki R, Moaieri H. Ensuring safety and sustainability: HSE guidelines for ship breaking. J Adv Environ Health Res. 2025; 13(3):168-175. doi: 10.34172/jaehr.1400

Introduction

Ship breaking, also known as ship recycling, is the process of dismantling decommissioned vessels to salvage steel and other valuable materials.[1,2] It is an essential industry that supplies raw materials to various sectors, particularly in developing countries.[3,4] Despite its economic significance, ship breaking presents serious environmental, health, and safety challenges. Workers are frequently exposed to toxic substances, and improper management can result in hazardous waste, accidents, and environmental degradation[5]. While the industry offers employment and contributes to resource recovery, it also poses considerable risks to both human health and ecosystems[6]. To mitigate these risks, the implementation of stringent Health, Safety, and Environmental (HSE) guidelines is critical. These guidelines aim to ensure that ship breaking activities are conducted safely and sustainably, protecting both workers and the environment[6,7]. The importance of HSE guidelines in this industry cannot be overstated[8]. This article reviews the key components of HSE guidelines, including worker safety protocols, environmental protection measures, and emergency response plans. It also examines the challenges associated with implementing these guidelines and presents case studies from major ship breaking hubs to illustrate best practices and areas for improvement.

Materials and Methods

This study employed a systematic review methodology to analyze existing literature on HSE guidelines in ship breaking facilities. The following steps were taken:

Data Sources

A comprehensive search was conducted across peer-reviewed journals and authoritative reports from organizations such as the International Maritime Organization (IMO) and the Basel Convention. Academic databases including PubMed, Google Scholar, and Scopus were utilized to identify relevant studies.

Inclusion Criteria

Only studies published within the last 15 years that specifically addressed HSE guidelines and their implementation in ship breaking operations were included. Articles focusing on unrelated industrial sectors were excluded from the analysis.

Data Analysis

The selected studies were analyzed qualitatively, focusing on the identification of (1) key components of HSE guidelines, (2) common implementation challenges, and (3) the impact of these guidelines on worker safety and environmental protection.

The results are presented in two parts:

1. An overview of the key components of HSE guidelines, and
2. A discussion of the challenges encountered in their implementation.

In addition, this review incorporates an analysis of HSE frameworks recommended by international bodies, including the IMO, the Basel Convention, and the ISO 30000 series. A detailed assessment of cleaner production strategies and their applicability to diverse ship-breaking facilities was conducted. Furthermore, interviews with industry experts were carried out to gather insights on implementation obstacles and emerging trends in ship recycling.

Results and Discussion

Understanding the Hazards of Ship Breaking

Before discussing HSE guidelines, it is essential to understand the inherent hazards associated with ship breaking:

1. Occupational hazards: Workers in ship breaking yards are exposed to multiple risks, including falls from heights, contact with toxic substances such as asbestos, and injuries from heavy machinery. The confined spaces within ships and the presence of flammable materials further increase the danger.[2,9]
2. Environmental impact: Ship breaking activities can significantly impact the environment. The release of hazardous substances, including oil, heavy metals, and asbestos, into the sea and surrounding soil leads to pollution, which adversely affects marine ecosystems and local biodiversity[10].
3. Health risks: Prolonged exposure to toxic substances can result in chronic health conditions among workers, such as respiratory diseases, cancers, and skin disorders. These risks are exacerbated by the lack of proper personal protective equipment (PPE) and inadequate safety protocols.[11,12]

The Importance and Challenges in Implementing of HSE Guidelines

HSE guidelines are critical in ship breaking facilities for the following reasons:

1. Worker Safety: The process of ship breaking involves heavy machinery, hazardous materials, and dangerous working conditions. Proper HSE practices ensure the safety of workers, thereby reducing the risk of injuries and fatalities.[13,14]
2. Environmental Protection: Ship breaking can release toxic substances such as asbestos, heavy metals, and oil into the environment. Adhering to environmental guidelines helps prevent pollution and protects marine ecosystems.[15]
3. Regulatory Compliance: Compliance with international and national regulations is essential for legal operation and to avoid penalties. These regulations often incorporate HSE standards to ensure sustainable practices.[16]

Challenges

While the implementation of HSE guidelines is crucial, ship breaking facilities often face significant challenges:

1. Lack of resources: Many facilities operate with limited financial and technical capacity, making it difficult to fully implement comprehensive HSE measures. This often leads to incomplete safety protocols and insufficient environmental protections.[17]
2. Lack of awareness and training: In many developing countries, there is a lack of awareness about the importance of HSE guidelines. Training programs need to be robust and ongoing to ensure all workers are aware of and adhere to safety protocols.[17]
3. Regulatory enforcement: In some regions, regulatory enforcement is weak, allowing facilities to bypass essential HSE guidelines. Stronger governmental oversight and penalties for non-compliance are necessary to ensure adherence.[17,18]
4. Technological gaps: Access to advanced technologies that can improve safety and environmental protection is limited in some regions. Investment in technology and infrastructure is essential for effective HSE implementation.[19]

Key Components of HSE Guidelines

To mitigate these risks, ship breaking facilities must adhere to strict HSE guidelines. These guidelines encompass various aspects of operations, from pre-breaking assessments to waste management, worker safety, and environmental protection.

1. Pre-breaking Assessment and Planning

Before any ship breaking activity begins, a thorough assessment and planning phase is crucial:

a. Hazardous material inventory: A complete inventory of hazardous materials onboard the vessel—such as asbestos, polychlorinated biphenyls (PCBs), and radioactive substances—must be conducted. This inventory forms the basis for the safe removal, handling, and disposal of toxic materials.[1,9,20]

b. Risk assessment: A detailed risk assessment should be performed to identify potential occupational and environmental hazards. This includes evaluating

the structural integrity of the vessel and identifying high-risk zones that require specialized handling or additional safety precautions.[13, 21]

c. *Environmental impact assessment (EIA)*: An Environmental Impact Assessment is necessary to predict and evaluate the potential environmental consequences of the ship breaking process. The EIA should propose strategies to prevent contamination of soil, water, and air, and include appropriate mitigation and monitoring measures.[20]

In line with the importance of HSE guidelines, an evaluation of the applicability of cleaner production options for ship recycling is illustrated in Figure 1, which outlines best practices based on source ship characteristics.

2. Worker Safety and Training

Worker safety is a top priority in ship breaking facilities. To ensure a safe working environment, comprehensive safety protocols and training programs must be implemented:

a. *Personal protective equipment (PPE):* All workers must be equipped with appropriate PPE, including helmets, gloves, safety boots, respiratory masks, and protective clothing. PPE should be regularly inspected and replaced as necessary to maintain effectiveness.[24,25]

b. *Safety training:* Regular safety training must be provided, focusing on hazard identification, safe work practices, emergency procedures, and the correct use of tools and equipment. Training should also cover the safe handling and disposal of hazardous materials.[9]

c. *Emergency response plan:* A well-defined emergency response plan must be developed and implemented to address potential incidents such as fires, explosions, and chemical spills. The plan should include evacuation procedures, first aid protocols, and clear communication strategies.[26]

3. Safe Dismantling Practices

The dismantling process should be carried out with the utmost care to prevent accidents and environmental damage:

a. *Controlled dismantling:* A systematic dismantling approach should be followed, beginning at the top of the vessel and progressing downward. This method reduces the risk of structural collapse and facilitates the safe removal of materials.[27,28]

b. *Containment of hazardous materials*: Effective measures must be implemented to contain hazardous substances during dismantling. For example, containment booms can be used to control oil spills, and asbestos-containing materials should be sealed or covered to prevent the release of harmful fibers.[29]

c. *Monitoring and inspection:* The dismantling process should be continuously monitored to ensure adherence to safety and environmental standards. Regular inspections must be conducted to detect and promptly address any emerging risks or hazards.[9]

4. Environmental Protection Measures

Protecting the environment is a critical aspect of HSE guidelines for ship breaking:

a. *Waste management:* Develop a comprehensive waste management plan that ensures the safe handling, segregation, and disposal of both hazardous and non-hazardous waste. The plan should include recycling procedures for reusable materials such as steel and appropriate disposal methods for toxic substances.[30,31]

b. *Pollution prevention:* Implement strategies to prevent soil, water, and air pollution. This includes the safe storage of hazardous materials, treatment of contaminated wastewater, and measures to minimize emissions from equipment and machinery.[32]

c. *Environmental monitoring:* Establish a system for continuous environmental monitoring, including routine testing of soil and water quality. Early detection of contamination enables timely corrective actions and helps ensure compliance with environmental regulations.[33]

5. Emergency Response Planning

Developing and maintaining emergency response plans

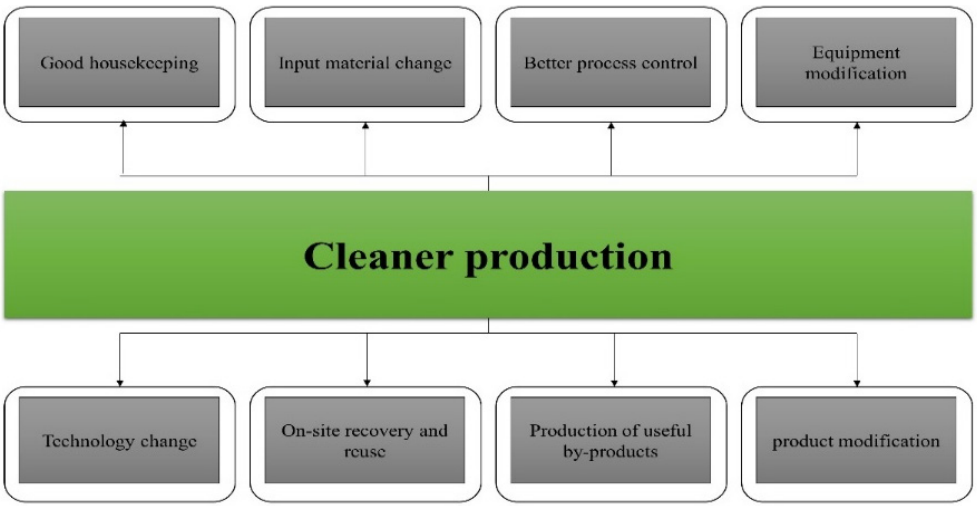

Figure 1. Evaluation of Applicability of Cleaner Production Options to Ship Recycling Source[22,23]

for accidents, fires, and hazardous material spills is necessary. These plans should be regularly updated and practiced through drills.[34]

6. Compliance With International Standards

Ship breaking facilities must adhere to internationally recognized standards and conventions that promote worker safety and environmental sustainability. Key frameworks include:

a. *Hong Kong International Convention:* This convention, adopted by the International Maritime Organization (IMO), sets standards for the safe and environmentally sound recycling of ships. Compliance with this convention ensures that ship breaking practices meet global safety and environmental benchmarks.[35]

b. *Basel Convention:* The Basel Convention regulates the transboundary movement of hazardous wastes and their disposal. Ship breaking facilities must ensure that hazardous materials are handled and disposed of in accordance with the guidelines set by this convention.[36,37]

c. *ISO 30000 Series:* The ISO 30000 series provides a framework for implementing effective ship recycling management systems. Certification to these standards demonstrates a commitment to safety, environmental protection, and continuous improvement.[38]

7. Health Monitoring

Regular health check-ups and medical monitoring are essential to detect early signs of occupational illnesses or exposure to hazardous substances among ship breaking workers. Ensuring access to appropriate medical facilities and healthcare services is a critical component of workplace health and safety.[32]

The key components and associated challenges of the HSE directives, as comprehensively examined in the results, are summarized in Tables 1 and 2.

Best Practices for Implementation

1. Adopting international standards: Facilities should implement internationally recognized standards, particularly those established by the International Maritime Organization (IMO) and the International Labour Organization (ILO). The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships serves as a critical framework for global compliance.[39,40]
2. Continuous improvement: Promoting a culture of continuous improvement through regular audits, employee feedback, and updates to safety protocols based on emerging technologies and new research findings is essential.[39]
3. Stakeholder collaboration: Engaging with stakeholders, including regulatory bodies, environmental organizations, and the local community, to ensure transparency and shared responsibility in maintaining HSE standards.[41]
4. Technological integration: Utilizing advanced technologies for safer dismantling processes, such as remote-controlled equipment and improved waste management systems.[39]

Impact of Proper HSE Implementation

The proper implementation of HSE guidelines in ship breaking facilities has far-reaching benefits:

1. Enhanced worker safety: Significant reductions in accidents and occupational diseases lead to a healthier workforce and improved morale.
2. Environmental conservation: Minimizing pollution and effective waste management contribute to the protection of marine and coastal ecosystems.
3. Economic benefits: Sustainable practices can improve the reputation of ship breaking facilities, leading to better business opportunities and compliance with international trade requirements.

In support of these outcomes, Table 3 presents data on metal recycling percentages and the associated economic benefits, illustrating the financial value of environmentally responsible ship dismantling.

4. Social Responsibility: Demonstrating a commitment

Table 1. Components of a complete and comprehensive HSE guideline

Component	Description
Worker safety	Use of PPE, regular safety training, and emergency response protocols
Environmental protection	Waste management, pollution control, and environmental monitoring programs
Risk assessment	Hazardous materials inventory and risk assessment prior to dismantling
Compliance with standards	Adherence to international conventions (e.g., IMO, Basel Convention)
Health monitoring	Regular health checks for workers exposed to hazardous materials

Table 2. Challenges of a Complete and Comprehensive HSE Guideline

Challenge	Description
Lack of resources	Limited financial and technical resources, especially in developing countries
Regulatory enforcement	Weak enforcement of regulations, leading to non-compliance
Technological Gaps	Inadequate access to advanced technology for safe dismantling and monitoring
Lack of awareness and training	Insufficient training programs for workers on safe practices

to worker welfare and environmental stewardship enhances the social license to operate and fosters community trust.[43,44]

Case Studies of Successful HSE Implementation

To demonstrate the effectiveness of stringent HSE guidelines, the following case studies highlight notable improvements in major ship breaking regions:

1. Alang, India: Once notorious for its poor safety record, the Alang ship breaking yard has made significant improvements by adopting the Hong Kong Convention guidelines. The introduction of better training programs, enhanced PPE, and stricter waste management protocols has led to a noticeable reduction in accidents and environmental violations.[13]
2. Chittagong, Bangladesh: Another major ship breaking hub, Chittagong has implemented the Basel Convention guidelines on the control of transboundary movements of hazardous wastes. This has resulted in better handling and disposal of toxic materials, safeguarding both workers and the environment.[45]

In this regard, Figure 2 shows the amount of severe injuries and fatalities in Southeast Asian countries in shipbreaking yards between 2015 and 2021.

Figure 2 focuses on the volatile nature of safety in shipbreaking yards, with years of significant risk followed by apparent improvements. While fatalities have decreased substantially after 2016, severe injuries remain a recurring issue, particularly in 2019 and 2021. It underscores the need for continuous efforts in improving workplace safety to prevent both injuries and fatalities in this dangerous industry.

Table 3. The percentage of metal recycling and its economic benefits[42]

Saving Type	Savings Percentage (%)
Energy	74
Raw materials	90
water	40
Pollution of water sources	76
Air pollution	86
Reducing the amount of waste	97

Case Studies and Future Directions

The case of Alang, India, demonstrates the importance of adopting international standards like the Hong Kong Convention, which led to significant improvements in worker safety and environmental management. In Chittagong, Bangladesh, the adoption of Basel Convention guidelines has improved the handling of hazardous materials, reducing environmental pollution.

Looking forward, the future of ship breaking depends on the development of "green ship recycling" methods that minimize environmental impact. International collaboration is essential for sharing best practices and ensuring that facilities in developing countries have access to the necessary technology and resources.

Future Directions for HSE in Ship Breaking

The future of HSE in ship breaking lies in innovation and global cooperation:

1. Green ship recycling: Developing and adopting green ship recycling methods that minimize environmental impact is a crucial step forward. This includes the use of non-toxic materials in ship construction and improved recycling techniques.[46,47]

In this regard, in order to reach the ideal conditions of green ship recycling, the projected need for ship recycling capacity according to forecast models between 2011 and 2044 is shown in Figure 3.

Figure 3 projects a dramatic increase in the need for ship recycling capacity in the coming decades, peaking between 2030 and 2040. Shipbreaking yards and related industries will need to prepare for this surge by enhancing capacity and improving safety and environmental practices. The decline in demand post-2040 provides some relief but suggests the necessity for sustainable long-term planning within the ship recycling sector.

2. International collaboration: Strengthening international collaboration to share best practices, technologies, and regulatory frameworks can help harmonize HSE standards globally.[41]
3. Community engagement: Involving local

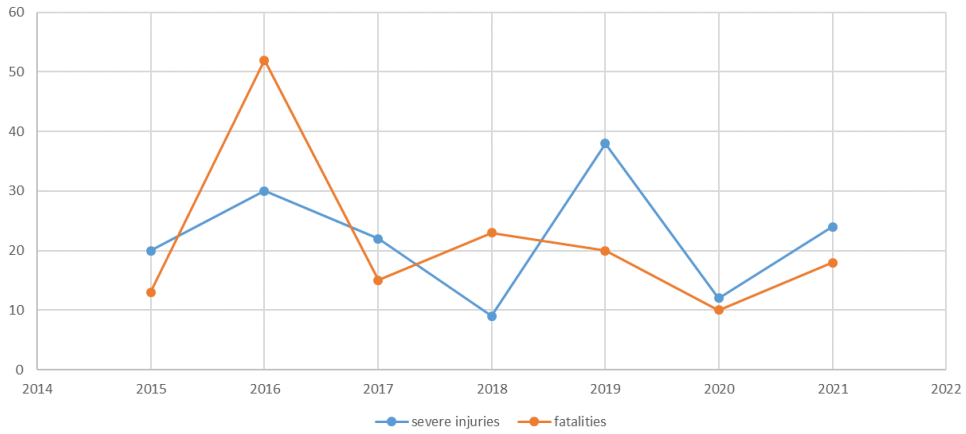

Figure 2. Severe Injuries and Fatalities in Shipbreaking Yards Between 2015 and 2021[16]

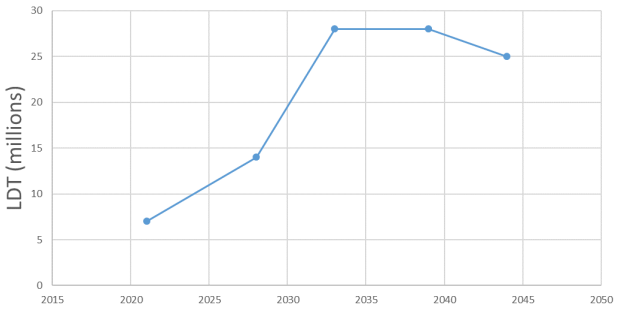

Figure 3. Projected Need for Ship Recycling Capacity Between 2011 and 2044[48]

communities in the decision-making process ensures that their concerns are addressed and benefits are shared. This also fosters greater transparency and accountability.[49,50]

4. Technological advancements: Investing in research and development to create safer and more efficient ship breaking technologies can further reduce risks. Innovations such as automated dismantling systems and advanced waste treatment processes hold great promise.[50]

Practical Recommendations for Low-Resource Countries

For countries with limited financial and technological resources, implementing comprehensive HSE strategies can be challenging. However, the following steps can provide practical pathways for improvement:

- Low-cost safety training: Developing local training programs that focus on basic safety practices, utilizing low-cost visual aids and local trainers. In countries like Bangladesh, similar programs have led to a significant reduction in worker injuries.
- Collaboration with international NGOs: Facilities in low-resource settings can seek partnerships with international organizations to receive support in implementing HSE strategies. For example, collaborations between Indian shipyards and European environmental groups have resulted in the establishment of better waste management protocols.
- Incremental adoption of technology: Instead of immediately investing in expensive machinery, ship breaking facilities can gradually adopt affordable technological solutions, such as improved waste storage containers, which help contain hazardous materials without requiring large capital investment.

Conclusion

This study focuses on the critical importance of HSE guidelines in the ship breaking industry, a sector that plays a vital role in global material recycling. Case studies from major ship breaking hubs such as India and Bangladesh demonstrate that adherence to international standards, particularly the Hong Kong International Convention and the Basel Convention, can lead to substantial reductions in workplace injuries and environmental degradation. These findings emphasize that the implementation of robust HSE frameworks is not only feasible but also essential for ensuring worker well-being, environmental sustainability, and long-term industry viability.

Key findings from this review include:

- The critical importance of safety training and the use of PPE in reducing occupational hazards.
- Effective waste management and environmental monitoring as key factors in preventing pollution and protecting marine ecosystems.
- The necessity of international cooperation and technological innovation to address the unique challenges faced by ship breaking facilities in developing countries.

Future Research and Policy Recommendations

Further research should explore the development of low-cost, scalable technologies that can be implemented in resource-constrained regions. Policymakers should promote international collaboration to share best practices, focusing on incentivizing facilities that comply with HSE guidelines. Furthermore, greater emphasis should be placed on the development of "green ship recycling" initiatives, which can reduce the environmental impact while maintaining economic viability.

Authors' Contribution

Conceptualization: Ramin Maleki.
Data curation: Hamid Moaeiri.
Formal analysis: Hamid Moaeiri.
Funding acquisition: Hamid Moaeiri.
Investigation: Ramin Maleki.
Methodology: Ramin Maleki.
Project administration: Hamid Moaeiri.
Resources: Hamid Moaeiri.
Software: Hamid Moaeiri.
Supervision: Hamid Moaeiri.
Validation: Hamid Moaeiri.
Visualization: Hamid Moaeiri.
Writing–original draft: Ramin Maleki.
Writing–review editing: Ramin Maleki.

Competing Interests

None declared.

Ethical Approval

Not applicable.

Funding

This is a self-funded research project that did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Galley M. Shipbreaking: Hazards and Liabilities. Springer; 2014.
2. Uddin MK, Nobi MN, Islam ANM. Environmental hazards and health rights of workers in shipbreaking in Bangladesh. Int J Hum Rights Healthc. 2024;17(3):300-14. doi: 10.1108/ijhrh-03-2022-0014.
3. Sarraf M, Stuer-Lauridsen F, Dyoulgerov M, Bloch R, Wingfield S, Watkinson R. The Ship Breaking and Recycling Industry in Bangladesh and Pakistan. Washington, DC: The World

Bank; 2010.
4. Du Z, Zhu H, Zhou Q, Wong YD. Challenges and solutions for ship recycling in China. Ocean Eng. 2017;137:429-39. doi: 10.1016/j.oceaneng.2017.04.004.
5. Dewan C, Sibilia EA. Global containments and local leakages: structural violence and the toxic flows of shipbreaking. Environ Plan C. 2024;42(1):80-101. doi: 10.1177/23996544231208202.
6. Hossain MS, Fakhruddin AN, Chowdhury MA, Gan SH. Impact of ship-breaking activities on the coastal environment of Bangladesh and a management system for its sustainability. Environ Sci Policy. 2016;60:84-94.
7. Akamangwa N. Working for the environment and against safety: how compliance affects health and safety on board ships. Saf Sci. 2016;87:131-43. doi: 10.1016/j.ssci.2016.03.027.
8. Rizvi MJ, Islam MR, Adekola O, Margaret ON. A sustainable shipbreaking approach for cleaner environment and better wellbeing. J Clean Prod. 2020;270:122522. doi: 10.1016/j.jclepro.2020.122522.
9. Andersen AB. Worker Safety in the Ship-Breaking Industries. Geneva: International Labour Office; 2001.
10. Fakhruddin AN, Talukdar MI, Hossain MA. Environmental impacts of ship breaking and recycling industry of Sitakunda, Chittagong, Bangladesh. Adv Nat Sci. 2015;8(1):51-8. doi: 10.3968/6492.
11. Wu WT, Lin YJ, Shiue HS, Li CY, Tsai PJ, Yang CY, et al. Cancer incidence of Taiwanese shipbreaking workers who have been potentially exposed to asbestos. Environ Res. 2014;132:370-8. doi: 10.1016/j.envres.2014.04.026.
12. Wu WT, Lin YJ, Yang YH, Yang CY, Hsu JH, Wu TN. Mortality among ship-breaking workers—a retrospective cohort study. Epidemiology. 2011;22(1):S110. doi: 10.1097/01.ede.0000392005.94355.21.
13. Sahu G. Challenges for the Implementation of Workers' Rights in Hazardous Industries: A Critical Analysis of Alang-Sosiya Ship Breaking Yard, Bhavnagar, Gujarat from 1983-2013. Deonar: National Human Rights Commission; 2014.
14. Chowdhury PA, Ali MM, Shahjahan AT. Impacts of Ship Breaking Industries on Environment and Socio-Economic Condition of Bangladesh-A Case Study of Sitakunda Shitolpur Ship Breaking Yard, Chittagong [dissertation]. Chittagong: Chittagong University of Engineering & Technology; 2015.
15. Du Z, Zhang S, Zhou Q, Yuen KF, Wong YD. Hazardous materials analysis and disposal procedures during ship recycling. Resour Conserv Recycl. 2018;131:158-71. doi: 10.1016/j.resconrec.2018.01.006.
16. Gazzola G. Shipbreaking in the Indian Subcontinent-Practices, Consequences and Applicable Legislation [dissertation]. Università Ca' Foscari Venezia; 2022.
17. Neşer G, Ünsalan D, Tekoğul N, Stuer-Lauridsen F. The shipbreaking industry in Turkey: environmental, safety and health issues. J Clean Prod. 2008;16(3):350-8. doi: 10.1016/j.jclepro.2006.08.018.
18. Tanha M. Adoption of H&S Practices in Shipbreaking Operations: An Empirical Investigation of Shipbreaking Industry in Bangladesh [dissertation]. University of Canterbury; 2021.
19. Mutahi SW. Invigorating Kenya's Absorptive Capacity for Health, Safety and Environmental Technology in the Upstream Petroleum Sector [dissertation]. Strathmore University; 2020.
20. Pasha M, Mahmood AH, Rahman I, Hasnat A. Assessment of ship breaking and recycling industries in Bangladesh—an effective step towards the achievement of environmental sustainability. In: International Conference on Agricultural, Environment and Biological Sciences (ICAEBS'2012); 2012; Phuket.
21. Shameem KA. The Role of the Ship Breaking Industry in Bangladesh and its Future with Special Emphasis on Capacity Building Through Education and Training [dissertation]. World Maritime University; 2012.
22. Jain KP, Pruyn J, Hopman H. Strategic guidance based on the concept of cleaner production to improve the ship recycling industry. Environ Syst Decis. 2018;38(2):250-60. doi: 10.1007/s10669-017-9654-5.
23. Idoko DO, Agaba JA, Ijeoma N, Badu SG, Ijiga AC, Okereke EK. The role of HSE risk assessments in mitigating occupational hazards and infectious disease spread: a public health review. Open Access Res J Biol Pharm. 2024;11(2):11-30. doi: 10.53022/oarjbp.2024.11.2.0029.
24. Atomic Energy Regulatory Board (AERB). Personal Protective Equipment. Mumbai: AERB; 2004.
25. Mansdorf SZ. Personal protective equipment (PPE). In: Applications and Computational Elements of Industrial Hygiene. CRC Press; 2018. p. 583-627.
26. Baalisampang T, Abbassi R, Garaniya V, Khan F, Dadashzadeh M. Review and analysis of fire and explosion accidents in maritime transportation. Ocean Eng. 2018;158:350-66. doi: 10.1016/j.oceaneng.2018.04.022.
27. Paik JK. Ship-Shaped Offshore Installations: Design, Construction, Operation, Healthcare and Decommissioning. Cambridge University Press; 2022.
28. Senavirathna GR, Galappaththi UI, Ranjan MT. A review of end-life management options for marine structures: state of the art, industrial voids, research gaps and strategies for sustainability. Clean Eng Technol. 2022;8:100489. doi: 10.1016/j.clet.2022.100489.
29. Chaîneau CH, Bourguignon JC, Goubard G, Bang P, Jean P, Lefebvre B, et al. Decommissioning of a FSO containing hazardous waste: a successful story. In: International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production. Perth, Australia: SPE; 2012. doi: 10.2118/157017-ms.
30. Hadjiyianni I, Pouikli K. End-of-life ships as hazardous waste under the Basel Convention and the EU Waste Shipment Regulation. In: The Regulatory Landscape of Ship Recycling. Edward Elgar Publishing; 2024. p. 122-64. doi: 10.4337/9781035314683.00012.
31. Misra V, Pandey SD. Hazardous waste, impact on health and environment for development of better waste management strategies in future in India. Environ Int. 2005;31(3):417-31. doi: 10.1016/j.envint.2004.08.005.
32. Khanam Z, Sultana FM, Mushtaq F. Environmental pollution control measures and strategies: an overview of recent developments. In: Geospatial Analytics for Environmental Pollution Modeling: Analysis, Control and Management. Cham: Springer; 2023. p. 385-414. doi: 10.1007/978-3-031-45300-7_15.
33. Stedmon CA, Seredyńska-Sobecka B, Boe-Hansen R, Le Tallec N, Waul CK, Arvin E. A potential approach for monitoring drinking water quality from groundwater systems using organic matter fluorescence as an early warning for contamination events. Water Res. 2011;45(18):6030-8. doi: 10.1016/j.watres.2011.08.066.
34. Erickson PA. Emergency Response Planning: For Corporate and Municipal Managers. Elsevier; 1999.
35. Ahmed I. Ungovernable ships at the end of their lives and the response of the Hong Kong convention: a critical appraisal of the treaty on ship-breaking from the perspective of south Asian ship-breaking nations. Santa Clara J Int Law. 2020;18:124-74.
36. Hackett DP. Assessment of the Basel convention on the control of transboundary movements of hazardous wastes and their disposal. Am Univ Int Law Rev. 1989;5(2):291-323.
37. Ahmed I. The Basel convention on the control of transboundary movements of hazardous wastes and their disposal: a legal misfit in global ship recycling jurisprudence. Washington Int Law J. 2019;29(2):411-54.

38. Trifoni C. Framework of ISO 14000 on Shipping of Hazardous Cargoes [dissertation]. University of Piraeus; 2019.
39. Balkin R. The international maritime organization and maritime security. Tulane Maritime Law Journal. 2006;30(1-2):1-34.
40. Ali MA. The International Labor Organization for minimum labor standards: the seafarers' case. In: Lewin D, Kaufman BE, Gollan PJ, eds. Advances in Industrial and Labor Relations. Vol 18. Emerald Group Publishing Limited; 2011. p. 215-61. doi: 10.1108/s0742-6186(2011)0000018010.
41. Hsuan J, Parisi C. Mapping the supply chain of ship recycling. Mar Policy. 2020;118:103979. doi: 10.1016/j.marpol.2020.103979.
42. Togo K. Japan's Foreign Policy, 1945-2009. Leiden: Brill; 2010.
43. Hiremath AM, Pandey SK, Asolekar SR. Development of ship-specific recycling plan to improve health safety and environment in ship recycling yards. J Clean Prod. 2016;116:279-98. doi: 10.1016/j.jclepro.2016.01.006.
44. Mikelis N. Ship recycling. In: Psaraftis HN, ed. Sustainable Shipping: A Cross-Disciplinary View. Cham: Springer International Publishing; 2019. p. 203-48. doi: 10.1007/978-3-030-04330-8_6.
45. Sejan SS, Muhfuz MI, Urmi US. A critical analysis of legal regime of ship-breaking and ship-recycling in Bangladesh. J Environ Law Policy. 2024;4(1):54-83. doi: 10.33002/jelp040103.
46. ElMenshawy OM, Ülkü MA, Hsuan J. Navigating green ship recycling: a systematic review and implications for circularity and sustainable development. Sustainability. 2024;16(17):7407. doi: 10.3390/su16177407.
47. ElMenshawy O. Sailing Towards Sustainable Supply Chains: A Multi-Objective Optimization Model for Green Ship Recycling in a Circular Economy [dissertation]. Halifax, Nova Scotia: Dalhousie University; 2023.
48. Bleischwitz R, Höller J, Kriegl M. Ship recycling—estimating future stocks and readiness for green steel transformation. Environ Res Lett. 2023;18(12):124034. doi: 10.1088/1748-9326/ad0a55.
49. Skerritt DJ. Seeking clarity on transparency in fisheries governance and management. Mar Policy. 2024;165:106221. doi: 10.1016/j.marpol.2024.106221.
50. Munim ZH. Autonomous ships: a review, innovative applications and future maritime business models. Supply Chain Forum. 2019;20(4):266-79. doi: 10.1080/16258312.2019.1631714.