Proceedings of the 5th International Conference on Civil Engineering for Sustainable Development (ICCESD 2020), 7~9 February 2020, KUET, Khulna, Bangladesh (ISBN-978-984-34-8764-3)

ASSESSMENT OF THE ENVIRONMENTAL QUALITY OF SITAKUNDA SHIP BREAKING YARD

M. T. H. TUHIN*[1], N. Chowdhury[1] , M. R. Karim[1], A. Hoque[1], M. S. A. Julfikar[1] and B. Basak[1]

[1]Department of Civil Engineering, Chittagong University of Engineering & Technology (CUET), Bangladesh, e-mail: thtuhin488@gmail.com,

***Corresponding Author**

ABSTRACT

Over two decades ship-recycling industry in Bangladesh has received considerable attention via providing raw materials to steel industry, shipbuilding industry and some other industries in Bangladesh and some other countries of South Asia. Bangladesh derives 80-90% of its steel from end-of-life ships. This industry affects the environment in some seriously harmful ways. Workers safety, child labor, environmental issues are also threatened by this industry. This paper focuses on the Environmental Quality around the Ship Breaking and Recycling Industry (SBRI) to access its present situation and impact on the environment.It tries to asses the water quality of sea water and ground water, air particulate matter, soil quality of the Ship Breaking yard . Additionaly, it tries to provide an up-to-date picture of environmental impact of ship recycling industry by available liturature reveiw.

The Ship Breaking Yards are located along 7 km long coastline of Sitakunda Upazilla, Chittagong District,Bangladesh.
After taking permission from the relative authority of the Ship Breaking Yard, water samples from the inside & Outside of the Ship Yard are collected.Soil samples are collected only from inside of the Ship Yard Zone.Then samples of water and soil are measured in Environment Engineering lab,CUET.To investigate Air Particulate matter a digital machine is used for taking reading. Heavy metals like Chromium and Cadmium are also tested from the samples.

From the analysis of samples of water for particular sites parameters like pH(SW & GW),EC(SW), Chloride(SW), BOD(SW & GW) and Oil & Grease values are within the permissible limits. On the other hand parameters like Turbidity(GW & SW), EC(GW),TDS(GW & SW), Chloride(GW), DO values are not within the permissible value. From the analysis of soil samples it is seen that, the soils of site are slightly alkaline(pH & Alkalinity). EC value indicates that, the soil is not suitable for plant growth and the TDS value is a matter of concern. But the amount of chloride in the soil is okay. As we have taken the reading of air particulate matter in rainy season, the values of particulate matters are within safe range. According to the results of the heavy metal, the water body is safe from cadmium and chromium concentration. In the soil, the cadmium value is okay but the chromium is in a alarming condition. Considering the overall results, the study suggests that a considerable approach should be taken to minimize the negative impacts of ship breaking activities in the coastal zone of Bangladesh

Keywords: *Water quality, Air quality, Physico-chemical parameters of soil sample, Heavy metal test.*

1. INTRODUCTION

Bangladesh has a long coastal belt of about 710 km which is enriched with natural resources specially fish and other aquatic species of different varieties and has been the focal point of different economic activities. Most of these seashore areas are situated in Chittagong. Sitakunda is a Coastal area situated a few kilometres north-west of Chittagong City where most of the ship-breaking yards are concentrated.

The only ship-breaking industry of the country has been developed in Sitakunda areas,
Chittagong. Now, there are about 20 ship-breaking yards in Sitakunda where thousand and hundreds of labours are working and hundreds of labours are working. The workers are all engaged in dangerous labour but they don‘t have safety equipment like helmets, goggles, gloves, boots and work suits, medical facilities and moreover financial security. Over the last twenty years more than 400 workers have been killed and 6000 seriously injured (shipbreakingbd.info) . It can be said that the human rights are seriously violated in this significant and potential industry in our country.

Ship-breaking is a potential industry for Bangladesh. At present, Bangladesh secures top position in ship-breaking(dhakatribune.com).The largest ships of the world are cut in the shipyard of Bangladesh.This industry pays about 700 crores taka each year to the government of Bangladesh. Bangladesh needs eight million tons of building materials per year, in which most needed material is iron and ship breaking industry is supplying 90% iron materials to the country (shipbreakingbd.info).There is no distinct and well-balanced policy for ship-breaking industries. Actually, still now it is not declared as industry by the government. Due to unconsciousness and un-patronization of government, the industry is facing several internal and external problems. Above all, to solve all these problems a distinct and well-balanced policy is necessary for ship-breaking industries. 70% of ships are simply run ashore in developing countries for disassembly, where (particularly in older vessels) asbestos, lead, polychlorinated biphenyls and heavy metals pose a danger for the workers. Burns from explosions and fire, suffocation, mutilation from falling metal, cancer, and disease from toxins are regular occurrences in the industry.

Although the age of ship breaking in Bangladesh is more than three decades, but primitive working atmosphere and the lack of compulsory control mechanism generally cause the scrapping yards as a source of environmental and occupational health problems. The problem is caused by negligence from national governments, shipyard operators, and former ship owners disregarding the Basel Convention. According to the Institute for Global Labour and Human Rights, workers who attempt to unionize are fired and then blacklisted. The employees have no formal contract or any rights, and sleep in over-crowded hostels. The authorities produce no comprehensive injury statistics, so the problem is underestimated. In Bangladesh, a local watchdog group claims that one worker dies a week and one is injured per a day on average. Child labour is also widespread: 20% of Bangladesh's ship breaking workers are below 15 years of age, mainly involving in cutting with gas torches.

Several United Nations committees are increasing their coverage of ship breakers' human rights. In 2006, the International Maritime Organization developed legally binding global legislation which concerns vessel design, vessel recycling and the enforcement of regulation thereof and a 'Green Passport' scheme. Water-craft must have an inventory of hazardous material before they are scrapped, and the facilities must meet health & safety requirements. The International Labour Organization created a voluntary set of guidelines for occupational safety in 2003. Many ship breaking yards operate in developing nations with lax or no environmental law, enabling large quantities of highly toxic materials to escape into the general environment and causing serious health problems among ship breakers, the local population, and wildlife. Environmental campaign groups such as Greenpeace have made the issue a high priority for their activities. Along the Indian subcontinent, ecologically-important mangrove forests, a valuable source of protection from tropical storms and monsoons, have been cut down to provide space for water-craft disassembly In Bangladesh, for example, 40,000

mangrove trees were illegally chopped down in 2009 (Wikipedia). The World Bank has found that the country's beaching locations are now at risk from sea level rise. 21 fish and crustacean species have been wiped out in the country as a result of the industry.

2. METHODOLOGY

1.1 Overview of the Project

.

Taking permission from the relative authority to enter into the Ship Breaking Yard

↓

Collecting Water samples from the inside & Outside of the Ship Yard.

↓

Collecting soil samples from the Ship Breaking yard

↓

Investigate the amount of Air Particulate Matter inside & outside of the Ship Breaking Yard

↓

Tests of the Soil & Water samples in the laboratory

↓

Determination of the present Environmental Quality of Air,Water & Soil

↓

Graphical Representation of the physicochemical Parameters of Air, Water & Soil and Heavy Metals for water and soil

Figure1: Workflow Diagram

Figure 1 briefly exhibits the step by step procedure of how the complete work was conducted.

1.2 Study Area

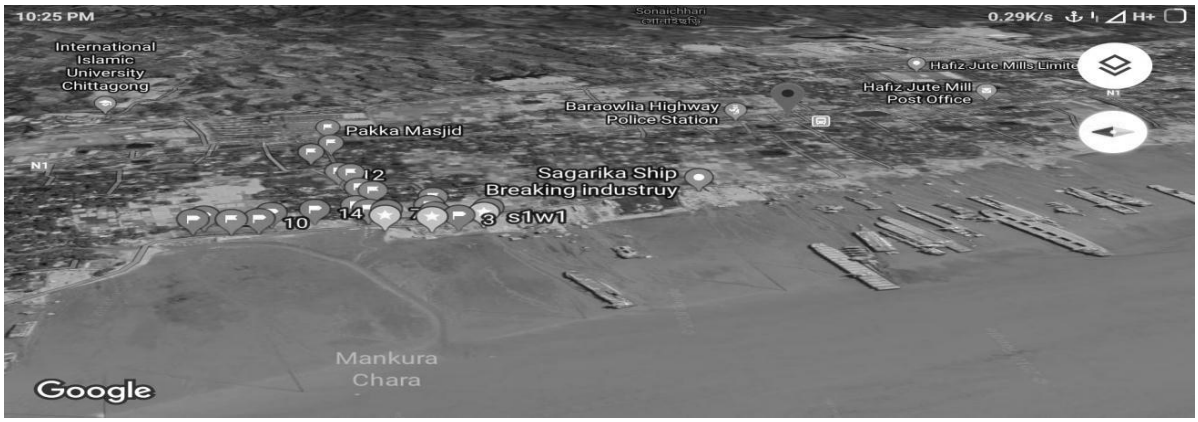

Figure 2 : Study area

Most of the Ship Breaking Yards of Bangladesh are situated at Sitakunda Upazilla in Chittagong District.The Ship Breaking Yards are located along 7 km long coastline of Sitakunda Upazilla.At present there are about 48 Ship Breaking Yards (36 yards are active and 12 yards are inactive) are lying along Dhaka Chittagong Highway which is 10 km. Away from the Chittagong City. Our project area is situated behind the well-known Baroawlia Pakka Mosque beside the Sagorika Ship Breaking

Yard.The industry is situated at the shore of Bay of Bengal,at the western side of Dhaka-Chittagong Highway.

1.3 Physicochemical Parameters for Water Sample and test apparatus:

The parameters that were selected for test of water samples are pH, Turbidity, Electrical Conductivity, Chloride, Total Dissolved Solid, Dissolved Oxygen, Biological Oxygen Demand and Oil & Grease and respected appurtenances are pH Meter; Turbid Meter; EC Meter; SX823-B Portable Multi-Parameter Meter; Titration; Separating Funnel.

1.4 Physicochemical Parameters for Soil Sample and test apparatus:

The parameters that were selected for test of filtered water samples are pH, Electrical Conductivity, Chloride, Total Dissolved Solid, Carbon-Di-Oxide, Alkalinity and respected appurtenances are SX823-B Portable Multi-Parameter Meter; Titration. For conducting these tests, at first, we had to prepare the soil sample. Preparation of soil sample consists of drying the soil sample in air dry conditions, making powder form when the sample becomes dry, weighing 25 gm of soil sample, mixing it with 100 ml of distilled water. Then the mixture is kept for one day so that the qualities of soil can be transferred into the water. And after one day, the mixture is filtered and filtered water is collected.

1.5 Air Particulate Matter determination in the air:

It is a digital machine to detect the particulate matter in the air. It is just to switch on the machine in the position from which we want to take the data of the air particulate matter.

3. RESULT & DISCUSSION

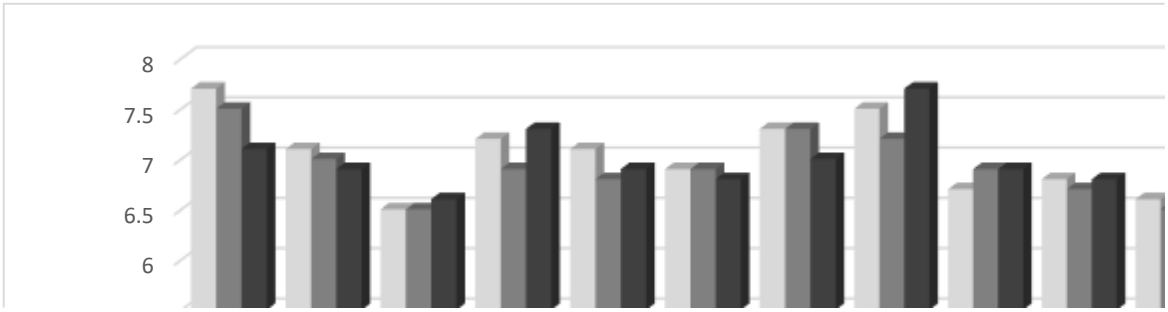

Figure 3: pH value of Water samples

The standard value range of pH for surface and ground water by the US-EPA guideline is 6.5-8.5 and pH of the samples are within the standard limit. In an average, the graph shows that, ground waters of the site are 10 times more acidic than the surface water. But, there is no risk in the pH value. Because, for fish reproduction, pH level is 6.5-9.0, so, the surface water is fit for fish propagation. And, the ground waters are used for drinking purpose in that area which is also found safe for this use.

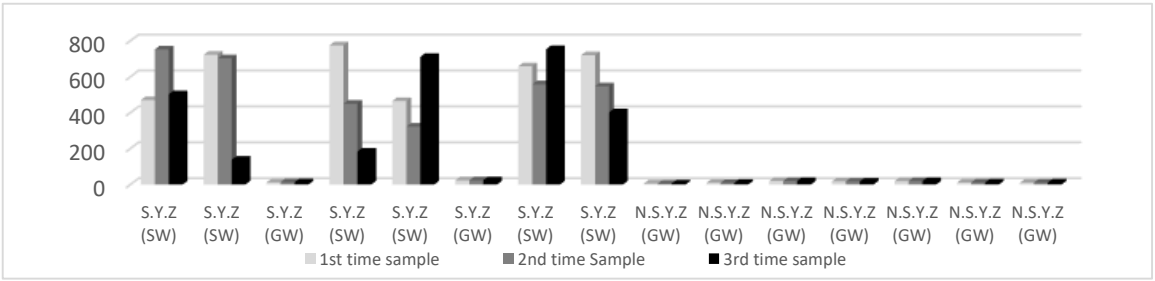

Figure 4:Turbidity (JTU) value of Water samples

The US-EPA Standard value of Turbidity for Surface Water is 72.5 JTU and for ground water is 12.5 JTU. In the surface water we can see from the Graph that, the values exceed the Standard Limit & 3 Tube well's turbidity value exceed the standard limit of No Ship Yard Zone. So, there is high risk in the surface water for turbidity. Turbidity value of some tube wells are within permissible limits, but 3 tube wells exceeds the limits,because they were shallow or poorly built wells and they were in the close proximity to the canals than the others.Hence, that 3 tube wells are risky for drinking purposes. In the surface water, as it is so much turbid, photosynthesis will be hindered and so the production of oxygen for fish and aquatic life will be reduced

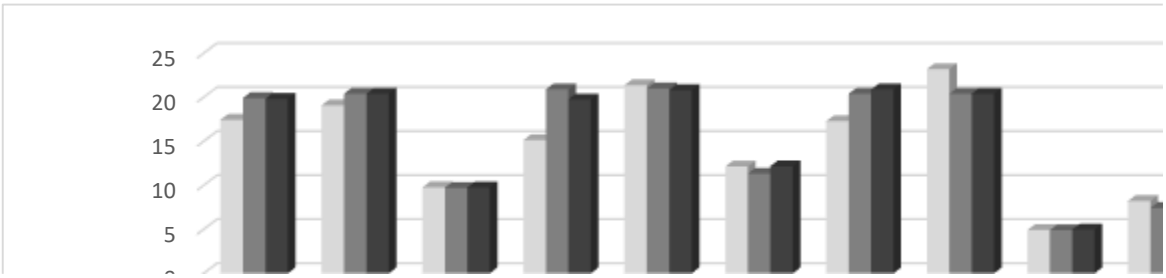

Figure 5: EC (mS/cm) value of water sample

The standard range of Electrical Conductivity for drinking water purpose is 0.05-0.5 mS/cm and the value of Standard Sea Water is 50 mS/cm. The EC values of the Surface Water are far under the permissible limit which is quite good for the fishes and other aquatic life, but all the ground water sources exceeds the permissible limits.This exceedence occured due to the change in land use pattern of the area ,leaching of pollutanats, saline water intrusionm or upconing of saline water . And hence the tubewell water is quite risky for drinking purpose.

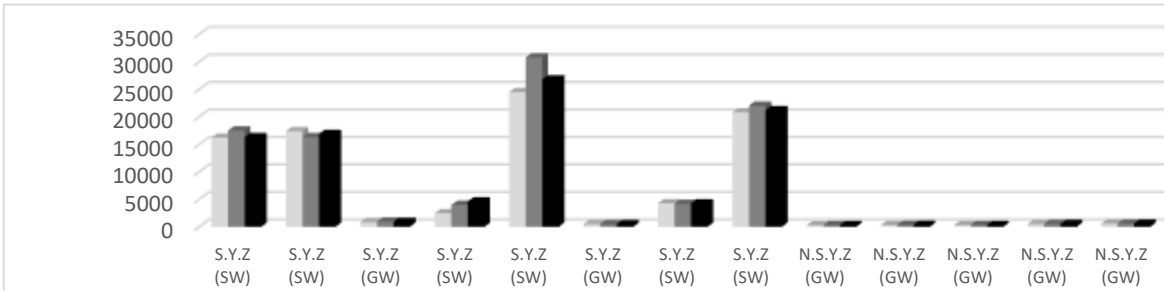

Figure 6: TDS (mg/L) value of water Samples

According to USEPA for ocean water standard TDS value is 35,000 mg/L & for ground water the permissible limit is 300-500 mg/L Here, from the Graph, we can see that, surface water TDS values are within permissible limit, which is ok for aquatic life. But, 3 Tube Wells in the No Ship Yard Zone and 1 tape water of Ship Yard Zone, the values exceed the permissible limit.This exceedence occured due to sea water intrusion,stormwater and agricultural runoff and point or non-point waste water

discharges. And hence,these above mentioned sources of water are quite risky for drinking water purpose.

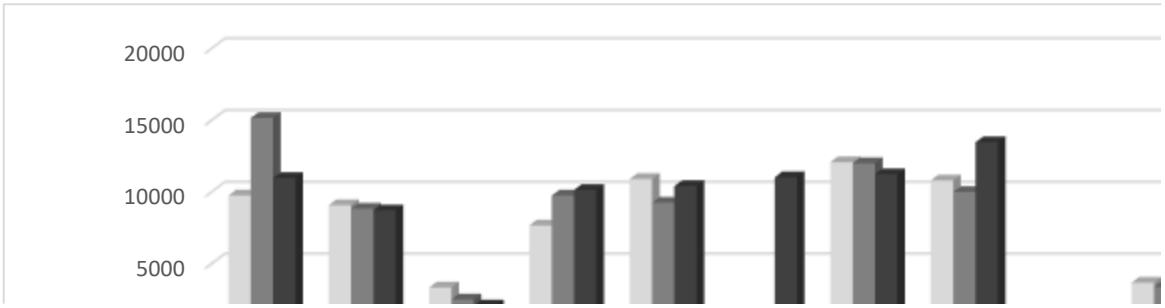

Figure 7: Chloride(mg/L) value of water sample

Here, from the graph, we can see that, the Chloride values for surface water are under the Standard limit which is quite safe for the aquatic life, but the chloride values of tube wells have exceeded the permissible limit, which is unsafe for drinking water purposes. Here, due to the salt intrusion the chloride values of Ground Water is increasing day by day

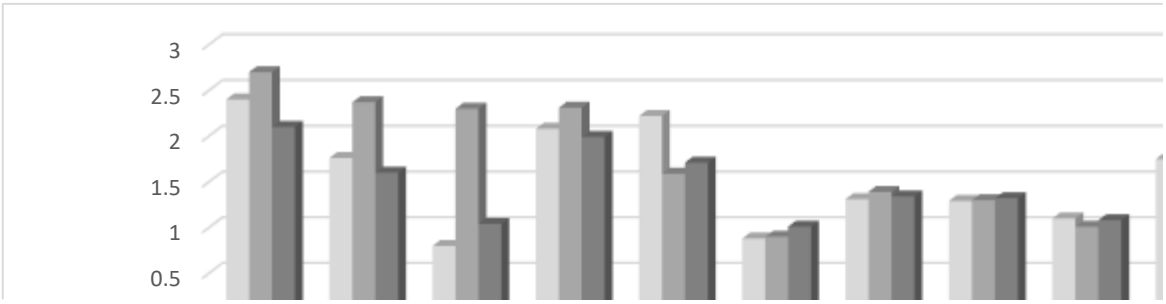

Figure 8: Dissolved Oxygen (mg/L) value of water sample

USEPA standard DO value 9.0 mg/L. Here, from the graph we can see that, the DO values of all the sources are quite below the Standard Value due to excessive algae and phytoplankton growth caused by phosphorous and nitrogen,die-off and decomposition of submerged plants or variation of water temperature and altitude. So, the tube well waters are not suitable for Drinking purpose and the surface water is not suitable for the fish propagation. Aquatic animals are most vulnerable to lowered do levels in the early morning on hot summer days when stream flows are low, water temperatures are high and aquatic plants have not been producing oxygens since sunset.

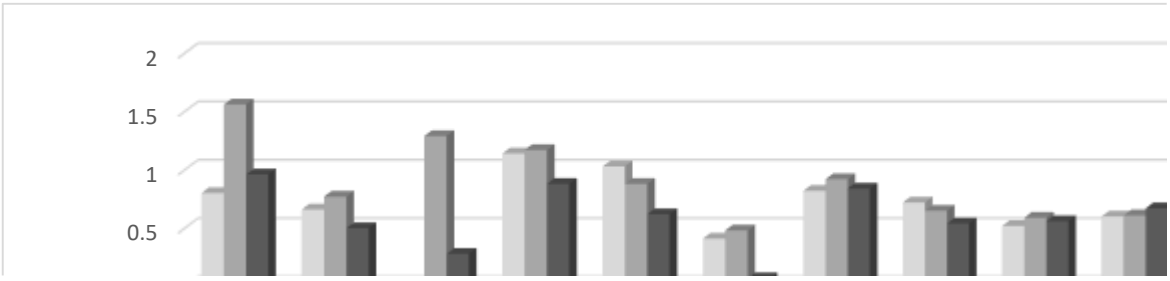

Figure 9: Biological Oxygen Demand(mg/L) value of water samples

The USEPA standard value for BOD is 5 mg/L. But the BOD value of the tasted samples of surface water and ground water is lower than the standard level. As we know, BOD indicates the amount of

putrescible organic matter present in the water, therefore a low BOD is an indicator of good quality water and it ensures that there is enough oxygen left for fish and aquatic plants. It is also suitable for drinking water purpose.

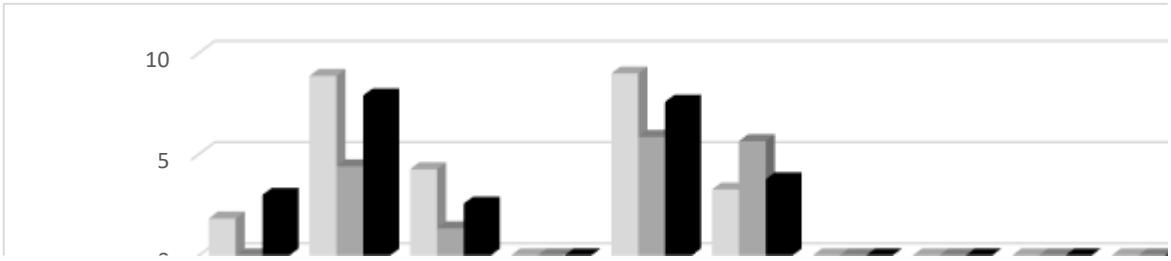

Figure 10: Amount of Oil & Grease in Water Samples

Here, from the Graph, we can see that, there are no oil in the Ground Water and in the Surface Water the amount of Oil is within the Standard Limit. So, the Surface Water is ok for aquatic life and the drinking water is also good for drinking purpose

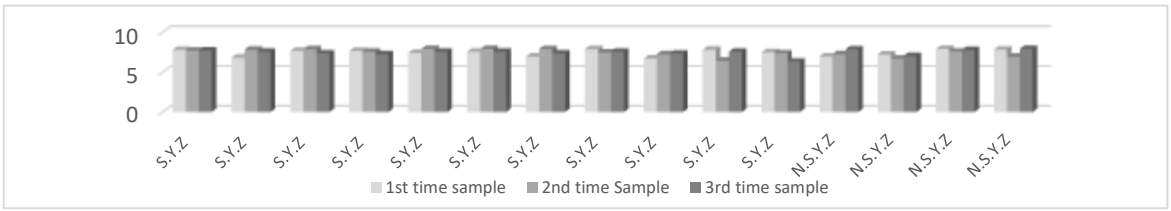

Figure 11: pH of soil Samples

According to graph the soil samples of the study area is slightly alkaline. As the soil pH decreases, most desirable crop nutrients become less available while others, often undesirable, become more available and can reach toxic levels.Plant nutrients leach the soil much faster at pH value below 6.0 than from the soils within the 6.0-7.5 range according to Eileen Ward, 2015. pH is not an indication of fertility, but it does affect the availability of fertilizer nutrients. The soil samples of the site are not within the Standard Limit so it is not a good sign for fertility

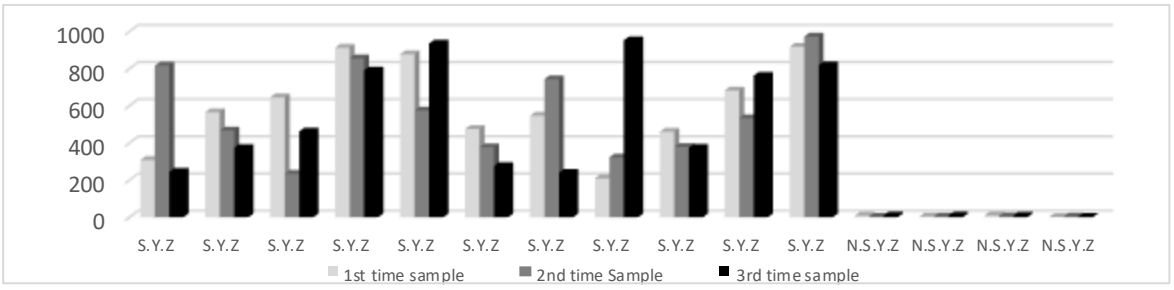

Figure 12: EC (ms/cm) of Soil Samples

In soil, Electrical Conductivity is a measure of the ability of the soil to conduct an electrical current. Optimal EC levels in the soil may range from 1.10-5.70 mS/cm. Too low EC levels indicate low available nutrients, and too high EC levels indicate an excess of nutrients. Low EC‘s are often found in sandy soils with low organic metal levels, whereas high EC levels are usually found in soils with high clay content. But the EC values of the Ship Yard Zone is too much higher which is not suitable

for plant growth. The EC values of Not Ship Yard Zone also exceeds the Standard limit, but it is far ok than the Ship Yard Zone.

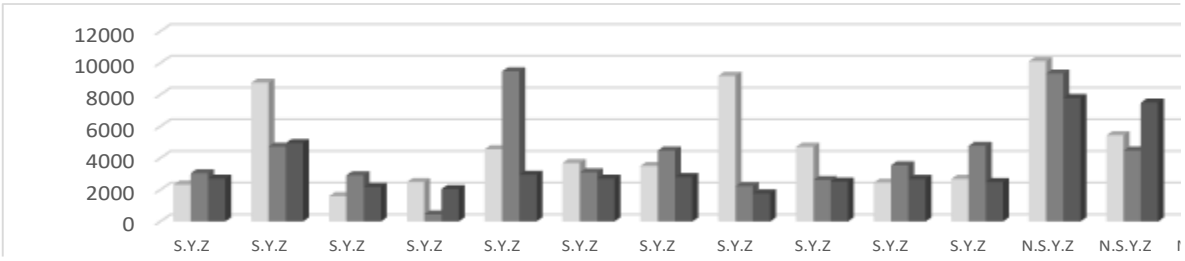

Figure 13: TDS(mg/kg) of Soil Samples

Here, from the graph we can see that, the dissolved oxygen in the soil of Ship Yard Zone is quite low from the No Ship Yard Zone. Because of the direct contact with the water, the dissolvable solid particles get dissolved into the sea water. As the amount of dissolvable solid is very high in the soil, it is a matter to be concerned. Because, these solids are dissolving in the water and the amount of Dissolved solid in the water is growing higher day by day

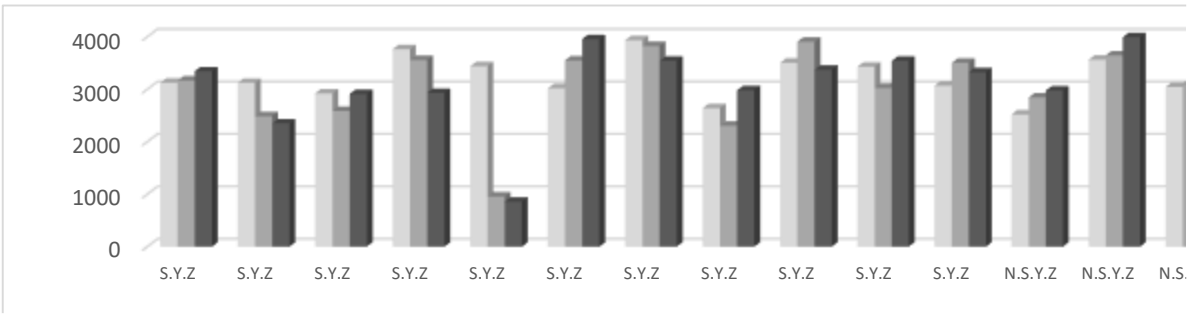

Figure 14: Chloride (mg/kg) of soil samples

Natural inputs of chlorine to soils come mainly from rainwater, sea spray, dust and air pollution. In addition, human practices, contribute significantly to chlorine deposition. As our site is a coastal region, we can see also from the graph 4.12 that, the value of chloride in soil is quite ok for the Crop production

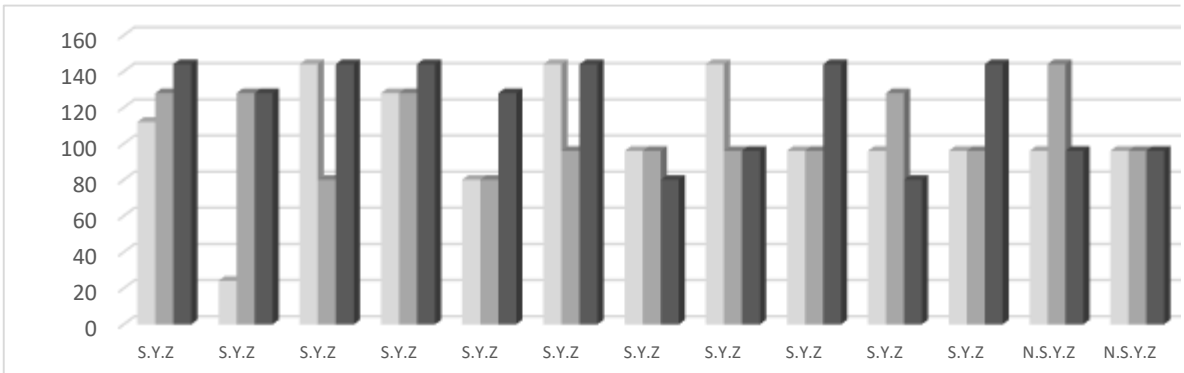

Figure 15: Alkalinity(mg/kg) in the soil samples

From the observation of result, it is clear that, the soil is slightly alkaline

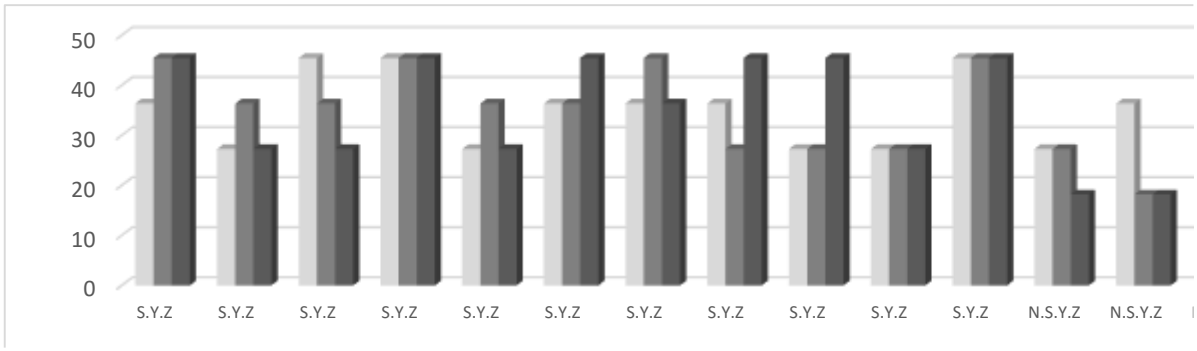

Figure 16: Carbon-dioxide(mg/kg) value of Soil Samples

From the observation of result, we found it that, the concentration of Carbon-dioxide in the Ship Yard Zone is much higher than the No Ship Yard Zone, because of the release of Carbon-dioxide during evaporation of water, the high solubility of Carbon-dioxide in soil water and high rate of microbiological activity.

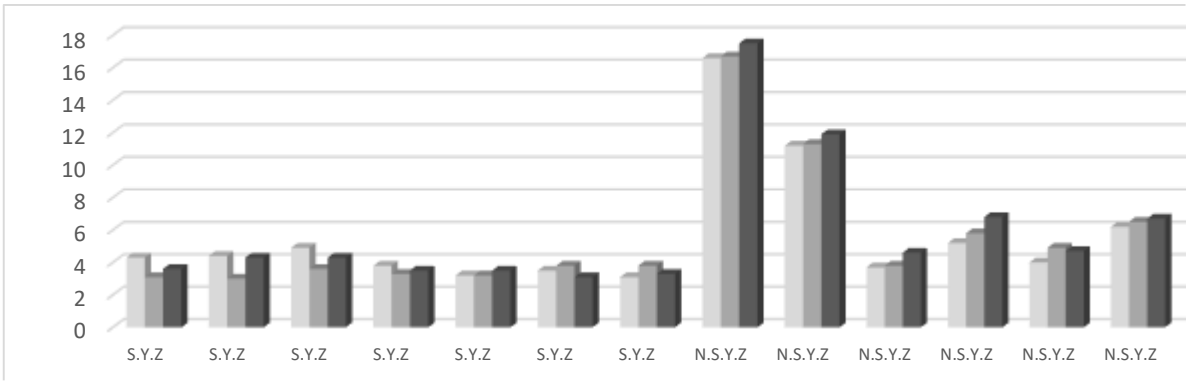

Figure 17: Amount of Air particulate matter ($PM_{2.5}$)

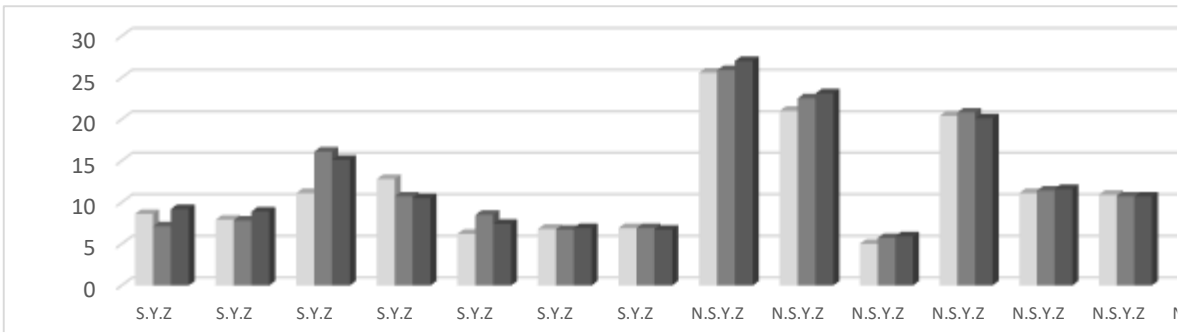

Figure 18 : Air particulate matter (PM_{10})

According to the USEPA standard we can see from results of the study area is that, the values of $PM_{2.5}$ and PM_{10} is within the range of standard value. As the reading was taken in a rainy day, the reading was quite good.

Generally in the winter season the amount of air particulate matter is high and in the rainy season the amount is low, because in the rainy season, in the air there is huge amount of fogs.So the value becomes very high. But in the rainy season the air becomes clear, so the value becomes very low

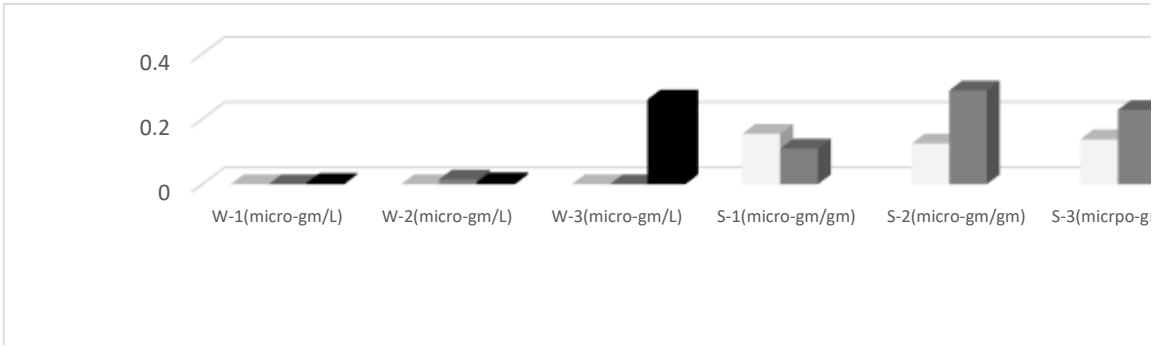

Figure 19: Chromium(Heavy metal) in the water & Soil sample

According to the USEPA standard limit, the Chromium value for water is 0.05 microgm/L and for soil it is 0.05 micro-gm/gm. From the test results, we have found that, Chromium concentration in the water body is okay but in the soil, the amount is quite alarming.

No Cadmium(Heavy metal) was found in the water and soil sample of the ship yard which is a good sign against heavy metal pollution.

4. CONCLUSIONS

From the analysis of samples of water for particular sites parameters like pH(SW & GW),EC(SW), Chloride(SW), BOD(SW & GW) and Oil & Grease values are within the permissible limits. On the other hand parameters like Turbidity(GW & SW), EC(GW),TDS(GW & SW), Chloride(GW), DO values are not within the permissible value. From the analysis of soil samples it is seen that, the soils of site are slightly alkaline(pH & Alkalinity). EC value indicates that, the soil is not suitable for plant growth and the TDS value is a matter of concern. But the amount of chloride in the soil is okay. As we have taken the reading of air particulate matter in rainy season, the values of particulate matters are within safe range. According to the results of the heavy metal, the water body is safe from cadmium and chromium concentration. In the soil, the cadmium value is okay but the chromium is in a alarming condition. Considering the overall results, the study suggests that a considerable approach should be taken to minimize the negative impacts of ship breaking activities in the coastal zone of Bangladesh.

ACKNOWLEDGEMENTS

Authors would like to express sincere gratitude to Department of Civil Engineering,Chittagong University of Engineering & Technology(CUET).The authors express his best gratitude and thanks to Mr. Anawarul Islam, lab assistant of the Environmental Engineering Laboratory, CUET for his untiring assistance during the study.

REFERENCES

Aktaruzzaman, M., Chowdhury M. A. Z., Fardous, Z.2, Alam, M. K., Hossain, M. S. and Fakhruddin, A. N. M. (2013). Ecological Risk Posed by Heavy Metals Contamination of Ship Breaking Yards in Bangladesh.

Dr. Md. M. Maruf Hossain. Mohammad Mahmudul Islam. (2006) ―Ship Breaking Activities and its Impact on the Coastal Zone of Chittagong, Bangladesh: Towards Sustainable Management. ISBN : 984-32-3448-0.

https://en.wikipedia.org/wiki/Ship_breaking

https://shipbreakingbd.info/worker-rights-violation/

https://www.dhakatribune.com/bangladesh/2019/11/14/bangladesh-secures-top-position-in-ship-breaking

https://www.shipbreakingbd.info/Baseline.pdf

Helal Ahammad, Mohammad Sujauddin. (2017). ―Contributions of Ship Recycling in Bangladesh: An Economic Assessment.‖ WBS Element No. TC/1514-01-2320

Hasan Muhammad Abdullah1, M. Golam Mahboob, Ahammad Al Biruni. ―Drastic expansion of ship breaking yard in Bangladesh: a cancerous tumor to the coastal environment‖

Khandakar Akhter Hossain (2017**) "**Ship Recycling Practice and Annual Reusable Material Output from Bangladesh Ship Recycling Industry.‖.. Hossain, J Fundam Renewable Energy Appl 2017, 7:5 DOI: 10.4172/2090-4541.1000238

https://www.bing.com/search?q=Parameters+of+water+quality+EPA+pdf&form=P

Khandakar Akhter Hossain.(2017). " Ship Recycling Status in Bangladesh and Annual Reusable Material Output‖.. Open Acc J of Toxicol. 2017; 2(2): OAJT.MS.ID.555581 USEPA Standard April 30, 2018. Chapter 62-302.

Md. Imrul Jobaid, Md. Moniruzzaman Khan, A.K.M Kamrul Haque, Istiaque Ahmed Shawon.―Ship Recycling and Its Environmental Impact: A Brief Overview of Bangladesh.‖.. *IOSR Journal of Business and Management (IOSR-JBM) e-ISSN: 2278487X, p-ISSN: 2319-7668. Volume 16, Issue 10.Ver. I (Oct. 2014), PP 31-37 www.iosrjournals.org*

Md. Juel Rana Kutub, Nishat Falgunee, Shahreen Muntaha Nawfee and Yasin Wahid Rabby.(2017). ―Ship Breaking Industries and their Impacts on the Local People and Environment of Coastal Areas of Bangladesh.‖ DOI: 10.1515/hssr -2017-0013

Muhammad Muhibbullah (2013). ―Health hazards and risks vulnerability of ship breaking workers: A case study on Sitakunda ship breaking industrial area of Bangladesh.‖ Global Advanced Research Journal of Geography and Regional Planning (ISSN: 2315-5018) Vol. 2(8) pp. 172-184, November, 2013

Mosabbir. Pasha, Aziz. HasanMahmood, Istiakur. Rahman, and Abul. Hasnat. (2012). ―Assessment of Ship Breaking and Recycling Industries in Bangladesh - An Effective Step Towards The Achievement Of Environmental Sustainability.‖ International Conference on Agricultural, Environment and Biological Sciences (ICAEBS'2012) May 26-27, 2012 Phuke

Thanasis Karlis, Dionysios Polemis, Anastasios Georgakis (2016). ―Ship demolition activity. An evaluation of the effect of currency exchange rates on ship scrap values.‖.. SPOUDAI Journal of Economics and Business, Vol.66 (2016), Issue 3, pp. 53-70

Parameters of Water Quality, EPA, 1992**.**

REXEN&mkt=enus&httpsmsn=1&refig=544687ba02b043fc88804e39eff0d550&pq=parameters+of+w ater+quality+epa+pdf&sc=0-29&sp=-1&qs=n&sk