

An Evaluation of the Ship Recycling Process in Bangladesh in Accordance with the Hong Kong Convention Guidelines

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Abstract: Ship recycling is an important phase in the life cycle of a ship, where valuable materials are reclaimed and waste is reduced. Ship recycling is a series of processes: initial vessel inspection, development of an Inventory of Hazardous Materials (IHM), decontamination, structural dismantling, and ultimate material recycling or disposal. Traditional ship breaking procedures, particularly beaching in South Asia, have faced intense global criticism for poor labor practices, lack of regulation enforcement, and extensive environmental destruction. Ship breaking laborers are often exposed to hazardous chemicals such as asbestos, heavy metals, and polychlorinated biphenyls (PCBs), leading to serious health risks and regular on-site accidents. Further, the illegal dumping of toxic waste is one of the leading causes of devastating ecological degradation, including marine pollution and soil contamination. To address these issues, the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC) was passed by the International Maritime Organization (IMO) in 2009. HKC establishes legally binding duties aimed at promoting improved safety, health, and environmental practices within ship recycling facilities. It involves the production of a certified IHM, installation of ship recycling schemes, and the imposition of strict safety controls, such as protective equipment, staff training, and emergency arrangements. Furthermore, the convention promotes the use of dry-docking or sophisticated slipway technology over the age-old beaching methods, essentially reducing the risk to the environment. Since its implementation, HKC has brought about increased international consciousness, closer government regulation, and better facilities in certified ship recycling facilities, especially in regulated nations. This paper presents a comprehensive evaluation of the ship recycling process in Bangladesh, emphasizing the adoption of the Hong Kong Convention (HKC) guidelines. It examines the transformation of industry practices under these regulations, assessing their impact on worker safety, environmental sustainability, and operational efficiency. Through case studies from leading ship recycling nations, the study highlights both the progress made and the ongoing challenges in global HKC implementation. Additionally, it explores the potential advancements toward greener, more responsible ship recycling. By critically analyzing the effectiveness of HKC in Bangladesh, this paper contributes to the broader discussion on establishing a safer and more sustainable ship recycling industry worldwide.

Keywords: Ship Recycling, Shipbreaking, Hazardous Materials, Hong Kong Convention (HKC), Worker Safety, Sustainable Ship Dismantling, Inventory of Hazardous Materials (IHM), IMO, Waste Management, Pollution Control, Ship Lifecycle, Regulatory Compliance.

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I. INTRODUCTION

Ship recycling, ship breaking, or ship dismantling refers to the process of scrapping ships at the end of their lifespan

to recover valuable material such as steel, aluminum, and other recyclable items. Ship recycling is a significant component of the shipping industry that facilitates environmentally sound disposal of old ships as well as

promotes resource conservation and economic growth. Ship recycling is particularly significant in developing countries, as it continues to be a main source of raw material for most industries and a field of job opportunity for thousands of workers [1]. While the sector provides economic benefits, it also faces different problems, including pollution of the environment, treatment of toxic waste, and the health and safety of workers. The shipbreaking industry has traditionally been associated with hazardous working conditions, exposure to harmful materials, and pollution, which have raised concerns about the sustainability and safety of traditional ship recycling methods [2]. The impact of Ship Breaking and Recycling Industries (SBRI) based on a study on a specific shipbreaking yard is discussed [3]. The study focused on environmental impact assessment through seventeen parameters from personnel involved in the related work and water quantity parameters like Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Electric conductivity (EC), pH, Turbidity, Total Dissolved Solids (TDS), Chloride, Ammonia, Oil, and Grease Concentrations. Hence, regulatory frameworks such as the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC) have emerged in an effort to ensure safer and environmentally friendlier operations in ship recycling [4].

Bangladesh also ranks among the leading ship recycling nations, in addition to India and Pakistan. The country's shipbreaking industry began unofficially in the 1960s when a Greek vessel, "MV Alpine", stranded on Chattogram beaches during a destructive cyclone. The vessel was later dismantled, and this marked the beginning of shipbreaking activities in Bangladesh unofficially [2]. The industry continued to expand exponentially over time with the availability of cheap labor, favorable geography, and immense demand for scrap metal. By the first decade of the 21st century, Bangladesh had become one of the prominent ship recycling centers in the globe, accounting for a

significant portion of global ship breaking activities [1]. Chattogram shipbreaking yards, popularly called the "ship graveyards," supply an enormous quantity of steel requirements of the nation, saving foreign exchange expended on importing raw materials and adding to the industrial growth of the nation [5]. But the rapid growth of the industry has also led to increased concerns regarding environmental as well as safety standards.

The traditional shipbreaking process in Bangladesh is typically conducted by means of the beaching operation, whereby ships are grounded on tidal mudflats and subsequently dismantled manually. This method, although cheap, is very environmentally and health-risky as it provides for the spilling of such toxic materials as asbestos, heavy metals, and oil residues that contaminate the surrounding ecosystem [6]. Shipbreaking workers typically lack any facilities to work from under dangerous conditions with no full PPE utilization and training to deal with toxic wastes. The majority of the workers experience occupational diseases induced by long-time exposure to dangerous chemicals, while work accidents are common due to inadequate strict control measures [5]. Due to all these concerns, international agencies as well as the environment groups have been pushing for enhanced safety protocols and regulation aimed at curbing the negative consequences of shipbreaking.

To address these challenges, the International Maritime Organization (IMO) in 2009 adopted the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC) for establishing world-class standards on ship recycling. The convention aims to avoid environmental harm and protect the laborers by requiring ship recycling facilities to maintain hazardous waste management, conduct risk assessment, and provide appropriate training and protection for workers [4].

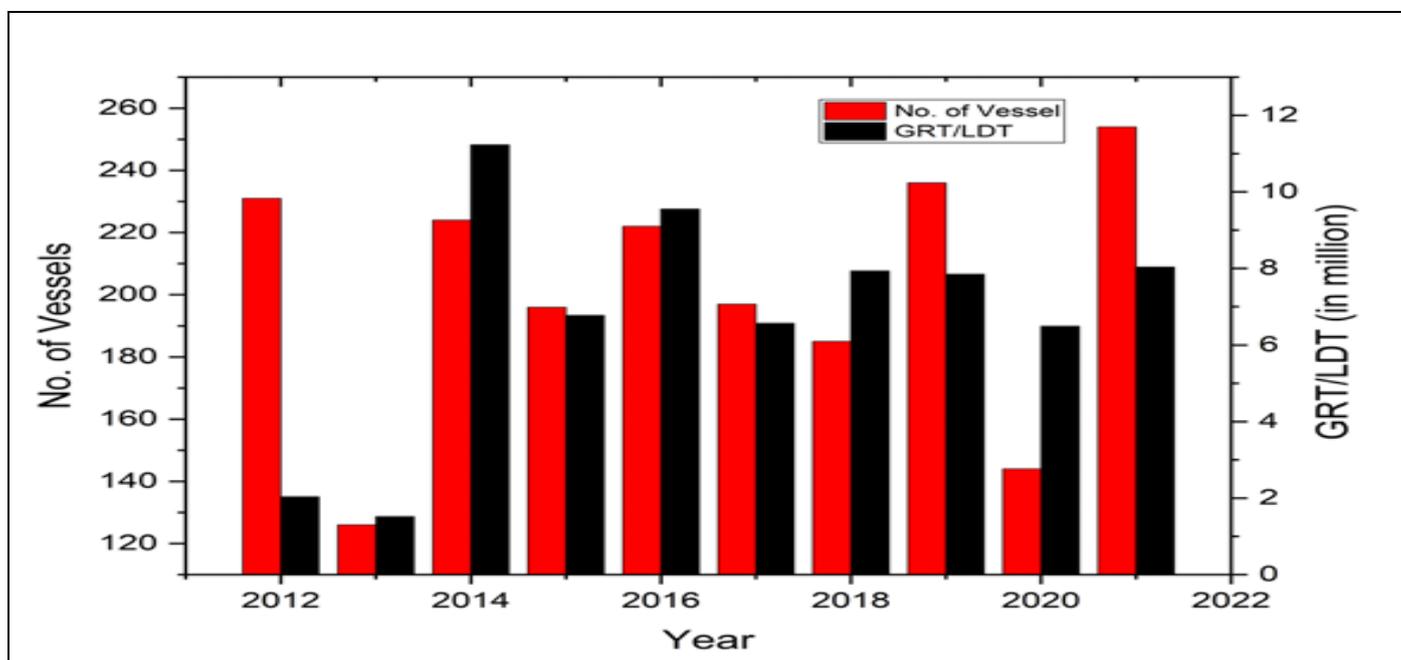


Fig 1 Yearly Number of Scrapped Ships and Associated GRT/LDT in Bangladesh (NGO Shipbreaking Platform, 2022)

II. BANGLADESH'S SHIP RECYCLING INDUSTRY COMPARED TO THE REST OF THE WORLD

Before the 1960s, ship recycling facilities were known to be comparatively technologically dependent. Also, ship recycling was conducted by industrialized nations like the United Kingdom, Germany, Italy, and the United States to a large extent. However, things began changing in a dramatic manner in the 1980s, with ship owners getting increasingly interested in selling their scrap ships to South Asian shipbreaking facilities in Bangladesh, India, Pakistan, Philippines, and Vietnam in trying to achieve the maximum profits [7].

The shipbreaking industries of Bangladesh are primarily located in Sitakunda (Bhatiary to Kumira), the northern side of Chittagong City, and the Bay of Bengal. Ship recycling is expected to thrive because of the geographical advantages of this location. South Asian countries like Bangladesh, Pakistan, and India are currently

regarded as the global hub for shipbreaking and recycling. Ship recycling has excellent significance in Bangladesh's impoverished macro- and micro-economies and plays a significant role in developing this country. Bangladesh receives raw material support from these shipbreaking industries yearly, contributing significantly to the national economy.

Figure 1 illustrates the annual ship-scrapping statistics within the shipyards of Bangladesh. The data suggests an average of approximately 202 ships being dismantled each year. Additionally, the figure presents the yearly values for gross tonnage (GRT) or light displacement tonnage (LDT), with an average of 6.8 million per year. The graphical representation highlights that the peak year for ship scrapping was 2021, while the maximum GRT/LDT value was recorded in 2014. It also signifies a significant decrease in shipbreaking activities and GRT/LDT values during the year 2020. The catalyst for this phenomenon was the worldwide impact of the COVID-19 pandemic [7].

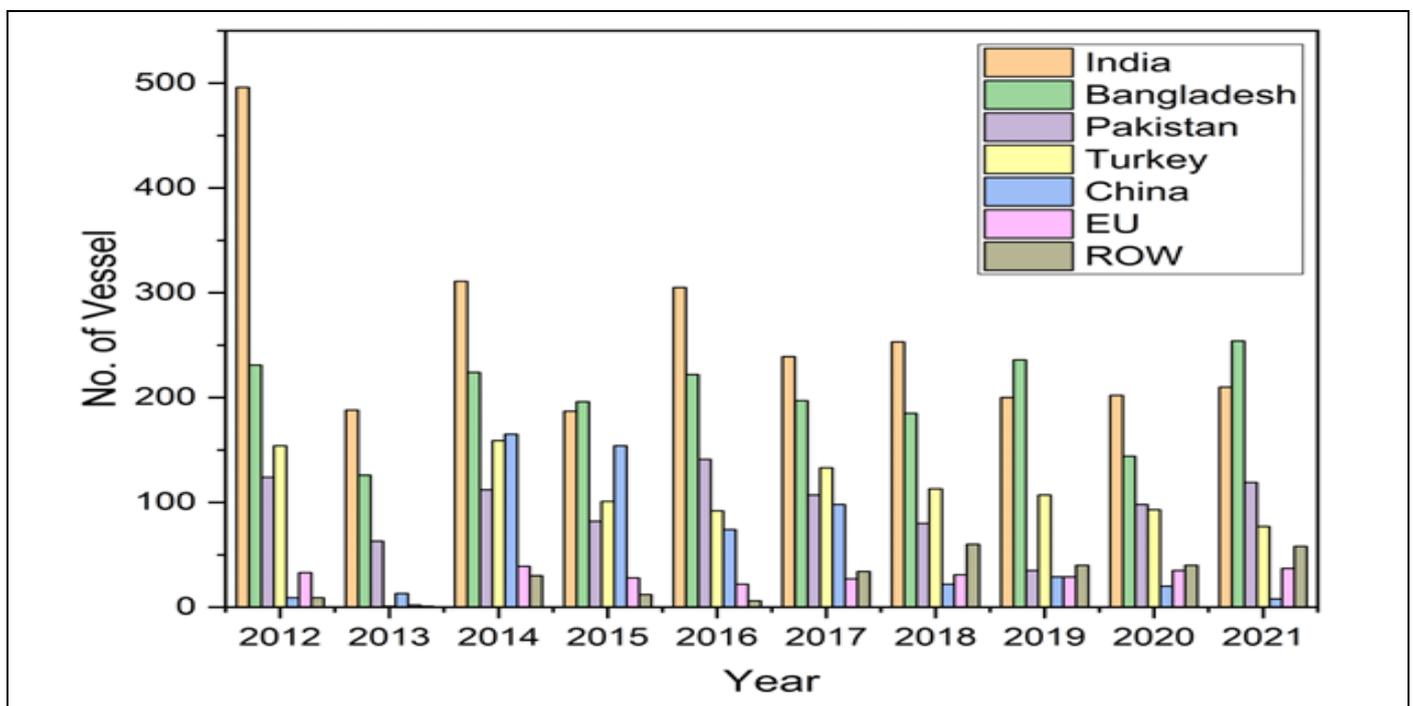


Fig 2. Yearly number of scrapped ships in India, Bangladesh, Pakistan, Turkey, China, EU, and ROW (NGO Shipbreaking Platform, 2022).

Figure 2 provides a visual representation of ship-breaking activities across various countries over the past decade (2012-2021), including India, Bangladesh, Pakistan, Turkey, China, the EU, and the rest of the world (ROW). Notably, the figure emphasizes India's prominent role in global shipbreaking, contributing significantly to this industry. Additionally, the figure highlights the evolving status of Bangladesh in this sector, with intermittent improvements. Bangladesh notably claimed the top position in 2021. In contrast, Turkey, Pakistan, China, and the EU are progressively establishing their presence in shipbreaking. The data indicates a gradual increase in their contributions [7].

III. THEORETICAL FRAMEWORK

Ship recycling is a vital activity involving the dismantling of ships at the end of their life cycle to recover useful materials while minimizing environmental and health risks. Occupational health and safety have been widely debated and remain a contentious issue in the ship recycling industry. Historically, the sector has been perceived by the international community as secretive, resistant to change, and unwilling to adopt new practices [8]. In order to ensure that ship recycling is conducted in a safe and responsible manner, several international conventions and regulations have been formulated. These conventions, including the Hong Kong

International Convention (HKC), the Basel Convention, the Stockholm Convention, the Rotterdam Convention, and the International Labour Organization (ILO) Guidelines, establish regulatory standards in terms of environmental protection, laborers' safety, and waste management.

➤ *Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC, 2009)*

The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC), adopted by the International Maritime Organization (IMO) in 2009, is one of the most significant global treaties on ship recycling. The primary aim of HKC is to ensure that ships are recycled in an environmentally friendly and safe in human health context manner. It insists that vessels be equipped with a Ship-Specific Inventory of Hazardous Materials (IHM) that outlines the existence of dangerous substances such as asbestos, heavy metals, and PCBs. Furthermore, the convention insists on ships being recycled at Ship Recycling Facilities (SRFs) certified to high environmental and safety standards. Further, HKC emphasizes the importance of good-fidelity Ship Recycling Plans (SRPs) that should come before any dismantling procedure. Although the HKC has yet to be formally ratified by all member nations, it has already had a big influence on countries like Bangladesh, India, and Pakistan, which have been encouraged to adopt safer and environmentally friendly ship recycling practices.

➤ *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989)*

The Basel Convention, in effect since 1992, is accountable for regulating the transboundary export of hazardous waste, including vessels and vessel parts [9]. The convention prohibits developed countries from exporting hazardous waste, such as old vessels, to developing countries without appropriate disposal of hazardous waste. The convention operates through a Prior Informed Consent (PIC) system, whereby countries exporting the hazardous waste must have the importing country's approval before exporting it. The Basel Convention also stresses environmentally sound management (ESM) of the hazardous waste, promoting safe disposal to minimize harm to the environment. The convention has been necessary in preventing illegal shipment of hazardous vessels to poorly regulated nations.

➤ *Stockholm Convention on Persistent Organic Pollutants (POPs, 2001)*

The Stockholm Convention on Persistent Organic Pollutants (POPs), adopted in 2001, aims at the elimination of harmful chemicals that are likely to persist in the environment for a long time, e.g., PCBs, dioxins, and furans. Such harmful substances are frequently utilized as materials on ships, e.g., insulation, cables, paint, and fire retardants. The Stockholm Convention attempts to decrease the challenge of dealing with POPs during ship dismantling through promoting detection and elimination of chemicals in a secure way. The convention also calls for removing permanent environmental risks created by using hazardous

materials using different, more safe ones while making ships. Since the convention itself does not abolish ship dismantling, its applications have an elemental role in avoiding the discharge of toxins while demolishing ships.

➤ *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides (1998)*

The Rotterdam Convention of 1998 is another significant instrument that influences ship recycling through regulating the exportation of certain hazardous chemicals and pesticides. Like the Basel Convention, it binds countries to have a Prior Informed Consent (PIC) procedure for exporting hazardous materials, including those contained in ships. The Rotterdam Convention is a regulatory regime for regulation of dangerous substances transported by ships, such as asbestos and lead-based paints, to ensure that the substances cannot be sold or destroyed without warning and permission. The Rotterdam Convention promotes safer alternatives of the kind of material used in ship-building so that future ship-breaking contamination can be prevented.

➤ *International Labour Organization (ILO) Guidelines for Safety and Health in Shipbreaking (2003)*

International Labour Organization (ILO) has published definitive guidelines for the improvement of the health and safety conditions of workers in the shipbreaking industry. ILO Guidelines for Safety and Health in Shipbreaking, according to 2003, were established to transcend occupational hazards encountered by ship recycling industry workers. These rules emphasize the need for proper training and the use of Personal Protective Equipment (PPE) to ensure the safety of workers in the process of dismantling ships. They also lay down the installation of emergency readiness systems, including medical centers and fire-fighting equipment, inside ship recycling facilities. The ILO guidelines play a critical role in safeguarding the health of workers, particularly in countries where ship recycling is typically carried out in informal and unsafe settings.

➤ *Bangladesh Ship Recycling Act (2018)*

The Government of Bangladesh establishes a Board by name the Bangladesh Ship Reprocessing Board. The Board shall be a statutory and permanent body consisting of a common seal and, except as otherwise expressly provided for in this Act, subject to the provisions hereof shall be competent to acquire, hold, and dispose of immovable as well as moveable property and the Board is empowered to sue in its own name and in its own behalf and a case may also be brought against. Subject to other provisions of this Act, the functions and powers of the Board shall be as follows, namely:- overall monitoring of ship reprocessing activities; evaluate the performance of the yard from time to time; approval of ship reprocessing plan; approval of Ship Reprocessing Facility Plan; ensure workers' safety and health and to eliminate workplace hazards; Taking steps to ensure ship reprocessing in an environment friendly manner and coordination with concerned ministries, organizations or departments wherever necessary; submit suggestions or proposals to the Government for development of the ship reprocessing industry and conduct activity as per

Government directions in this regard; submit suggestions to the Government for new areas or expansion of existing ones for the purpose of development of ship reprocessing industry; accept domestic and foreign cooperation in ship reprocessing activities, into agreements with domestic and foreign organizations or institutions, etc.

IV. CURRENT FACILITIES AND PRACTICES OF SHIP RECYCLING PROCESS

Breakage of ships, particularly in Bangladesh, is very prominent in global shipbreaking business. Bangladesh is one of the world's largest ship recycling facilities, with most of the shipbreaking activity taking place on the coastal perimeters of Chattogram (formerly Chittagong), particularly in Sitakunda. This section discusses the facilities and practices currently found in the ship recycling process in Bangladesh, the heart of the industry but plagued by a variety of issues involving the safety of workers, environmental protection, and regulatory compliance. To begin the recycling process of an obsolete vessel, an expert beaching master collaborates with the vessel's captain to carry out the intertidal landing. Once the ship reaches the shore facilities, it is ready for dismantling. The first step involves the removal of navigational equipment, including radar, GPS, autopilot systems, speed logs, compasses, electronic charts, echo sounders, transponders, and other components of the LRIT and AIS systems. This task is handled by the Bangladesh Navy [10].

Following this, the ballast and bilge water are discharged, but not before undergoing an initial assessment. The concentration of organic compounds in the water is checked, and the level of chromium pollutants is tested to ensure safe disposal. Once the ballast and bilge water are separated from the vessel, the next step is the gradual removal of oily residues and substances. This process is carried out in two phases. First, fuel tanks, bunkers, and any other spaces containing oily residues are emptied. This is done through bunkering, where the majority of the oil is transferred to medium or small oil tankers and oil barges. The remaining oil is then collected and stored in oil drums using specialized equipment such as pipes, valves, gauges, compressors, and regulators. Pipelines running along the beach facilitate this process. To prevent oil spills, shipyards employ oily-water separator trays or impermeable flooring in designated onshore plant areas.

Once the ship has undergone preliminary inspections and cleaning, it is prepared for dismantling. The vessel is cut into sections according to a detailed cutting plan, with blocks being separated and moved as required. The initial cutting takes place in the intertidal zone, where the detached blocks are released using the gravity fall method. These blocks are then transferred to the secondary cutting zone with the help of winches and ropes. After undergoing secondary cutting, the metal components are either sent to the tertiary cutting area for further processing or sold directly to vendors, depending on market demand.

V. IMPROVEMENT OF HEALTH, SAFETY, AND ENVIRONMENTAL STANDARDS IN SHIP RECYCLING IN BANGLADESH

The ship recycling industry in Bangladesh, as previously outlined, has been marked by a range of safety, environmental, and regulatory challenges. These challenges include inadequate safety equipment, insufficient worker training, improper handling of hazardous materials, poor environmental management, and the lack of facility standards and certifications. However, with the introduction of international frameworks like the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC), there is now a structured approach to addressing these concerns. While Bangladesh has made progress in certain areas, there remain substantial gaps when compared to the standards set forth by the HKC.

Current shipbreaking practices in Bangladesh have been historically plagued by a lack of proper safety measures. Workers face significant exposure to hazardous materials like asbestos and toxic chemicals, often without adequate protective gear. The industry, especially smaller yards, suffers from a shortage of trained personnel and poor enforcement of safety protocols, contributing to a high accident rate. Additionally, there are no standardized health checks or risk assessments for workers. The Hong Kong Convention, on the other hand, mandates the implementation of comprehensive safety measures. This includes providing workers with proper Personal Protective Equipment (PPE), ensuring safe working conditions, conducting risk assessments, and monitoring workers' health regularly. Bangladesh needs to implement these protocols more rigorously, offering better training, enforcing PPE usage, and regularly evaluating health and safety risks at shipbreaking yards. Statistics show that almost 46.42% of the workforce at ship breaking yards have no high school diploma or equivalent, which allows workers unaware of their legal rights and international health and safety laws that may keep them safe while at work [7].

Treatment of dangerous materials, such as asbestos, petroleum products, and PCBs, remains among the major challenges in Bangladesh's ship breaking process. Hazardous waste is often dealt with insufficiently, and therefore there is pollution of the environment and severe risks to workers' health. In addition, not every shipbreaking yard has an infrastructure and operation for safe removal of dangerous products. The HKC stipulates that ships carry an expansive Inventory of Hazardous Materials (IHM) onboard so shipbreaking facilities are ready for safe removal of harmful substances. The convention mandates ship recycling centers have specialized facilities in order to find, regulate, store, and dispose of dangerous substances under regulated conditions so there is as little environmental destruction as possible, together with minimization of employees' exposure to risks. Bangladesh needs to implement these best practices by proper adoption of IHM procedures and facilities with adequate systems to protect safe handling of hazardous materials.

Ship recycling in Bangladesh is also a cause of significant environmental pollution. Pollution caused by ship breaking, for example, air and water pollution, is rampant notwithstanding some efforts at minimizing the impact. While some of the yards have embarked on basic pollution control measures like dust suppression systems, general environmental management remains poor. Furthermore, pollution caused by improper waste disposal and oil spillage continues to affect the local ecosystem and nearby communities. The HKC also requires ship recycling facilities

to adhere to stringent environmental protection standards. These include emission control, prevention of water body and soil pollution, and recycling of wastes appropriately. The convention also promotes the adoption of cleaner technology to minimize the environmental impact of shipbreaking operations. Bangladesh has to enhance its environmental management through the inclusion of more effective pollution control devices, such as more efficient oil-water separators and air filters, and more efficient waste recycling technologies to minimize environmental impacts.

Table 1 Accidents and Death Statistics in the Ship Breaking Industry (Off the beach, 2022)

Year	Dead Worker	Seriously Injured
2016	22	29
2017	15	22
2018	20	12
2019	24	34
2020	10	14
2021	14	34

The infrastructure and facilities in Bangladesh's ship recycling yards are often outdated and lack the necessary certification required to meet international standards. Many yards do not have proper waste management systems, and there is minimal regulatory oversight to ensure that safety and environmental standards are met. Furthermore, Bangladesh's shipbreaking facilities are not typically certified by international organizations, which further exacerbates the issue. The HKC stipulates specific requirements for ship recycling facilities, including the design of the yard, waste management systems, and worker safety standards. Only facilities that meet the convention's standards are allowed to receive ships for recycling. This means that Bangladesh should work toward certifying its ship recycling yards according to HKC standards, upgrading infrastructure, introducing modern recycling technologies, and ensuring that regular audits are conducted to ensure compliance.

Currently, one of the major concerns in Bangladesh's ship recycling industry is the lack of detailed inventories of hazardous materials before ships arrive at the yards. In the past, shipbreaking yards did not follow any proper procedures for handling hot work (such as welding and cutting) or cold work. Hot work, in particular, posed a huge risk of fire and explosion when improperly managed. The lack of a cold work permit system also led to unsafe working conditions during tasks that involved handling materials like flammable liquids, oils, and other hazardous substances.

This lack of preparedness makes it difficult to handle dangerous substances safely, often leading to accidental exposure to harmful chemicals or materials. The HKC mandates that all ships must carry an Inventory of Hazardous Materials (IHM) before they are brought for recycling. This inventory helps shipyards prepare for the safe disposal of these substances and ensures that proper safety measures are in place. Bangladesh must adopt this practice and regulate that all ships entering its shipbreaking yards must present an accurate IHM, ensuring that hazardous materials are managed safely and in compliance with environmental

regulations. As part of the upgrading process, shipbreaking yards have started implementing hot work and cold work permit systems, which control the fire and explosion risks. The permits ensure that proper safety precautions are taken before undertaking any task related to welding, cutting, or handling flammable materials. The system also incorporates the issuance of permits only after risk analysis and ensuring that the relevant safety precautions are in place.

In Bangladesh, while some shipbreaking yards provide basic training, many workers lack comprehensive education on safety protocols, hazardous materials handling, machinery operation, and environmental protection. Investigation of occupational noise exposure in a ship recycling yard showed that ship recycling workers are at risk of experiencing occupational noise and there is a lack of appropriate hearing protection being used in ship recycling yards [11]. Table 1 shows the accident and death statistics in the shipbreaking industry from 2016 to 2021. This lack of awareness contributes to accidents and environmental harm. The HKC requires that all workers involved in ship recycling be adequately trained in safety measures, the use of machinery, hazardous materials handling, and environmental protection. Regular training programs must be conducted, and workers' knowledge must be updated in accordance with the evolving safety standards. Bangladesh should invest in more widespread and standardized training programs, focusing on worker awareness, safety skills, and environmental impact. Furthermore, stronger enforcement of safety regulations is essential to reduce accidents and improve working conditions.

VI. SUGGESTIVE MEASURES FOR IMPLEMENTATION

The life of a ship is segmented into three stages. After building a new ship, its operational phase starts, where the ship needs to keep its seaworthiness by performing necessary maintenance and repair. Her working life usually ends after 20–25 years, so it comes to its graveyard for recycling purposes. Usually, a recyclability analysis of a

ship is conducted considering various factors such as onboard materials, reusability potential, market price, and many others [12]. For smooth implantation of green ship recycling the sector has to change some aspects. But in real sense green ship recycling needs more change in the infrastructure, process and management system because of uneducated workers, the yard owners are not in the context of green ship regulation and safety precautions. As a whole, the ship recycling yard does not have an appropriate standard operational procedure

The following alternative measures should be enforced during the practice of green ship recycling in light of Hong Kong Convention guidelines:

- **Pre-Recycling Ship Inventory (IHM):** This refers to the Inventory of Hazardous Materials (IHM), a key document that lists all hazardous materials on board the ship. It helps in ensuring that the materials are identified and managed properly before recycling starts.
- **Ship Recycling Facility Certification:** This ensures that the recycling facility complies with the international standards set by the HKC. The facility should be certified and equipped to safely recycle ships and handle hazardous materials.
- **Worker Safety and Health Measures:** This involves ensuring the health and safety of workers in the recycling yard by providing them with necessary protective equipment (PPE), proper training, and emergency protocols.
- **Hazardous Material Management:** This step focuses on the proper removal and management of hazardous

materials, such as asbestos, oil, and PCBs, which pose environmental and health risks.

- **Decontamination and Dismantling Process:** Before the ship is dismantled, it needs to be decontaminated to prevent the release of hazardous substances into the environment. This process ensures the safe removal of oils, fuels, and other potentially harmful materials.
- **Pollution Control and Waste Management:** This step ensures that environmental pollution is minimized during ship dismantling. It includes measures for air filtration, water treatment, and waste disposal systems to reduce emissions and prevent contamination.
- **Recycling and Disposal of Materials:** After dismantling, the recyclable materials like metals, steel, and plastics are processed, while non-recyclable waste is disposed of safely to prevent pollution.
- **Environmental and Worker Health Monitoring:** Ongoing monitoring is crucial to ensure that the recycling process does not adversely affect the environment or worker health. Regular assessments help maintain compliance with safety and environmental standards.
- **Post-Recycling Waste Management and Final Report:** After the ship has been dismantled, a final report is created to document the recycling process, materials recycled, hazardous waste removed, and how environmental and safety protocols were followed.
- **Compliance Audits and Continuous Improvement:** This step involves auditing the recycling facility to ensure ongoing compliance with the HKC guidelines. The recycling facility should regularly update their processes based on audit findings to improve operations.

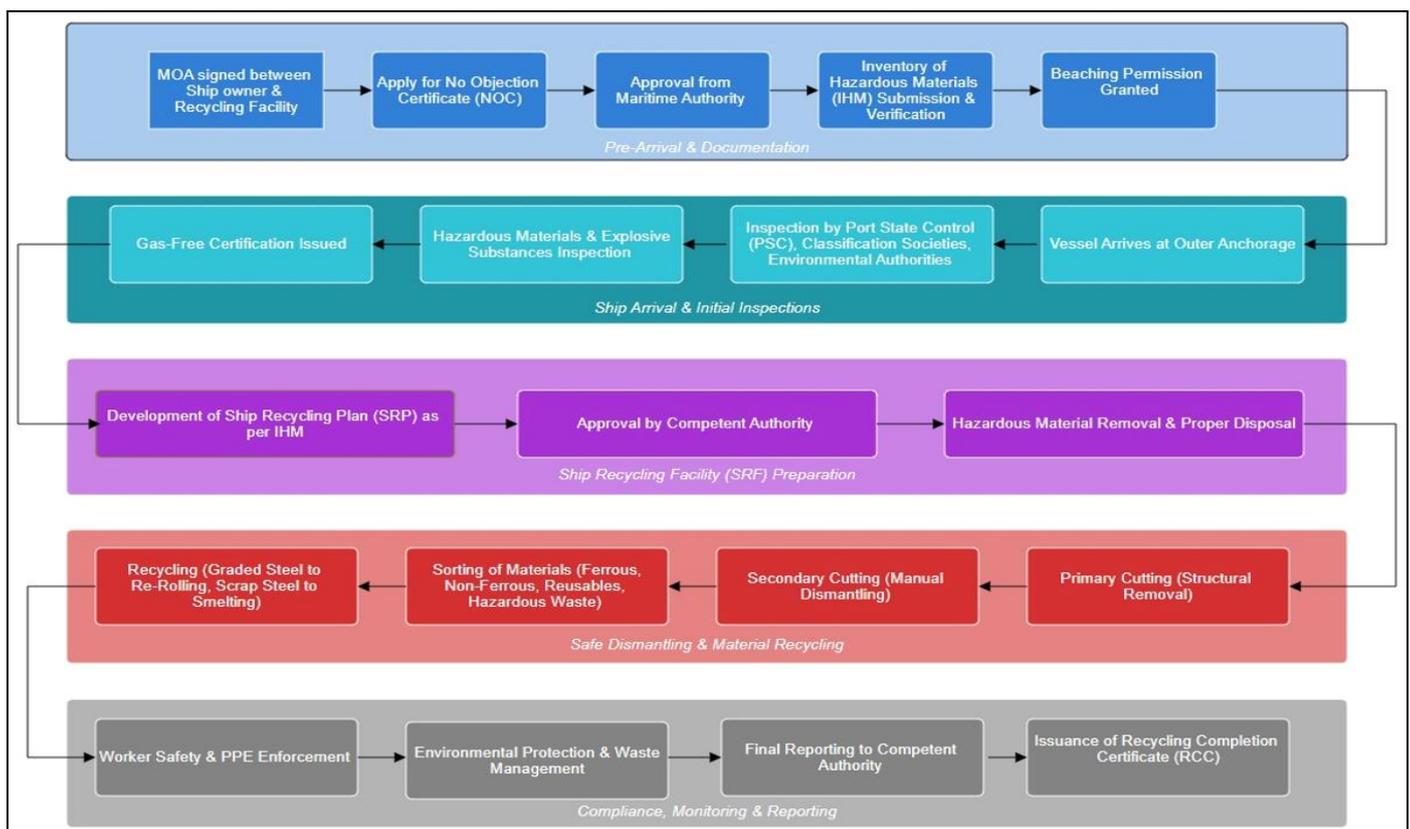


Fig 3 Ship Recycling Process Followed in Bangladesh

VII. CONCLUSION

This study identifies the current state of ship recycling in Bangladesh, in particular the practices that have been adopted in the industry. It is evident that the ship recycling industry in Bangladesh is at the starting point of meeting international standards, in particular the Hong Kong Convention (HKC). There exists a general unawareness among shipowners of the environmentally responsible and safe procedures required by the HKC, especially as regards worker protection and handling hazardous materials. Occupational safety and health are of major concern as the majority of recycling facilities still employ traditional methods, which are dangerously unsafe for the workers and environment. The reluctance to change and adopt more sustainable practices has been an issue in the business for a long time, as evident in previous studies [8]. However, enforcing the Hong Kong Convention can be the turning point for transforming the business. The HKC has precise rules and regulations established on how dangerous materials are to be handled, safeguarding workers and minimizing environmental pollution when recycling. By adopting the HKC, Bangladesh ship breaking yards can significantly improve their environmental footprint, enhance employee health and safety standards, and assist in global sustainability efforts. If the industry becomes more sensitive to these factors, particularly with the regulations of the HKC in place, Bangladesh's ship breaking industry can have best practices in place and lead the way in promoting safe, environmentally friendly, and economically viable ship recycling. This change will not only improve the industry's reputation but also advance the long-term health of the workforce and environment to the advantage of local communities and the global maritime industry. However, due to the convention's recent adoption and the ongoing process of ratification and implementation, empirical evidence demonstrating a direct reduction in accident rates and pollution levels is not yet available.

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