



UNDERLYING PROBLEMS OF SHIP RECYCLING INDUSTRIES IN BANGLADESH AND WAY FORWARD

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Abstract:

Ship-recycling in Bangladesh has been playing as a catalyst for the economy by supporting steel industry, shipbuilding industry and other industries and it has also been generating huge employments for the country. But, existing problems of this industry in terms of safety, health and environmental issues bring negative image for the country sometimes. This paper is aimed to identify the underlying problems of ship recycling industry and then analyze the nature of the problems to make it helpful overcoming the obstacles. A brief overview about strength, weakness, opportunity and threat of the industries in global perspective has been also discussed.

Keywords: Ship recycling, ship dismantling, safety, safety hazards and environmental hazards

1. Introduction

Ship-recycling is defined as the activity of complete or partially dismantling of a ship at ship breaking yard in order to recover components and materials for reprocessing and re-use. It is an important segment of the maritime sector as it provides cash flow for the renewal of fleet. Usually, the decision to end the ship's life is taken when the maintenance costs start to exceed the forecasted incomes or when new international legislation enforces or when the ship stops to be of interest for the second-hand market. Re-use of scrap iron and steel, which is the main output of the shipbreaking industry, is an environment-friendly activity since it reduces the need for mining for production of raw metal of steel industry from pig iron. From energy saving and emission point of view, the production per ton of steel from scrap requires more than 5 times less energy and 7 times less CO₂ emission compared to steel production from iron ore (Naser 2008). Thus the ship recycling meets a key sustainability requirement in recycling of resources, if carried out properly.

Ship-recycling is mainly labour intensive industry and therefore, major ship-recycling countries are mainly developing countries. Until 1970s, ship-recycling was a common industrial activity both in the United States of America and in Europe. Specialized salvage docks, equipped with cranes and other heavy equipment were used to scrap the ships, providing material for the steel industry. But increase labour costs and stringent environmental regulations caused the scrapping industry to be concentrated at the docksides in Taiwan and South Korea in the 1970s. But those countries lost interest in ship breaking as it was no more cost-effective and they rather focused on using their shipyards for building ships in the 1980s. So, to maximize profits ship owner's found alternative destinations in India, China, Pakistan, Bangladesh, Philippines and Vietnam, where health and safety standards were minimal and where workers were cheap and desperated for work. Bangladeshi industrialists also took the opportunities of this lucrative business which resulted importing more and more ship to Bangladesh. Thus, within a short period, Bangladesh established herself as a leading ship recycling nation in the international market.

Although the age of ship breaking in Bangladesh is more than 3 decades, but primitive working conditions and the lack of necessary control mechanism generally cause the scrapping yards as a source of environmental and occupational health problems. Again adopted preventative measures against the unsafe, primitive conditions of scrapping yards are still below standard.

This paper highlighted the general practice of shipbreaking industry in Bangladesh. Based on the field survey, through study, working condition, infrastructure facilities and current practice, an effort has been made to identify the problems related to safety, health and environmental issues. Present status of the industry has been updated relevant to newly formulated rules and regulations. After analysis the nature of the problems, a brief guide lines have been given to overcome the obstacles. Also, a brief overview about strength, weakness, opportunity and threat of the industries in global perspective has been discussed and recommendations for sustainable development have been outlined.

2. Ship Recycling Industry in Bangladesh: Brief Description, Methodology Characterization & Performance Study

Ship-recycling industries have been located along the coastal belt of Bangladesh, from Bahatiary to Barwalia at Sitakund, some 20km southwest of Chittagong divisional city. The geographical location of the ship recycling zone is between latitude $22^{\circ}25'$ and $22^{\circ}28'N$ and longitude $91^{\circ}42'$ and $91^{\circ}45'$. There are more than 100 registered ship-recycling yards located in this area. This is one of the major shipbreaking sites in the world where world largest LDT vessels usually scrap every year. The location of ship-recycling yards is shown in Fig. 1.

The process of ship-recycling starts in Bangladesh with the acquisition of the ship by a purchaser (specialized broker or the operator of the ship breaking yard) when the ship owner decides to end the economic life of the ship. Typically, after necessary inspection and certification, the ship sails towards the breaking yard for dismantling. The beaching method is widely used by the local ship breaking yard in Bangladesh, where using very high tidal differences along with flat slope are used for beaching a ship. The ship is generally sailed with its maximum speed using its own power during the high tide and forced to be beached over the flat muddy land. After recovering unused or partially spent materials, ship is cutting into small pieces. Gas cutting is widely used to make relatively small pieces from the steel structure. Usually no study is carried out to follow any order of which parts should be separated first and which should be the next. Minimum knowledge of safety and minimum technological know-how are used in this process. So, sometimes this method of inhuman working condition leads to frequent accidents like explosion, death, fatal injuries and permanent disabilities. That is why, apart from economic benefit from this industry, the social and environmental costs demand huge attention for further development of this industry.

India and Pakistan, major ship breaking nations in South Asia also use beaching method for dismantling ships using natural advantages. On the other hand, China mainly uses Afloat/ Pier method for dismantling ships, where relatively small LDT ships can be managed efficiently.

The past data of ship recycling showed that Bangladesh played a significant role in terms of LDT (Statistics, 2011) in the world ship recycling, particularly during 2004 to 2009. In Fig. 2, the share of Bangladeshi performance to the total world ship recycling in LDT is shown. In Fig. 3, it is seen that Bangladesh led the world ship recycling during 2004 to 2008 and India was just behind it. Before 2004, India was the number one in ship recycling for long period. However, currently (2009-2011) India has again retained their leading position in the ship recycling world leaving China/Bangladesh as their follower. The trend of Bangladesh showed ups and downs in early of this decade, but sharply increased in the last few years. In Fig. 4, ship recycling contribution in year 2011 is shown in pie chart. So from these figures it is clear that Bangladesh has been maintaining very strong position among the world shipbreaking nations since year 2002.

3. Economic Contributions

Various industries in Bangladesh such as re-rolling industry for steel making, ship building industry, heavy and light engineering industries etc are directly benefited from ship-recycling industry. Use of scrap which is the main components from ship recycling industries is shown in Fig. 5. Of them, the recycled steel from the shipbreaking yards is an important component of the steel production in Bangladesh. Bangladesh has got more than 350 re-rolling mills and for the raw materials they are highly depend on scrap steel from ship recycling industry. Yearly statistics of steel market shows that shipbreaking is supporting up to 60% of total steel produced in Bangladesh (Hossain, 2010). More than 1,50,000 people are directly and indirectly involved in these industries.

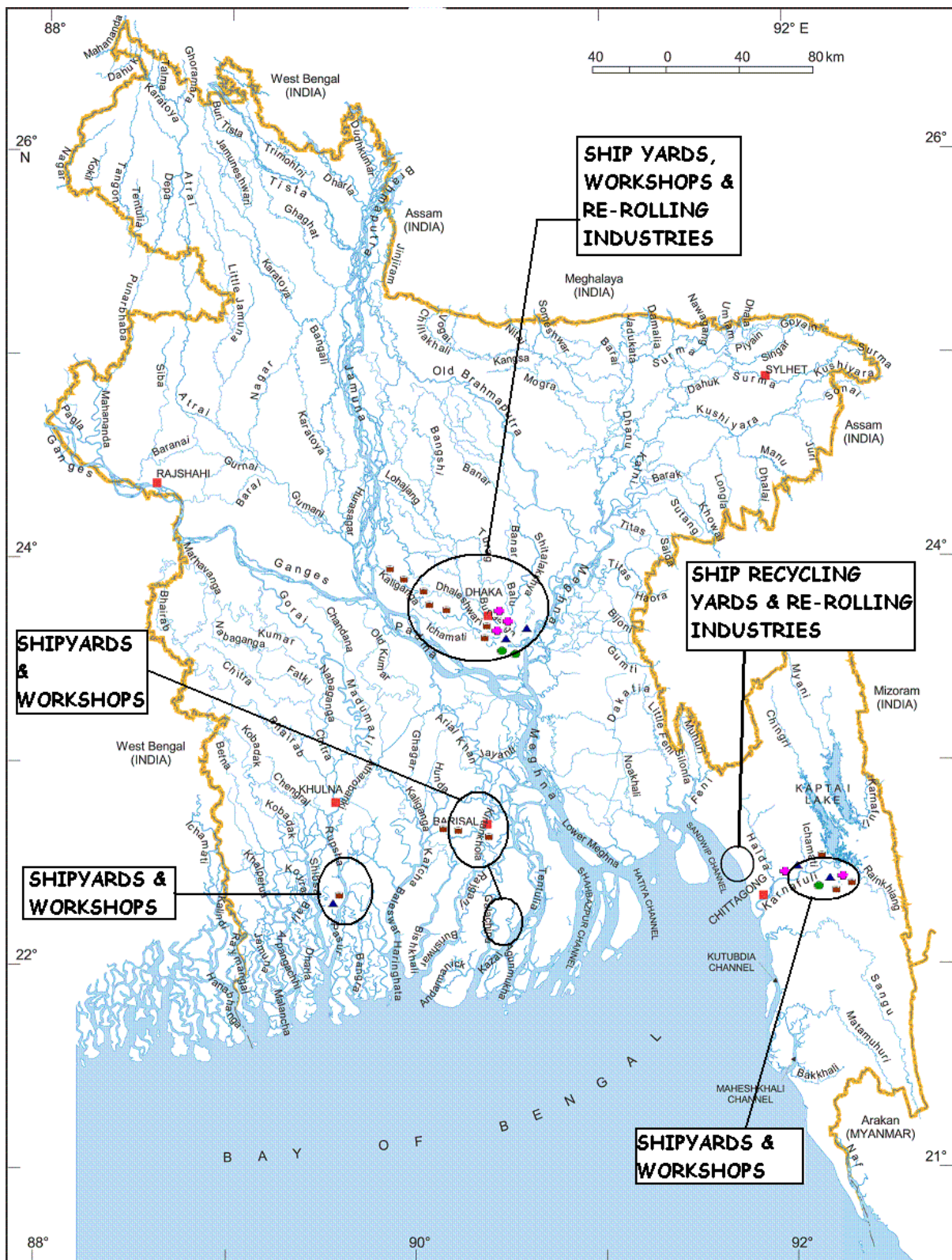


Fig. 1: Location of ship-recycling yards as well as inland class shipbuilding industries & workshops

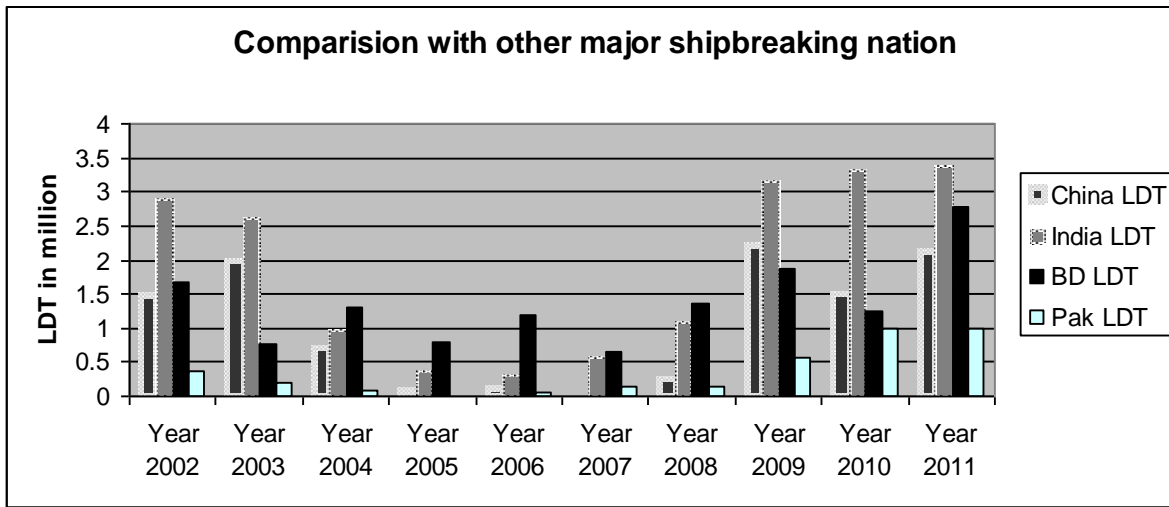


Fig. 2: Comparison of Bangladeshi ship recycling capacity with other countries (2002-2011)

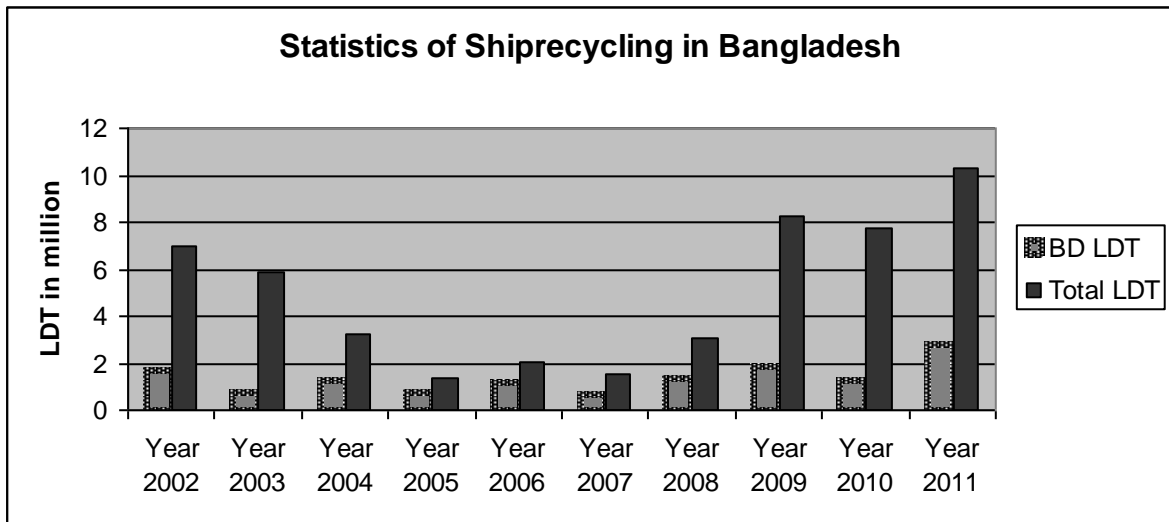


Fig. 3: Comparison of Bangladeshi ship recycling capacity with total world capacity (2002-2011)

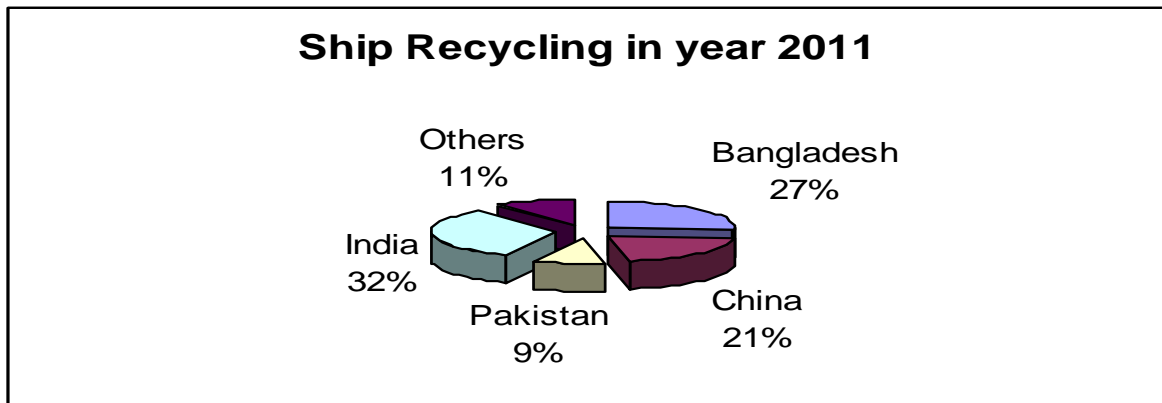


Fig. 4: Contribution of Bangladeshi share of ship-recycling in 2011

Ship-breaking is supporting our indigenous ship building industry enormously. There are more than hundreds shipyards located in and around Dhaka Division. Few more shipyards also located in Chittagong, Khulna and Barisal division. The location of these shipyards and workshops all over the country is shown in Fig. 1. Except export quality shipyard, most of the shipyards are making local quality ships for the inland waterways which is considered as the cheapest mode of transport for carrying passenger and commodities in Bangladesh. Every year more than 200 ships are added to the local fleet and main raw materials come from this scrap yard (Hossain, 2010). Considering the existing fleets and the growth pattern of inland ships, approximately 35,000-45,000 tons of steels are needed in the local shipyards and workshops and these portion of raw materials (for building new ship and maintenance of existence fleet) are supplied by the shipbreaking yard in Bangladesh. It is observed that due to the support from this scrapping yard, Bangladeshi shipyards are producing the ships at least 30-40% cheaper rate and this is only possible because scrap yard in supporting main raw materials of steel plate and structural members. Even doors, pump, generators, switch board, cable, valves, elbow, pipe, deck equipment, panel board, navigational equipment, firefighting equipment, safety equipment etc are used in local ship and thus contributing to build ship at a cheaper rate. Typical cost breakdown of cargo ship of inland standard using scrap material is shown in Fig. 6.

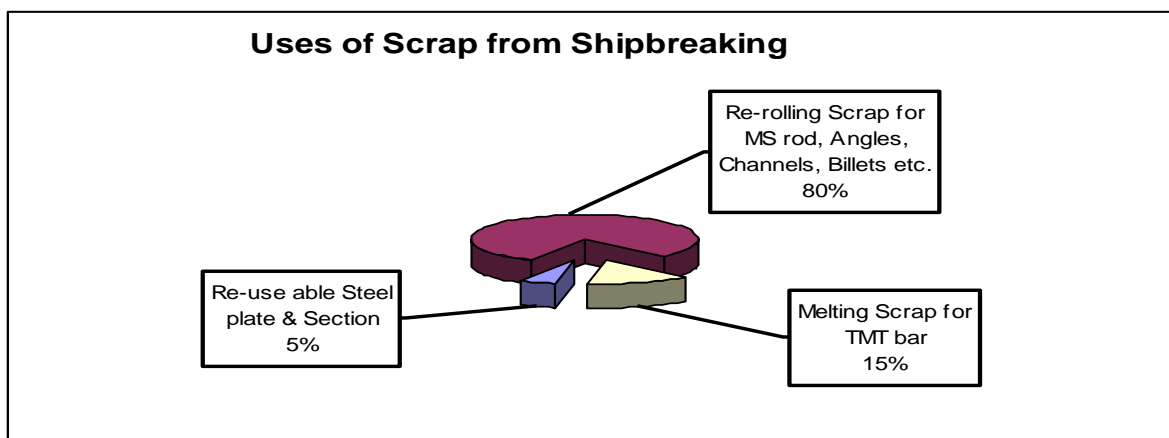


Fig. 5: Uses of scrap from shipbreaking yards in Bangladesh

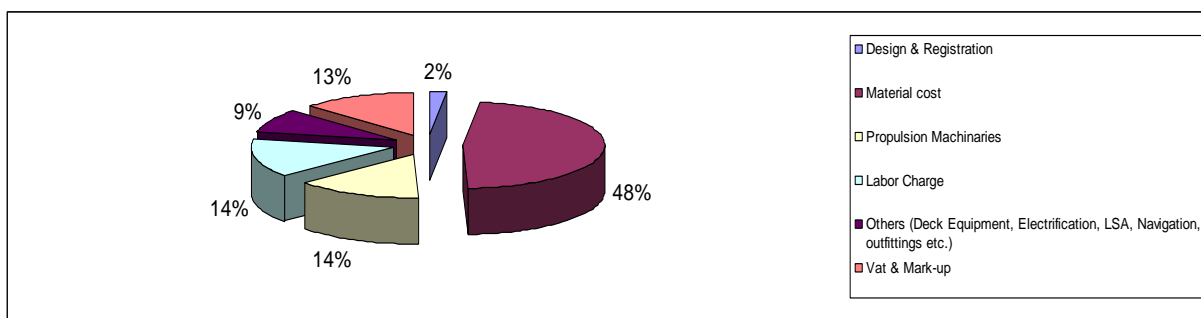


Fig. 6: Typical cost breakdown of cargo ship of inland standard

4. Problem Identification

4.1 Methodology to identify problems

To identify the underlying problems of ship-recycling industries in Bangladesh, surveys and field visits were carried out in some renowned local yards. Existing working condition, physical infrastructure and management practice have been observed to understand real life scenario. Primary and secondary data about labor type, skill, labour hour and labour cost were collected. To understand the worker profile, worker satisfaction, workers awareness on HSE, information through discussion and questionnaire were collected. Professional participations were conducted through questionnaire and interviews. Consultations and meetings with government authorities,

shipbreaking associations, and stakeholders were made to get a picture about the challenges they were facing at present and their future vision. Since a good database on such industry was not available, data was also collected from various print media, NGO reports, private and government organizations.

4.2 General problems of ship-recycling industries in Bangladesh

Although, the basic construction material of ocean going ships is harmless structural and non-structural steel, but ship dismantling activities may generate lots of other materials like non-ferrous metallic materials, glass and wood, polymeric and composite materials, sludge water, oil, undifferentiated materials as well as dangerous solid substances such as mineral wool like asbestos. So, for a risk free, environmental friendly, energy conserving and economical ship recycling process comprehensive knowledge of the materials, regarding quality, quantity and location onboard is very important. Determination of work plan, allocation of human resources and position of tools & equipment used must be designed not only in the context of productivity but also in the context of maintaining safety and health provisions. Also strict adherence to well-designed cutting plan for dismantling operations reduces safety issues and ensures quick and trouble free ship dismantling. Downstream management concerning removal/storage and handling on and from the ship must be planned in advance so that reception areas is able to accommodate hazardous materials safely. Cutting operations must be carried out in conjugation with well-designed lifting and handling operation as well.

Ship-recycling industry of Bangladesh has been in the dominating position since last decades. But, the general practice based on the collected information in the dismantling yards in Bangladesh has identified the absence of safe working practice and sufficient control mechanism is the main sources of environmental and occupational health threats. Existing problems may be categorized in the following broad headings:

i) Safety Problems:

Lack of labour safety is one of the major concerns of present ship recycling industry in Bangladesh. Labours are generally unskilled and sometimes, they do not have even any basic training for this risky job like ship-recycling. Non compliance of the safety issues during cutting operation causes various kinds of accident. There is no standard sequence of cutting operation. Sometime the sequence is defined by labour themselves and it is varied with ship types, size etc. It is observed that while starting cutting processes, labours usually cut all the side shells at first. During such practice, accident due to fall of plate is very common. Plates are carried away by group of labours without knowing the weight of the plate. Some time heavy plate weight as well as very sloppy and muddy ground make the plate carrying job very risky. While cutting at height in the main deck or upper deck, no special safety measure like erection of scaffolding, wearing safety belts etc. has been taken. As a result, falling from the height is a very common accident in Bangladesh. It is also observed that worker is assigned to work below others particularly where there is a danger of tools, equipment and cut sections or any other loose work item falling from the upper work location. As a result, accident due to falling of heavy object is very common.

While cutting plate, no care is taken about removing coating and usually plates are cut with coating. While working in confined space, due to lack of enough safety measure like measurement device, safety suite, ventilations etc. serious accident occurs. Cutting operation in the cargo tank without following proper gas freeing and gas monitoring procedures cause serious fire hazard risk to the workers. Many minor accidents like cutting due to sharp edge, bruising etc. have not been reported. Lack of appropriate emergency response, rescue and first aid is also common in ship breaking industry in Bangladesh. Winch/ pulley / crane etc are not tested periodically and so there is no way of ascertaining their capacity. This is risking occupational safety of the involved workers.

Fig. 7 shows the percentile distribution of accident caused over last 4 years in ship-recycling yard in Bangladesh. Fire explosion especially for oil tanker is one of the major reasons for frequent fatal accident in Bangladesh. Inadequate safety measure also result in high fatality rate related to falling at height. Fall of plate and parts causes 25% accident and toxic gas inhalation causes 16% accident.

ii) Health Problems:

Although shipbreaking is one of the most hazardous activities of any maritime industry, but most of the workers in ship breaking yards in Bangladesh have no basic knowledge about the impact of ship scrapping on health. As

a result, particular hazard exposure especially generated by asbestos, PCBs, heavy metals and chemicals causes serious health problems of the worker dealing with shipbreaking industry. Asbestos is very risky substance. The workers dismantle asbestos materials without knowing the consequences of inhaling such materials. They went to their living space without taking shower, thus risking others persons who live with him. Exposure of poisonous paints like Tributyltin (TBT) causes serious health problem in shipbreaking worker's in Bangladesh. Most of the cutter has to work in very intense light of cutting torches. Though, they use goggles, but these PPEs are sometimes not up to mark for heavy duty works like ship breaking activities. Thus workers complain of facing problems like eye redness, tearing, burring sensation, blurring of vision and conjunctivitis etc after long working hour. Some workers complain of impairment of hearing after working in the harsh environment of shipbreaking industry where excessive noise is present.

A study (Hossain, 2008) on occupational health of workers working in Bangladeshi shipbreaking industry confirmed that most of the workers were found to suffer from multiple disease and health hazard. Abdominal, urinary, muscle and skin problems as well as nutritional deficiency were also identified among the workers which were mainly caused due to toxic metal, oil and chemical contamination as well as excessive workload, long working hour, monotonous works, irregular eating, insufficient diet, unsafe and drinking water.

iii) Environmental Problems:

Poor practice of present shipbreaking industry generates huge environmental pollution in the coastal area of Bangladesh. For example, cutting operation is generally advanced from forward to aft end slice by slice. While slicing the ship, little care is taken about the contained inside the double bottom or pipe. This action paves the way to release bilge, ballast water into the sea. Sometimes, the slice is pulled near to the yard for further cutting. During pulling/dragging, poisonous paint such as Tributyltin (TBT) causes heavy pollution of sea water and beach sand.

Limited environment protection is a major concern of ship-recycling industry in Bangladesh. Sound management of asbestos, PCBs, ODS, heavy metals etc. is virtually nonexistent. Due to lack of appropriate procedure and trained worker, asbestos containing material causes atmospheric pollution by forming carcinogenic powder. Practice of stripping the electrical cables off their insulation by burning is another source of environmental pollution as it produces highly toxic gases such as dioxins, polychromatic hydrocarbons, etc. Disassembling of air conditioning and refrigeration systems can also result in the release of chloro-floro carbon series chemicals that are hazardous to the ozone layer. Some shipboard fire extinguishing systems is also the source of such gases.

Engine, pumps, compressors, motors etc which contain oils, oily substance should be stored on impermeable surface with shaded storage area. But in case of ship-recycling industry in Bangladesh, these equipment are stored in open space and thus soil is contaminated due to mixing of oil with soil.

The World Bank study (WB, 2010) already identified the accumulation of considerable amount of hazardous materials over last few decades in ship breaking area in Bangladesh due to poor practices and improper management of hazardous materials. It also apprehended huge amount of hazardous materials entering in the society with equipment off the yards and emphasized the need for improving overall environmental management in ship-recycling yard in Bangladesh.

One of major advantages of presently practicing beaching method by Bangladeshi yards is that it is a natural process where instead of installing expensive and heavy infrastructure for pulling and docking the ship, huge labour forces are used. Beaching method is preferred by local ship breakers because of presence of huge pools of cheap labour. At the same time, they must focus on improving environmental friendly approach to be competitive & sustainable in world market in coming years too.

5. Recent Development of Ship-recycling Industry in Bangladesh

Although Bangladeshi Ship recycling industry has been playing dominant role in world shipbreaking market since year 2002, but only recently have yards begun to care for safety, occupational health & environmental issues. Legal battle between environmentalist group and ship breaking association even brought temporary shutdown of all ship breaking activities in year 2010 for some time. On the other hand, legal battle also brings some qualitative improvement of ship recycling industry as per instruction given by the Apex court of

Bangladesh. Acknowledging the contribution of ship-recycling to national economy of Bangladesh, Govt. declared the ship-breaking as an industry and placed under the Ministry of Industries by Gazette notification on 21 April 2011. In the meantime, Ministry of industry has framed (GOB, 2012) 'The ship breaking and ship recycling rules 2011' and Gazetted on January 11, 2012. Govt. has declared this industry as a thrust sector and looked to focus on upgrading the standard in respect of safety, health and environmental issues. Govt. also sought help from Norwegian Govt. in order to foster its efforts towards green ship-recycling in Bangladesh.

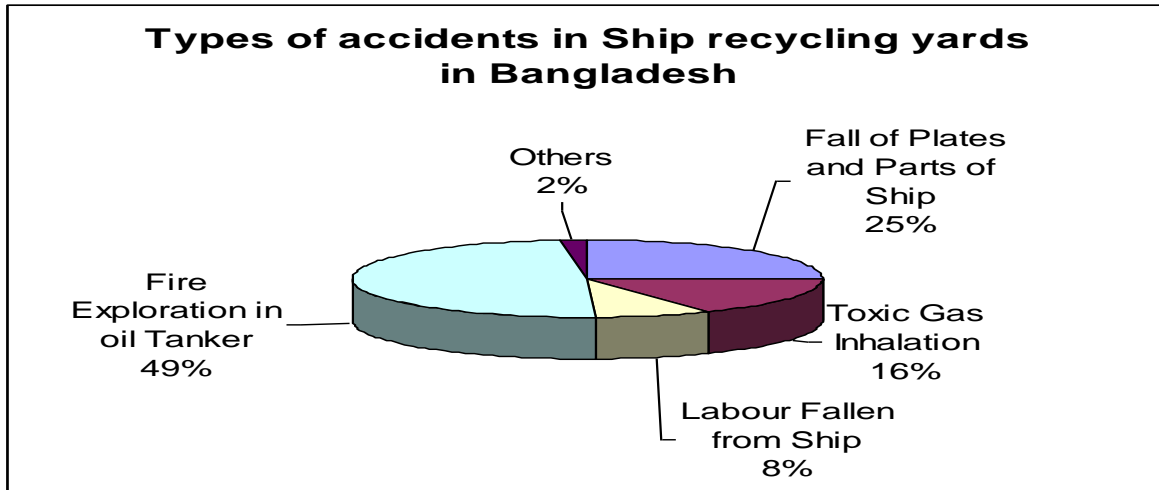


Fig. 7: Accident statistics of ship-recycling yard in Bangladesh

A pleasing development in shipbreaking industry is the establishment of mandatory asbestos removal center in every yard. In order to prevent the emission of asbestos-containing dust and handling of hazardous materials etc., the ship breakers must employ trained personnel in their yards. To improve working conditions and safety, the use of personal protective equipment is mandatory. Some mandatory requirements like ensuring training facility of all workers have to be implemented. In order to reduce manual workload of the workers, infrastructure development and mechanization of facility etc. are being implemented by the recycling yards now. Rest room, drinking water facilities are implementing now by each of the shipbreaking yards. Well-equipped firefighting facility with necessary reservoir tank, foam tank is being installed in every shipbreaking yard. A 150 bed hospital for shipbreaking yard is setting up now for the treatment of workers. A limited training facility for the workers has been introduced for this industry from year 2011. Practice of stripping of cables and wires by burning has been discontinued in the recent time.

To improve environmental quality related to ship recycling yards, some mandatory infrastructures are being implemented as per instruction given by Department of Environment (DOE). Table 1 shows the usual practice in case of dealing hazardous materials from ship breaking industry in Bangladesh. A brief description regarding infrastructure that is implementing now or needs to be implemented (Watkinson, 2012) has also been given in the same Table.

6. Ways Forward

Ship breaking is a labour intensive industry and labour related accidents/fatalities related to ship breaking is very frequent in Bangladesh. To improve these types of occupational healthy and safety related problems particularly for ship recycling industry, the first thing that must be ensured is comprehensive labour training for all workers. Basic trainings on first aid, Health and safety, fire safety, use of equipment & PPE etc. are mandatory for all workers. At the same time specialized training for identifying and dealing hazardous materials like asbestos, PCB's, ODS and heavy metal etc. is also mandatory. Currently Bangladesh is lacking these types of extensive training facilities and so for improving all the problems related to health and safety of workers, it must be implemented on priority basis.

Table 1: List of hazardous materials and usual and standard practice:

Hazardous Materials	Usual Practice in Bangladesh	Infrastructure Implementing/ to be implemented
Asbestos	Re-use for insulation in cold storage and central air conditioning system. Uncontrolled landfill is seen.	Separate chamber & temporary storage facility for handling asbestos have been implemented. Also, need secured landfill.
Antifouling materials/paint coating	No standard practice is available now. Torch cutting and re-rolling of steel are done without removing coatings.	Need to develop system that includes analysis, removal and disposal of paint through solidification, landfill in waste management system.
Waste substance and article containing Polychlorinated Biphenyls (PCB), Poly Brominated Biphenyls PBB, Poly Brominated Diphenyl ethers (PDBE), Poly Chlorinated Naphthalenes	Some PCB containing equipment and materials are re-used. In many cases, neither any standard format nor any available ways for analysis, labeling and inventory preparation is practiced.	High Temperature Incineration is implementing now in each ship breaking yard. Need capacity development in identifying, analysing & labelling of PCB materials.
Ozone Depleting Substances (ODS)	Release in the atmosphere.	High Temperature Incineration is needed with special vendor to handle ODS.
Cadmium, Chromium, Lead, Mercury	Batteries, light fittings, level switches etc reuse. In remaining case, no standard practice available.	Physico-Chemical Treatment, Secured Landfill is necessary for environmental friendly disposal.
Medical/Pharmaceuticals wastes	No standard practice available, disposed of informally elsewhere.	Need temporary waste station, landfill site.
Bilge water	Release to sea sometimes	Storage facility is implementing. Need Physico-Chemical Treatment, Landfill etc.
Compressed gas cylinders	Cylinder reused	Metal recovery by special vendor is needed.
Electrical Equipment	Re-use	Recycling, residues to Landfill is needed.
Fluorescent Tubes	Re-used in case of good condition.	Mercury/glass recovery need to be implemented.
Lead Acid Batteries	Re-use if good condition; handling of batteries accumulators seem to be inadequate.	Recycling and Physico-Chemical Treatment, Residues to Landfill etc. need to be developed.
Oils	Re-use	Recovery, Incineration is also needed.
Waste oil/Oily water	Release to sea sometimes	Oil water separator is being installed. Also Physico-Chemical Treatment is needed.
Sludges	Re-use in brick field.	Incineration facility is implementing now.

All the available ship recycling methodologies are based on very simple principle and that is ship recycling is reverse engineering process of modern shipbuilding. What Bangladeshi ship breakers have been practicing over last few decades is far from this basic principle and that is why overall standard in terms of health safety and even environment is very poor. The situation can be improved by involving the professional like Naval Architect who has a sound knowledge of ship structure and can contribute more to improve ship recycling activity focusing on health-safety and environmental aspect. Also, no research work has been done so far to identify and find need based solution for up-gradation of ship breaking industry in Bangladesh. That is why, for long sustainability of this industry the following measures of Research and Development (R&D) need to be done:

- 1) Developing methodology for ship recycling industry in Bangladesh focusing on integrated scientific and technological knowledge, risk and safety analysis and socio-economical analysis.
- 2) Optimisation of infrastructure and ship recycling activities through investigating alternative processes, techniques and upcoming regulations.
- 3) Extensive environmental sampling of air, water and soil in and around ship breaking yards to investigate short term and long term impact.

The fusion cutting or gas cutting that uses the combustion of the gas is generally used for dismantling of vessel in Bangladesh. However, in absence of strict/adequate measure, heavy casualties due to gas explosion are frequently occurred in Bangladesh which is shown in Fig. 5. Negative environmental impact such as toxic gases generated from the coating and CO₂ generated from combustion become a problem and a new alternative technique is needed to replace the fusion cutting method. Water jet cutting machine is one of such alternatives. Japan is trying to introduce water jet as a replacement for gas cutting (Shimuzu, 2012). In future, ship-recycling industry can be benefited by using such technology. The advantage of water jet cutting is that while cutting by high pressure water, there is no chance of explosion because it does not accompany fire and thus the improvement of work environment can be expected. It is possible to remove the coating by adjusting the injection pressure so that the toxic gas generation can be avoided.

For downstream waste management, instead of individually creating own hazardous material removal department by each ship dismantling yard, all ship dismantling yards may outsource the IHM and waste removal to waste management unit. It will have the following benefit:

- Waste management unit will work as a part of ship recycling yards
- Waste management unit can be handled with more integrated way using the similar number of workers, specialized technical persons, common TSDF(Treatment , Storage , Disposal Facilities) etc.
- Waste management unit can be operated efficiently and cost effectively.

Ship-recycling industry in Bangladesh did not receive any grants, subsidies or tax waivers and other benefit from the govt. since it was not recognized as a industry. Now situation has changed a lot and ship breakers is expecting more support from ministry in terms of cash incentives, infrastructure development, access road development, utility service like water- electricity- sanitation facilities development etc. Technical assistance and funding from Govt. for setting up a modern laboratory is also necessary to improve environmental monitoring of ship-recycling industry in Bangladesh. IMO is trying to play a vital role for improving overall standard of shipbreaking industry in Bangladesh in collaboration with Norwegian Govt.

7. SWOT Analysis

On the basis of the identified problems and present development, strength, weakness, opportunity and threat can be summarized as follows:

Strength	Weakness
<ul style="list-style-type: none"> • Cheap and available workforce • Bigger size of yard area • Geographical benefit of tide level 	<ul style="list-style-type: none"> • Non availability of waste disposal facilities • Lack of awareness about health, safety and environment • Lack of extensive training facilities for workers.

Opportunity	Threat
<ul style="list-style-type: none"> • Proper infrastructure for handling and disposal of hazardous waste • Requirement of create mass awareness about SHE issues • Ensure sustainable development as total capacity still dependent on the traditional approach. 	<ul style="list-style-type: none"> • Non-compliance of rules and regulation • Expansion of Green ship recycling facilities by other countries like China • Long term health hazard and environmental pollutions

8. Conclusions

Ship breaking is an important activity in the economics of Bangladesh. It makes a significant contribution to the global conservation of energy and resources. From the above discussion, the following conclusions can be drawn:

- Ship recycling has become a major contributor to the development of national economy. Contribution of ship breaking to inland shipbuilding in Bangladesh is enormous.
- Well-designed cutting plan focusing on technological, safety and environmental issues must be ensured to avoid labours casualties of ship-recycling industry in Bangladesh.
- Occupational health safety can be ensured by strict monitoring of governmental regulatory bodies as well as imparting extensive training to the worker and also providing personal protective clothing & equipment to the workers. These equipment include hand gloves, face musk, helmets, aprons, etc.
- Environmentally sound and safe downstream management of hazardous waste related to ship recycling activities in Bangladesh appears to be improving than previous period. New legislation put forward by MOEF [10] could play a catalyzing effect on developments and improvement of waste management sector in ship-recycling yard. In addition, environmental monitoring needs to be strengthen through capacity enhancement of concerned departments as well as developing laboratory facilities etc. Baseline study in terms of environmental aspect should be carried out immediately to find the level of environmental pollution and remedial measures that need to be taken.
- To retain competitive edge in the long run, Bangladesh has no other alternatives but to improve the safety, health and environment aspect through significant infrastructure and capacity development and this should be based on the outcome of the research work.

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