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Identification of Nondegradable Toxic Chemicals from Industrial Effluents of Narayonganj and Surroundings Areas, Bangladesh, Responsible For Environmental Pollution

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ABSTRACT

Waste water disposal scenario in Bangladesh becomes a serious threat to the natural environment. Nonscientific and unplanned waste water disposal into open areas, canals, river, and ponds caused remarkable environmental pollution. Narayonganj is a hub of textile industries in Bangladesh and located near the capital city Dhaka. Bangladesh is one of the world largest garment production country. The effluent generated from the textile industries is a complex mixture of inorganic and organic chemicals which are not biodegradable. For present study eighteen wastewater samples were collected from different industries and seventeen sediment samples collected from adjacent areas of the wastewater stream. The sediment samples were collected by auguring at depth of 5-10 meter near the drain or cannel. Physical properties such as P^H, Conductivity, Total Dissolved Solid (TDS) and temperature were measured by field kits in the field. The concentrations of Cu, Zn, Cd, Ni, Pb, Co, Mg & Al were determined in the Analytical Chemistry laboratory of Geological Survey of Bangladesh. Highest value of TDS, P^H and temperature of the effluent was found 1560 ppm, 10.4 and 35^0C respectively. Conductivity of the samples ranged between 3350- 584 µs. Maximum value of BOD was found 66.8mg/l and minimum value of DO was 0mg/l. Highest chloride& fluoride concentration of effluent water was measured around 1523 mg/l and 25 mg/l respectively. Among all the industrial sector textile waste water is the most polluting agent of that area which ultimately harms the ecosystem and damage aquatic life. A primary individual effluent treatment should be placed before the outlet point of each industry. Finally a central ETP (Effluent Treatment Plant) can be established for treatment of the waste water.

Keywords: *Textile Effluent, Toxic, Pollution, ETP*

1. INTRODUCTION

Narayonganj is a city of Industries. About 400 numbers of different textile, ship breaking, steel and many other industries are situated in the district. Most of the industries leave the effluent water without any treatment which ultimately falls into the Sitalakha river through different canals. The textile waste water is rated as the most polluting among all industrial sectors. Textile industries have taken an extremely important and major part of the Bangladesh economy for a long time and their activities are still expanding. Main pollution in textile wastewater came from dyeing and finishing processes. These processes require the input of a wide range of chemicals and dyestuffs. The effluent from textile is a complex and highly variable mixture of many polluting substances ranging from inorganic compounds and elements to polymers and organic products (Banat et al.,1996). Many of these chemicals are not biodegradable and ultimately harm the human and aquatic life. The process of dyeing generates large complex waste water stream containing suspended solids, large amount of dissolved solids, un-reacted dyestuffs, recalcitrant organics, toxicants, inhibitory compounds, surfactants, chlorinated compounds, and other chemicals that are used in different stages of dyeing, fixing, washing and other processing.

2. LOCATION

The geographical location of the studied area is in between 90° 26' E and 90° 32' E longitudes and 23° 37' N and 23° 43' N latitudes as well as covers an area of approximately 30 km^2. Narayonganj city is situated in the eastern side of Dhaka city (Fig. 1)

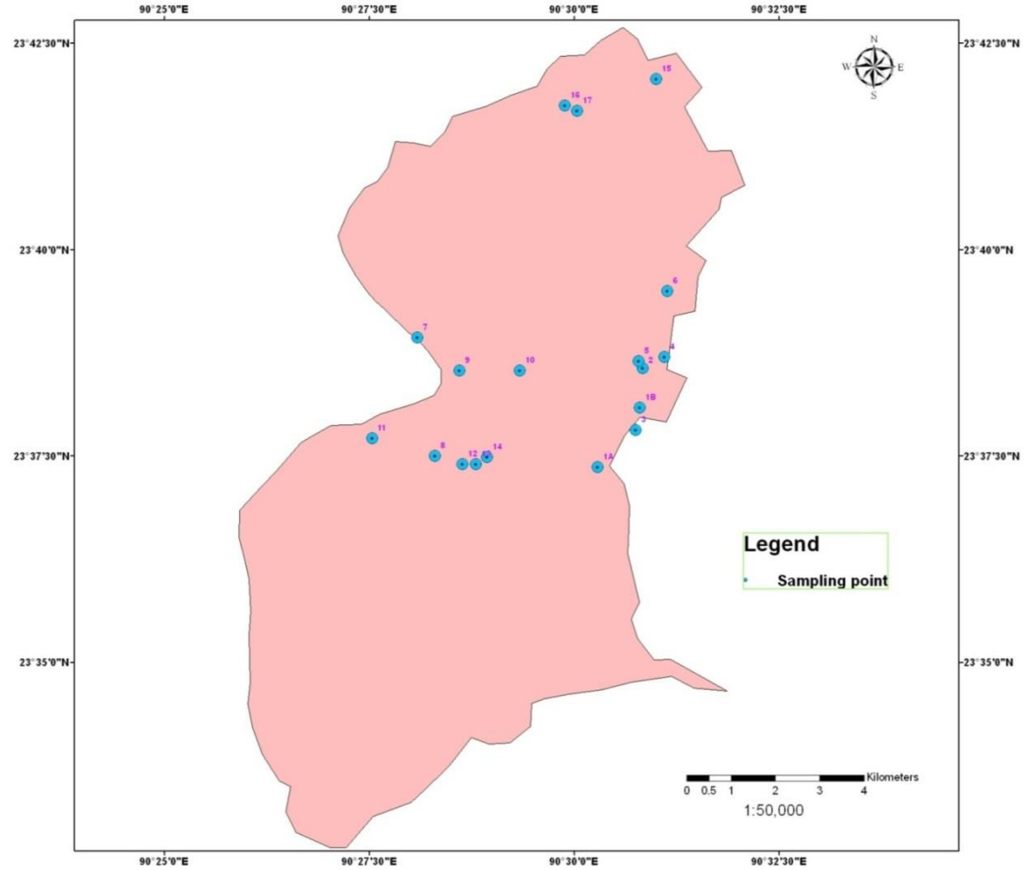

Figure 1. Location Map

3. SAMPLING

Eighteen numbers of effluent water sample and seventeen solid samples were collected from textile industries in Narayonganj District. Water samples were collected from the outlet of Industries. The sediment samples were collected by auguring at depth of 5-10 meter near the drain or cannel. All the water samples were preserved in 1000 ml polypropylene bottle and marked properly. During the collection of water sample TDS (Total dissolved solids), P^H, Conductivity, and Temperature were instantly measured by using different scientific devices and the test results were noted. Dissolved oxygen concentration was measured by DO meter. Rest of the parameters was analyzed in chemical laboratories of Geological Survey of Bangladesh.

List of testing parameters and equipment's in-situ

1. Total dissolved solids (TDS): -By TDS meter (Model no- cyberscan con-110) .- TDS was also measured in laboratories by filtration to remove suspended solids and then evaporation of the filtrate (remaining liquid portion, usually done at 105°C) to leave a solid residue which was weighed.

2. P^H: - By P^H meter (Model no- Hanna HI-8314) .
- P^H Meter: Calibrated P^H meter probe is submerged in a sample of the effluent and after
stirring gently for a few moments the P^H meter should give a stable P^H reading.

3. Temperature: By using thermometer calibrated in degree Celsius.

4. Conductivity: measured by conductivity meter (Model no- cyberscan con-110)

5.Dissolved oxygen – By DO meter (Model no – YK-22DO).

4. METHODOLOGY

Major pollutants in textile waste water are high suspended solids (TSS), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), heat, color, acidity & other soluble substances (Vandivevere P.C. et al. 1998).Chemical analysis of collected samples were performed in the laboratory by following the Rapid Analysis of Silicate, Carbonate and Phosphate Rocks. (U.S. Geological Survey Bulletin 1401).

Laboratory analysis method of water sample

Parameters like Fe (iron), Al (Aluminum), and Mn (Manganese) were determined as oxide by colorimetric method using UV- Visible Spectrophotometer (Spectronic instrument-Model: 4001/4, USA) at wavelengths of 555 nm, 475 nm and 525 nm respectively; Na (Sodium) and K (Potassium) by Flame Analyzer as oxides; Ca (Calcium) and Mg (Magnesium) by EDTA titration. And the rest of the parameters like Cu (Copper), Co (Cobalt), Cd (Cadmium), Pb (Lead) and Zn (Zinc),Nickel (Ni) were determined by ICP-OES. All chemicals & reagents used in the laboratory were German Mark and de-ionized distilled water 18 cm was used throughout the studies.TDS was also measured in laboratory by filtration to remove suspended solids and then evaporation of the filtrate (remaining liquid portion, usually done at 105°C) to leave a solid residue which was weighed.

Laboratory analysis method of solid waste sample

All the elements both major elements and trace elements were determined from the preserved solution of solid waste samples. Iron (Fe),Aluminum (Al), Manganese (Mn) was determined by UV Spectrophotometer by Colorimetric method using their selective wavelength. CaO & MgO were determined by EDTA titration method. Na (Sodium), K (potassium) was determined by Flame Analyzer their respective wavelength. Trace element Cu, Zn, Pb, Cd, Co & Ni were determined by using ICP-OES (Induced Couple Plasma).

5. RESULTS & DISCUSSION

The parameters temperature, Electrical Conductivity, TDS, P^H, DO and ORP values were determined in the field. Most of these values do not satisfied national standard values.

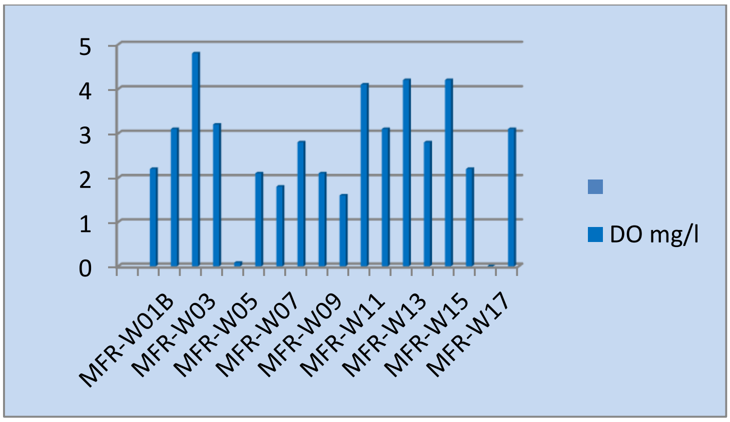

Figure 2.Graphical representation of DO mg/l of waste water.

Represents the DO (Dissolved oxygen) value in mg/l of waste water. It was found that DO values of waste water could not satisfy the national acceptance limit. The DO values of most of the water were higher from the national standard limit. In case of two samples DO value is nearly zero, which is not suitable for fish and other aquatic life.

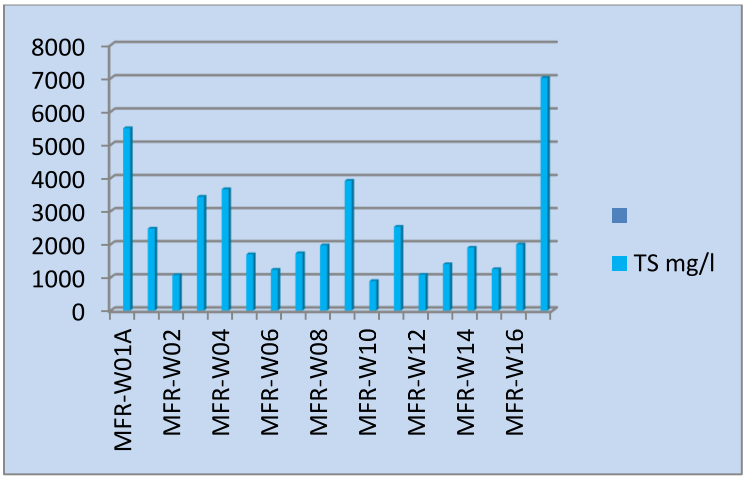

Figure 3. Graphical representation of TS mg/l of waste water.

Represents the TS (Total solid) value in mg/l. of waste water. Most of the TS value was found beyond the national acceptable limit. Higher TS value increases turbidity, reduce photosynthesis, causes fish's gills to get plugged up, reduces lifetime of lakes, changes benthic ecology.

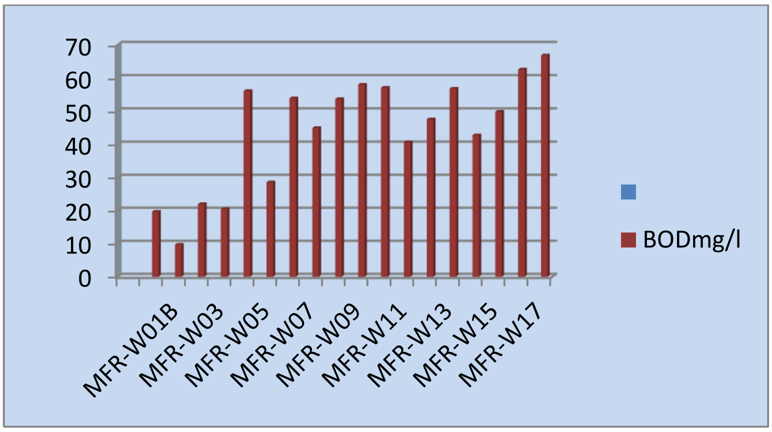

Figure 4. Graphical representation of BOD mg/l of waste water.

Graphical representation of BOD mg/l of waste water were shown in figure. It was found BOD values of some of the industries do not satisfy the national standard limit. Higher BOD value depletes dissolved oxygen from streams, lakes and oceans which cause death of aerobic organisms; increases anaerobic properties of water.

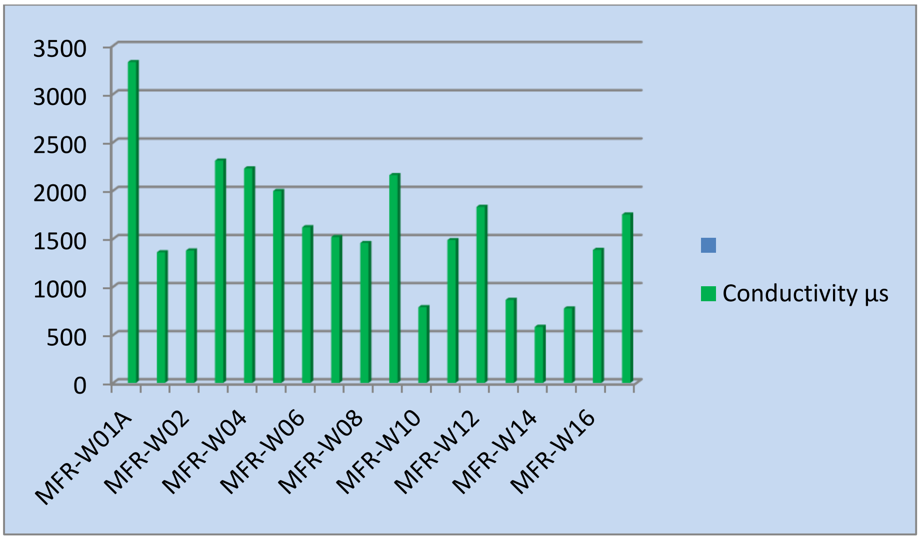

Figure 5.Graphical representation of conductivity of waste water.

The figure represents the conductivity level of different samples. Higher conductivities was found (1200 µs above national standard) at almost all the wastewater of the studied textile industries. Electrical Conductivity is an indicator of dissolve common metals that may be found in surface water including Iron, Aluminum, Calcium, Magnesium etc. High conductivity concentration can damage aquatic life because of increased salinity and possible smothering of the stream bed.

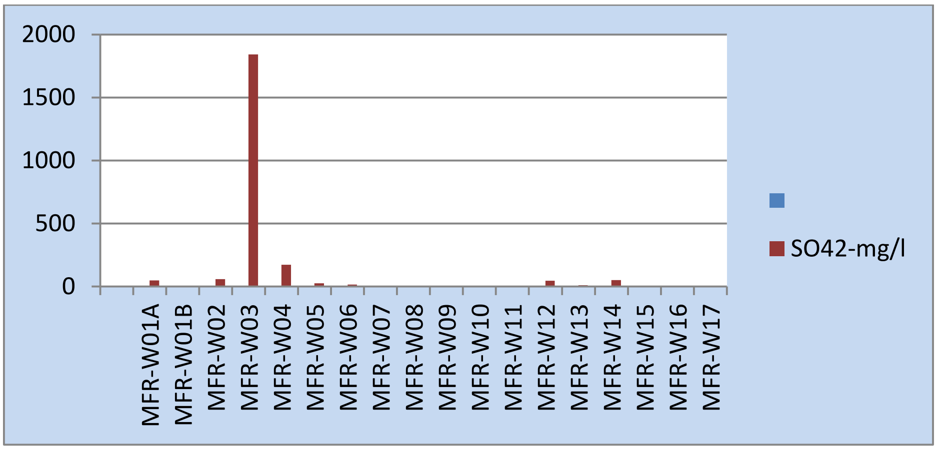

Figure 6.Graphical representation of SO_4^{2-}mg/l in wastewater.

The figure indicates the concentration of sulphar of waste water. Very high concentration was found in case of sample no. 3.The values are within the limit in case of other samples.

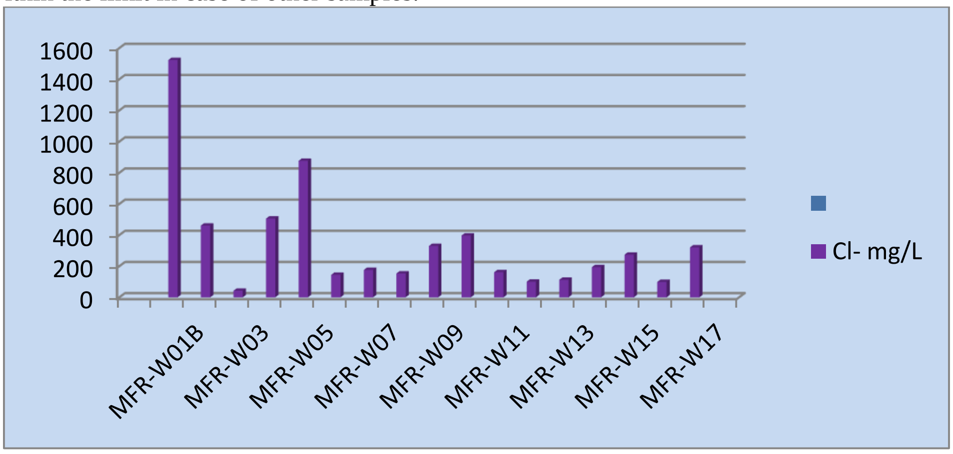

Figure 7.Graphical representation of Cl^-mg/l in wastewater.

The figure indicating the concentration of Cl^- in waste water. Higher concentration of Cl^- was found in case of some samples. Chlorine is poisonous and it is harmful for aquatic life and human beings.

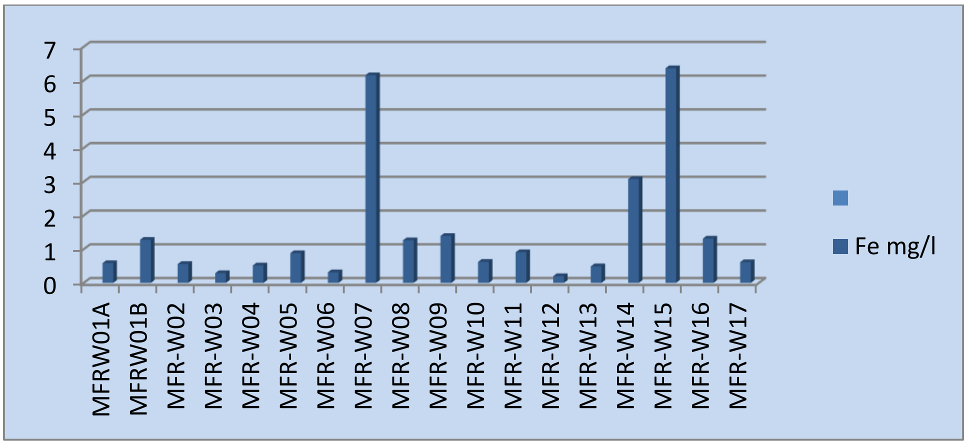

Figure 8. Graphical representation of Fe mg/l in wastewater

The figure represents Iron (Fe) concentration of different samples. Higher Fe values were found in some industries. High level of precipitated iron oxides may cause smothering of stream bottoms and plugging of organism's gills. High iron concentration in fresh water is also a problem. In domestic use, iron enriched water may induce rust formation on plumbing fixtures, the staining of laundry and a metallic taste in drinking water.

Concentrations of Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), Lead (Pb), Zinc (Zn) and Cadmium (Cd) were measured. The parameters were found within the limit of national standards.

To determine extent of pollution in the soil due to industrial waste, seventeen sediment sample collected from water stream side were analyzed. The concentrations of Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), Lead (Pb), Zinc (Zn) and Cadmium (Cd) in mg/kg. It was found that the sample no. 8 Contains high value of Zinc, Mn & Ni. The rest of the parameters were found within the standard limit. The amount of Al, Fe, Mg, Ca, Na, k and Ti. Very high Ca concentration was found in the sample no.8 which was beyond the accepted national limit.

6. CONCLUSIONS

The quality of the effluent generated by the textile industries in Narayonganj cannot satisfy national effluent quality standard. It was found that the effluent characteristics of different industries are not same. Some industries produce effluent containing high value of BOD, some produces high sulphur and low DO. Different industries use different types of chemicals for dyeing and other processes. No unique or universal method of treatment is suitable for all types of effluent. Sometimes the wastewater streams of some industries mixed with other drains. For treatment and reuse possibilities textile industry waste stream should be in principle considered separately. When the characteristics of separate streams are known, it can be decided which stream may be combined to improve treatment. A primary individual effluent treatment should be placed before the outlet point of each industry. Finally a central ETP (Effluent Treatment Plant) can be established for treatment of the wastewater. Administration should monitor the entire textile processing industries and take step to establish a central ETP.

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