PLANNING IMPLICATIONS OF INDUSTRIAL WASTE MANAGEMENT IN TEJGAON INDUSTRIAL AREA OF DHAKA CITY

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Thesis submitted to Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology, in partial fulfillment of the requirements for the degree of Master of Urban and Regional Planning

May, 1995

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET),
DHAKA
THESIS ACCEPTANCE FORM

PLANNING IMPLICATIONS OF INDUSTRIAL WASTE MANAGEMENT IN TEJGAON INDUSTRIAL AREA OF DHAKA CITY

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DEDICATED
TO THE MEMORIES OF MY BELOVED SISTER FARZANA HAQUE
WHOM I HAD LOST DURING THIS STUDY.
ABSTRACT

Rapid industrialization and urbanization and the consequent encroachment of industrial areas into residential areas or vice versa have been identified as some of the major reasons for environmental degradation in the urban areas in most of the developing countries as the industries of these countries are yet not fully exposed to the modern technologies for their production processes and yet to adopt modern methods for the overall management of industrial wastes.

Growth rate of urbanization in Bangladesh is one of the highest in Asia and by the end of this century it is expected to reach 26.4% which means around 37.3 million people of Bangladesh will be living in urban areas. Most of the industries of Bangladesh are already either in the existing urban areas or expected to be within the urban areas by the end of this century. Industrial development is essential for catering the needs of the growing populations of Bangladesh. Unfortunately, the industries in Bangladesh do not follow any systematic approach for managing their wastes so it is feared that more people will be exposed to the potential threat of environmental pollution which may endanger their physical and mental health in future.

Realizing the gravity of the situation this study has been initiated with the expectation that this study would help formulating policies for industrial waste management in a systematic and scientific way for Tejgaon Industrial Area and which can be replicated for other industrial estates near the urban areas of Bangladesh.

This study finds that there is an urgent need and scope to improve the present industrial waste management practices in Tejgaon Industrial Area as the industries of this area do not practice any scientific way for managing their produced wastes. Moreover, the agencies involved in waste management task at area level lack in adequate technical and nontechnical manpower, necessary facilities and equipments and above all they are starved with adequate budgetary allocations needed for their
smooth functioning. Besides individual actions by the agencies involved with out coordination among other agencies have made the task more complicated. The enforcement activity of environmental laws, standards for the IWM are extremely limited in the country. The people living in the industrial areas or the surrounding areas of industrial estates are not well informed about the harmful effects of waste mismanagement. Industry owner have been found reluctant to adopt scientific measures for waste management in their respective industrial units.

From this study a model has been developed for industrial waste management in TIA and roles of different organizations have been identified. It has been observed that 3 levels of activities viz., national level, area level and plant level activities are necessary for integrated management of industrial wastes in TIA. A good coordination among the agencies and organizations involved in different activities and a firm commitment from the industry owners can help in better managing the industrial wastes which are being produced in TIA.
ACKNOWLEDGEMENT

All Praises goes to almighty Allah the most merciful, most benevolent to man and his action.

I am indebted to Dr. M. A. Mohit, my supervisor and Associate Professor of Urban and Regional Planning Department of Bangladesh University of Engineering and Technology for his encouragement, sympathetic Co-operation and guidance at all stages of this thesis work.

I would like to express my gratitude to Prof. Dr. Mir Shahidul Islam, Head of the Department, URP, BUET for his valuable suggestions. Thanks are also due to BUET authorities for funding this research work and providing me with fellowship during my post graduate studies.

I am also indebted to my employer Khulna University Authority and specially to Mr. Rezaul Karim Head of the discipline of Urban and Rural Planning and Mr. Akhter Hossain Choudhery Asstt. Professor (Head in Change) of URP Discipline for helping me in the best possible way to continue the research.

I would like to express gratitude to all teachers of the Urban and Regional Planning Department of Bangladesh University of Engineering and Technology.

I would like to express my sincere thanks to the officers and employees of Department of Environment and specially to Mr. Anwarul Islam, Deputy Director, Dhaka Division of DOE for his nice co-operation in the course of work.

I would like to thank, My friend Mr. Abul Kalam Azad who shared the troubles with me in taking various photographs of the study Area.

I would like to thank Mr. Matiur Rahman, Md. Jakirul Islam Sarker and others of Concord Computers for helping me in typing the manuscripts of the thesis.

Finally I am expressing my deep gratitude to my parents and to my family for standing all the way in my side.

- Shamim Mahabubul Haque.
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<td>---------------------------------</td>
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<tr>
<td>ADB</td>
<td>Asian Development Bank.</td>
<td></td>
</tr>
<tr>
<td>Ag</td>
<td>Silver</td>
<td></td>
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<tr>
<td>B.B.S</td>
<td>Bangladesh Bureau of Statistics.</td>
<td></td>
</tr>
<tr>
<td>BOD</td>
<td>Biochemical Oxygen Demand.</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>Carbon mono Oxide.</td>
<td></td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand.</td>
<td></td>
</tr>
<tr>
<td>CL₂</td>
<td>Chlorine</td>
<td></td>
</tr>
<tr>
<td>CU</td>
<td>Copper</td>
<td></td>
</tr>
<tr>
<td>Cd</td>
<td>Cadmium</td>
<td></td>
</tr>
<tr>
<td>CWASA</td>
<td>Chittagong Water and Sewerage Authority</td>
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<tr>
<td>DDT</td>
<td>Dichloro Dimethyl Trichloroethane.</td>
<td></td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved Oxygen.</td>
<td></td>
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<tr>
<td>DOE</td>
<td>Department of Environment.</td>
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<tr>
<td>DWASA</td>
<td>Dhaka Water and Sewerage Authority.</td>
<td></td>
</tr>
<tr>
<td>DCC</td>
<td>Dhaka City Corporation.</td>
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<td>DEPC</td>
<td>Department of Environment and Pollution Control.</td>
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<tr>
<td>DMDC</td>
<td>Dhaka Metropolitan Development Planning.</td>
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<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>EC</td>
<td>Electrical Conductivity</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>H₂S</td>
<td>Hydrogen Sulphide</td>
<td></td>
</tr>
<tr>
<td>H₂SO₄</td>
<td>Sulfuric Acid</td>
<td></td>
</tr>
<tr>
<td>H₃PO₄</td>
<td>Phosphoric Acid</td>
<td></td>
</tr>
<tr>
<td>HF</td>
<td>Hydrogen Fluoride</td>
<td></td>
</tr>
<tr>
<td>HC</td>
<td>Hydro Carbon</td>
<td></td>
</tr>
<tr>
<td>Hg</td>
<td>Mercury</td>
<td></td>
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<tr>
<td>IEE</td>
<td>Initial Environmental Examination.</td>
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<tr>
<td>IPPS</td>
<td>Industrial Pollution Projection System.</td>
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<tr>
<td>IGECM</td>
<td>Industrial Gaseous Emission Control and Management.</td>
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<td>ILWM</td>
<td>Industrial Liquid Waste Management.</td>
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<td>ISWM</td>
<td>Industrial Solid Waste Management.</td>
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<td>ITWM</td>
<td>Industrial Toxic Waste Management.</td>
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<td>IWM</td>
<td>Industrial Waste Management.</td>
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<td>JICA</td>
<td>Japan International Co-operation Agency</td>
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<tr>
<td>JTU</td>
<td>Jackson Turbidity Unit.</td>
<td></td>
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<tr>
<td>Km</td>
<td>Kilo-Meter</td>
<td></td>
</tr>
<tr>
<td>mg/l</td>
<td>Milligram/Liter</td>
<td></td>
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<tr>
<td>micro-mho/cm</td>
<td>Micro-mho/Centimeter</td>
<td></td>
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<tr>
<td>m³/day</td>
<td>Cubic meter/day</td>
<td></td>
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<tr>
<td>mm</td>
<td>Milli-meter</td>
<td></td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
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<td>--------------</td>
<td>-------------</td>
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<tr>
<td>MOEF</td>
<td>Ministry of Environment &amp; Forest</td>
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<tr>
<td>NEMPCP</td>
<td>National Environmental Management and Pollution Control Project.</td>
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<tr>
<td>NO</td>
<td>Nitric Oxide</td>
<td></td>
</tr>
<tr>
<td>NH₃</td>
<td>Ammonia</td>
<td></td>
</tr>
<tr>
<td>Ni</td>
<td>Nical</td>
<td></td>
</tr>
<tr>
<td>NOₓ</td>
<td>Nitrogen per Oxide.</td>
<td></td>
</tr>
<tr>
<td>NTU</td>
<td>Nephelometric Turbidity Units.</td>
<td></td>
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<tr>
<td>p[H]</td>
<td>Negative Logarithm of Hydrogen ion Concentration.</td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>Lead</td>
<td></td>
</tr>
<tr>
<td>ppb</td>
<td>Parts per billion.</td>
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<tr>
<td>ppm</td>
<td>Parts per million.</td>
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<tr>
<td>PWD</td>
<td>Public Works Department.</td>
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<tr>
<td>SO₂</td>
<td>Sulfur di Oxide</td>
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<tr>
<td>SPM</td>
<td>Suspended Particulate Matter.</td>
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<tr>
<td>S.S.</td>
<td>Suspended Solid.</td>
<td></td>
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<tr>
<td>TIA</td>
<td>Tejgaon Industrial Area.</td>
<td></td>
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<tr>
<td>T.S.</td>
<td>Total Solid.</td>
<td></td>
</tr>
<tr>
<td>T.D.S</td>
<td>Total Dissolved Solid.</td>
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CHAPTER 1 : INTRODUCTION
1.1 BACKGROUND

Between 1990 and 2030 world’s population will grow by 3.7 billion, demand for food will almost double, industrial output and energy use will probably triple worldwide and increase six fold in developing countries. Under current practices, the result could be appalling environmental conditions in cities and countries. (The World Development Report, 1992). This observation of World Development Report reveals the fact that the pace of worldwide industrialization globally is going to be raised manifolds in the coming years to meet the increasing demands of the population and at the same time the threat to the very existence of human being will also be heightened in substantial amount. This threat is due to the rapid degradation of environment and water pollution and water scarcity, air pollution, solid and hazardous wastes, soil degradation, deforestation, Loss of bio diversity, atmospheric changes, are the major causes of this environmental degradation.

Of the causes of major environmental degradation, most of those are directly or indirectly, partially or fully related to the industrialization and more particularly with the mismanagement of industrial waste which are disposed of haphazardly without any treatment in the surrounding environment by most of the industries particularly industries of the developing nations.

In most of the developing countries the very distribution of people between countryside and towns is going to be reversed within next three to 4 decades. In 1990 most people lived in rural areas by the year 2030 the opposite will be true. It has been mentioned in the world development report "urban populations will be twice the size of rural population. Developing country cities as a group will grow by 160 percent over this period, where as rural population will grow by only 10 percent." (World Development Report, 1992 p-27). Three factors intensify the environmental problems associated with industrial development. First, as emissions from existing activities increase, they pass the point at which they can be readily assimilated by the environment. Second as industrial town expands more people are exposed to pollution. Third, within industry the structure shifts away from activities that are moderately polluting, such as textiles, wood products and food
processing and others with much greater potential for causing environmental harm, such as metal chemical and paper. Incidentally, the industrial developments in most of the developing countries are very near to the major urban centers or the urban centers grow near the industrial belts. So in the fourth five year plan of GOB it is categorically mentioned that "impact on environment should be one of the major factors to be taken into consideration while selecting sites/location of industries" (Fourth Five Year Plan, GOB, 1990).

Bangladesh now contains about 30,000 industrial units of which about 24000, are small and cottage industries (IUCN Report 1991). The contribution of industrial sector to G.D.P was 8.20% in the year 1992-93 (Annual budget, GOB 1993-94). Industrial production for all industrial groups, such as garment production, leather products and industrial chemicals increased production by 200 to 4000 percent over the last ten years (B.B.S.1989).

On the other, hand level of urbanization has been showing a gradual upward trend with 15.1% in 1981 and 20.1% in 1990 and is expected to be 26.4% at the end of this century. The total urban population in Bangladesh increased tremendously from 13.5 million in 1981 to 22.9 million in 1995 and is expected to be 37.3 million by the end of this century (Bangladesh Economic and Social Development Prospect, P-126). With a few exceptions, industries in Bangladesh are not equipped with pollution control systems. 5 industrial zones with 328 different industries around Dhaka discharges about 49 metric tons/day of polluting loads into the surrounding rivers of Dhaka (Ahmed, 1988). In another study of Dhaka Metropolitan Development Planning regarding waste management it was observed that with the increase of future industrial development in and around Dhaka City the industrial waste generation would rise at the rate of 3 percent per year and expected to reach 85,565 metric tons in 2000 A.D. from 63,875 metric tons of 1992 (DMDP Waste Management Report, 1992).

Besides after the completion of first phase of Greater Dhaka Flood Protection works several problems which lead to environmental degradation such as drainage congestion and industrial (both liquid and solid) waste disposal have already begun to appear. It is expected that situation may further aggravate after the completion
of second phase work in the north and eastern part of Dhaka city (Karim, 1992).

Industrial solid wastes are collected along with municipal solid wastes. Air pollution due to industrial activities is till now not a major problem. Actually in the context of Bangladesh industrial waste water is the major threat to environment at the present moment. With the rapid expansion in urbanization process in Bangladesh it is expected that Dhaka metropolitan area will be a bigger size than what it is now by the end of this century and the expected population of Dhaka by the end of this century will be 10 million (NEMFCP Report, 1992). Industrial zones now in the periphery of the city will be well inside of it.

A survey was conducted in 1986 by Department of Environment to identify the number of polluting units in Bangladesh. This survey focused on water, as the most easily identifiable form of pollution. The concentration of pollution parameters (BOD, COD, pH etc.) are found to exceed the maximum allowable limit suggested by different pollution control authority. Of the industries identified as major polluter a good number of them fall in the five industrial zones around Dhaka city.

Both physical and policy planning are implicated for the judicious management of industrial wastes in these zones. Physical planning is needed to develop planned infrastructural facilities, required to manage industrial wastes. On the other hand, policy planning is needed to encompass various issues such as legislation institutional and financial aspects related to industrial waste management.

1.2 IMPLICATIONS OF IWM IN URBAN PLANNING

Industrial estates are often situated in the closer proximity to the urban center. Rapid urbanization process follows the establishment of industrial estates in peripheral urban areas. In both the cases industrial waste management has got a number of implications on urban planning. Followings are some implications of IWM in urban planning.
1.2.1 Character, Size and Structure of Urban Population: Sound industrial waste management improve the living conditions of the areas nearer to industrial establishments. For different types of industrial activity services from different types of people having different occupations such as labor, suppliers of raw materials to the industries, traders of industrial products, factory employees, managers are needed. The improved living condition in the industrial area may encourage the people related with the industries to live in the industrial area. This situation may change the size, character and structure of population in the industrial area.

1.2.2 Landuse of The Urban Centers: Land use of the areas inside and nearer to the industrial areas is highly influenced by the sound management of the industrial waste in the industrial area. Improved environmental condition in the industrial area will enhance different activity such as housing, trading, recreational, educational, etc. in the industrial area and the surrounding area as well. So the land use pattern of these areas may change emphatically within a very short span of time.

1.2.3 Air and Water Quality: Industrial waste management has definite effect on ambient air quality and surface and ground water quality of the areas within or near to the industrial area. Harmful gaseous emissions from the industries may impair ambient air quality of the area while haphazard disposing of solid waste and waste waters from the industries containing toxic ingredients may pollute both surface and ground water of the areas inside or nearer to the industrial area.

1.2.4 Drainage System: Haphazard disposing of industrial wastes in the open drains storm sewerage system. Canals and ponds may lead to the disruption of drainage system in the urban areas causing severe water logging in some areas. Dumping of industrial solid wastes in the ponds and ditches which may act as water retention bodies may aggravate the situation. Channel blockages and blockages in the open drains disrupt the free movement of waters to the outfalls. Moreover disposing of industrial waste in the drains may reduce its useful life.
1.2.5 Municipal Waste Collection, Treatment and Disposal System: Municipal waste collection system is disrupted by industrial wastes. Municipal dustbins are often used by the industries for dumping their wastes. It reduces the capacity of the dustbins for disposing of municipal wastes. Moreover industrial wastes which are different in nature from the domestic sanitary waste may upset the treatment facilities for sanitary wastes. Disposal of municipal waste along with industrial wastes may prove detrimental to the urban environment.

1.2.6 Recreational Facilities: Open fields, parks are often destroyed by dumping of industrial solid waste. Liquid waste discharge in the water bodies destroys the aquatic life and water qualities of the water bodies which may not be used for any recreational purpose like fishing, boating etc. Haphazard disposing of waste has adverse effect on plant life also.

1.2.7 Social Implication: A very large group of urban people depends on the waste management system for their livelihood. Scavengers, small shopkeeper (vangaries), owners and workers of recycled product industries are the major groups dependant on waste management systems for their livelihoods.

1.2.8 Health and Sanitation: Various diseases may spread out due to poor health and sanitation condition in the industrial estates. The effect of some industrial wastes on human health may not be observed immediately but their long run effects are very horrifying. The major diseases which may spread out from industrial wastes are diarrhoea, respiratory diseases, typhoid, jaundice skin disease, allergy, eye trouble, tuberculosis, rheumatic fever, etc.

1.3 RATIONALE OF THE STUDY

Tejgaon Industrial Area is situated in a very important location in Dhaka city. It is a part of Tejgaon Thana located within ward No. 71 of Dhaka metropolitan area. The total population of this area is 52,302 (Community Series, Dhaka 1993). This industrial zone which was once at the northern periphery of Dhaka town is now well inside the city and is surrounded by some important government establishments, high and medium class residential areas and
commercial areas. There are 156 different types of industries in this area with virtually no waste water treatment facility in a single unit. Industrial solid wastes in this area are dumped with municipal solid wastes in the municipal waste bins (See Plate 1). Waste water from the industries are emptied in the open drains or WASA sewerlines (See Plate 2).

Besides discharges from outfalls of storm sewerage line of DWASA in the low lying area (Near Begunbari Khal) of the study area is creating severe health sanitation problem (NEMPCP, 1992). Highly colored and polluted water (See Plate 3) of Begunbari Khal have already crossed the limit for its any beneficial use (See Table 5.25 and Table 5.26). It has been observed that the water of Begunbari khal which receives industrial discharges from TIA is already heavily polluted and found under septic condition during dry weather period and construction of the second phase of flood protection embankment would only accelerate the degradation of the khal water quality(Karim,1992). Though air pollution problem is not acute upto present time (NEMPCP Report, 1992) however future risks can not be over ruled. Various harmful effects, of industrial waste mismanagement have already begun to appeared in the TIA (See Section 5.17) which is making the living environment in TIA polluted to some extent.

Absence of appropriate laws and regulations relating to industrial waste management have further aggravate the situation in TIA. Various shortcomings of the involved agencies and independent actions by different agencies without any co-ordination with other agencies involved in waste management is making the waste management task difficult (NEMPCP, 1992). Therefore a detailed study to develop a suitable management policy and to suggest future actions for the agencies involved in waste management in TIA, is urgently needed to mitigate adverse environmental impacts in the area.
1.4 OBJECTIVE(S) OF THE STUDY

The purpose of the study is to develop a suitable management system of industrial wastes for TIA. As such following objectives have been set for the study:

01. To identify various issues related to IWM in Bangladesh and their present status in TIA.

02. To identify the problems of existing management practices of industrial wastes in TIA and to examine the effects of haphazard disposal of industrial wastes.

03. To develop appropriate planning policies and to propose necessary actions for industrial waste management of Tejgaon Industrial area.

1.5 SCOPE OF THE STUDY

In the present study, the main emphasis has been given to develop a suitable planning policy for industrial waste management for TIA. As air and sound pollutions in Tejgaon are not that much severe till now the main focus has been concentrated at industrial waste water and solid waste management. Nevertheless, the problems of air and sound pollution have also been discussed to a limited extent. The detailed engineering design for industrial waste management is beyond the scope of the study.

1.6 METHODOLOGY OF THE STUDY

In order to obtain the objectives set for the present study, methodology adopted for the study includes: selection of study area, research design, discussion with officials of relevant organizations and data analysis.

1.6.1 Selection of The Study Area: For the present study, Tejgaon industrial Area was selected as study area. The study area selection was based upon the following considerations:

a. Tejgaon Industrial Area is one of the planned industrial estates in Bangladesh but lacks in any appropriate management practice for the industrial wastes generated in this estate.
b. Though Tejgaon Industrial Area is an industrial estate but a good number of residential establishments are also present in this industrial estate, providing housing to the officers and employees of various government, semi-government and private organizations. Besides many industries of this area have their workers accommodation in this area. Because of the availability of government owned vacant lands, a considerable number of slums and squatters have also mushroomed in the area. So the total population living in and around this area is large and they are under the potential threat of any industrial pollution in this area.

c. Due to the heterogeneity of industrial establishments in the area it is possible to identify different cases, sources, types and effects of pollution by different types of industries and different management options for wastes produced by different types of industries can be examined.

1.6.2 Research Design

a. **Inventory of the Industries:** An inventory of the industries situated in the Tejgaon Industrial Area was made from the secondary sources. This inventory included the following items

i) Names and addresses of the industries  
ii) Major products produced by different industries  
iii) Number of employees/officers in different industries  
iv) Waste water generation potentials of different industrial units.

b. **Identification of Waste Generation Potential:** On the basis of "Environmental Guide Lines for Industries" developed by Department of Environment, Bangladesh, waste generation potential of different industries of TIA were identified.

c. **Categorization of Different Types of Industries:** Industries of Tejgaon TIA Area were categorized into 7 groups on the basis of their products and ISIC categorization system.
d. **Sample Survey in The Study Area**: Two types of questionnaire survey were administered in the study area in the month of April 1994. One questionnaire survey was conducted for the industry owners/managers and another one was for the inhabitants of the study area. Besides a suitable number of industries were also inspected by the author and field visit reports were prepared for use in the analysis.

e. **Questionnaire Survey For the Industry Owners/Managers**: The main objective of this survey was to quantify the volume of wastes produced from different type of industries, nature of the wastes, method of disposal of industrial wastes from various types of industries. Storage facilities of raw materials of different types of wastes. Characteristics of different types of wastes from different industries, waste management practiced in different types of industries and finally to know what can be done to improve the waste management system in TIA. Managers/owners of 19 industries which generate solid, liquid and gaseous waste in TIA and which are among the major polluting industries of TIA, as identified by DOE have been interviewed in this connection. 13 major waste generating industries in TIA produce nearly 50% of waste water which is being generated in this area (list given in the appendix F). Most of those industries have been surveyed at the present study. So this sample size is well representative for TIA to discuss various issues of wastes management in the area. Location of the surveyed industries have been shown in Figure 1.

f. **Questionnaire Survey for Inhabitants of TIA**: The main objective of this survey was to understand what the people living in this area thinks regarding industrial pollution, their level of awareness, nature and level of problem they are facing due to the absence of systematic industrial waste management system in the study area and what do they suggest for developing a suitable management system for industrial wastes in the study area. A total of 252 inhabitants living in the housing areas and slums inside TIA were surveyed in this connection. Survey spots have been shown in Figure 2.
g. **Field Visit Reports**: The main objective of the preparation of field visit reports were to cross check the information provided by the owners and managers of different industries in the study area.

h. **Reconnaissance Survey**: Reconnaissance survey was conducted by the author in the study area to observe present practice of industrial waste disposal in the study area and to identify various problem created due to the absence of any appropriate management system of industrial waste in the study area.

i. **Literature Survey**: An extensive survey of all the available and relevant literature was made to understand the prevailing experts opinion in this aspect. Besides an in depth investigation into the various documents/reports published by different organizations was also made to obtain various information related to industrial waste management.

1.6.3 **Data Analysis**: Collected information were analyzed through statistical tools and techniques. SPSS/ PC+ software was used to analyze the data collected from questionnaire survey.
Fig. 1: Location of Industries Surveyed in TIA.
Fig. 2: Location of Households Surveyed in TIA.
1.6.4 Discussion With The Concerned Officials: Discussions were made with the officials of DOE, DWASA and DCC regarding various issues related to industrial waste management in the study area.

1.7 LIMITATIONS OF THE STUDY

Following the methodology described above sincere attempts were made to achieve the objectives set for the present study. But due to the non-co-operation of the industry owners and managers, information collected from the questionnaire survey for the industry owner/manager were not adequate. Therefore, the author had to use his observation and field reports. Besides, in Bangladesh a very limited study has been done in the field of industrial waste management particularly at a micro area such as TIA having such a wide variety of industrial establishments. So the study has to be based mainly on the availability of secondary data and information which were not enough in some respects.

1.8 ORGANIZATION OF THE STUDY

The present study has been divided into seven chapters. Chapter one presents background, objectives, scope, methodology and limitations of the study.

Description of the study area is given in chapter two with all necessary information and contextual setting of the area with respect to Dhaka City.

Chapter three deals with the natures, types, pollution potentials, sources, characteristics of industrial wastes and their effects on the surrounding environment.

In chapter four various issues related to IWM with specific reference to Bangladesh have been discussed.

Chapter five deals with the existing IWM practices in the study area. Adverse effects due to mismanagement of industrial waste in the study area have also been discussed in this chapter.
In chapter six opinion of industry owners/managers and inhabitants of TIA regarding various issues related to IWM have been compiled to incorporate them in developing a suitable management system of industrial waste for the study area.

In chapter seven findings from the study have been summarized and from those findings some recommendations have been made to make IWM system in TIA more efficient and effective.
CHAPTER 2 : STUDY AREA
2.1 INTRODUCTION

In this chapter a brief description of the study area with necessary maps and figures have been given. Besides some socio-economic information of the inhabitants of TIA which are relevant for the present study have also been analyzed in this chapter.

2.2 LOCATION

Tejgaon Industrial Area is a part of Tejgaon Thana which is located between 23°50' north latitudes and between 90°25' and 90°30' east longitudes. It is a part of ward number 71 of Dhaka city Corporation. It occupies an area of 2.05 sq kilometers. Tejgaon industrial area is bounded on the north by Mahakali Gulshan road, on the south by Begunbari area, on the east by Begubari Khal and on the west by Dhaka-Tongi railway lines. (See Figure 3)

2.3 MICRO CLIMATIC CONDITION

Direction and speed of the wind and rainfall patterns have major implications for industrial waste management.

i) Speed and Direction of wind: The dominant wind direction in the study area is from the North and North west in the months between October to February and from south to south west in the months between March to September. Average wind speed in the study area from October to February is 2.79 km/hr and from the March to September it is 3.42 Km/hr.

ii) Rainfall pattern: Maximum rainfall in the study area occurs in the month of June which is about 399 mm and minimum rainfall occurs in the December which is 0 mm. The study area experiences a typical monsoon climate with high rainfall in the months from June to September and is relatively dry in other times of the year.

2.4 PHYSICAL INFRASTRUCTURES

I) Roads: Tongi diversion road is the major arterial road in the study area. The study area possesses a well connected road network throughout the entire area. (See Figure 4)
Fig. 3: Dhaka City and Location of Study Area.
LAYOUT MAP OF TEJGAON LIGHT INDUSTRIAL AREA
SHOWING STANDARD CATEGORIES OF INDUSTRIES PLOT WISE AND
OTHER LAND USES:
(1993 DMOP SURVEY RESULTS)

Fig. 4: Road Network Within TIA.

SOURCE:
MAP LAY OUT PLAN ADAPTED FROM THE OFFICE OF THE
DMOP PLANNING HIRING, NAGRAI
DATE 25/11/88
REPRODUCED BY H.K. HASSAN NOV/DEC 1993

Fig. 4: Road Network Within TIA.

SOURCE:
MAP LAY OUT PLAN ADAPTED FROM THE OFFICE OF THE
DMOP PLANNING HIRING, NAGRAI
DATE 25/11/88
REPRODUCED BY H.K. HASSAN NOV/DEC 1993
Fig. 5: Sanitary Sewerage Network in TIA.
Fig. 6: Storm Sewerage Network in TIA.
Fig. 7: Typical Plan & Section of D C C's Dustbin
Available in TIA.
ii) **Sewerage Network**: According to DWASA the entire TIA has sanitary sewerage connection with 24" diameter main lines under almost all the major roads of TIA. There exists a WASA lift station in TIA also. From this lift station 36" diameter pipe line is connected up to Khilgaon lift station. From Khilgaon 48" diameter pipe line is connected up to slaughter house and from there with 54" diameter pipe line to Pagla treatment plant. (See Figure 5).

iii) **Open/Covered Drains**: According to DCC the entire study area is connected with either open or closed drains.

iv) **Storm Sewerage System**: Entire TIA is connected with a storm sewerage network of both brick sewer and pipe sewer of varying diameters ranging from 18" to 48". Main storm sewerage line in the area is the line under Tongi diversion road. The line has varying diameters at different sections ranging from 24" to 48". There are two outfalls of this storm sewage network at TIA - one at Begunbari Khal another is at ditches near Mohakhali bus stand. (See Figure 6, plate no. 6 and plate no. 7).

v) **Dustbins**: According to DCC there are approximately 30 dustbins in the study area. Average capacity of each dustbin is 5.5 m³. The typical plan and cross section of the dustbins available at TIA is given in Figure 7.

2.5 **SOME IMPORTANT FEATURES OF THE STUDY AREA**

2.5.1 **Sanitation Condition**: 50.97% of the household have sanitary toilet facilities, 32.90% have no sanitary toilet facilities and rest 16.13% have no toilet facilities in the study area. The sewage stream in Begunbari Khal causes severe public health problems in the dry season in the low lying areas of the study area.

2.5.2 **Sources of Drinking Water**: 83.61% of the households in the study area have access to the tap water while 12.89% use tube well as a source of drinking water. Rest use ponds and rivers as the main sources of their drinking water in the study area.
2.5.3 Topography and Drainage Pattern: The study area is situated in a fairly plain land with gentle slope towards the east. Though there are some scattered ditches in the area but natural drainage pattern of this area is towards east, towards balloon river. The main discharge path way for the study area is from Begunbari Khal to Norai Khal and finally to Balu river.

2.5.4 Surface Water Quality: In general surface water in the study area is highly colored due to the dye discharged from the textile industries and have high pH values due to chemical discharges and high level of dissolved solids and BOD. In the dry season the out falls discharge into the flood plains and causes damage to rice field. In wet season the out falls discharge into receiving water bodies which become septic due to domestic and industrial wastes. (See Section 5.17.1 for more detail information).

2.5.5 Ambient Air Quality: Ambient air quality in the study area is good. Industrial units at Tejgaon are not critical sources of air pollution SO₂ and NOₓ concentration in the ambient air in the study area is low enough to cause any serious concern. (See section 5.14.2 for more detailed information)

2.5.6 Housing: 9.67% of the main house of the dwelling households are made of straw/bamboo 42.73% are made of cement and 47.60% are made of combination of different types of material on study area (B.B.S, 1993).

2.6 SOCIO-ECONOMIC CONDITION OF THE PEOPLE

Total population in the study area is 41,298. Of them 26,685 are males and 14,613 are females. The sex ratio of the study area is 182 males per 100 females as against 143 male per 100 females in the Tejgaon thana. The average household size in the study area is 5.8.
Table 2.1: Population by Broad Age Group and Sex.

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>09.13</td>
<td>14.86</td>
</tr>
<tr>
<td>5-9</td>
<td>08.44</td>
<td>14.97</td>
</tr>
<tr>
<td>10-14</td>
<td>07.71</td>
<td>12.41</td>
</tr>
<tr>
<td>15-17</td>
<td>04.57</td>
<td>06.25</td>
</tr>
<tr>
<td>18-34</td>
<td>43.45</td>
<td>35.95</td>
</tr>
<tr>
<td>35-59</td>
<td>23.79</td>
<td>13.51</td>
</tr>
<tr>
<td>60+</td>
<td>02.91</td>
<td>02.05</td>
</tr>
</tbody>
</table>

Source: BBS, 1993

Table 2.1 reveals that 25.28% male and 42.24% of female population in the study area are below 15 years of age, 43.45% of male and 35.95% of female population of the area are in the age group which constitutes the major labour force. Children are normally more vulnerable to any kind of pollution problems. As such 1/4th of the male and 2/5th of the female population in the study area are in the easy prey of any kind of pollution.
Table 2.2: Population 10 Years and Above by Main Economic Activity.

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>Occupation</th>
<th>(%) of population involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not Working</td>
<td>15.38</td>
</tr>
<tr>
<td>2</td>
<td>Looking for work</td>
<td>02.06</td>
</tr>
<tr>
<td>3</td>
<td>Household work</td>
<td>17.39</td>
</tr>
<tr>
<td>4</td>
<td>Agriculture</td>
<td>0.30</td>
</tr>
<tr>
<td>5</td>
<td>Industry</td>
<td>21.58</td>
</tr>
<tr>
<td>6</td>
<td>Water/electric/gas</td>
<td>0.64</td>
</tr>
<tr>
<td>7</td>
<td>Construction</td>
<td>2.47</td>
</tr>
<tr>
<td>8</td>
<td>Transport and Communication</td>
<td>10.19</td>
</tr>
<tr>
<td>9</td>
<td>Business</td>
<td>7.67</td>
</tr>
<tr>
<td>10</td>
<td>Service</td>
<td>1.18</td>
</tr>
<tr>
<td>11</td>
<td>Others</td>
<td>21.14</td>
</tr>
</tbody>
</table>


Table 2.2 reveals that more than 1/5th of the population in the area are directly associated with the industrial sector in the study area.

2.7 SUMMARY

Tejgaon Industrial Area is a planned industrial area with all necessary infrastructural facilities and is located in a very important location of Dhaka City. Over the years this industrial area has gradually turned into a mixed use area with a wider variation of people living and working there. With the densely populated residential and commercial development around the area it is now under the potential threat of environmental pollution as the industries of the area are not practicing any scientific methods of waste disposal from the respective industries.
CHAPTER 3: INDUSTRIAL WASTE AND ENVIRONMENT
3.1 INTRODUCTION

To develop a suitable IWM system it is necessary to have a clear idea about the meaning of environment and industrial waste. Pollution potential and effect on environment by different types of industrial waste also bear a great significance in developing a suitable IWM system. This chapter intends to discuss these issues.

3.2 DEFINITION OF ENVIRONMENT

That which environs or encompasses or surrounds us is called environment. The aggregate of all the external conditions in which we exist is our environment. All forces or phenomenon which influences the environment, be it physical, social mental or others do effect the life and development of individual or that of a community.

3.3 INDUSTRIAL WASTE

Wastes generated from different processes of industrial activity may be termed as industrial waste. Manufacturing process in any industrial enterprise is a compilation of a number of activities. It varies from industry to industry and even from plant to plant producing similar products.

3.4 TYPES OF INDUSTRIAL WASTE

Industrial wastes can be categorized into four basic types depending upon their physical nature. These are:

1. solid.
2. Semi solids.
3. Liquid.

3.4.1 Solid Industrial Waste: Solid Industrial waste may be defined as non liquid waste material arising from industrial activity. Solid waste comprises of countless materials namely food waste, paper, packing boards, metals, plastics, glasses and discarded and process wastes. Almost all the industries produce some amount of industrial solid wastes.
3.4.2 Semi-sold Industrial Waste: Semi-solid industrial wastes are mainly process wastes. These types of wastes are generated mainly in textile and dying industries, paper and pulp industries, basic metal industries, industrial chemical industries and to some extent in the pharmaceutical industries. Sludge and slurries from treatment plants can also be termed as semi-solid industrial waste. This type of waste possesses a considerable amount of moisture in them.

3.4.3 Liquid Industrial Wastes: Liquid industrial wastes are commonly known as the waste water. Chemicals, residues from raw materials along with the water required for manufacturing process constitutes liquid industrial waste. The characteristics of liquid wastes varies considerably from industry to industry and even from plant to plant producing same product. Textile and dying industries, Paper and pulp industries fertilizer industries, chemical industries, basic metal industries are the major waste water producers.

3.4.4 Gaseous Industrial Wastes: Industries which use boilers and furnaces in their manufacturing process, produces significant amount of gases and smokes, $SO_2$, $CO$, NO, $H_2S$ etc. These are the major gases produced from different types of industries. These gases and suspended particulate matters from different industries may impair the ambient air quality of the surrounding places of the industries by producing bad odor, and by creating irritation in eye and disturbance in respiration. These gases and smokes can be termed as gaseous industrial wastes.

3.5 CHARACTERISTICS OF INDUSTRIAL WASTES

Unlike domestic waste, industrial wastes are very difficult to generalize. The characteristics of the industrial wastes not only vary with the type of industries but also from plant to plant producing the same product. Major characteristics of industrial wastes are high suspended solids, colloidal and dissolved organic matter mainly protein, fat, high dissolved organic solids containing nitrogen, high BOD, high COD, high and low $pH$, dissolved inorganic matters etc. Detailed characteristics of different type of industrial wastes are given in Appendix B.
3.6 SOURCES OF INDUSTRIAL WASTES

The major sources of industrial waste include the wastes from the raw materials, process chemicals, final products, process intermediates, process by products and impurities in raw materials. Sources of the major industrial wastes are given in Appendix B.

3.7 CHARACTERISTIC PARAMETERS OF INDUSTRIAL WASTES

The increased emphasis on water quality for multipurpose use and growing concern about ambient air quality has defined a number of parameters of special significance in industrial waste water and industrial gaseous emission management.

3.7.1 Parameters for Waste Water: The characteristics parameters for waste water are:
   a. The Biochemical Oxygen Demand (BOD).
   b. The Chemical Oxygen Demand (COD).
   c. Suspended, Settleable and Volatile solids.
   d. Total solids.
   e. PH, Alkalinity, Acidity.
   g. Heavy metal and Inorganic salts.

a. Biochemical Oxygen Demand (BOD): It is usually defined as the amount of oxygen required to oxidize the organic matter under aerobic condition. It is used to determine the biodegradable organic contents of the waste in terms of oxygen which will be required if discharged into natural course in which aerobic condition prevails.

b. Chemical Oxygen Demand (COD): Chemical Oxygen Demand is widely used to determine the organic matter in the sample of waste water to carbon-dioxide and water. It is an attempt to carry out a wet chemical combustion of all carbonaceous material of waste water sample. There are however some carbonaceous material which will not be completely oxidized, also there may be oxidation of nitrogenous materials under certain circumstances. So there is no definite relationship between the carbonaceous content of a sample and its COD value. The COD value however, is important in testing
industrial wastes for it gives reasonably close approximation of total chemically oxidizable carbonaceous content of a sample.

c. **Suspended Solids**: It is important to measure the concentration of suspended solids in effluent since such solids can cause pollution of surface waters and add to the sludge problem at treatment works. Organic suspended and dissolved solids undergo biodegradation and their pollution potentials are usually expressed in terms of BOD. The fixed or inorganic solids and heavier organic solids settle quickly and form a sludge blanket near the point of discharge. Colour may be partially imparted by the suspended solids but turbidity is almost wholly caused by suspended solids.

d. **pH**: pH is a measure of hydrogen ion concentration. The acidity or alkalinity of waste are frequently expressed in terms of pH value. Many industrial wastes are either acidic (e.g. wine stillage pH <3.5) or alkaline (e.g. laundry waste pH>9.0). pH is a parameter having a direct effect on the treatibility of waste by biological means particularly in the control of aerobic digestion of organic matter.

e. **Nitrogen and Phosphorus**: The determination of nitrogen was used for many years for examining the sanitary quality of water. The significance of nitrogen in Biological waste water treatment arises from the fact that it is essential for growth of micro-organism which are responsible for biological composition. Because of this, addition of nitrogen to the waste water is sometimes required in order to make the wastes biologically treatable.

Phosphorus is another nutrient which like nitrogen is essential for biological treatment of wastes. In natural water phosphorous occurs usually in the form of orthophosphate, condensed phosphate (pyrophosphate, meta phosphate and poly phosphate) and organic phosphate. Phosphorous is also significant for growth of alge and different micro and macro - organisms causing unpleasant condition in receiving water.

f. **Heavy Metal and Inorganic Salts**: Waste waters from industrial sources contain elements like arsenic, boron, copper, cyanide, chromium, lead, mercury etc. which are toxic to micro - organisms
responsible for biological treatment. Severe poisoning can arise from ingestion of as little as 100 mg arsenic. Chronic effect can appear from its accumulation in the body at low intake levels. Carcinogenic properties also have been imputed to arsenic. Lead is a serious cumulative body poison. Natural waters seldom contain more than 20 μg/l, although values as 400 μg/l have been reported. Organic and inorganic mercury salt are very toxic and their presence in the environment, especially in water should be monitored. Zinc is an essential and beneficial element in human growth. Concentration above 5 mg/l can cause a bitter astringent taste and an apalsunce in alkaline water. Toxic threshold limit for copper, Zinc, Cadmium etc. has been reported as approximately 1.0 mg/l (Feroz, 1986-87).

3.7.2 Parameters for Ambient Air Quality: The characteristic parameters for ambient air quality are:

a. Carbon-Mono-Oxide (CO)
b. Sulphur-di-Oxide (SO₂)
c. Oxides of Nitrogen (NOₓ)
d. Suspended Particulate Matters (SPM)
e. Lead

a. Carbon-Mono-Oxide (CO): CO is one of the major gaseous waste emitted from the industries. Non recording NDIR based instantaneous CO monitor is used to measure CO emission at 10 minute interval during 6 peak hours on 5 days in a month.

b. Sulphur-di-Oxide (SO₂): SO₂ concentration in the air impairs the ambient air quality seriously. It is measured by HVS. Para rosaniline for 24 hours in 5 days of a month.

c. Oxides of Nitrogen (NOₓ): It is measured by HVS - NEDA for 24 hours in 5 days in each month.

d. Suspended Particulate Matters (SPM): It is the parameter which shows the concentration of particulate matter and dust in the ambient air in any industrial estate. It is measured by HVS-weightmnt for 24 hours is 5 days of a month.
3.8 INDUSTRIAL WASTE AND POLLUTION

Industrial emission, effluent and solid waste are active sources of air, water, soil, thermal and noise pollution.

3.8.1 Air Pollution: Air pollutant have been generally present in quite low concentrations in large volumes of an inert carrier gas. After dispersion in the atmosphere they get further diluted; so it becomes essential that they are controlled before emission at, or as close as possible to the source. It implies that treatment at the plant rather than at some central depot, as can take place in case of solid and liquid wastes. Suspended particulate matters, fumes, hydrocarbons, hydrogen sulphides, carbon mono oxides, chlorine ammonia etc. are the major air pollutant. These air pollutants impairs the ambient air quality of the industrial estates and the surrounding areas.

3.8.2 Water Pollution: A huge amount of water is required for different industrial processes. Only a small fraction of the same is incorporated in their products and lost by evaporation, the rest is discharged as waste water. This waste water contains high BOD and COD pollution load, Suspended solids, acids or alkalis, hydrocarbons, toxic Chemicals. These pollutants impair the quality of water of the receiving stream. If untreated waste water is disposed of in the water bodies which have other uses (such as source of drinking water, fishing, bathing etc.) may be destroyed. Besides presence of toxic material in the receiving streams can endanger human and aquatic lives.

3.8.3 Soil Pollution: Untreated waste water discharge in the agricultural land and haphazard industrial solid waste dumping may reduce the fertility of the agricultural land and cause soil pollution.
3.8.4 **Thermal Pollution**: Thermal pollution may result from the heat discharged into receiving waters. The extent of thermal pollution chiefly depends on the volume of receiving water.

3.8.5 **Noise Pollution**: Noise is unwanted sound. It is the sound which makes one distressed, irritated or even agitated. Normal conversation produces a noise of 60-65 (decibels). An industrial enterprise may produce 120-130 dB of noise. A direct exposure up to 80-85 dB is normally tolerable. The effect of noise may range from mental distress to loss of hearing. It effects efficiency of the workers in industry. Industrial pollution from different type of industries is shown in Table 3.1.

3.9 **Pollution Potential of Industrial Wastes**

Pollution potential of industrial wastes arises from high concentration of organic and inorganic loads, presence of toxic substances, acids and alkalies, oils and other floating substances in waste water. Cooling waters are the largest in volume for industries. Ordinarily they are quite clean. However, their heat content is high and may impose a heavy thermal load on the body from which cooling water are derived and into which they are emptied. In some circumstances the temperature of receiving water may be raised so high that the normal stream life is destroyed either directly or by the effect of temperature on the oxygen economy of the stream.

The proteins present in the tannery wastes are biodegradable and cause a very high oxygen demand. Spent vegetable tan liquors have dark brown and also a high BOD in addition to having a significant portion of non-biodegradable materials which can persist in stream. The salt and hydrogen sulphide present in the tannery waste water may adversely affect the stream quality and can cause bad taste and odours. The waste carry large amount of suspended matters in the form of lime suspension, hairs, flashing etc. which is detrimental to the utility of stream in that they can make the water turbid and settle on the bottom, thereby affecting fisheries by covering the bottom of the stream and destroying fish food, benthic fauna or spawning ground of fish. The waste water from vegetable tannery are reddish in colour and become inky blue when they come in contact
with water. This colour may persist for a long period. Chrome tanning is highly toxic to fish and other aquatic life. Anthraze may also be transmitted to bather, coming in contact with tannery effluents discharged into stream. The crude waste from cotton and woolen textile mill, if discharged into streams causes, rapid depletion of the dissolved oxygen of the streams. The condition aggravates due to the settlement of the suspended substances and subsequent decomposition of the deposited studges in aerobic condition. The alkalinity and toxic substances like sulphide and chromium affect aquatic life. Zine and sodium poly sulphide present in the viscous Rayon mill waste are highly toxic to Rayon mill waste are highly toxic to aquatic life, particularly to fish.

If crude waste from an antibiotic waste is discharged into the streams, it not only imparts an objectionable odor to the streams but also adversely affects biological population in it. The toxic elements like cyanides and heavy metals present in pharmaceutical industry waste are harmful to aquatic life. Due to their high BOD content a raw waste when discharged into stream rapidly depletes the dissolved oxygen of the stream and renders the water unsuitable for further use.

The lead containing wastes may come in the environment from exhaust of petrol engine, effluent of paint industries, steel and engineering mills, dying industries, battery manufacturing industries, and pesticide industries.

The electroplating industries use chlorinated hydrocarbons, chromium, nickel, copper Zinc and silver salts along with other chemicals. So the residues of the toxic materials with waste water impart toxicity to the effluent.

The hydrocarbon fuels have aromatic part which is carcinogenic in nature and can go into human body through contaminated food chain.

Major pollutants of different types of industries are given in Table 3.1.
<table>
<thead>
<tr>
<th>Industry</th>
<th>Major pollutant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Water borne</strong></td>
</tr>
<tr>
<td>Tannery</td>
<td>Lime, salt, Sulphates,</td>
</tr>
<tr>
<td></td>
<td>Sulphides Chromium, Oils,</td>
</tr>
<tr>
<td></td>
<td>Suspended solids, high BOD, Colour</td>
</tr>
<tr>
<td>Pulp, paper &amp; Rayon</td>
<td>Chlorine, alkali, mercury suspended</td>
</tr>
<tr>
<td></td>
<td>solid, BOD, Colour</td>
</tr>
<tr>
<td>Fertilizer (Nitrogen)</td>
<td>Ammonia, Chromium, arsenic</td>
</tr>
<tr>
<td></td>
<td>ammonia Salts, urea, Suspended solids</td>
</tr>
<tr>
<td>Textile</td>
<td>Alkali, chlorine, Chromium dyes,</td>
</tr>
<tr>
<td></td>
<td>suspended solids</td>
</tr>
<tr>
<td>Sugar and food</td>
<td>Suspended solids, high BOD</td>
</tr>
<tr>
<td>Distilleries</td>
<td>Suspended solids, very high BOD</td>
</tr>
<tr>
<td>Fertilizer (Phosphate)</td>
<td>Acids, flourides, phosphate</td>
</tr>
<tr>
<td>Cement</td>
<td>Suspended Solids</td>
</tr>
<tr>
<td>Jute</td>
<td>Suspended solids</td>
</tr>
<tr>
<td>Chemicals (small)</td>
<td>Acids, alkalis, Chlorine ammonia,</td>
</tr>
<tr>
<td></td>
<td>Suspended solids</td>
</tr>
<tr>
<td>Iron and Steel</td>
<td>Acids, solvents, Cyanides</td>
</tr>
<tr>
<td>Metal Finishing</td>
<td>Suspended solids</td>
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<tr>
<td>Industry</td>
<td>Pollutants</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Petroleum</td>
<td>Hydrocarbons, Sulphides, H₂S, NO₂, Hydrocarbons</td>
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<tr>
<td>Refinery</td>
<td>Phenols, Oils, suspended solids, BOD</td>
</tr>
<tr>
<td>Pharmaceutical</td>
<td>Mineral &amp; organic acids and alkalis, ammonia, suspended solid, BOD</td>
</tr>
<tr>
<td>Pesticides</td>
<td>Acids, solvents, cyanides chlorine, phenolic compound, lead, copper arsenic, suspended solids</td>
</tr>
<tr>
<td>Rubber and Plastic Products</td>
<td>Solvents, oils, Suspended solids, BOD.</td>
</tr>
</tbody>
</table>

Source: Khandaker, 1992

3.10 **ENVIRONMENTAL PARAMETERS AFFECTED BY INDUSTRIAL POLLUTION**

The following environmental parameters have got direct effect from industrial pollution.
- ground water hydrology
- surface water hydrology
- air quality.
- land quality
- fisheries
- socio-economic
- public health
- ground water quality
- surface water quality
- vegetation
- forests
- land uses
- aesthetics

The impacts on major environmental parameters arising from a few selected type of industries are shown in Table 3.2.
Table 3.2 Environmental impact on some selected parameters by some selected type of industries.

<table>
<thead>
<tr>
<th>Type of Industries</th>
<th>Surface water hydrology</th>
<th>Surface water quality</th>
<th>Ground water hydrology</th>
<th>Air quality</th>
<th>Land quality (Pollution)</th>
<th>Fisheries</th>
<th>Vegetation</th>
<th>Forests (Resource depletion)</th>
<th>Mineral resources</th>
<th>Aesthetics</th>
<th>Socio-Economic</th>
<th>Public health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food processing</td>
<td>◉</td>
<td>◉</td>
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<td>◉</td>
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<td>◉</td>
<td>◉</td>
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</tr>
<tr>
<td>Sugar refining</td>
<td>◉</td>
<td>◉</td>
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<td>◉</td>
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<td>◉</td>
<td>◉</td>
<td>◉</td>
<td>◉</td>
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<tr>
<td>Pulp and paper</td>
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<td>◉</td>
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<tr>
<td>Fertilizer</td>
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<tr>
<td>Cement</td>
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<tr>
<td>Tannery</td>
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<tr>
<td>Pharmaceutical</td>
<td>◉</td>
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</tr>
<tr>
<td>Steel and iron manufacture</td>
<td>◉</td>
<td>◉</td>
<td>◉</td>
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<tr>
<td>Electroplating</td>
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<tr>
<td>Petrochemical</td>
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<td>◉</td>
<td>◉</td>
<td>◉</td>
<td>◉</td>
<td>◉</td>
</tr>
</tbody>
</table>

Note: ◉ Significant impact  
① Moderate impact  
② Negligible impact  
Source: Environmental Management Training Project (1992)
3.11 **INDUSTRIAL WASTE AND TOXICITY**

Toxic chemicals and toxic wastes are those substances which contain components which by coming in contact with, or on being ingested directly or indirectly, or inhaled by plants and animals (including human beings), can seriously affect, or damage their normal metabolic activity and can even cause death.

Most of the toxic chemicals and toxic wastes are of industrial origin and may be produced in the form of solids, liquids and gases. Being released in the environment, toxic chemicals may appear as pollutants in the air we breathe, the water we drink and the food we eat. With exponential rise of population and consequent rise of demand for various basic needs and luxuries increasing use of chemicals has been prominent along with other things. So probability of hazard from waste chemicals and chemical accidents and intoxication has also increased to an alarming position all over the world. In appendix C, industries which can generate toxic wastes are identified, some potential hazards from toxic chemicals and wastes are shown in Table 3.3
### Table 3.3: Toxic Compounds and Their Potential for Damages.

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Chemicals/wastes containing Toxic compounds</th>
<th>Potential damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mercury compound</td>
<td>Damages brain and acute toxicity cause death</td>
</tr>
<tr>
<td>2</td>
<td>Lead/or leaded wastes/Chemicals</td>
<td>Nervous breakdown paralysis, madness Anaemia</td>
</tr>
<tr>
<td>3</td>
<td>Cadmium containing wastes/Chemicals</td>
<td>Damage of kidney function</td>
</tr>
<tr>
<td>4</td>
<td>Arsenic</td>
<td>Causes acute poisonic and death</td>
</tr>
<tr>
<td>5</td>
<td>Chromium containing wastes/chemicals</td>
<td>Poisoning and carcinogenic effect</td>
</tr>
<tr>
<td>6</td>
<td>Pesticides</td>
<td>Poisoning effect</td>
</tr>
<tr>
<td>7</td>
<td>SO₂, Cl₂, NH₃ Acid fumes</td>
<td>Exposure in excess quantity can cause death</td>
</tr>
<tr>
<td>8</td>
<td>Hydrocarbons (oil) aromatic component</td>
<td>Carcingogenic effect</td>
</tr>
<tr>
<td>9</td>
<td>Phenolic compound</td>
<td>Poisoning at 0.1 ppm.</td>
</tr>
</tbody>
</table>

Source: Khandaker, 1992

### 3.12 SUMMARY

From this chapter it becomes apparent that the industries of different variety produces wastes of different natures and different wastes have different impacts on environment. Characteristic parameters for different type of wastes (solid, liquid, gaseous) are also different. There are a number of environmental parameters and different type of wastes from different industries have separate effects on these parameters.
CHAPTER 4: INDUSTRIAL WASTE MANAGEMENT & RELATED ISSUES
4.1 INTRODUCTION

Industrial waste management be it for a particular industry or an industrial estate, has got a number of both technical and nontechnical aspects, different components, different approaches to deal with, different issues to address, different conflicts of interests, different actors, different implications on urbanization process and economic activities of the near by areas. In this chapter various issues related to IWM have been discussed.

4.2 COMPONENTS OF INDUSTRIAL WASTE MANAGEMENT

As discussed earlier industrial activity produces basically three types of wastes - solid, liquid and gaseous. Of these three types of wastes, some are highly toxic while others have no toxic effect but some effects which disturb the surrounding environment and have adverse effect on the municipal waste management system. Basically industrial waste management may be divided into four major components. These are:

1. Industrial Solid Waste Management (ISWM).
2. Industrial Liquid Waste or Waste Water Management (ILWM).
3. Industrial Gaseous Emission Control and Management (IGECM).
4. Industrial Toxic Waste Management (ITWM).

4.2.1 Industrial Solid Waste Management: Solid wastes are generated almost from all types of industry. But the sources, mature, handling and disposal system of solid wastes are different from industry to industry. Industrial solid waste management deals with the various issues associated with industrial solid waste generation, handling, transportation, collection, disposal and relevant policy, legislative and institutional issues.

4.2.2 Industrial Liquid Waste or Waste Water Management: Tanneries, fertilizer industries, food processing industries, sugar industries, breweries, distilleries textile industries, steel and iron industries and chemical industries are the major waste water producing industries in Bangladesh. Industrial waste water management basically deals with identifying sources of waste water, characterization of waste water, selecting appropriate treatment facilities of waste water and designing the same and finally ways and means of safe disposal to natural streams and related policy legislative and institutional issues.

4.2.3 Industrial Gaseous Emission Control and Management: Many industries produce harmful gases like SO₂, NOₓ, CO, H₂S etc. during production processes of the industries. Moreover some industries like cement industries produce high suspended particulate matters. These gases and particulate matters not only affect the workers working in the industries but they have significant impact on the ambient air quality of the surrounding areas of the industries.
Both macro climate of a country and micro climate of industrial area have significant influence on determining the extent of air quality degradation of any particular area. The main objective of the gaseous waste management is to develop ways and means so that gaseous emissions from the industries are reduced to an acceptable limit. Gas absorption in solids and liquids are the major ways to reduce gaseous emission while filtering baghousing etc. are the methods for controlling particulate matter emission in the atmosphere.

4.2.4 Industrial Toxic Waste Management: Tanning industries, Textile dyeing and printing industries, fertilizer factories, electroplating industries, refineries, pesticide industries, chemical industries are the major toxic waste producing industries in Bangladesh. Toxic waste may be of any nature, solid liquid or gaseous. Toxic chemicals/wastes are to handle with sufficient safety measures. Toxic waste management deals with safe handling and disposal of toxic wastes.

4.3 TECHNICAL ASPECTS OF IWM

Industrial waste management is a system developed for the safe handling, treatment and finally disposal of the industrial wastes, generated from various types of industries into the environment in most conducive way so that surrounding environment is not affected by the harmful wastes produced from the industries.

Following are the major technical aspects of industrial waste management.

1. Generation
2. Characterization and quantification
3. Handling
4. Storage
5. Transportation
6. Treatment
7. Disposal
8. Environmental impact assessment
9. Determination of Environmental Guide lines for industries
10. Monitoring of the discharges from the industries

4.1 Generation: Different types of industries generate different types of industrial waste depending upon the type of industries, nature of products and state of technology being used in the particular industry. For example the paper and pulp industries produce waste of large volume with comparatively low pollution potential while iron industries and pesticide chemical industries produce small quantity of waste with high pollution potential.

i) Solid Waste: Almost al the industrial units in Bangladesh are the major sources of industrial wastes of some kind or other. In Dhaka 12.9% of the total solid wastes generated is industrial solid
wastes (Louis Berger Inc... et al. 1991). Tanneries are the major source of industrial solid wastes. It is observed that tanneries in Hazaribag areas are producing 40 metric tons (MT) of industrial solid wastes daily (IUCN report, 1991). Of the other types of industries paper and pulp mills produce maximum amount of solid waste. Abandoned rubbers and plastics and rejected rubber and plastic products are the major solid wastes produced from rubber and plastic industries. Steel scraps are the major types of solid waste from the iron and steel industries. Besides, depending upon nature of products polybags, Jute bags, hard paper boxes, glass bottles plastic containers, steel drum for packing their products and storing their raw materials. After their use they are left over as solid wastes. Pharmaceutical and chemical units do not produce any significant amount of solid wastes.

ii) Waste Water: A huge amount of water is required for different industrial processes only a small fraction of the same is incorporated in their products and lost by evaporation, the rest is discharged as waste water. All industrial units in Bangladesh excluding garments manufacturing units, electronics assembling units, fabricated metal industries some cottage industries of cane products, produces waste water. Fertilizer factories, paper and pulp industries are the largest single units which produces waste water in Bangladesh. Ashuganj fertilizer factory discharges 10,000 m³/day in the Meghna river while Khulna news prints mill discharges 4500 m³/hour of waste water in the Vairob river (IUCN, et el, DOE, 1990). Besides Textile units. Chemical units, pharmaceutical units also produce industrial waste water in significant quantity. In Tejgaon Industrial area of Dhaka City 100 out of 156 different type of industries discharges waste water from their units while rest 56 do not discharge any waste water (see section 5.3). In Hazaribag area over 200 different sized tanneries discharge about 4000 m³/day in Buriganga river (NEMPCP/DOE, 1988-89).

iii) Gaseous Emissions: Gaseous emissions in Bangladesh are of two types - suspended particulate matters emission and emission of inorganic gases (H₂S, NOₓ, SO₂, CO) etc. Lather tanneries, Electroplating industries textile industries (Dying and printing), petroleum oil refineries are the major industries, responsible for gaseous emissions in Bangladesh. A study carried out by Seatec International Consulting Engineers identified 32 industries as major air polluting industries in Dhaka City. At the present stage of industrial growth industrial emissions do not cause any problem in Bangladesh thought some localized complains against some industries such as tanneries of Hazaribag (odor pollution) and against T.S.P. fertilizer factory at Chittagong (fumes of Hcl and H₃PO₄) are already in the knowledge of DOE.

iv) Hazardous Material Emission: In Bangladesh there is no accounting of types and quantities and sources of emissions of hazardous material. Leather tanneries, Electroplating Industries Textile industries (Dying and printing), Petroleum oil refinery,
fertilizer industries, caustic chlorine plants, H_2SO_4 plant, paint industries, Pesticide industries, shipyard, Battery manufacturing industries and car assembly and servicing units are the probable major hazardous waste (toxic pollutant) producing industries in Bangladesh. The wastes from these industries are considered hazardous due to probable presence of heavy metal concentration on their effluent and solid wastes. An excellent example can be found in Hazaribagh Tanneries have been operating their over the last 30 years. Current estimates are that 40 metric tons of solid waste are produced daily in this area and that about 50 percent are hazardous due to its high chromium contents. The highly insoluble chromium is ubiquitous through out the area. In particular in the river flood plain that receives the waste water discharges from the tanneries.

4.3.2 Waste Characterizations and Quantification: No industries in Bangladesh have ever taken measures to characterize the water produced from respective plants. The amount of waste produced from different industries is also not available in Bangladesh. DOE and interested research personnel sometimes undertook steps to identify the character of industrial wastes from different industries. Typical character of waste water from some major polluting industries is given in Appendix E.

Regarding quantification waste water as there is no measuring arrangements for waste water installed in any plants only estimates are made to serve different purposes at different times. The volume of waste water varies considerably from industry to industry and also from plant to plant producing same final product depending upon size, capacity of industries and nature of product and state of technology available in a particular plant. In Bangladesh paper and pulp mills are the largest producer of waste water. It is estimated that Khulna Newsprint Mill produces 4500 m^3 waste water per hour. Fertilizer factories are the second largest producer of waste water. Ashugarj Fertilizer Factory produces 10,000 m^3 waste water per day.

Regarding gaseous emission, Textile, Dying and Printing, Beverage and Chemical units, cause air emission primarily from their Boiler stacks although some of the chemical units may also have some process emission. In Bangladesh there is no accounting of type and quantity of gaseous emission from any factories. An estimate was made by Seatech International consulting Engineers regarding type and amount of various emissions from different type of industries in Dhaka city in 1992. Table 4.1. gives the estimates.
Table 4.1: Estimate of Gaseous Emission from Different Types of Industries.

<table>
<thead>
<tr>
<th>Size of industry</th>
<th>Medium size</th>
<th>Small size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SPM</td>
<td>CO</td>
</tr>
<tr>
<td>Unit</td>
<td>kg/day</td>
<td>kg/day</td>
</tr>
<tr>
<td>Type of industries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textile/Dying</td>
<td>-</td>
<td>250</td>
</tr>
<tr>
<td>Chemicals</td>
<td>-</td>
<td>250</td>
</tr>
<tr>
<td>Beverage and food products</td>
<td>-</td>
<td>250</td>
</tr>
<tr>
<td>Rubber products</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Metal products</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Glass and Refractory</td>
<td>20</td>
<td>50</td>
</tr>
</tbody>
</table>


Khandaker (1992) identified probable pollutants in the effluent of different type of industries in Bangladesh. Those are summarized in Table 4.2.
Table 4.2: The Polluting Industries and Probable Pollutants in Bangladesh.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Polluting Industries</th>
<th>Type of effluent</th>
<th>Pollutants in effluent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Leather Tanneries</td>
<td>Water borne</td>
<td>Dissolved lime, hydrogen sulphide, acids, chromium dyes, oils, suspended solids, Organic matters</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>H₂S, SPM.</td>
</tr>
<tr>
<td>2.</td>
<td>Electroplating</td>
<td>Water borne</td>
<td>Oil and grease, chlorinated hydrocarbons, acids, alkalis, H₂S, Cyanide, Chromium, Cd, Ni, Cu, Zn, Ag.</td>
</tr>
<tr>
<td></td>
<td>Industries</td>
<td></td>
<td>Acid mists, vapors.</td>
</tr>
<tr>
<td>3.</td>
<td>Textile Industries</td>
<td>Water borne</td>
<td>Alkalis, chlorine, dyes, organic matters, Suspended solids,</td>
</tr>
<tr>
<td></td>
<td>(Dying and Printing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>SPM.</td>
</tr>
<tr>
<td>4.</td>
<td>Petroleum oil Refinery</td>
<td>Water borne</td>
<td>Hydrocarbons, Sulphide, Phenol, Organic matters, SO₂,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>NOₓ, HC, SPM.</td>
</tr>
<tr>
<td>5.</td>
<td>Sugar Industry</td>
<td>Water borne</td>
<td>Suspended solids, organic matters SPM</td>
</tr>
<tr>
<td>6.</td>
<td>Fertilizer Industries</td>
<td>Water borne</td>
<td>H₂SO₄, H₃PO₄, HF, fluorides, phosphates, NH₃, NH₄-salts, Urea, Amins, CH₃OH,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>SPM, fluorides, NH₃, H₂S.</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Polluting Industries</td>
<td>Type of effluent</td>
<td>Pollutants in effluent</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------</td>
<td>------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>7</td>
<td>Caustic Chlorine Plants</td>
<td>Water borne</td>
<td>Hg, chlorides</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>cl\textsubscript{2}, NO\textsubscript{x}</td>
</tr>
<tr>
<td>8</td>
<td>H\textsubscript{2}SO\textsubscript{4} Plants</td>
<td>Water borne</td>
<td>Acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>SO\textsubscript{2}</td>
</tr>
<tr>
<td>9</td>
<td>Paint Industries</td>
<td>Water borne</td>
<td>Heavy metals (cd, Pb, cr), Organic solvents</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>cyanide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>Organic Solvents.</td>
</tr>
<tr>
<td>10</td>
<td>Pesticide Industries</td>
<td>Water borne</td>
<td>Acids, Organic Solvents, cyanides, cl\textsubscript{2}, phenolic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>compound, Heavy metals (ph, cu, As) Hg based</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>compound.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>Cl\textsubscript{2}, Organic solvents</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>acid vapors</td>
</tr>
<tr>
<td>11</td>
<td>Shipyard</td>
<td>Water borne</td>
<td>Oil, grease, acids, Heavy metals, Solvents.</td>
</tr>
<tr>
<td>12</td>
<td>Battery manufacturing</td>
<td>Water borne</td>
<td>Acid, lead,</td>
</tr>
<tr>
<td></td>
<td>and servicing</td>
<td>Gaseous</td>
<td>Acid mists, fumes.</td>
</tr>
<tr>
<td>13</td>
<td>Car assembly and servicing</td>
<td>Water borne</td>
<td>Waste HC oil, grease solvents, acid</td>
</tr>
</tbody>
</table>


Waste characterization and quantification is very important for industrial waste management. Industries in Bangladesh are not equipped with any arrangements for waste characterization and quantification. Most of the industries do not feel it necessary as they think their waste is not harmful or is not of significant quantity.
4.3.3 **Handling**: During many industrial process waste in huge quantity may be produced. Again wastes produced from various industries may have toxic effect to the human being and corrosive effect to the physical structures. Some wastes may be flammable. Necessary safety measures like using of gloves and musks by the garbage crews of or factory workers, adequate fire fighting arrangement etc. are essential for the industries which use harmful chemical or produce harmful waste. So safe handling of industrial waste is a major aspect in the industrial waste management.

4.3.4 **Storage**: It may be often necessary to store the industrial solid waste produced from different industries and sludge produced from the treatment plants before those are recycled or disposed of ultimately. Generally storage of industrial solid wastes and liquid wastes are done in the dump yards inside the particular industries. Sludge from the treatment plants are stored in the sludge treatment basins, designed in such way to enable the sludge to become concentrated and further stabilized by continued anaerobic biological activity.

Various type of waste may be produced from the raw materials (chemicals etc.) necessary for particular industry. Safe storage of industrial raw material is equally important for the industrial waste management. The planning implications here are to know the amount of waste produced from different industries and the method of their temporary storage in different industries.

4.3.5 **Transportation**: Industrial wastes sometimes need to be transported to some other places for disposal. Very often industrial solid wastes are transported along with municipal solid wastes. Separate transport arrangement for industrial waste and containerized arrangement for toxic wastes are absolutely necessary for safe transportation of industrial waste.

Pipe lines, Truck, Barge, Rail or any combination of these four modes are used to transport industrial solid and liquid wastes from one place to another.

To minimize the danger of spills, odors and dissemination of pathogens into the air, liquid sludge should be transported in
closed vessels, such as tank trucks, covered or tank barges or railroad tank cars. Stabilized, dewatered sludge and industrial solid wastes can be transported in open vessels, such as dump trucks, or in railroad gondolas if they are covered.

The method of transportation chosen and its costs are dependent on a number of factors, including (1) the nature, consistency, and quantity of sludge to be transported (2) the distance from origin to destination, (3) availability and proximity of transit modes to both origin and destination (4) the degree of flexibility required in the transportation method chosen and (5) the estimated useful life of ultimate disposal facility.

4.3.6 Treatment: Generally industrial waste water and gaseous emissions from the industries are treated for stripping out the harmful ingredients from the waste water and gases to make it possible to discharge them into the surrounding environment.

a. Industrial Waste Water Treatment: There are several ways of treating industrial waste water. Industrial waste water can be treated in the premises of any particular industry or wastes from similar industries which are similar in nature can be treated in a combined treatment plant. Treatment of industrial waste water is a complex activity comprising of a number of processes. Contaminants in waste water are removed by physical, chemical and biological means. The methods usually are classified as physical unit operations, chemical unit process and biological unit processes.

The characteristics of industrial waste water varies considerably with that of domestic waste water. Advanced waste water treatment is necessary for the treatment of industrial waste water. The performance of industrial waste water treatment operation and selection of processes depend on the concentration and characteristics of the waste water. Selection of a given operation, process or combination thereof depends on (1) the use to be made of the treated effluent, (2) the nature of waste water (3) the compatibility of the various operations and processes, (4) the available means to dispose the ultimate contaminants and (5) the economic feasibility of the various combination.
In Bangladesh so far very limited efforts are made for the treatment of industrial wastes both in plant level and in estate level. Majority of the industries in Bangladesh are concentrated in the industrial zones of Dhaka, Chittagong, Khulna, Narayanganj. Fertilizer factories, sugar mills, Jute mills and cotton mills are dispersedly located throughout the country. Besides Bangladesh small and cottage Industries corporation BSCIC has established industrial estates in all major district towns. There is no combined treatment plant in any of the industrial estates or zones in Bangladesh. So far some plant level treatment of industrial wastes have been carried out. Table 4.3. shows the different conventional treatment method and their use in Bangladesh.

Table 4.3: Treatment Methods of Industrial Waste in Bangladesh.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>TYPE OF INDUSTRIES</th>
<th>CONVENTIONAL TREATMENT METHODS</th>
<th>USE OF METHODS IN BANGLADESH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Leather Tanneries</td>
<td>Segregation of process waste water, sedimentation, neutralization, biological treatment</td>
<td>Old tanneries do not have treatment plants. Natural decomposition occur in the natural stream/river. Only Bata tannery of Noyarhat has modern treatment plant in Bangladesh.</td>
</tr>
<tr>
<td>2.</td>
<td>Electroplating Industries</td>
<td>Ion exchange or alkali treatment for precipitation of metals. Wet scrubbing</td>
<td>A few use alkali treatment for recovery of metal and neutralized Gaseous pollution not controlled anywhere in Bangladesh.</td>
</tr>
<tr>
<td>3.</td>
<td>Textile dying and printing</td>
<td>Equalization, Neutralization, chemical coagulation, flocculation, Bio-chemical treatment for gases-wet Scrubbing</td>
<td>Nothing is done anywhere in any textile industry.</td>
</tr>
<tr>
<td>4.</td>
<td>Petroleum oil refinery</td>
<td>Gravity separation, dissolved air flotation, biological treatment for gases, wet scrubbing</td>
<td>No treatment of effluent before discharge.</td>
</tr>
<tr>
<td>5.</td>
<td>Sugar Industry</td>
<td>Anaerobic lagoon followed by aerobic treatment</td>
<td>Only lagooning is done in almost all sugar mills and distilleries.</td>
</tr>
<tr>
<td>6.</td>
<td>Fertilizer Industry</td>
<td>Stream stripping, neutralization separation, flocculation and anaerobic followed by aerobic treatment, for gases wet scrubbing</td>
<td>In Ghorasal only lagooning is done But CFL and JFL modern waste treatment facilities are there.</td>
</tr>
</tbody>
</table>
Table No.4.3 (Continued)

<table>
<thead>
<tr>
<th>S1. No.</th>
<th>TYPE OF INDUSTRIES</th>
<th>CONVENTIONAL TREATMENT METHODS</th>
<th>USE OF METHODS IN BANGLADESH</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Caustic chlorine plant</td>
<td>Sedimentation, filtration and for gaseous net scrubbing</td>
<td>Sedimentation is done.</td>
</tr>
<tr>
<td>8.</td>
<td>H2SO4, Plant</td>
<td>Neutralization for gaseous wet scrubbing</td>
<td>Neutralization and wet scrubbing done.</td>
</tr>
<tr>
<td>9.</td>
<td>Paint Industries</td>
<td>Flocculation, Sedimentation, filtration and biological treatment, for gaseous pollutants wet scrubbing</td>
<td>Nothing is done at present.</td>
</tr>
<tr>
<td>13.</td>
<td>Car assembly and servicing industries</td>
<td>Gravity separation, neutralization biological treatment</td>
<td>Nothing done at present.</td>
</tr>
</tbody>
</table>


Regarding disposal of industrial wastes, solid wastes generated from various industries are disposed of in the municipal waste bins along with domestic household wastes in the big cities like Dhaka and Chittagong. From municipal waste bins they are transported to the dump sites and dumped along with other municipal wastes. Direct dumping in the open drains. Ditches and low lying areas of cities are also evident in Bangladesh. Industrial estates or individual industrial units, situated in the smaller towns of Bangladesh make their own arrangement for disposing of their solid wastes.

Industrial waste water is discharge into open drains or municipal sewerage system (where available). Open drains are discharged into major rivers through out the country. For Dhaka city, industries in
Hazaribagh area discharge their waste water in the open drains of the area, which are ultimately discharged into Buriganga river. In Tejgaon Industrial area all most all the industries discharge their waste water in the open drains of the industrial area. These drains are discharged into Begunbari Khal. Begunbari Khal is further discharged into Eastern Flood Plains/Balu River. All major industrial zones and isolated industries of the country discharge their waste water in the near by rivers.

b. **Industrial Emission Treatment** : Removal of pollutant from an emission gives rise to two separate problems, depending on whether the pollutant has been gaseous or particulate. Particulate matters can be acted on by a whole range of physical forces including gravitational and electrostatic and gases have been homogeneous with carrier gas and can only be removed by diffusion to controlled surfaces where they have been preferentially adsorbed or in some cases chemically changed to a less noxious product.

4.3.7 **Disposal** : The sludge generated from the treatment plants and industrial solid waste disposal methods includes, the open dump, hog feeding, disposal at sea, grinding and discharge in to sewer, land farming, deep well injection, pyrolysis, composting, incineration and sanitary land fill. Selection of particular method depends upon character of solid waste produced from any particular industry and character of sludge from treatment plant.

a. **Disposal of Industrial Solid Waste** : Generally in Bangladesh industrial solid wastes are disposed with the municipal solid wastes. So primary disposal is done in the municipal waste bins. From there these are collected along with municipal solid wastes and ultimately disposed of with domestic municipal wastes in the dump sites. But separate disposal arrangements for industrial solid waste are necessary because there exists many ingredient in industrial solid waste which can be recycled. Moreover, as the very nature of industrial solid waste is different from household waste, options suitable for disposing of household waste may not be suitable for industrial waste disposal.

b. **Disposal of Waste Water From The Industries** : Industrial waste water can be disposed of in the treatment plant through separate
sewerage system. But in Bangladesh very often they are disposed of in the open drains, ditches and ponds adjacent to the industry, lakes and canals and near by rivers.

c. Disposal of Sludge From Treatment Plants: The most common methods of sludge disposal include spreading on land, lagooning, dumping and land filling.

Besides gaseous wastes from the industries of Bangladesh are generally disposed of in the surrounding environment without any treatment.

4.3.8 Environmental Impact Assessment: Environmental Impact Assessment refers to a procedure for measuring and predicting the effects of concentrated human activity on the surrounding environment, specifically in relation to environmental alterations that have a direct bearing on human welfare. EIA procedures should, at a minimum, include baseline environmental measurements, review and quantification of the development activity, prediction of the effect of the development activity on environmental values along with economic analysis, and review of measures taken to minimize negative effects.

Depending upon the size and type of products being produced in the different type of industries in Bangladesh different type of Environmental Impact Assessment are necessary. Different type of Environmental Impact Assessment includes:

a. Initial Environmental Examination.

DOE has identified 48 different type of industries which require no environmental impact assessment. Proposed Environmental requirements for different type and size of industrial units are given in Appendix D.

In Bangladesh, Environmental Impact Assessment is needed for establishment of all type of industries excluding the types mentioned in List5 of appendix F. DOE examine the EIA reports,
submitted by the probable industry owners, and after necessary examination, DOE gives consent order to them. Upto 1988 DOE has given NOC'S to 232 proposed industrial establishments.

4.3.9 Environmental Guidelines for Industries: Each industrial unit, whatever its nature or size, may generate a number of environmental impacts, many of them may be adverse to the quality of environment. This is so because all industry involves use of raw materials and energy and a part of these, and also of various intermediates, by products and main products invariably escape into environment, causing various impacts. The factors involved in such environmental impacts include some that are site dependent and that some are site independent. The influence of site dependent factors can be minimized by appropriate siting of the industrial units while that are site independent factors can be minimized by appropriate choice of raw materials, process, equipments, work space, waste treatment, proper waste disposal, infrastructural facilities, tree plantations and green belt etc. The objective of these guideline is to keep adverse environmental impacts and risks to acceptable low levels. Followings are some environmental guide lines for industries.

a. Classification of Industrial Units: DOE has classified industrial units of Bangladesh as small, medium and large units on the basis of number of manpower in the industries, capital investment and energy consumption. If a unit qualifies for different size classes by different criteria, the largest of the 3 classes shall apply. Details of the classification is given in Table D1 and Table D5 of Appendix D.

International classification on the basis of product / process for different type of industries are also available. The classification on the basis of size / scale varies considerably from country to country.

b. Acceptable Siting: Acceptable siting standard for industries varies widely from country to country depending on the geological formation, meteorological condition, economic condition, pace and trend of urbanization of the particular country. Acceptable siting can even vary from region to region of a particular country.
Product and process of a particular industry also play important role in determining acceptable siting. Acceptable siting requirements for the industries of Bangladesh as developed by DOE are given in Table D2 and Table D3 of Appendix D.

c. **Site Clearance Requirements**: Establishment of industry in any particular place and subsequent operations may adversely affect the surrounding area. So in every country there is an agency to look after the matter that establishment of industry in any particular site or area would not affect the environment of the area adversely. In Bangladesh DOE is entrusted with this responsibility. Depending upon size, products and processes of a particular industry DOE issues site clearance no objection certificates. Site clearance requirements for industries of Bangladesh are given in Table D4 of Appendix D. 8 types of industries as mentioned in List 6 of Appendix F do not require any site clearance NOC in Bangladesh. Site Clearance Requirements for industries of TIA have been given in Table 5.23 of Section 5.15.

d. **Environmental Consent Order Requirements**: Consent orders for storage, handling and disposal of various types of industrial wastes such as solid, liquid, gaseous and hazardous from environmental protection agencies are must for minimizing industrial pollution problem in a particular country. In Bangladesh DOE is entrusted with this responsibility. Consent order requirements of different industries are given in Table D4 of Appendix D. Environmental Consent Order Requirements for the industries of TIA have been given in Table 5.24 of Section 5.16.

e. **Effluent/Emission Standards**: Generally there are two approaches to regulate discharge of effluent to the surrounding environment. One view is to permit regulated waste discharges consistent with maintenance of receiving water quality. The other view is "end of the pipe" effluent limitations. The latter approach is the current trend in industrially developed countries, because end of the pipe standards are easier to enforce. However, around a decade earlier, maintenance of receiving water quality used to be the basis of effluent discharge into the environment. With growing problems of industrial pollution, there has been a change in the philosophy of effluent disposal and end of pipe standard is increasingly adopted.
the policies for adoption of standards should not imitate blindly those existing in the industrialized countries.

Government should take initiative to set techno economically acceptable effluent/emission standards. Codes and standards and their mandatory adoption by industries can reduce wastage. Adoption of such codes and standards can help better assessment of technologies to be imported, allow growth of spare parts industries for eventual replacement of worn out sections, and reduce the incidence of obsolescence. Tentative effluent and emission standards for the Industries of Bangladesh are given in Table E1 in the Appendix E. along with the standards of some other countries of the world.

4.3.10 Monitoring of The Discharges From Industries: Regular monitoring of the effluent and emissions from the industries to have information regarding pollution potential quantity and concentration of wastes is absolutely necessary for the industrial waste management as effective monitoring provide the basis for proper decision making in regard to waste management. Monitoring the data from treatment plants regarding waste character and pollution potential and ambient air quality data for the area where industry or industrial estate is situated may help planners to arrive at an effective decision regarding industrial waste management. Industries should have their own monitoring system, environmental protection agencies of a country may be entrusted with the responsibility of monitoring the environmental data for waste management.

Up to present date DOE still does not have enough data to estimate the level of industrial waste water pollution in Bangladesh. The essential first steps in developing an economically rational, national pollution control strategy is to collect data on level of pollutant discharged, understand the technology that generates the pollution and identify methods by which pollution can be easily and cost effectively reduced. However, DOE has compiled the water quality data of some major rivers in some locations of industrial concentration. Water quality data of Buriganga at Hazaribag, Sitalakhya at Ghorasal Fertilizer factory, Balu at Tongi, Meghna at Ashugonj Fertilizer Factory may play very important roles in
developing waste load management system which is an important aspect in industrial waste management, of the aforesaid rivers. Regular monitoring of effluent and emission levels of different industries by DOE is not done due to the lack of manpower, laboratory facilities, absence of necessary legislation to visit the industries without notice and necessary financial support.

4.4 NONTECHNICAL ASPECTS OF IWM

Along with the technical aspects a number of nontechnical aspects are related to the industrial waste management. Efficient and orderly management of the nontechnical aspects expedite the orderly management of the technical aspects leading to a sound management system for industrial wastes.

Bangladesh currently does not have a systematic ways for I.W.M and pollution control. There are numerous gaps in the present system. The gaps may be apparent in institutional capacity made up of the physical, manpower, financial and management system for functioning within a unified frame work for achieving specific goals. Gaps are also apparent in current policy formulations, usually due to lack of inter-agency working agreements. Finally, gaps exist in legislative mandates, which are the formal pronouncements of policy and institutional programs.

4.4.1 Institutions

i. Line Institutions: The regulation of pollution within country is vested in the Department of Environment (DOE). The execution of pollution controls in the public sector is responsibility of Paurashava administrations, and the water and Sewerage Authority of Dhaka and Chittagong (DWASA and CWASA). Industries are responsible for implementing pollution control measure for their own operation.

The DOE was formed in August 1990 from the old Department of Environment and pollution Control (DEPC). At the same time administrative control was transferred from the Ministry of local Government to the newly formed Ministry of Environment and Forest (MOEF). Since formation of DOE, departmental activities have increased somewhat; however the actual resources available to the
Department have not increased significantly. There are some additional resources presently reaching the department, which will augment DOE activities over the next five years. The DOE is also receiving technical assistance from a project sponsored by the Asian Development Bank (ADB). The assistance is mainly to help evolve policies and implement monitoring for industrial and urban pollution.

The DOE has a technical staff of about 40 people located in Dhaka, at the head office, and in four regional divisions, Dhaka, Chittagong, Bogra and Khulna. The DOE has four small laboratories equipped only for wet chemical and micro biological examinations, various items of office equipment and furniture and a collection of files containing data in various state of organization. The operating budget of DOE is only enough to pay salaries and perform limited amounts of field work represented by current activities at DOE. So far there has not been any strong linkages developed between DOE and the Ministry of law through which regulatory measures could be taken backed by the force of law. The necessary policies have not yet been formulated which might support vertical linkages between MOEF and DOE, or horizontal linkages between DOE and sector agencies, such as WASA or Ministry of Industries (MOI). While there are a number of transactions in the form of memoranda, briefs and general statements, the delineation of policy upon which co-ordinated institutional actions may be based is still in an infant state.

**ii. Executive Groups:** DWASA and CWASA are the major executive agencies dealing with waste water collection and treatment system in Dhaka and Chittagong. Their efforts in systematic collection and treatment of waste water in Dhaka and Chittagong have been improving with the financial and technical assistance from Japanese International Cooperation Agency (JICA) and the World Bank.

The paurashava and City corporation Administrations are responsible for solid waste management (both industrial and domestic) and sanitation in local wards. These agencies are starved of skills and finances.
iii. Other Public Institutions and NGOs: There are many government research organizations, Universities and NGOs responsible for environmental activities. Environment, natural resources and human welfare are closely interlinked. In this sense environment is in the interest of virtually all organization. Their activities in general include: environment development activities, Public awareness and social impact assessment. Bangladesh University of Engineering and Technology, Bangladesh Center for Advanced studies are the leading institutions in this respect.

4.4.2 Policies

Industrial waste management is intimately related to the industrial and environmental policy of a country.

i. Industrial Policy of GOB (1991): In Industrial policy of GOB due emphasis is given on preventing environmental pollution by the industries and maintain ecological balance. "To take appropriate measures for preventing environmental pollution and maintaining ecological balance" (Industrial policy MOI, 1991) has been identified as one of the major objective of Industrial policy of present government. In the Industrial policy it is also suggested that all approving authorities of industries must ensure that appropriate environmental pollution control and other precautionary measures are included in the project proposals where there are possibilities for causing environmental pollution and which may endanger public health. It is also suggested in industrial policy that existing industries which has the potential to cause environmental pollution or endanger public health, must take adequate precautionary measures against environmental pollution within a time specified by the government and in this regard the Government will formulate specific policies.

ii. Environmental Policy of GOB (1992): In the environmental policy of GOB the main emphasis in the industrial sector have been given on the control of pollution by the industries mandatory conducting of EIA for new industries, prohibiting the approval of probable pollution generating industries, gradual closing of existing polluting industries, developing sustainable substitute
and less polluting products in those industries and or the continued research to develop sustainable technology which will be environment friendly. For this reason following actions have been suggested in the Environmental Policy of 1992.

a) Urgent pollution control measures have to be taken in the DOE identified polluting industries.

b) Pollution control arrangement should be included in all established probable polluting industries.

c) Arrangement should be made for conducting EIA for all industries, be it Government and private.

d) Industries established in residential areas should be removed in appropriate places and places should be earmarked for planned establishment of industries.

e) Approval of the industries which produce harmful and non bio-degradable products, should be stopped.

f) Any initiative of establishing industries which will use imported harmful and toxic wastes as raw material, should be stopped.

g) Steps should be taken to discourage the use of heavy metals in the industrial sector.

h) Polluting industries should include self monitoring units for their produced wastes.

i) Waste permit / consent order system should be adopted to improve waste treatment and disposal system in industrial sector.

j) Recycling of various products should be encouraged in industrial sector.

k) Necessary steps should be taken for maintaining good health for the employees in this sector.

4.4.3 Legislation: Sound Industrial waste management and effective pollution control are the results of combined legislative mandates. IWM is associated with the laws regarding zoning and land use, direct nuisance and liability, administrative and municipal ordinances and laws regarding pollution control.

i. Zoning and Landuse: The Ministry of Industries and local government agencies are both partially responsible for reviewing the proposed locations of industrial activities and can practically control location through trade licenses and other form of
licensing. Zoning restriction exist for Dhaka and Chittagong, which specify residential, commercial and industrial areas. The Paurashava ordinance provides legal frame work of restricting land use in small municipalities.

ii. **Nuisance and Liability**: Nuisance ordinances have been used to bring about actions to reduce noise odors and prevent the degradation of adjacent property that might occur as a result of waste discharges. The local Government Ordinance, 1976, and Paurashava Ordinance, 1977 contain clauses that are similar to public nuisance laws in other developed countries. However it is doubtful that there has been any prosecutions of nuisance offender in Bangladesh.

iii. **Municipal Ordinances**: Various types of legislation have been used in Bangladesh to establish responsibility for administration of municipal infrastructure, some of which are related with IWM. The Paurashave Ordinance places responsibility on the Paurashava/ city corporations administration for construction and maintenance of latrines, open drains and for maintaining general health and sanitation within the administrative district. The water Supply and Sewerage Authority Ordinance, 1963 establishes executive responsibility for WASA authorities. In neither case, however, is there any explicit mechanism for prosecuting these organizations for failing to carry through with assigned responsibilities nor they have the power to take any penal action against any industries for indiscriminate dumping of wastes outside dustbins or in open drains or storm sewerage lines which are constructed for rain water only.

iv. **Pollution Control Laws**: The current law related directly to pollution control, out side of the partial applicability of the laws already mentioned, is the Environment Protection Act 1995. This law was promul gated in February 16, 1995. This law is intended to regulate industrial and domestic waste water discharges at the source. The law's main attribute is the requirement that all establishments (factories and, by implication, public treatment works) that discharges waste water must have a pollution control system. The law also established the right for DOE to enter industrial premises, and to obtain relevant information concerning an establishment’s activities. The law provides clearly defined
executive authority to DOE for assuring that this requirement is met. DOE has been given the authority to issue environmental consent order to the industries for their operations. Though in this law provisions have been kept for the strict enforcement of the law and taking penal action against the defaulters for non compliance with law and non co-operation with the DOE official, but its applicability is yet to be evaluated.

New Environment Protection Act 199 would provide a significant improvement. This law will establish the basis for an industrial waste permit system and will assign authoritative powers to DOE for entering the premises, inspection and closure, if necessary of industries. A clause relating to Environmental Impact Assessment (EIA) is also contained in the ordinance. The success of this law is dependent on commitments at high levels of government to work through the legal and policy issues related to its enactment and use within political framework of Bangladesh.

4.5 PEOPLE'S PARTICIPATION IN IWM

Peoples participation in industrial waste management is a vital aspect. Attitude of industry owners towards pollution abatement is a dominant factor in deciding options of industrial waste management. Their Co-operation in updating pollution control data base and installation of pollution control and waste characterization facilities in their respective factories is also very important. Knowledge about pollution potential and subsequent health hazards of industrial waste among the workers and employees of the industries are also necessary for industrial waste management. General awareness among the people who live nearer to any industrial unit or industrial estates can force the industrialists to take necessary pollution control and waste management for their untreated wastes.

4.6 APPROACHES OF IWM

Industries like sugar industries, fertilizer factories, cement clinker factories, paper and pulp industries, Jute mills and textile mills etc. which are big in size and scale are established in isolated places. Secondary development process give rise to
urbanization in the area nearer to the isolated industries. The waste character of a particular isolated industry is unique and its effects on a particular area are also unique in nature.

Various types of light manufacturing industries may be established in single industrial estate. Generally small textile units, chemical industries, electroplating industries, pharmaceutical industries food and beverage industries etc. are established in industrial estates. The nature, character and effects of the wastes produced from different industries varies considerably from industry to industry. The industries which are situated isolated may make their own arrangements for treating their wastes. For the industries situated in industrial estates, there prevail two approaches of waste management system. These are viz.,

1. Plant level or In house management approach.
2. Area level or Combined management approach.

4.6.1 **Plant Level or In House Management Approach**: In this approach industries make their own arrangement for their waste management. They make arrangements for smaller waste generation. They dispose of the solid waste produced from their industries by their own arrangements. They treat their effluent and emissions in the facilities provided in their own industry. Only harmless waste water is discharged in the surrounding environment. The responsibility of environmental protection agencies in this case is to monitor the character of effluent and emissions from the industries.

4.6.2 **Area Level or Combined Management Approach**: Combined management approach is the combined effort to deal with waste management issue of different industries which produce different types of waste and make different effects on environment and which are situated in one industrial estate. In combined management approach solid wastes from different industries are collected, transported and disposed of by a single arrangement. Waste water from different industries are collected by a single arrangement (e.g. sewerage system) and treated in a combined treatment plant and finally sludge from the treatment plants is disposed of by a single arrangement. Generally municipal authorities and sewerage
authorities of a country share the responsibilities of waste treatment and disposal while the environmental protection agencies provide technical and logistic support for waste management in this approach.

4.7 EXPERIENCES OF IWM IN SOME FOREIGN COUNTRIES

4.7.1 Controlling Emissions From Public Enterprises in Brazil:
In Cubatao, Brazil, and Katowice, Poland, state-owned enterprises were implicated in severe and persistent air pollution that caused extreme levels of exposure to particulate. In Cubatao the main sources were steel, fertilizer, petrochemical, and cement plants. In Katowice steel mills, nonferrous metal smelters, chemical plants, power stations, and a wide range of other industrial plants were the principal polluters.

In September, 1984 an atmospheric inversion and mounting levels of particulate spurred the governor of Sao Paulo state to decree an unprecedented state of emergency in Cubatao. The state environmental agency promptly shut down nine industries in the district of Vila Parisi and ordered an evacuation. Police from Sao Paulo city were sent to assist in the evacuation and to prevent looting. The mayor of Cubatao made the soccer stadium available for displaced residents and provided food and blankets. When atmospheric conditions improved, the state of emergency was downgraded to a state of alert (the eighth that year), and people were allowed to return to their homes.

A few months later a pipe at a fertilizer plant ruptured, releasing massive amounts of ammonia gas. Six thousand residents were evacuated and more than sixty people hospitalized. The fertilizer plant was fined, but the state governor protested that the penalty was too small.

Conditions in Cubatao have improved since then (though crises still occur periodically); plants are installing pollution control equipment and are switching to less-polluting fuel, and thousands of residents are being helped to move to more suitable areas. The environmental agency has become more aggressive in using fines and temporary plant closures to deal with recalcitrant polluters, and
the government has initiated public civil actions seeking restoration of damaged wetlands, waterways, and hillsides. Extensive newspaper and television coverage of the environmental fiasco in Cubatao has given the whole country an environmental education.

4.7.2 Controlling Emissions From Public Enterprises in Poland:
Throughout the 1980s the provincial government in Katowice attempted to improve the city's air quality by levying fees for emissions that exceeded permissible levels. Although the rates were double those set by the national government for the rest of Poland, they were revised infrequently during the 1980s and fell sharply in real terms as prices rose. Furthermore, because industrial plants claimed that they lacked the resources to invest in better environmental controls, emissions permits were typically set much too high to achieve reasonable ambient air quality, and enterprises were often exempted from paying fees and fines. Technically, provincial governments could close down plants for persistently violating emissions standards, but this power seems to have been exercised only once - in the case of an aluminum plant in Krakow that was due to be closed anyway.

The situation in Katowice has changed radically since 1990. Air quality has improved significantly, and enterprises are considering or actually investing in environmental controls. There are three reasons for this change: (a) some of the worst polluters have closed down permanently; (b) the level of fees and fines has been raised more than ten times in real terms, and payment is enforced under a real threat of closure; and (c) the prospect of privatization means that enterprises no longer face "soft" budget constraints and provincial authorities no longer strive to maintain industrial production at the expense of other objectives.

The moral to be drawn from these two cases is that unless public enterprises are subject to "hard" budget constraints and are accountable to the public, economic incentives for pollution control are likely to be ineffective, and direct regulation may be required.
4.7.3 Regulating Hazardous Wastes: An Innovative Approach in Thailand:
To control hazardous wastes from industrial sources, the Thailand Development Research Institute has proposed the creation of an autonomous Industrial Environment Fund. In line with the "polluter-pays" principle, the fund would be financed from waste charges that would first be estimated for each industry and later verified by environmental auditing. The charge would be set at a level that covers the cost of transport, treatment, and disposal of hazardous wastes and provides a margin for running the program. A charge of 1,000 baht per ton on the 600,000 tons of industrial hazardous wastes projected for 1991 would raise 600 million baht. This is only 0.3 percent of the GDP originating in the 17,000 industrial plants in Thailand that generate hazardous wastes, or 1.5 percent of net profits.

The proceeds would be used to establish and operate central treatment and disposal facilities for hazardous wastes collected from factories would deposit with the fund their waste charges for the entire year. Plants that attained lower waste per unit of output, as verified by accredited private environmental auditing firms, would then be eligible for rebates. The operation of the treatment and disposal facilities would be contracted out to private waste management firms through competitive bidding.

The main message of this initiative is that pollution control costs can be minimized if the incentives are right. The more efficient an industry's production process, the less waste it generates and the less it pays for waste treatment and disposal. The scheme would thus give industry an incentive to reduce wastes and would encourage the development of business opportunities in hazardous waste management.

4.8 Research, Education and Training for IWM

Continuous research is needed to update various pollution control standards such as effluent and emission standards, technology standards etc. to the present day standard and befitting to the meteorological, social, economic condition of a particular country. As IWM system is a complex task involving expertise from a number of individual fields such as, engineering, planning, social
science, Economics, biological science etc. Continuous research in these fields regarding various issues of IWM can help developing most efficient IWM for particular country. The universities, research organizations can play a vital role in this regard.

General education regarding waste generation, their effects and ways and means of management of industrial wastes should be imparted at secondary and higher secondary level and specialized education should be imparted at graduate levels.

Besides training regarding various issues of IWM to the industrial workers and managers and special training to the personals of pollution control agencies may be helpful in this regard.

4.9 DEVELOPING A INDUSTRIAL POLLUTION PROJECTION SYSTEM (IPPS)

The industrial pollution projection system is a modeling system which can use industry or trade data to estimate comprehensive profiles of industrial pollution for countries, regions, urban areas or proposed new projects. Most of the developing country have little or no reliable information about their own pollution though many of them have relatively detailed industry survey information on employment, value added or output. IPPS is designed to convert this information into the best possible profile of the associated pollutant output. For Bangladesh no such system does exists. Research organization can take steps to develop such a system for Bangladesh to make IWM task more easier.

4.10 SUMMARY

Industrial waste management is associated with a number of technical and nontechnical aspects. It deals with various issues and methodologies. It encounters various conflicts of interests. The issues discussed in this chapter are the major issues to be addressed for developing suitable management system for industrial wastes for a particular area or country. In the following chapter their status in TIA has been discussed with necessary data and information.
CHAPTER 5 : PRESENT PRACTICES OF IWM, IT'S DRAWBACKS AND EFFECTS IN TIA
5.1 INTRODUCTION

In this chapter different issues of present management practices for industrial wastes in TIA have been discussed. Besides role of different organization involved in waste management, drawbacks of present management practices and consequences of waste mismanagement in TIA have also been discussed in this chapter.

5.2 TYPES OF INDUSTRIES IN TIA

There exist 156 industries of varying types and sizes in TIA. In the following section industries of TIA are classified according to DOE developed guide lines (see Table D1 of Appendix D). A classification on the basis of nature of waste are also given in the following sections. Industries of TIA have been categorized according to DOE developed guide line:

5.2.1 Classification Based on Size: DOE has developed a guide line to determine the size of industries in Bangladesh. Capital investment, power consumption and manpower employment per day are the those determining factors of this classification. Detail guide line is given in Table D1 of Appendix D.

The inventory prepared in NEMPC project has been used to classify the industries of TIA according to size. Employment per day has been considered as the basis of this classification. 95 (60.89%) out of 156 industries provided information regarding manpower employment in their respective industries. None of the industries provided any information regarding their capital investment and power consumption. Table 5.1 shows the classification of industries of TIA according to size.

Table 5.1 : Classification of Industries of TIA According to Size.

<table>
<thead>
<tr>
<th>Types of Industries</th>
<th>Number</th>
<th>%</th>
<th>Manpower per day range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>11</td>
<td>7.1</td>
<td>below 20</td>
</tr>
<tr>
<td>Medium</td>
<td>59</td>
<td>37.8</td>
<td>20-100</td>
</tr>
<tr>
<td>Large</td>
<td>25</td>
<td>16.00</td>
<td>above 100</td>
</tr>
<tr>
<td>No-information</td>
<td>61</td>
<td>39.11</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>100.00</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Inventory, NEMPCP/1990
Table 5.1 reveals that 39.1% of the industries of TIA did not provide any information regarding manpower employment in their industries. Of the industries which provided information, majority (37.8%) fall in the medium size category with manpower per day ranging from 20 to 100.

5.2.2 Classification Based on Process Adopted: This classification has been done according to international classification proposed by DOE. Details of the classification procedure has been given in Table D5 of appendix D.

Table 5.2 shows the number and percentages of industries falling in different groups for TIA.

Table 5.2: Industries of TIA categorized according to ISIC Product/Process category

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>ISIC No.</th>
<th>Product/Process Category</th>
<th>No. of Industries in TIA</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>3112</td>
<td>Manufacture of dairy products</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>02</td>
<td>3115</td>
<td>Manufacture of vegetable and animal oils and fats</td>
<td>03</td>
<td>1.92</td>
</tr>
<tr>
<td>03</td>
<td>3116</td>
<td>Grain Mill Products-Rice Mill</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>04</td>
<td>3117</td>
<td>Manufacture of bakery products</td>
<td>03</td>
<td>1.92</td>
</tr>
<tr>
<td>05</td>
<td>3119</td>
<td>Manufacture of Coca, Chocolate and Sugar Confectionery</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>06</td>
<td>3134</td>
<td>Manufacture of Soft Drinks and carbonated waters Industries</td>
<td>02</td>
<td>1.28</td>
</tr>
<tr>
<td>07</td>
<td>3140</td>
<td>Tobacco Manufactures</td>
<td>02</td>
<td>1.28</td>
</tr>
<tr>
<td>08</td>
<td>3211</td>
<td>Spinning, Weaving and finishing textiles</td>
<td>12</td>
<td>7.69</td>
</tr>
<tr>
<td>09</td>
<td>3212</td>
<td>Manufacture of made up textile goods except weaving</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>10</td>
<td>3240</td>
<td>Manufacture of footwear except vulcanized molded rubbers or plastic footwear</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>11</td>
<td>3411</td>
<td>Manufacture of Pulp, Paper and paper board</td>
<td>02</td>
<td>1.28</td>
</tr>
<tr>
<td>12</td>
<td>3420</td>
<td>Printing, publishing and allied industries</td>
<td>07</td>
<td>4.49</td>
</tr>
<tr>
<td>13</td>
<td>3511</td>
<td>Manufacture of basic industrial chemical except fertilizer</td>
<td>03</td>
<td>1.92</td>
</tr>
<tr>
<td>14</td>
<td>3512</td>
<td>Manufacture of fertilizer and pesticide</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>15</td>
<td>3521</td>
<td>Manufacture of paints varnishes</td>
<td>03</td>
<td>1.92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Industry Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>16</td>
<td>3522</td>
<td>Manufacture of Drugs and Medicine</td>
<td>15</td>
<td>9.62</td>
</tr>
<tr>
<td>17</td>
<td>3523</td>
<td>Manufacture of soap and clearing preparation, perfume cosmetics and other toilet preparation</td>
<td>06</td>
<td>3.85</td>
</tr>
<tr>
<td>18</td>
<td>3551</td>
<td>Tire and tube industries</td>
<td>03</td>
<td>1.92</td>
</tr>
<tr>
<td>19</td>
<td>3559</td>
<td>Manufacture of rubber products</td>
<td>05</td>
<td>3.21</td>
</tr>
<tr>
<td>20</td>
<td>3560</td>
<td>Manufacture of plastic products</td>
<td>05</td>
<td>3.21</td>
</tr>
<tr>
<td>21</td>
<td>3620</td>
<td>Manufacture of glass and glass products</td>
<td>02</td>
<td>1.28</td>
</tr>
<tr>
<td>22</td>
<td>3710</td>
<td>Iron and steel basic industries</td>
<td>12</td>
<td>7.69</td>
</tr>
<tr>
<td>23</td>
<td>3711</td>
<td>Electroplate</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>24</td>
<td>3720</td>
<td>Non-ferrous metal basic industries</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>25</td>
<td>3811</td>
<td>Manufacture of cutlery hand tools and except hardware</td>
<td>02</td>
<td>1.28</td>
</tr>
<tr>
<td>26</td>
<td>3813</td>
<td>Manufacture of structural metal products</td>
<td>03</td>
<td>1.92</td>
</tr>
<tr>
<td>27</td>
<td>3819</td>
<td>Manufacture of fabricated metal products excepts machinery and equipment</td>
<td>21</td>
<td>13.46</td>
</tr>
<tr>
<td>28</td>
<td>3823</td>
<td>Manufacture of metal and wood working machinery</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>29</td>
<td>3831</td>
<td>Manufacture of electrical machinery and apparatus</td>
<td>01</td>
<td>0.646</td>
</tr>
<tr>
<td>30</td>
<td>3832</td>
<td>Manufacture of radio television, communication equipment and apparatus</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>31</td>
<td>3833</td>
<td>Manufacture of electrical appliances and housewares</td>
<td>02</td>
<td>1.28</td>
</tr>
<tr>
<td>32</td>
<td>3839</td>
<td>Manufacture of electrical apparatus</td>
<td>02</td>
<td>1.28</td>
</tr>
<tr>
<td>33</td>
<td>3843</td>
<td>Manufacture of motor vehicles</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>34</td>
<td>3844</td>
<td>Manufacture of motor cycle and bicycle</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>35</td>
<td>3903</td>
<td>Manufacture of sporting and athletic goods</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>36</td>
<td>3911</td>
<td>Aluminum Utensils</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>37</td>
<td>5000</td>
<td>Construction company</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>38</td>
<td>9513</td>
<td>Motor services workshops</td>
<td>05</td>
<td>3.21</td>
</tr>
<tr>
<td>39</td>
<td>9520</td>
<td>Laundry</td>
<td>01</td>
<td>0.64</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>Not specified</td>
<td>18</td>
<td>11.54</td>
</tr>
</tbody>
</table>

Source: Inventory of NEMPC Project 1990

There are 39 different types of industries in TIA. From Table 5.2 it can be also observed that fabricated metal manufacturing industries constitute the major portion (13.46%) of the industrial structure of TIA, comprising of 21 establishments in TIA followed by manufacturer of drugs and medicines. There are 18 industries in TIA which could not be specified in any category.
5.2.3 Classification Based on Probable Environmental Impacts: Industries of TIA have been classified in this section according to their probable impacts. Basis this classification has been given in the Appendix D.

This classification determines the siting requirements of the industries. The siting requirements for different types of industries have also been given in the Appendix D. Table 5.3 shows the classification of industries in TIA according to their probable impacts.

Table 5.3: Classification of Industries in TIA According to Their Probable Adverse Impacts on Surrounding Environment.

<table>
<thead>
<tr>
<th>Category</th>
<th>Extent of Impact</th>
<th>No. of Industries</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Low</td>
<td>07</td>
<td>04.49</td>
</tr>
<tr>
<td>B</td>
<td>Medium</td>
<td>56</td>
<td>35.90</td>
</tr>
<tr>
<td>C</td>
<td>High</td>
<td>23</td>
<td>14.74</td>
</tr>
<tr>
<td>D</td>
<td>No-Information</td>
<td>70</td>
<td>44.87</td>
</tr>
</tbody>
</table>


Table 5.3 reveals that 35.90% of the industries of TIA have medium impacts on the surrounding environment. 14.74% of the industries have very significant impacts on the surrounding environments while rest 4.49% have negligible impacts. Again 44.87% of the industries did not provide necessary information so their probable impact could not be determined.

5.2.4 Grouping of the Industries of TIA According to Waste Generation Potential: Industries of TIA were classified into 7 groups considering the products being produced from the industries and nature of their waste water. This grouping was done in NEMPC project and have been adopted for the present study.
Table 5.4: Grouping of Industries in TIA Based on Characteristics of Waste Water as Suggested in NEMPCP.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Major Products manufactured in the industries of the group</th>
<th>ISIC No. of the industries in the group</th>
<th>No. of Industries in the group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Food, Beverage and Tobacco</td>
<td>3112, 3117, 3134</td>
<td>12</td>
<td>07.69</td>
</tr>
<tr>
<td>02</td>
<td>Textile, Wearing Apparel, Leather Products</td>
<td>3211, 3212</td>
<td>13</td>
<td>08.33</td>
</tr>
<tr>
<td>03</td>
<td>Paper Products Printing and Publishing</td>
<td>3411, 3420</td>
<td>09</td>
<td>05.78</td>
</tr>
<tr>
<td>04</td>
<td>Chemical, Petroleum, Coal Rubber, Plastic Products</td>
<td>3511, 3522, 3523</td>
<td>41</td>
<td>26.28</td>
</tr>
<tr>
<td>05</td>
<td>Basic Metal</td>
<td>3710</td>
<td>12</td>
<td>07.69</td>
</tr>
<tr>
<td>06</td>
<td>Fabricated metal Products, Machinery and Equipments</td>
<td>3611, 3613, 3619, 3644</td>
<td>28</td>
<td>17.95</td>
</tr>
<tr>
<td>07</td>
<td>Others</td>
<td></td>
<td>23</td>
<td>14.74</td>
</tr>
<tr>
<td>08</td>
<td>No information</td>
<td></td>
<td>18</td>
<td>11.54</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>156</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Source: NEMPCP, 1991

From Table 5.4 it can be observed that group No. 4 is the largest group containing 41 (26.28%) industries in TIA. Group 3 is the smallest one containing only 9 (5.78%) industries. No information was available regarding either the type of product, or process being practiced or character of wastes from 18 industries. As such they could not be grouped in any category.

5.3 GENERATION OF INDUSTRIAL WASTE IN TIA

Almost all the industries of TIA generate industrial wastes of some kind or other. Depending upon the products, process being practiced in different industries and technology standards available in different industries significant volume of solid, liquid and gaseous wastes are generated from different industries of TIA. Only some rough estimates of generation of liquid wastes from the industries of TIA are available. There is no authentic estimation regarding generation of solid and gaseous waste in TIA. Table 5.5 shows the nature of wastes generated from 19 surveyed industries in TIA.
Table 5.5: Nature of Waste Generated From Various Categories of Industries in TIA.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of surveyed industries</th>
<th>Nature of Waste Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Only Solid</td>
<td>Only Liquid</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>2 (10.53)</td>
</tr>
</tbody>
</table>

Source: Field Survey March - April, 1994

*Figures in the brackets indicate percentages.

From Table 5.5 it appears that out of 19 surveyed industries only 2 (10.53%) generate only solid waste, 4 (21.05%) generate only liquid waste and 2 (10.53%) do not generate any kind of wastes while rest 11 (57.89%) generate wastes which are either combinations of any two of the three types mentioned here or combinations of all the three types of wastes.

Of the combinations liquid gaseous combination 5 (26.32%) is the highest followed by solid liquid gaseous combination 3 (15.74%). Number of solid liquid combination is 2 (10.53%) while solid gaseous combinations is 1 (5.20%) which is the lowest among the surveyed industries.

5.3.1 Generation of Liquid Waste: A study carried out by SEATEC INTERNATIONAL CONSULTING ENGINEERS, Bangkok, Thailand identified waste water generation potential of industries in TIA. Their findings are shown in Table 5.6.

Table 5.6: Waste Water (Liquid Waste) Generation Potential of Industries of TIA.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generate waste water</td>
<td>58</td>
<td>37.18</td>
</tr>
<tr>
<td>May generate waste water</td>
<td>42</td>
<td>26.92</td>
</tr>
<tr>
<td>Do not generate waste water</td>
<td>34</td>
<td>21.79</td>
</tr>
<tr>
<td>No information</td>
<td>22</td>
<td>14.11</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: NEMPCP, 1991
Table 5.6 reveals that 100 (64.10%) out of 156 industries of TIA either generate or have the potential to generate waste water (Liquid wastes).

Table 5.7: Group-wise Breakdown of Liquid Waste Generating Industries in TIA.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of IndustriesGenerating Liquid Waste</th>
<th>Waste water generation potential</th>
<th>( \text{%} )</th>
<th>No.</th>
<th>( \text{%} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Significant:</td>
<td></td>
<td></td>
<td>Insignificant:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td></td>
<td>No.</td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td>5 (08.62)</td>
<td>0</td>
<td>00.00</td>
<td>5</td>
<td>08.62</td>
</tr>
<tr>
<td>Group 2</td>
<td>8 (13.79)</td>
<td>6</td>
<td>10.34</td>
<td>2</td>
<td>03.45</td>
</tr>
<tr>
<td>Group 3</td>
<td>1 (01.72)</td>
<td>0</td>
<td>00.00</td>
<td>1</td>
<td>01.72</td>
</tr>
<tr>
<td>Group 4</td>
<td>21 (36.21)</td>
<td>4</td>
<td>06.90</td>
<td>17</td>
<td>29.31</td>
</tr>
<tr>
<td>Group 5</td>
<td>3 (05.17)</td>
<td>1</td>
<td>01.72</td>
<td>2</td>
<td>03.45</td>
</tr>
<tr>
<td>Group 6</td>
<td>14 (24.14)</td>
<td>2</td>
<td>03.45</td>
<td>12</td>
<td>20.69</td>
</tr>
<tr>
<td>Group 7</td>
<td>6 (10.35)</td>
<td>0</td>
<td>00.00</td>
<td>6</td>
<td>10.34</td>
</tr>
<tr>
<td>Total</td>
<td>58 (100.00)</td>
<td>13</td>
<td>22.41</td>
<td>45</td>
<td>77.59</td>
</tr>
</tbody>
</table>


* Figures in the brackets indicate percentages.

From Table 5.7 it reveals that 13 (22.41%) out of 58 waste water generating industries of TIA generate significant volume of waste water while rest 45 (77.59%) generate insignificant amount of waste water. It can also be observed from Table 5.7 that though in group no.4 there exists maximum number 21 (36.21%) of waste water generating industries but 4 (6.90%) of them generate significant amount of waste water or liquid waste while rest 17 (29.31%) generate insignificant amount of waste water.

It can be further observed that group no.2 with 6 (10.34%) significant waste water generating industries out of 8 (13.79%) waste water generating industries is the major group of waste water generating industries in TIA.

5.3.2 Generation of Gaseous Waste: As far as gaseous emissions are concerned there exist only 9 medium/lower medium sized industrial units in TIA (NEMPCP, 1992). Table 5.8. shows the group wise breakdown of the gaseous emission generating industries in TIA. List of the industries is available in the appendix F.
Table 5.8 : Group Wise Breakdown of Gaseous Emission Generating Industries in TIA.

<table>
<thead>
<tr>
<th>Group</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group No. 1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Group No. 2</td>
<td>3</td>
<td>33.33</td>
</tr>
<tr>
<td>Group No. 3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Group No. 4</td>
<td>3</td>
<td>33.33</td>
</tr>
<tr>
<td>Group No. 5</td>
<td>1</td>
<td>11.12</td>
</tr>
<tr>
<td>Group No. 6</td>
<td>2</td>
<td>22.22</td>
</tr>
<tr>
<td>Group No. 7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>100.00</td>
</tr>
</tbody>
</table>


From Table 5.8 it can be observed that group no.2 and group no.4 are the largest group of gaseous emission generating industries in TIA. with 3 (33.33%) industries in each group. It can also be observed from Table 5.5 and Table 5.8 that in group numbers 1, 3 and 7 there is no gaseous emission generating industries.

5.3.3 Generation of Industrial Solid Waste : Regarding generation of solid wastes no such group wise break down was available. But from the field observations it was found that almost all the industries in TIA generate solid waste of varying nature.

5.3.4 Generation of Toxic Waste : No accounting was available regarding generation of toxic waste from the industries of TIA as no industries of TIA had ever characterized its wastes or any organization had ever taken any initiative to characterize the wastes from the industries of TIA. It is believed that industries belonging to all of the groups in TIA may have some toxicity potential.

5.4 CHARACTERIZATION AND QUANTIFICATION OF INDUSTRIAL WASTES IN TIA

So far no precise study has been done regarding characterization and quantification of industrial wastes from the industries at TIA. At the present study attempts were made to characterize and to quantify the wastes being produced from different industries. But none of the industries could provide any kind of information regarding characteristics of their wastes as they had no facilities and intentions to characterize their wastes. Regarding quantification they provided very rough and misleading information. So the author had to rely on some previous studies which also
provide very rough and tentative information to discuss this issue.

5.4.1 Characteristics and Quantity of Solid Wastes from TIA:
Solid wastes produced from different types of industries can be characterized in two major groups:

i) Process solid wastes.
ii) Non process solid wastes.

i) Process Solid Wastes: This type of solid wastes are produced due to some industrial processes. In TIA very insignificant amount of such wastes are produced from the industrial groups.

In group 1 biscuits and bread industries produce some powdered biscuit and bread chips. In group 2 Textile and dying industries produce sludge from waste treatment and chemical residues. Apparel industries produce discarded cloth pieces. Industries of group 3 produce some amount of discarded paper and bards, in group 4 Rubber and Plastic product manufacturing industries produce discarded rubber and plastic materials, industries of group 5 produce sludge in their process and industries group no.6 produce some metal chips. In most of the cases such wastes are either recycled in the manufacturing process or sold to some other industries. So they are not of too much concern.

ii) Non Process Solid Wastes: All the industries of TIA generate such solid wastes. Discarded packing boxes, discarded portions of raw materials, broken glasses, gunny bags, poly bags, plastic cans, bottles etc fall into this category. These types along with some process wastes are dumped either in the municipal dustbins or in the nearby places of the factories. (See plate .3).

Quantification: Industry wise break down of solid wastes produced from different industries was not available. According to the information provided by Zone 9 office of DCC total amount of solid waste procured from TIA is about 5 metric tons daily. As there exists a number of housing areas inside TIA and household wastes are also dumped in the same dustbins along with industrial wastes so this amount (5 MT) includes both domestic and industrial solid wastes in TIA. Excluding the household waste, the author estimates that the amount of industrial solid waste may be between 1.5 to 2.0 MT daily.

5.4.2 Characteristics and Quantity of Waste Water (Liquid Waste) from Industries of TIA Characteristics: Characteristics of waste water varies considerably from industry to industry and even from plant to plant producing same final product. Neither of the industries nor of any government organizations (e.g. DOE) have ever undertaken any initiative to characterize the waste water being generated from different industries of TIA. So it is difficult to characterize the waste water coming out of different industries. Some typical characteristics of waste water of some typical
industries which are also present in the TIA are given in Appendix E.

**Quantity** : An estimate of amount of waste water flow from different types of industries in TIA is given in Table 5.9

Table 5.9 : *Estimated Waste Flow from Some of the Industries in TIA.*

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the industry</th>
<th>Group No.</th>
<th>Types of industries</th>
<th>Waste flow m$^3$/day</th>
<th>No. of industries producing similar amount of waste in TIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phoenix Textile Mills Ltd.</td>
<td>Group No. 2</td>
<td>Textile</td>
<td>264</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Kohinoor Chemical Industry</td>
<td>Group No. 4</td>
<td>Chemical</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Gaco Pharmaceutical and Research Ltd.</td>
<td>Group No. 4</td>
<td>Pharmaceutical</td>
<td>200</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Appolo Steel Mills Ltd.</td>
<td>Group No. 5</td>
<td>Iron and Steel</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Monwar Ind. Pvt. Ltd.</td>
<td>Group No. 6</td>
<td>Electroplate</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Bangladesh Cycle Industries</td>
<td>Group No. 6</td>
<td>Electroplate</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Tiger Wire Products</td>
<td>Group No. 6</td>
<td>Galvanizing</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Bengal Steel Works</td>
<td>Group No. 6</td>
<td>Electroplate</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Karnaphuli Works</td>
<td>Group No. 7</td>
<td>Motor Cycle Assembling</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 8: Major Waste Water Producing Industries in TIA.
Table 5.10 shows the group wise estimate of the waste water being produced from different industrial groups.

Table 5.10 : Group-wise Estimates of Waste Flow from Different Industrial Group.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of significant waste producing industries in the group</th>
<th>Waste flow/industry/day m^3/day</th>
<th>Total waste flow/day m^3/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>264</td>
<td>1584 (82.03)</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3+1*</td>
<td>10,200</td>
<td>30 + 200 - 230 (11.91)</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>23</td>
<td>23 (01.19)</td>
</tr>
<tr>
<td>6</td>
<td>2**</td>
<td>47</td>
<td>94 (04.87)</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0 (00.00)</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>-</td>
<td>1931 (100.00)</td>
</tr>
</tbody>
</table>


Note : * in group 4, 3 chemical industries considered to produce same waste flow while the only pharmaceutical industry is considered to produce separate volume of waste.

** Average flow of Sl. No. 5, 6 & 8 of Table 5.9 have been considered.
Plate 1: Road Side Dumping of Industrial Solid Waste in TIA.
Plate 2: Disposal of Liquid Waste in Open Drains by the Industries of TIA.
Plate 3: Highly Colored and Polluted Water of Begunbari Khal.
Plate 4: Haphazard Dumping of Industrial Solid Wastes Outside DCC's Wastebins in TJA.
Plate 5: Drain Blockage by Haphazard Dumping of Wastes in TIA.
Plate 6: Area Level Disposal of Waste Water from TIA Through Sewerage Outfall at Begunbari Khal.
Plate 7: Area Level Disposal of Waste Water from TIA Through Sewerage Outfall near Mohakhali Bus Stand.
From Table 5.10 it is observed that industries of group no. 2 at TIA are responsible for major waste water generation with 1584 m$^3$/day (82.03%) waste water while the only industry of group 5 generates the minimum amount of 23 m$^3$/day (1.19%) waste water at TIA. Industries belonging to group no 1,3 and 7 do not discharge any significant amount of waste water.

5.4.3 Characterization and Quantification of Gaseous Waste:

**Characteristics**: All the boilers and furnace of TIA use natural gas as fuel. Such boiler shall normally emit negligible suspended particulate matters (SPM), $SO_2$, $NO_x$, CO and some unburnt hydrocarbons (HC).

**Quantity**: The capacity of the individual boilers of the medium scale units often ranges between 3 and 5 tons of steam/hour, an average of 3.5 tons/hour would be a reasonable estimate. In TIA there are only 9 industrial units having any kind of boilers or furnaces (NEMPCP, 1992) of them 6 can be categorized as medium scale units and rest 3 as small scale units.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of industries in the group</th>
<th>Small Scale units</th>
<th>Medium scale units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>11.11</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>22.22</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9</td>
<td>33.33</td>
<td>6</td>
</tr>
</tbody>
</table>


Group wise estimation of different types of gaseous emissions from the industries of TIA is shown in Table 5.12.
Fig. 9: Location of Major Gaseous Emission Generating Industries in TIA.
Table 5.12: Estimation of Gaseous Emission from the Industries of TIA.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of industries in the group</th>
<th>Medium boilers</th>
<th>No. of Small boilers</th>
<th>Generated gaseous emission</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CO Kg/day</td>
<td>SPM Kg/day</td>
<td>HC Kg/day</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1500</td>
<td>0</td>
<td>1500</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>750</td>
<td>0</td>
<td>750</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>50</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>100</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>2400</td>
<td>60</td>
<td>2400</td>
</tr>
</tbody>
</table>

Source: NEMPCP, 1992

Table 5.12 reveals that major gaseous emission from the industries of TIA are carbon mono-oxide CO (2400 Kg/day) and Hydro carbon Hc (2400 Kg./day). It can also be observed from Table 5.11 that industries of group no. 2 and group no.4 are the largest gaseous emission generating industries in TIA.

5.5 STORAGE OF INDUSTRIAL WASTES IN TIA

During the field visit it was found that 6 (31.58%) out of 19 inspected industries were equipped with safe storage facilities for their generated solid and/or liquid wastes. 7 (36.84%) had no storage facility while rest 6 (31.58%) did not provide any information regarding storage of their produced waste. All the six industries which possess storage facilities store their solid wastes in gunny bags and poly bags. Two of them have their own dump yard inside the factory.

Regarding storage of their liquid waste, they use containers, and drums 3 industries have septic tanks.

The industries which do not have their storage facilities have informed that they do not require storage facilities because their produced wastes are either sold to some other factories or reused in the process.
5.6 HANDLING OF WASTE IN TIA

None of the industries in TIA have adequate safety measures for the workers who handle the wastes. Though it was observed that all the surveyed industrial units had fire fighting arrangements but the use of mask and gloves by the workers were not well practiced. Table 5.13 shows the group wise break down of industries regarding the use of mask, gloves by the workers.

Table 5.13: Use of Mask and Gloves by the Workers of Industries in TIA.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of surveyed industries</th>
<th>Use</th>
<th>Occasionally use</th>
<th>Do not use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td></td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>19 (100.00)</td>
<td>3 (15.79)</td>
<td>4 (21.05)</td>
<td>12 (63.16)</td>
</tr>
</tbody>
</table>

* Figures in the bracket indicate percentages.

From Table 5.13 it can be observed that only 3 (15.79%) units in TIA provide necessary safety arrangement to their workers/garbage crews, 4 (21.05%) units provide limited arrangements while rest 12 (63.16%) units do not provide any kind of safety arrangement to their workers.

During the field visit it was also observed that in none of the industries there exist any mechanical arrangement of waste handling. Wastes are handled manually by the industry workers.

5.7 TREATMENT FACILITIES OF INDUSTRIAL WASTE IN TIA

Table 5.14 demonstrates that only 4 (21.05%) out of 19 surveyed industries in TIA have some kind of treatment facilities for their
produced wastes in TIA.

Table 5.14: Availability of Treatment Facilities in the Industries of TIA.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of Surveyed Industries in the group</th>
<th>Did not reply</th>
<th>Waste Water Treatment Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exist</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>


It can be observed that all 4 industrial units which have claimed to have any kind of treatment facility belong to group no. 4. No industries of any other group possess any kind of treatment facility.

5.8 RECYCLING AND SELLING OF WASTES

5.8.1 Recycling: It was found by the experts of National Environmental Monitoring and Pollution control project that only 2 metal industries out of their 20 visited industrial units of TIA had recycling practice of their generated wastes. In the present study it was found that 7 (36.84%) out 19 surveyed industrial units thought that recycling of their wastes was possible. Table 5.15 shows the group wise breakdown of the possibility of recycling of wastes by different groups of industries.
Table 5.15: Possibility of Recycling of Wastes by Various Industrial Groups.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of surveyed industries</th>
<th>Did not reply</th>
<th>Recycling of Wastes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Possible</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>


From Table 5.15 it can be observed that industries of group no. 2 have informed that recycling of their wastes are not possible. They opined that at the present state of technology in their respective units could not make any cost effectiveness if they would recycle their wastes.

5.8.2 Selling: Metal industries rubber industries, and some chemical industries in TIA usually sale out their wastes. Fabricated metal industries sale out their wastes which are mainly iron clips to the foundry shops. Rubber industries sale out their discarded rubbers to the small scale units. Soap foots and sodium silicates produced from some industrial chemical producing plants, are used by the poor industry workers as soap. Besides non process solid wastes of different industries are sold to the vangari shop owners.

5.9 DISPOSAL OF INDUSTRIAL WASTES IN TIA

5.9.1 Disposal of Solid Waste: Disposal of industrial solid wastes from the industries of TIA is done into the 25 to 30 municipal dustbins scattered around the industrial area. From this municipal dustbins wastes are collected by the dump trucks of DCC and finally
disposed of along with other municipal solid wastes at the dump sites of Dhaka City Corporation at Jatrabari.

Though only 2 (10.53%) out of 19 inspected industries, said that they dispose their solid waste in the municipal dustbin but disposing of industrial solid wastes to the municipal dustbin by almost all the industries of the study area was noticed by the author, DCC’s zonal office also testified the practice.

Regarding problems being faced by the industries in disposing their wastes in the municipal dustbins 1 industry replied that it faced problem as the dustbin were at a long distance from the factory while the other one did not mention any problem.

During the field visit it was found that 12 (63.16%) out of 19 surveyed industries had access to dustbin within 5 to 30 yards from the factory premises while rest 7 (36.84%) did not have any municipal dustbin within 30 yards from the respective factory premises.

During field visit though it was it was found that 12 industrial units had dustbins within a very convenient distance from the factory yet haphazard dumping of solid wastes outside the bins by the industries were found (See plate 4). It is also evident from the questionnaire survey among the inhabitants of TIA that there is widespread haphazard dumping of industrial solid waste through out Tejgaon Industrial Area by the industries of TIA. 94.44% of the respondents (238 out of 252) have said that industries dump their solid wastes in and around their residence while rest 5.56% (14 out of 252) do not think that the industries dump their wastes in and around their residence. The places of solid waste dumping by the industries as mentioned by the respondents are given in Table 5.16.
Table 5.16 : Respondents Views Regarding Places of Solid Waste Dumping by the Industries of TIA.

<table>
<thead>
<tr>
<th>Places of dumping solid wastes by the industries of TIA</th>
<th>No. of Respondents</th>
<th>% out of 252</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open City Corporation Dustbin</td>
<td>224</td>
<td>94.12</td>
</tr>
<tr>
<td>Open spaces/fields</td>
<td>84</td>
<td>35.29</td>
</tr>
<tr>
<td>Road side</td>
<td>56</td>
<td>23.53</td>
</tr>
<tr>
<td>Ditches and ponds</td>
<td>28</td>
<td>11.76</td>
</tr>
<tr>
<td>Others</td>
<td>14</td>
<td>05.88</td>
</tr>
</tbody>
</table>


It can be observed from Table 5.16 that most of the respondents (94.12%) think that industries dump their solid waste in city corporation dustbin. Besides dumping of wastes in open space/fields (35.29%) in road side (23.53%) in TIA and in ditches and ponds (11.76%) are also noticed by the respondents.

5.9.2 Disposal of Waste Water:

i) Plant Level Disposal : Table 5.17 shows the places of disposal of waste water by various industrial groups of TIA:

Table 5.17 : Places of Waste Water Disposal by the Industrial Groups of TIA.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of surveyed industries</th>
<th>Places of waste water disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Open drains near factory</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>19 (100.00)</td>
<td>9 (47.37)</td>
</tr>
</tbody>
</table>


* Figures in the bracket indicate percentages
Table 5.17 reveals that 9 (47.37%) out of 19 surveyed industries dispose of their waste water in the pucca or Katcha drains around the factories. 7 (36.84%) dispose in the WASA sewerage line while rest 3 (15.79%) disposes in the nearby ditches. 77.78% (196 out of 252) of the respondents has informed that industries of TIA are disposing their liquid waste indiscriminately through out the area. Table 5.18 shows the places where industries are disposing their waste water as described by the respondents.

Table 5.18: Respondents Observations Regarding Places of Waste Water Discharges by the Industries of TIA.

<table>
<thead>
<tr>
<th>Places of discharges</th>
<th>No. of respondents</th>
<th>% out of 252</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open drains</td>
<td>196</td>
<td>77.78</td>
</tr>
<tr>
<td>Sewer lines</td>
<td>56</td>
<td>22.22</td>
</tr>
<tr>
<td>Ponds and ditches</td>
<td>14</td>
<td>05.56</td>
</tr>
<tr>
<td>Canals</td>
<td>28</td>
<td>11.11</td>
</tr>
<tr>
<td>Open spaces</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Agricultural land</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


From Table 5.18 it can be observed that all the respondents have mentioned that industries of TIA discharge their waste water in the open drains near to the factory. 28.57% of the respondents have informed about the disposing of water in WASA sewerline. Besides 14.28% and 7.21% of the respondents informed about disposing of waste water into canals and ponds and ditches respectively by the industries of TIA.

ii) Area Level Disposal: From the open drains industrial waste water is discharged in the open ditches and from storm sewerage network to the Begunbari Khal through two major out falls in and around TIA. Begunbari Khal is further discharged in to eastern flood plain and finally in to the Balu river.
5.10 INDUSTRIAL POLLUTION LOAD FROM THE INDUSTRIES OF TIA

About 36 tons of BOD per day which is about 19.78% of the total BOD load of Dhaka City is discharged in the eastern flood plain/Balu river. 8% of this BOD load is constituted from the industrial discharges of TIA. Table 5.17 shows the pollution load of the industrial waste water from the industries of TIA:

Table 5.17: Industrial Pollution Loads from the Industries of TIA.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Load in TIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>Tons/day</td>
<td>33</td>
</tr>
<tr>
<td>T.S.S.</td>
<td>Tons/day</td>
<td>3</td>
</tr>
<tr>
<td>T.D.S.</td>
<td>Tons/day</td>
<td>5</td>
</tr>
<tr>
<td>Flow</td>
<td>m³/day</td>
<td>5000</td>
</tr>
</tbody>
</table>


5.11 OCCUPATIONAL HEALTH SITUATION IN THE INDUSTRIES OF TIA

Mainly ventilation, general cleanliness and lighting situation were observed inside the industrial units at the present study. Finding are summarized in Table 5.20.

Table 5.20: Occupational Health Situation in the Industries of TIA.

<table>
<thead>
<tr>
<th>Group No</th>
<th>No. of surveyed industry</th>
<th>Lighting</th>
<th>Ventilation</th>
<th>General Cleanliness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Good</td>
<td>Average</td>
<td>Bad</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>7</td>
<td>9</td>
<td>1</td>
</tr>
</tbody>
</table>


Table 5.20 shows that in 7 (36.84%) industries lighting situation is good, in 9 (47.37%) the situation is average while in rest 3 (15.79%) it is bad. It can also be observed that one industry from
group no.1 and two from group no.2 have extremely bad lighting situation inside the factory.

So far as ventilation is concerned, it can be observed from Table 5.18 that 6 (31.58%) have good ventilation 12 (63.6%) have average ventilation while rest 1 (5.26%) also from group no.1 has poor ventilation condition.

Regarding general cleanliness it can be observed that 3 (15.79%) have good general cleanliness, 13 (68.42%) average general cleanliness while rest 3 (15.79%) (2 from group no.2, and one from group no.6) have poor general cleanliness situation.

5.12 OPEN SPACE AND GREEN BELT AROUND THE INDUSTRIES

TIA is a planned industrial area where sufficient open space were found around the individual industrial units. But as far as green belting is concerned only 5 (26.32%) out of 19 surveyed industries were found to have some green belt in and around their factory premises. 88.89% (224 out 252) of the respondents have answered affirmative regarding reduction of trees over the recent years in the area.

5.13 SITING OF INDUSTRIES AND POLLUTION PROBLEM IN TIA

In TIA Nabisco Biscuits and Bread Factory is situated beside Farroque Chemical Industries which produces industrial chemical, Polar Ice Cream Factory is situated beside heavy metal industries, Haq biscuit Factory beside Kohinoor Chemical Industry. During the field visit and discussion Nabisco complained against Farroque chemical industry that the dust and gaseous emissions from Farroque Chemical might impair the quality of their products. Similar possibilities for other industries can not be over ruled.

5.14 WATER SUPPLY AND USE OF WATER IN DIFFERENT INDUSTRIES

Out of 19 surveyed industries 10 (52.63%) had mentioned that they had their own water supply arrangement while rest 9 (47.37%) had mentioned that they had WASA supply connections for water.
Table 5.21 shows the group wise break down of the sources of water from different industries.

Table 5.21 *Arrangements of Water Supply in Different Industrial Units of TIA*

<table>
<thead>
<tr>
<th>Group No</th>
<th>No. of surveyed industries</th>
<th>Self Arrangement</th>
<th>WASA Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>19 (100.00)</td>
<td>10 (52.63)</td>
<td>9 (47.38)</td>
</tr>
</tbody>
</table>


* Figures in the brackets indicate percentage.

It can be observed from Table 5.21 that 5 (26.32%) out of 6 (31.58%) industries of group no 2 had their own arrangement for water supply. It can also be observed that maximum industries (6 out of 8) of group no 4 on the other hand had WASA connection for water supply.

Different use of water by various industries can be understood from Table 5.22.
Table 5.22 Use of Water by Various Industries of TIA.

<table>
<thead>
<tr>
<th>Group No.</th>
<th>No. of Surveyed Industries</th>
<th>WATER USED FOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Washing raw material</td>
</tr>
<tr>
<td></td>
<td></td>
<td>component of product</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Washing finished goods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heat absorbent of machine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>19 (100.00)</td>
<td>9 (47.37)</td>
</tr>
</tbody>
</table>

* Figures in the bracket indicate percentages.

Table 5.22 reveals that water is mainly used as a component of products by the industries (73.68%), use of water for raw material washing (47.37%) and as heat absorbent of the machines (42.11%) are also prevalent in TIA.

5.15 SITE CLEARANCE REQUIREMENTS FOR THE INDUSTRIES OF TIA

When industries of TIA started functioning in TIA there was no environmental guide lines for the siting of industries in TIA and therefore, respective industry owner did not take any clearance from the officials of DOE for the siting of their industries in TIA. But the DOE developed guide line for industries have made it necessary to take clearance from DOE officials for the siting of the industries in TIA. Table 5.23 shows the site clearance requirements for the industries of TIA.
Table 5.23: Site Clearance Requirements for the Industries of TIA.

<table>
<thead>
<tr>
<th>Concerned Official from Whom Clearance is Required</th>
<th>No. of industries</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>No clearance needed</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Deputy Director, DOE</td>
<td>38</td>
<td>24.4</td>
</tr>
<tr>
<td>Deputy Director (enforcement), DOE</td>
<td>40</td>
<td>25.6</td>
</tr>
<tr>
<td>Director General, DOE</td>
<td>08</td>
<td>05.1</td>
</tr>
<tr>
<td>No Information</td>
<td>70</td>
<td>44.9</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>100.00</td>
</tr>
</tbody>
</table>


5.16 CONSENT ORDER REQUIREMENTS BY THE INDUSTRIES OF TIA

The industries of TIA did not take any consent order for their operations in TIA at the time of their operation commencement or any time afterwards. DOE developed guide lines have made it necessary for the industries to take consent order for their operation. Industries of TIA are yet to take any consent order from DOE. Table 5.24 shows the consent order requirements for operation by the industries of TIA.
Table 5.24: Consent Order Requirements for Different Operations by the Industries of TIA

<table>
<thead>
<tr>
<th>Consent order required for</th>
<th>No. of Industries</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>No consent order needed</td>
<td>03</td>
<td>01.9</td>
</tr>
<tr>
<td>Disposal of liquid/or solid waste</td>
<td>12</td>
<td>07.7</td>
</tr>
<tr>
<td>Gaseous emission</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Discharge of solid, liquid and gaseous wastes</td>
<td>53</td>
<td>34.0</td>
</tr>
<tr>
<td>Storage, handling and disposal of hazardous material/wastes</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Comprehensive environmental consent order needed</td>
<td>18</td>
<td>11.5</td>
</tr>
<tr>
<td>No information found</td>
<td>70</td>
<td>44.9</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>100.00</td>
</tr>
</tbody>
</table>


5.17 EFFECTS OF HAPHAZARD DISPOSAL OF INDUSTRIAL WASTE IN TIA

Haphazard disposal of industrial solid waste and waste water by the industries of TIA have already started creating adverse effects on the environments of TIA and surrounding areas. It is also creating strains on the municipal waste management system. Though the gaseous emissions from industries is yet not a major problem but their future pollution potential can not be neglected. Some of the
effects of haphazard waste disposal by the industries are discussed in the following sections.

5.17.1 Deterioration of Surface Water Quality: The water quality of Begunbari Khal can be considered as the representative of surface water quality of the area as the waste water from almost all the industries of TIA are finally disposed of here. Table 5.25 shows the surface water quality of Begunbari Khal.

Table 5.25: Water Quality of Begunbari Khal

<table>
<thead>
<tr>
<th>Period</th>
<th>Dry</th>
<th>Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample point No.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>pH</td>
<td>5.5</td>
<td>6.2</td>
</tr>
<tr>
<td>Color mg/l</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td>Chloride mg/l</td>
<td>-</td>
<td>194</td>
</tr>
<tr>
<td>Alkalinity mg/l</td>
<td>395</td>
<td>115</td>
</tr>
<tr>
<td>Turbidity</td>
<td>190</td>
<td>150</td>
</tr>
<tr>
<td>T.S mg/l</td>
<td>315</td>
<td>987</td>
</tr>
<tr>
<td>T.D.S. mg/l</td>
<td>80</td>
<td>538</td>
</tr>
<tr>
<td>S.S. mg/l</td>
<td>235</td>
<td>449</td>
</tr>
<tr>
<td>DO mg/l</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>BOD mg/l</td>
<td>437</td>
<td>690</td>
</tr>
<tr>
<td>COD mg/l</td>
<td>500</td>
<td>740</td>
</tr>
<tr>
<td>Ammonia mg/l</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Chromium mg/l</td>
<td>-</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Source: Karim (1992)
Table 5.26: Water Quality Standards for Water Use

<table>
<thead>
<tr>
<th></th>
<th>For Recreation</th>
<th>For Laundry</th>
<th>For Bathing</th>
<th>For Survival of Aquatic Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature °F</td>
<td></td>
<td></td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>pH</td>
<td>5.8-8.6</td>
<td>5.8-8.6</td>
<td>5.8-8.6</td>
<td>6.0-9.0</td>
</tr>
<tr>
<td>Color, mg/l</td>
<td>&lt;30-&lt;50</td>
<td>&lt;10-&lt;15</td>
<td>&lt;5-&lt;15</td>
<td></td>
</tr>
<tr>
<td>E.C. microhm/cm</td>
<td></td>
<td></td>
<td></td>
<td>500-1000</td>
</tr>
<tr>
<td>Chloride mg/l</td>
<td>&gt;300</td>
<td>&gt;200</td>
<td>&gt;200</td>
<td>250</td>
</tr>
<tr>
<td>Turbidity ppm</td>
<td>&lt;5-&lt;20</td>
<td>&lt;10-&lt;15</td>
<td>&lt;5-&lt;10</td>
<td>25</td>
</tr>
<tr>
<td>T.S. mg/l</td>
<td>&lt;100</td>
<td>&lt;500</td>
<td>&lt;500</td>
<td></td>
</tr>
<tr>
<td>T.D.S. mg/l</td>
<td>&lt;1000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.S. mg/l</td>
<td>&lt;10</td>
<td>Very small</td>
<td>Very small</td>
<td>80</td>
</tr>
<tr>
<td>D.O. mg/l</td>
<td></td>
<td></td>
<td></td>
<td>&gt; or = 4</td>
</tr>
<tr>
<td>BOD₅, mg/l</td>
<td>&lt;8-&lt;10</td>
<td></td>
<td></td>
<td>&lt; or = 5</td>
</tr>
<tr>
<td>COD mg/l</td>
<td>&lt;20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium mg/l</td>
<td>&lt;1.4</td>
<td>&lt;1.5</td>
<td>&lt;0.05</td>
<td>0.03-0.05</td>
</tr>
<tr>
<td>Ammonia mg/l</td>
<td>10-&lt;20</td>
<td>10</td>
<td>&lt;.5</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: JICA (1987) and Azad (1976)

Table 5.25 reveals that during dry period, near the discharge point of TIA, pH varies from 5.5 to 6.2; the DO is 0, BOD₅ varies between 437 to 1300 mg/l, COD ranges between 500 to 2000 mg/l; T.D.S from 80 to 680 mg/l; T.S. from 315 to 1108 mg/l; 150 to 250 NTU. The respective values for wet period is slightly lower than the dry period. These values indicate that canal water is grossly polluted and remain under septic condition during dry period.

Comparison of data between Tables 5.25 and 5.26 reveals that the water of the Begunbari Khal does not meet any standard quality.
criteria for any beneficial use. 88.89% (224 out of 252) of the respondents have said that quality of surface water in the area is bad. 5.56% have said it is average while rest of them have said that it is good.

5.17.2 Effects on Ambient Air Quality: In the NEMPCP project the ambient air quality of TIA was studied in 1990. The values of different parameters of ambient air quality for TIA are summarized in Table 5.27. Detail data sheets are given in Tables E6, E7, and E8 of Appendix E.

Table 5.27: Ambient Air Quality of TIA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Months in which max value observed</th>
<th>Total Sample</th>
<th>Max Value</th>
<th>Mean Value</th>
<th>Number of observations higher than following concentration limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPM</td>
<td>Jan.</td>
<td>5</td>
<td>478</td>
<td>401</td>
<td>100 200 250 500 1200 80 60 30 120 80 60 30</td>
</tr>
<tr>
<td>SO₂</td>
<td>Jan.</td>
<td>3</td>
<td>359</td>
<td>195.2</td>
<td>- - - 2 3 3 - - - - -</td>
</tr>
<tr>
<td>NOₓ</td>
<td>July</td>
<td>7</td>
<td>58.9</td>
<td>19.6</td>
<td>0 0 0 0 0 0 0 0</td>
</tr>
</tbody>
</table>

Source: NEMPCP, 1992

* Units are in Microgram/meter cube

Table 5.28: Standards for Ambient Air Quality.

<table>
<thead>
<tr>
<th>Area</th>
<th>Category</th>
<th>Concentration in micro gram/meter cube</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SPM</td>
</tr>
<tr>
<td>A</td>
<td>Industrial and mixed use</td>
<td>500</td>
</tr>
<tr>
<td>B</td>
<td>Residential and Rural</td>
<td>200</td>
</tr>
<tr>
<td>C</td>
<td>Sensitive</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Agrawal, 1983.

From Table 5.27 it can be observed that maximum observed values of SPM, SO₂ and NOₓ in TIA are 478, 359 and 58.9 microgram/meter cube respectively. Maximum values of SPM and SO₂ were observed in the month of January and NOₓ in the month of July.
Comparisons of findings content in Tables 5.27 and 5.28 lead to the conclusion that none of the values of SPM, SO$_2$, and NO$_x$ emission in TIA have crossed the standard values for industrial and mixed used areas. But as far as residential use of the area is concerned, the value of SPM and SO$_2$ concentration in the ambient air has exceeded the limit to some extent. The inhabitants of TIA have also complained about the poor air quality and probable air pollution in the area. 55.56% (140 out of 252) of the respondents have complained about air pollution by the industries, of them 38.89% have complained of offensive odors from different industries while rest 16.67% have complained of some physical troubles like eye irritations and skin diseases etc.

5.17.3 Effects on Ground Water Quality: Almost entire TIA is connected with the public water supply network provided by DWASA. During the field visit in study area, water quality of some hand tube wells was observed and nothing objectionable was noticed. The inhabitants of TIA also did not mention any major complain. But haphazard disposal of industrial solid and semisolid waste and subsequent leachet formation may lead to ground water contamination as the typical characteristic of leachet (See Appendix E.) from the solid wastes of Dhaka city has tremendous pollution potential (Islam, 1992). 22.22% (56 out 252) of the respondents have said that quality of drinking water in the area is good. Rest 77.78% (196 out of 252) have said that the quality is average.

5.17.4 Drain Blockage and Disruption of Storm Water Conveyance: During the field visit, haphazard disposal of solid wastes in the open drains (See Plate 5) was noticed. Besides the inhabitants of TIA also identified drain blockage by haphazard disposal of solid waste as major reason of water logging during the rainy season. 83.33% of the respondents of the study area think that water logging in the study area after minor rains is due to the drain blockages by the disposal of solid wastes by the industries. 72.22% of the respondent have identified shortage of sewer line in the area as the main reason.
Table 5.29 **Reason of Water Logging in TIA.**

<table>
<thead>
<tr>
<th>Reasons of Water logging</th>
<th>Opinion out of 252 respondents</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain blockage by haphazard dumping of industrial solid waste.</td>
<td>210</td>
<td>83.33</td>
</tr>
<tr>
<td>Shortage of sewer lines</td>
<td>182</td>
<td>72.22</td>
</tr>
<tr>
<td>Filling up of ditches by the solid wastes produced from industries</td>
<td>28</td>
<td>11.11</td>
</tr>
<tr>
<td>Canal mouth blockage</td>
<td>28</td>
<td>11.11</td>
</tr>
<tr>
<td>Filling up of the low lands for housing</td>
<td>42</td>
<td>11.67</td>
</tr>
</tbody>
</table>


Besides filling up of ditches by the industrial solid wastes, canal blockage filling up of the low lands for residences are also identified by the respondents as major causes of water logging in the area.

Untreated waste water disposal in the storm sewerage and open drains of TIA may cause early destruction of the drains and sewerage pipelines because a number of industries in TIA discharge highly corrosive waste water. Typical waste water characteristics of some of the typical chemical, Textile and Pharmaceutical Industrial units, present in Appendix E testify the fact.

5.17.5 **Municipal Waste Collection, Treatment and Disposal:**

i) Collection: Haphazard disposal of industrial solid waste (Plate 7) has been observed throughout the TIA. As told by the garbage crew of Dhaka City Corporation, this haphazard dumping of wastes outside the bins create much problems and make their task tedious. 7 out of 19 responding industries of TIA admitted about the disposal of their waste water in the public sewerage system. Values of different parameters of waste waters from some typical chemical dyeing and textile and pharmaceutical industries as presented in Tables E3 and E4 of Appendix E, are found far exceeding the standard limits for discharging into public sewer system (See Table E5 of Appendix E). This may lead to early destruction of the public sewer lines.
ii) **Treatment**: Only BOD, and T.S. data for the influent of Pagla waste water treatment plant are available. But it can be obviously said that Pagla treatment plant is treating quite a substantial amount of industrial waste from Tejgaon and Hazaribag. It is putting some sort of strain on the operation of Pagla treatment plant and in future it can upset the future operation of Pagla treatment plant (Karim, 1992).

iii) **Disposal**: Industrial solid wastes of TIA are disposed of along with municipal solid wastes in the dump site at Jatrabari. As in Bangladesh crude dumping is the only practiced option for disposing of the solid wastes so no significant problem has yet been noticed in disposing the industrial wastes in the dump site. Regarding the household disposal of solid waste in the municipal dustbin, 55.56% of the respondents informed that they face various problems for this mixed disposal.

All of the respondents have mentioned that in TIA industrial solid wastes and household solid wastes are dumped together. 94.44% of the respondent do not think that there are sufficient dustbins in TIA while rest 5.56% think that the number of dustbins in TIA are sufficient but 55.56% (140 out of 252) of the respondents have mentioned that they face problem in disposing of solid wastes from their houses in the same dustbin while 44.44% (112 out of 252) of the respondents did not has any problem.

Nature of problem being faced by the respondents in disposing of their household solid waste in the same dustbin are shown in Table 5.30.

Table 5.30 reveals that 90.00% the respondents identified shortage of space in the dustbins as the main problem being faced by them in disposing their household waste in the same dustbins of where industrial wastes are dumped in TIA. Besides offensive odors (70.00%), rapid destruction of dustbin (50.00%) are the other two main problems being faced by the inhabitants in disposing house hold solid waste in the same dustbin along with industrial waste as mentioned by the respondents.
Table 5.30: Nature of Problem of Household Solid Waste Disposal in TIA.

<table>
<thead>
<tr>
<th>Nature of problem</th>
<th>No. of respondents facing the problem</th>
<th>% Out of 140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortage of space for household waste disposal</td>
<td>126</td>
<td>90</td>
</tr>
<tr>
<td>Offensive odor</td>
<td>98</td>
<td>70</td>
</tr>
<tr>
<td>Rapid destruction of bins</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>Industrial wastes are scattered outside the dustbins by birds and animals</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>Others</td>
<td>56</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Field Survey, March-April 1994

So 55.56% (140 out 252) of the respondents in TIA think that industrial wastes should be dumped in separate dustbins while rest 44.44% do not think it necessary.

5.17.6 Effects on Health and Sanitation: Pollution potential of the industrial solid wastes from various industries of TIA is not very significant to cause health and sanitation problem. But the waste water from various industries of TIA may cause severe health and sanitation problems. Already severe problems have been reported in the low lying areas of the eastern flood plain i.e the areas along Begunbari Khal. During the dry season due to the discharges from Begunbari and Norai Khal thousands of small farmers and villagers are affected by various diseases especially very noticeable is skin problems and spread of gastro intestinal disease and worms (NEMPCP, 1992). From the questionnaire survey it was also found that 55.56% of the respondents have complained against some sort of physical trouble from the gaseous emissions of industries of TIA. Textile & dying industries, electroplating industries in TIA are generating various types of heavy metal and toxic wastes which may be dangerous for the workers working in those industries.

5.17.7 Effects of Beneficial Use of Water of Begunbari Khal: During the dry season the water of Begunbari Khal is used extensively for irrigation. It may cause various soil problems due to the high levels of deposited organic and inorganic solid and
possible heavy metal contamination (NEMPCP, 1992). Besides due to septic condition of Begunbari Khal during dry season fisheries have been completely destroyed. Additional negative impacts of the dry season Begunbari discharges include (i) contamination of shallow tube wells which are used extensively in the area (ii) unusability for livestock purposes and substantial number of cows had died from drinking the contaminated water (iii) unusability for bathing (iv) creation of aesthetic nuisance.

5.17.8 Others: Degradation of water quality of the Sitalakhya river in the dry season due to the discharges of water from Balu river which is fed by Begunbari Khal, may create problem for the proposed DWASA surface water treatment plant which will serve as source of drinking water for Dhaka city in future (NEMPCP, 1992).

5.18 ROLE OF DIFFERENT ORGANIZATIONS IN INDUSTRIAL WASTE MANAGEMENT IN TIA

Immense pollution potential of industrial wastes and their subsequent harmful effects on the surrounding environment constitute the main rationale of developing a systematic waste management system for any area. This may be the responsibility of one organization or may be a collective responsibility of a number of organizations. In Tejgaon I/A three organizations share this responsibility, namely Department of Environment (DOE), Dhaka City Corporation (DCC) and Dhaka Water and Sewerage Authority (DWASA). Their present role is discussed in the following sections.

5.18.1 Role of DOE: DOE is the only national level organization which deals with various environmental issues in Bangladesh. At present DOE is dealing with various environmental issues of 14 different sectors in Bangladesh. They have already formulated an Environmental policy for Bangladesh. In the industrial sector the main responsibility of DOE is to carry out a survey for the identification of the polluting industries and to take necessary measures for controlling air and sound pollution. To accomplish this task DOE has already developed National Environmental Quality Standard which contains standards for effluent and emissions from the industries.
According to the prevailing ordinance DOE officials possesses the legal authority to enter the premises of industries for inspection, and sampling purpose. DOE is also responsible for investigating the complains received from sources related to environmental pollution by industries.

Looking after the various environmental pollution issues by the industries of TIA is the responsibility of Dhaka Division office of DOE. This office is equipped with a laboratory with very limited modern equipments (DOE, 1990), and the staffing of this office is also very poor. There are only 11 persons presently working in this office of them 5 are officers and 6 are employees. Detail organogram of DOE is given in Appendix G.

The technical competence of the staff member in IWM is also not sufficient (NEMPCP, 1992). So with such a limited staff and facilities no waste water or gaseous emission characterization has even been done in TIA. Besides very often access into the premises of industries by DOE personnel is also denied by the industry owners (NEMPCP, 1992). So regular monitoring of the wastes produced from different industries or even waste characterization and quantification seems to be impossible by DOE.

Though DOE has identified some of the industries in TIA as polluting industries but the basis of this identification seems to be very tentative. The discussion with DOE official by the author identified some of the major constraints which limit the scope of DOE's work in controlling industrial pollution in TIA and made the IWM task difficult.

The constraints identified are:

i) Lack of adequate manpower.
ii) Lack of technical competence of the existing staff.
iii) Limited budget
iv) Lack of necessary laboratory facilities
v) Absence of effluent and emission standards (the existing one is yet in a draft form)
vi) Very big jurisdiction of Dhaka Division office
vii) Lack of co-ordination with other concerned agencies.
viii) Non-co-operation of industry owners.
5.18.2 **Role of DCC**: Main responsibility of DCC in industrial waste management is to deal with the industrial solid wastes, which are being dumped by the industries of TIA in the municipal dustbins. This is the responsibility of conservency department of zone 9 office of DCC. As informed by the DCC zone 9 office, there are 7 wards in the zone and TIA is a part of ward no. 71. There is one conservency officer in zone 9, one conservency supervising Inspector in each of the wards of the zone. DCC zone 9 is entitled to possess 8 vehicles of them 1 is earmarked for TIA. There are 411 seepers in zone 9 of DCC of them 86 are employed for TIA. The workers are paid 35 Taka each daily. The payment is done in monthly basis and there are provisions for deduction for absenting. Total budget for the conservency in zone 9 for the year 1994 is Tk. 93,21,562. Both industries and households are charged with a flat rate of 2% of the rental value of the houses or industries. From the discussion with the concerned officials of zone 9 of DCC it was learnt that the poor budgetary allocation for conservency was the main constraint of providing any better services by DCC in the area.

Present mode of operation in the area is at first dustbins along Tongi diversion road and near by areas are cleaned and then subsequently other areas are cleaned. There are about 30 dustbins scattered throughout the TIA. Typical plans and section of the dustbins are shown in the Figure 10. Open drains both Katcha and pucca in the study area are constructed and maintained by DCC. These open drains were not constructed following any systematic network. DCC does not have any plan of such network either. 83.33% of respondents of the survey conducted for the present study have informed that open drains of the area are not cleaned and maintained regularly.

5.18.3 **Role of DWASA**: Construction operation and maintenance of sanitary sewerage is the responsibility of zone 4 of Dhaka WASA while the construction, maintenance and operation of storm sewerage is the responsibility of Drainage Circle of DWASA. From the discussion with DWASA official following information were gathered:

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i) Industries with sanitary sewerage connection pay sewerage bills which is the same amount of water bill. Meters are installed in every household of industrial connections.

ii) No bills are required to pay either by household or by industries for connections of storm sewerage.

iii) Storms sewerage network was constructed for smooth draining of rain water only and no industries have any legal right to drain their waste water is the storm sewerage.

iv) Sanitary sewerage network is for the connections of toilet in the area. No industries have any legal right to discharge their waste water in the sanitary sewerage line.

v) The WASA official admitted that there might be some connections from the industries to both sanitary and storm water sewerage lines which are used for draining out waste water from the industries. But DWASA do not have any record.

vi) As only BOD and T.D.S. of influent of Pagla plant are monitored so possibility of existence of industrial waste in the influent of Pagla treatment is not possible to determine.

vii) WASA did not take any action against any such illegal connections by the industries.

5.18.4 Role of PWD: Tejgaon Industrial Area was established in the mid 50's by PWD (erstwhile C&B). After developing the site and making necessary sub-division of the plots, those plots were handed over to the private industry owners or other govt. agencies. PWD do not take care of any waste management related activities in the area at present. The plots of the area have been leased to the private industry owners or other govt. agencies. Though PWD is the owner of the land of TIA but its activity is found at the time of lease renewal, lease termination or lease transfer of the plots only.
5.19 SUMMARY

In TIA there exists 156 different types and sizes of industries which in the present study they have been classified into seven groups. All the industries in TIA produce solid waste, 58 of them produce waste water of them 13 produce about 50% of the total waste water generated from the area. Nine industries of TIA mainly medium and small units produce gaseous emissions. The impacts on surrounding environment by the different types of waste generated from the industries of TIA have been discussed in this chapter. Besides different management aspects along with role of different agencies involved in waste management task have also been discussed in this chapter.
CHAPTER 6 : OPINIONS OF INDUSTRY OWNERS/MANAGERS AND INHABITANTS OF TIA REGARDING IWM
6.1 **INTRODUCTION**

In this chapter views of industry owners/managers of some of the industries of TIA regarding various issues of IWM have been discussed. Besides, the opinions of the inhabitants of TIA, regarding present waste management practices by the industries and their effects on the surrounding environment of TIA and ways of improvement of the living environment of TIA have also been discussed in this chapter.

6.2 **VIEWS OF THE INDUSTRY OWNER/MANAGERS**

6.2.1 **Pollution Potential of Wastes** : All the managers/owners of the surveyed industries showed ignorance regarding pollution potential of their produced wastes. Their opinion in this regard is as they have not ever characterize their produced wastes and as the volume of generated waste is very insignificant so they are not sure about any kind of pollution by the wastes generated from their industries.

6.2.2 **Quantification and Characterization of Wastes** : None of the surveyed industries have any facility to quantity and characterize their wastes. Regarding reasons for not having such facilities, industry owner/managers gave top priority (26.32%) to the reason that they felt quantity of waste water was insignificant. However 5 (five) out of 19 managers/owners opined that not availability of laboratory facility was the reason of not quantifying and characterizing the wastes from the respective industries. None of them mentioned about the lack of technical know-how.

6.2.3 **Plant Level Treatment Facility** : 13 (68.42%) out of 19 surveyed industries informed that they were not equipped with any kind of treatment facility within their factory premises (see table 5.14), 12 of the factory managers of these 13 units said that the reason of not having such units in their respective factories was they thought the wastes produced from their respective factory were harmless. Only one factory manager of group 6 admitted that he
had no knowledge about the treatment technology. They also did not mention about the lack of competent and knowledgeable technical manpower in their respective units.

6.2.4 Complain Against Other Industries: 3 managers of the surveyed industries complained against other nearby industries of these 3 industries. 1 was from group 1 and other 2 were from group 4. In group 1 Nabisco complained against Farooque chemical industry which is an industrial chemical (sodium silicate) producing unit. Nabisco complained that generation of dust and fumes from Farroque chemical was hampering the quality of their products. Manager of Nabisco informed that they had brought this matter to DOE’s knowledge. The manager of Farooque chemical Industries did not comment on the issue.

Other two complains were against Auto Equipment Plant by Orion laboratories and against M/S Shahana Chemical Co by Kohinoor Chemical Company. Orion complained against excessive sound generation of the Auto Equipment Plant while Kohinoor complained against air pollution of Shahana Chemical Company. The author had been denied access to both of the plants - Auto equipment plant and M/s. Shahina Chemical Co. by their respective authorities.

6.2.5 Plan to Adopt New Technology: 15 (78.95) out of 19 surveyed industries managers/owners opined that they had no thinking regarding adoption of any kind of new technology which could reduce the volume of wastes from their respective units. 1 (Kohinoor Chemical Company) from group 4 and another (Swantax Waterproof Works) from group 7 opined that they would adopt new technology while rest 2 from group 4 did not comment on this matter.

6.2.6 Plan to Produce New Product: 2 each from group 2 and group 4 and 1 each from group 5 and group 7, a total of 6 (31.58%) out of 19 industry managers/owner informed that they would produce new products in the near feature. While rest 13 (68.42%) answered negative regarding this issue.
6.2.7 Change in Waste Generation Pattern: Regarding change in waste generation pattern one manager each from group 2 and group 4 informed that production of new product in their factory would not change waste volume, one manager from group no.4 informed that their waste would be decreased while rest 3 could not specify.

6.2.8 Government Help in Plant Level Management: Regarding government help in the plant level management of industrial waste 8 (42.11%) out of 19 industry owner/manager felt it necessary. 6 (31.58%) manager did not feel it necessary while rest 5 (26.32%) did not comment on this issue.

6.2.9 Steps to be Taken for the Improvement of Waste Management System at TIA: 8 different activities were suggested by the author to the managers/owners of industries at TIA regarding steps to improve the waste management system at TIA Those were:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DCC should expedite and regularize solid waste collection system from TIA.</td>
</tr>
<tr>
<td>2</td>
<td>Solid industrial wastes should be disposed in separate dustbins.</td>
</tr>
<tr>
<td>3</td>
<td>Government should establish a combined treatment plant for treating industrial wastes at TIA.</td>
</tr>
<tr>
<td>4</td>
<td>Government should provide financial and technical support to the industries for establishing treatment facilities respective industries.</td>
</tr>
<tr>
<td>5</td>
<td>Pollution control standards and laws should be updated.</td>
</tr>
<tr>
<td>6</td>
<td>Pollution control laws should be enforced rigidly.</td>
</tr>
<tr>
<td>7</td>
<td>Waste disposal permit system should be adopted.</td>
</tr>
<tr>
<td>8</td>
<td>Other (training etc)</td>
</tr>
</tbody>
</table>
The views of the industry Owners/Managers have been shown in Table 6.1

Table 6.1: Suggestions of Industry Owners/Managers to Improve IWM in TIA

<table>
<thead>
<tr>
<th>Activities</th>
<th>No. of Owners/Managers opted for the alternative.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity 1</td>
<td>17</td>
<td>89.47</td>
</tr>
<tr>
<td>Activity 2</td>
<td>08</td>
<td>42.11</td>
</tr>
<tr>
<td>Activity 3</td>
<td>15</td>
<td>78.95</td>
</tr>
<tr>
<td>Activity 4</td>
<td>05</td>
<td>26.32</td>
</tr>
<tr>
<td>Activity 5</td>
<td>11</td>
<td>57.89</td>
</tr>
<tr>
<td>Activity 6</td>
<td>06</td>
<td>31.58</td>
</tr>
<tr>
<td>Activity 7</td>
<td>01</td>
<td>05.26</td>
</tr>
<tr>
<td>Activity 8</td>
<td>01</td>
<td>05.26</td>
</tr>
</tbody>
</table>

Source: Field Survey, 1994

6.3 VIEWS OF THE INHABITANTS OF TIA

A questionnaire survey was conducted among the inhabitants of TIA to get their views regarding various issues related to industrial waste management in TIA.

6.3.1 General Information About the Respondents: General information of the respondents includes their age grouping, sex ratio, occupation, educational qualifications, length of stay in the area, reasons for staying in the area and their place of work.

6.3.1.1 Age Groups: Respondents were categorized into 4 age groups. Table 6.2 shows the age group of the respondents.
Table 6.2: Age Groups of the Respondents

<table>
<thead>
<tr>
<th>Age groups</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 - 17</td>
<td>28</td>
<td>11.11</td>
</tr>
<tr>
<td>18 - 34</td>
<td>98</td>
<td>38.89</td>
</tr>
<tr>
<td>35 - 59</td>
<td>112</td>
<td>44.44</td>
</tr>
<tr>
<td>60 +</td>
<td>14</td>
<td>05.56</td>
</tr>
<tr>
<td>Total =</td>
<td>252</td>
<td>100.00</td>
</tr>
</tbody>
</table>


From Table 6.2 it can be observed that nearly 90% of the respondents were within the age group of 18-34 and 60+. It was done deliberately to get a clear picture of the situation as the elderly people are usually thought to be well informed.

6.3.1.2 Sex Ratio: 168 male and 84 female were interviewed during the survey.

6.3.1.3 Occupation: Among the 252 respondents 11 were unemployed. Rest 241 were engaged in 7 different occupations. Table 6.3 shows the occupation wise distribution of the respondents.

From Table 6.3 it can be observed that main occupation of the respondents were own business (22.22%). This was due to the fact that during the questionnaire survey quite a good number of shop keepers in the TIA were interviewed. Excluding the retired persons and unemployed the occupation wise distribution of the respondents were quite closer. This closer distribution of respondents according to occupation would help to get the views of a well represented cross section of population at TIA.
Table 6.3 **Occupation of the Respondents**:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Govt. Service</td>
<td>30</td>
<td>11.90</td>
</tr>
<tr>
<td>Private Service</td>
<td>29</td>
<td>11.51</td>
</tr>
<tr>
<td>Own Business</td>
<td>56</td>
<td>22.22</td>
</tr>
<tr>
<td>Day Labour</td>
<td>42</td>
<td>16.67</td>
</tr>
<tr>
<td>Housewife</td>
<td>42</td>
<td>16.67</td>
</tr>
<tr>
<td>Student</td>
<td>28</td>
<td>11.11</td>
</tr>
<tr>
<td>Retired</td>
<td>14</td>
<td>05.55</td>
</tr>
<tr>
<td>Unemployed</td>
<td>11</td>
<td>04.37</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>252</td>
<td>100.00</td>
</tr>
</tbody>
</table>


6.3.1.4 **Educational Qualification**: Table 6.4 shows the educational qualification of the respondents in TIA.

From Table 6.4 it can be understood that 77.78% of the respondent had their education at least up to S.S.C. level. So they can be considered well informed about the various environmental consequences of the area.

Table 6.4 **Educational Qualification of the Respondents**.

<table>
<thead>
<tr>
<th>Qualification</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiterate</td>
<td>0</td>
<td>00.00</td>
</tr>
<tr>
<td>Upto Primary</td>
<td>28</td>
<td>11.11</td>
</tr>
<tr>
<td>Upto High School</td>
<td>28</td>
<td>11.11</td>
</tr>
<tr>
<td>S.S.C.</td>
<td>42</td>
<td>16.67</td>
</tr>
<tr>
<td>H.S.C.</td>
<td>112</td>
<td>44.44</td>
</tr>
<tr>
<td>Graduate</td>
<td>42</td>
<td>16.67</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>252</td>
<td>100.00</td>
</tr>
</tbody>
</table>

6.3.1.5 Duration of Stay In The Area: Table 6.5 shows the duration of stay of the respondents in TIA.

Table 6.5: Duration of Stay in TIA by the Respondents in TIA.

<table>
<thead>
<tr>
<th>Duration of stay</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 year</td>
<td>0</td>
<td>00.00</td>
</tr>
<tr>
<td>1-3 year</td>
<td>0</td>
<td>00.00</td>
</tr>
<tr>
<td>4-6 year</td>
<td>56</td>
<td>22.22</td>
</tr>
<tr>
<td>7-9 year</td>
<td>28</td>
<td>11.11</td>
</tr>
<tr>
<td>10 years or more</td>
<td>168</td>
<td>66.67</td>
</tr>
</tbody>
</table>


From Table 6.5 it can be observed that majority (66.67%) of the respondent have been staying in the TIA for more than 10 years. So their opinions would give a more clear picture of the various issues relating to industrial waste management and environmental consequences of the study area.

6.3.1.6 Place of Work: 126 (50.00%) of the respondent have their place of work inside TIA while 31 (12.30%) have their place of work outside TIA. Students, retired persons, unemployed and housewives constitute the rest 95 (37.70%)

6.3.2 Opinions Regarding Living Environment in TIA: Out of 252 respondents 168 (66.67%) have opined that the living environment of TIA is average, 70 (27.77%) have opined that it is poor while rest 14 (5.56%) have said that it is good. In table 6.6. opinions of the respondents of TIA regarding the cause of poor living environment in TIA have been incorporated.
Table 6.6 : Respondents View Regarding Causes of Poor Living environment in TIA :

<table>
<thead>
<tr>
<th>Causes of Poor living Environment</th>
<th>No. of respondent</th>
<th>% respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad Social condition</td>
<td>70</td>
<td>27.77</td>
</tr>
<tr>
<td>Direct Industrial pollution</td>
<td>14</td>
<td>5.56</td>
</tr>
<tr>
<td>Electricity failure</td>
<td>56</td>
<td>22.56</td>
</tr>
<tr>
<td>Shortage of water supply</td>
<td>14</td>
<td>5.56</td>
</tr>
<tr>
<td>Solid waste miss management</td>
<td>42</td>
<td>16.67</td>
</tr>
<tr>
<td>Miss management of open drains and sewer</td>
<td>42</td>
<td>16.67</td>
</tr>
<tr>
<td>Absence of Recreational facilities (open space, play ground, park etc.)</td>
<td>14</td>
<td>5.56</td>
</tr>
<tr>
<td>Total</td>
<td>252</td>
<td>100.00</td>
</tr>
</tbody>
</table>


Table 6.6 reveals that bad social condition is the main reason for poor living environment in the area according to the opinions of the respondents.

Direct pollution from the industries is the least spelled out cause by the respondents. But the causes mentioned from Sl. No. 3 to 7 of Table 6.6 individually or collectively are the results of industrial waste miss management and accounts for the main reasons of poor environment as 66.67% of the respondents have mentioned them.

6.3.3 Opinion Regarding Industrial Pollution: Most of the respondents (196 out of 252) think that there is possibility of industrial pollution which can endanger their lives by the industries of TIA. Their views regarding the way, the industries are polluting the area are incorporated in Table 6.7
Table 6.7: Respondents View Regarding How the Industries are Polluting the Environment of TIA.

<table>
<thead>
<tr>
<th>Industries are of polluting the environment.</th>
<th>No.</th>
<th>% out of 196</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haphazard disposal Solid Waste</td>
<td>182</td>
<td>92.86</td>
</tr>
<tr>
<td>Air pollution</td>
<td>126</td>
<td>64.29</td>
</tr>
<tr>
<td>Sound pollution</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Indiscriminate liquid waste disposal</td>
<td>196</td>
<td>100.00</td>
</tr>
<tr>
<td>Not applicable</td>
<td>56</td>
<td>--</td>
</tr>
</tbody>
</table>


From Table 6.7 it can be observed that indiscriminate disposal of liquid waste by the industries is the most spelled out way regarding how the industries are polluting. Haphazard disposal solid waste (92.86%) and Air pollution (64.29%) are also the main two spelled out reasons by the respondents regarding the way of industrial pollution in TIA.

6.3.4 Measures to be Taken to Check Environmental Pollution: 210 (83.33%) respondents think that they can be effected by the industrial pollution if they live in the TIA. Regarding the measures those can be taken to check any probable industrial pollution all of them (210 out of 252) suggested for the enactment of strict pollution control laws and strict enforcement of the same so that industries of TIA become more particular in establishing pollution control measures in their respective industries. 93.33% (196 out 252) of the respondents opted for the closure of polluting industries while 40% (84 out 252) of the respondents suggested that residentialites should be shifted else where from TIA.

6.3.5 Opinion Regarding Awareness Of The People About Industrial Pollution: 27.78% of the respondents think that the people are well informed about the harmful effects of industrial pollution while rest 72.22% think that people are not well informed. Table 6.8 shows the various options as suggested by the respondents to be
followed to make the people aware regarding industrial pollution problem.

Table 6.8: Options to be Followed to Make People More Aware About Industrial Pollution.

<table>
<thead>
<tr>
<th>Probable options</th>
<th>Number of respondents favoring the option</th>
<th>% out of 252</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through postering, leafleting</td>
<td>28</td>
<td>11.11</td>
</tr>
<tr>
<td>Through newspaper</td>
<td>168</td>
<td>66.66</td>
</tr>
<tr>
<td>Through TV program</td>
<td>168</td>
<td>66.66</td>
</tr>
<tr>
<td>Through Radio program</td>
<td>182</td>
<td>72.22</td>
</tr>
<tr>
<td>Through lessons in schools and colleges</td>
<td>56</td>
<td>22.22</td>
</tr>
</tbody>
</table>


Table 6.8 reveals that radio, TV and newspaper can play a vital role in this aspect. Nevertheless, the role of teaching in the schools and colleges should not be undermined at all.

6.4 SUMMARY

For any planning decision it is very important to incorporate the views of the actors involved in any particular problem for the solution of which planning is needed for intended. For a systematic waste management task for TIA industry owners/managers, and inhabitants of TIA play a very significant role their views in this aspect as discussed in this chapter would help formulating such a policy which would serve the logical interests of all the parties involved.
CHAPTER 7: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION
7.1 INTRODUCTION

In this chapter findings from all the chapters of the study have been summarized. From the these findings some general recommendations have been made. Specific recommendations for industrial waste management in TIA and responsibilities of different agencies, national legislative body, industry owners, inhabitants of TIA and mass media have also been identified in this chapter. Besides a IWM model for TIA have been also developed and have been appended in this chapter.

7.2 FINDINGS FROM THE STUDY

1) Though there exists an environmental policy in Bangladesh but none of the recommendations of this policy for industrial sector regarding industrial pollution control, have ever been exercised in TIA by either the industries concerned or any responsible agency.

2) Recommendations of Industrial Policy of 1991 regarding taking of adequate precautionary measures by the industries which have the pollution potential area not being followed by any industries in TIA.

3) Clauses relevant to industrial sector of newly promulgated Environment Protection Act 1995 should be strictly enforced.

4) Environmental quality standard especially industrial effluent and emission standard for Bangladesh is yet in draft form. It is limiting the DOE's scope of work.

5) Though DOE has developed an environmental Guide line for the industries but none of the industries in TIA follow that guide line.

6) DOE the only national level organization dealing with industrial pollution control in Bangladesh is starved with poor staffing. The budgetary allocation for the department is also poor.
So its responsibilities in IWM task is seriously hampered.

7) The performance of DCC in cleaning up operation industrial solid waste is not satisfactory the performance of this organization is handicapped due to poor budgetary allocation.

8) DWASA do not have any records regarding sewerage lines connections by the industries for disposing of industrial waste water in TIA.

9) There is no co-ordination of activities among DOE, DCC and DWASA regarding industrial waste management in TIA.

10) About 1.5 to 2.0 MT/day of solid 5000 m$^3$/day liquid wastes are produced from the industries of TIA.

11) No characterization of liquid wastes from the industries of TIA have ever been done in TIA.

12) 3 small scaled and 6 medium scale units in TIA produce about 2400 Kg CO, 60 Kg SPM, 2400 Kg Hc 300 Kg NO$_x$ and 30 Kg SO$_2$ per day.

13) Pollution load of waste water from TIA are, BOD 3 tons/ day, T.S.S. 3 tons/day, T.D.S. 5 tons/day and flow 5000 m$^3$/day.

14) None of the industries in TIA have ever taken site clearance NOC 's from DOE regarding siting of their industries in TIA.

15) None of the industries of TIA have ever taken any consent order for their operations in TIA from DOE.

16) Major harmful effects of haphazard disposal of industrial waste in TIA are identified as
   * Deterioration of surface water quality.
   * Effects on ambient air quality.
   * Effects on Ground Water quality.
Drain blockages and disruption of storm water conveyance
* Strain on municipal waste Collection Treatment and disposal system.
* Effects on health and sanitation of the inhabitants of TIA.
* Effects of beneficial use of water of Begunbari Khal.
* Degradation of water quality of sitalakhya river which may create problem in the operation of proposed surface water treatment plant.

17) Industry owners/managers of the surveyed industries showed ignorance regarding pollution potential of the produced wastes from their factory. They also mentioned that insignificant quantity unavailability of laboratory facilities were the main reasons of not quantifying and characterizing the wastes from their respective industries.

18) 42.10% of the responding managers/owners told that government help for plant level management would be necessary, 31.58% felt it was not necessary while rest 5 (26.32%) did not comment on this issue. But most of the (78.95%) responding industry owner/Manager favoured the idea of establishing joint treatment plant for treating the waste water generated from the industries of TIA.

19) From the questionnaire survey among the inhabitants of TIA it has been found that the inhabitants are quite aware of the probable pollution of environment by the industries of TIA. They have mentioned that they face problem in dumping their household waste along with industrial waste in the same bin they think the numbers of the dustbin are not sufficient. They are also not satisfied with the service provided by DCC in cleaning up operation of bins and open drains. They also viewed that pollution control laws should be strictly enforced by the responsible agencies to compel the industries to follow pollution control laws and take necessary measures to treat their waste before discharging them in surrounding areas.
7.3 INDUSTRIAL WASTE MANAGEMENT MODEL FOR TIA

The industrial waste Management model for TIA has been developed from the findings and recommendations of the present study. It has been developed in three steps. The model has been shown in the figure 10.

Step 1 : Identifying different components of IWM : From the discussion of chapter 3 of the present study it has been observed that though different industries produce different types of wastes but they can be grossly classified into 3 types viz., solid, liquid and gaseous wastes. It has been also observed from chapter 5 that in TIA a particular type of industry may generate any one of these 3 types or all the 3 types of wastes. Another important findings which has been found from chapter 3 is that any one of these 3 types of waste or all the 3 types may contain toxic ingredients. Considering these facts, total IWM system for TIA has been divided into 4 components. These components are, viz., Industrial Solid Waste Management (ISWM), Industrial Liquid Waste Management (ILWM), Industrial Gaseous Emission Control and Management (IGECM) and Industrial Toxic Waste Management (ITWM). (See chapter 4)

Step 2 : Identifying Different Activities for IWM: It has been observed from the discussion of chapter 4 that both physical and policy planning are implicated for comprehensive management of industrial wastes for a particular area. In chapter 5 existing unscientific management practices of industrial wastes by different types of industries in TIA, their drawbacks and the harmful effects from the unscientific management practices have been identified. In chapter 6 views of industry owners and the inhabitants of TIA regarding various issue of waste management have been incorporated. Besides different Policy, legislative and financial aspects of IWM have been discussed in chapter 4. Activities of different agencies related to waste management and their short comings and constraints have been identified in the discussion of various sections of chapter 5. (see section 5.18). From these discussions three level of activities have been felt necessary for coordinate waste management in TIA. These are viz., National Level Activities, Area Level Activities and Plant Level Activities.
Figure 10. IWM Model for TIA.
i) **National Level Activities**: In the National level those activities which are needed not only for TIA but also for the management of industrial wastes in anywhere in the country have been identified. Actually the activities those have been identified in this level are beyond the capacity of the individual industries, or the agencies involved in waste management in TIA. Various policy issues, promulgation of new laws, updating standards, awareness building among the industry owners and the people living in the industrial estates are the major activities in this level. Most of the activities in this level are related to policy level planning for IWM of the country as a whole.

ii) **Area Level Activities**: Area level activities begin after the disposal of wastes by the individual industries in the surrounding areas of the industries. In TIA management responsibilities in this level mainly rest on DOE, DCC and DWASA. Various shortcomings and constraints of these organizations as identified in the present study lead to putting forward some recommendations for these organizations for remodelling their activities in TIA for smooth management of industrial wastes in this level.

iii) **Plant Level Activities**: Plant level activities which have been identified for IWM in TIA are the responsibilities of individual industrial units. Actually in this level main emphasis has to be given on the restructuring of present mode of waste management operations by the individual industrial unit of TIA. In this level DOE's responsibility is limited in providing necessary technical assistance to individual industries.

**Step 3 : Relating various Activities in Different Components of IWM:**
All the three levels of activities as identified in the present model are not linked with all of the components of IWM in TIA.

National Level Activities are linked with all the component of IWM in TIA. Plant level activities play the key role in IGECM and ITWM. Both area and plant level activities are needed for ISWM AND ILWM management in TIA.
7.4 RECOMMENDATION

Industrial Pollution control and industrial waste management are closely related. Actually the main objective of industrial waste management is to check the industrial pollution. So management policy for industrial waste of a country or for a particular area (e.g., for TIA) has direct implications with the environment and pollution control policies of a country. For the efficient and safe management of industrial waste in TIA following recommendations could be made:

7.4.1 General Recommendations:

i) Recommendations which are made for industrial sector in the Environmental Policy of Bangladesh should be implemented without further delay.

ii) Newly promulgated Environmental Protection Act 1995 should be strictly enforced to control environmental pollution from mismanagement of industrial wastes in TIA.

iii) Proposed Environmental Quality Standard for industrial effluent and emissions should be adopted at the earliest possible time.

iv) Organizational structure of DOE should be strengthened with the increase of budgetary allocations and manpower.

v) Technical competence of DOE staffs should be developed through training.

vi) The activities of Dhaka City Corporation in cleaning up operation of industrial solid waste and maintenance of open drains should be made more efficient and co-ordinated.

vii) The scope of work of Dhaka WASA should be increased.

127
viii) Industrial Pollution Projection System for Bangladesh should be developed.

ix) Awareness regarding industrial waste and its pollution potential among the industry owners/ workers and the inhabitants of TIA should be developed.

x) Institutional link between industries, local government bodies (DCC and DWASA) and national environmental protection agency (DOE) and City Development Authority (RAJUK) should be strengthened.

xi) Continued research in this field should be carried out.

xii) Strict enforcement of the environmental laws should be ensured.

7.4.2 Specific Recommendations

7.4.2.1 For National Legislative Body:

i) Should consider either establishment of a separate agency or strengthen the existing law enforcing agencies to enforce the newly promulgated Environment Protection Act 1995 in industrial sector.

ii) Should take steps for more budgetary allocations for DOE, DCC, DWASA.

7.4.2.2 For Department of Environment:

i) Should establish closer link with DWASA and DCC for smooth management of industrial waste in TIA.

ii) Should increase its manpower, equipments and technical competence of the staff.
iii) Should monitor industrial effluent and emissions in TIA regularly.

iv) Should establish a separate section for dealing with industrial pollution control and industrial waste management in Dhaka zonal office of DOE.

v) With the co-ordination of other relevant agencies of GOB, should take immediate step to develop an Industrial Pollution Projection System for Bangladesh.

vi) Should establish a demonstration treatment plant for plant level treatment in any one of the big industrial waste producer (e.g. Phoenix Textile Mills) in TIA.

vii) Should provide necessary technical support to the industries regarding waste management and related issues.

ix) Should prepare an updated data base with details of waste character and quantity manpower, and state of technology for the industries of TIA.

x) Should undertake EIA for the industries of TIA.

xi) Should take account of present waste managements System of the industries of TIA and issue necessary consent order regarding waste generation, handling and disposal to the industries.

xii) DOE should enhance its publicity campaign to build awareness among industry owners, workers and inhabitants of TIA regarding environmental consequences of industrial pollution.

7.4.2.3 For Dhaka City Corporation:

i) DCC should increase its revenue earnings in conservency sector and for this it should change its present taxation system
(Flat 2% tax on rental value of the house/industry) and should go for users charge system.

ii) Should provide separate dustbins for industrial solid wastes and house hold solid wastes in TIA.

iii) Should provide closed dustbin instead presently given open dustbins.

iv) Should take tough punitive measures for the haphazard disposal of solid wastes by the industries or the households in the area and for this reason if necessary new municipal laws should be framed.

v) Should increase number of sweepers, garbage crews and vehicles to make the cleaning up operation more efficient.

vi) DCC should take necessary steps for the cleaning of the open drains in the TIA regularly.

vii) Should construct the open drains in the area in a organized manner in conformity with a well organized network of drains. There should not be any Katcha drain in TIA.

7.4.2.4 For Dhaka Water and Sewerage Authority :

i) Should construct a combined treatment plant for industrial waste water in TIA and for this reason DWASA should construct a separate sewerage network for industrial waste water disposal.

ii) Should take punitive measures for the industries who dispose industrial waste water in sanitary/storm sewerage system of the area.

iii) Should charge the industries in a separate rate to increase the revenue earning of DWASA.
iv) DWASA should start waste water permitting system for the disposal of waste water in the sanitary or storm water sewerage network.

7.4.2.5 For Public Works Department (PWD):

i) As the owner of the land of TIA, PWD should consider taking appropriate steps for coordinating pollution control activities by different agencies in this area.

ii) PWD should enforce individual industrial units to abide by the pollution control laws and for this reason PWD should take steps to include necessary clauses in the lease agreements.

7.4.2.6 For the Individual Industrial Units:

i) Individual industrial units should make necessary arrangements for characterization and quantification of the produced wastes (Solid, liquid and gaseous) from their respective units.

ii) Should dispose industrial solid waste in the dustbins specified for them.

iii) Should not dispose waste water in WASA sanitary sewerage lines and storm sewerage line and open ditches. However until the construction of separate sewerage system for waste water disposal they can dispose their waste in storm sewerage and canals after necessary treatment.

iv) Should establish small scale treatment units for waste water and gaseous emission, if necessary, in their respective units.

v) Should try to recycle the produced wastes if possible.

vi) Should take necessary safety measures for their garbage crews.
vii) Should plant trees in and around the factory premises.

viii) Should arrange training for their staff regarding waste management.

ix) Should undertake research for developing new technology which would produce less waste.

7.4.2.7 Role of the inhabitants of TIA:

i) The inhabitants of TIA can play a vital role in developing awareness among the industry workers and among themselves as well regarding pollution potential of industrial waste.

ii) They can arrange demonstrations and public meetings to make the industry owners understand the pollution problem in the area and to compel them to stop haphazard disposing of industrial wastes from the industries.

7.4.2.8 Role of Mass Media: Mass media can play a very vital role regarding developing awareness among the people about harmful effects of industrial wastes. Use of Electronic media (Radio - Television) will be most effective. Nevertheless posterising, publishing features and advertisement in the daily news papers can also be very effective.

7.5 CONCLUSION

Industrial waste management is a very vast and complex phenomenon involving a number of issues. Almost all the related issues and their present status in TIA are discussed in the present study. Though scope of work had to be reduced for some inevitable constraints, nevertheless this work can help initiating further studies in this regard.

Industrial waste management in TIA, as per the recommendations of the present study, if practiced in future the industrial area.
inside the city center, will not be a danger to the living environment surrounding areas and the findings of the research can be used for other industrial zones which are very close to the major cities of Bangladesh.

7.6 SCOPE OF FURTHER STUDY

i) Further studies can be done regarding engineering design aspects of waste management in TIA.

ii) A further study can be made for developing industrial Pollution projection system in TIA.
APPENDICES
APPENDIX A

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# APPENDIX B

**SUMMARY OF INDUSTRIAL WASTE: ITS ORIGIN, CHARACTER, AND TREATMENT**

<table>
<thead>
<tr>
<th>Industries producing wastes</th>
<th>Origin of major wastes</th>
<th>Major characteristics</th>
<th>Major treatment and disposal methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparel</td>
<td>Cooking of fibers; desizing of fabric</td>
<td>Highly alkaline, colored, high BOD and temperature, high suspended solids</td>
<td>Neutralization, chemical precipitation</td>
</tr>
<tr>
<td>Textiles</td>
<td></td>
<td></td>
<td>Equalization, sedimentation and biological treatment</td>
</tr>
<tr>
<td>Leather goods</td>
<td>Unhauling soaking, deliming, and bating of hides</td>
<td>High total solids, hardness, salt, sulfides, chromium, PH, precipitated lime and BOD</td>
<td>Screening, chemical precipitation, flotation and adsorption</td>
</tr>
<tr>
<td>Laundry</td>
<td>Washing of fabrics</td>
<td>High turbidity, alkalinity, and organic solids</td>
<td></td>
</tr>
<tr>
<td>Food and Drugs</td>
<td>Trimming, culling, juicing, and blanching of fruits and vegetables</td>
<td>High in suspended solids, colloidal and dissolved organic matter</td>
<td>Screening, lagooning, and absorption or spray irrigation</td>
</tr>
<tr>
<td>Canned goods</td>
<td>Dilution of whole milk separated milk, buttermilk, and whey</td>
<td>High in dissolved organic matter, mainly protein, fat, and lactose</td>
<td>Biological treatment, aeration, trickling filtration, activated sludge</td>
</tr>
<tr>
<td>Dairy products</td>
<td>Steeping and pressing of grain, residue from distillation of alcohol condensate from stillage evaporation</td>
<td>High in dissolved organic solids, containing nitrogen and fermented starches or their products</td>
<td>Recovery, concentration by centrifugation and evaporation, trickling filtration, use in feeds digestion of slopes</td>
</tr>
<tr>
<td>Meat and poultry products</td>
<td>Stockyard; slaughtering of animals; rendering of bones and fats; residues in condensates; grease and wash water; plucking of chickens</td>
<td>High in dissolved and suspended organic matter, blood, other proteins, and fats</td>
<td>Screening, settling and/or flotation, trickling filtration</td>
</tr>
<tr>
<td>Animal feedlots</td>
<td>Excreta from animals</td>
<td>High in organic suspended solids and BOD</td>
<td>Land disposal and anaerobic lagoons</td>
</tr>
<tr>
<td>Beet sugar</td>
<td>Transfer, screening, and juicing of waters; draining from sludge; condensates after evaporator; juice and extracted sugar</td>
<td>High in dissolved and suspended organic matter, containing sugar and protein</td>
<td>Reuse of wastes, coagulation, and lagooning</td>
</tr>
<tr>
<td>Pharmaceutical products</td>
<td>Mycelium, spent filtrate, and wash waters</td>
<td>High in a suspended and dissolved organic matter, including vitamins</td>
<td>Evaporation and drying feeds</td>
</tr>
<tr>
<td>Yeast</td>
<td>Residue from yeast distillation</td>
<td>High in solids (mainly organic) and BOD</td>
<td>Anaerobic digestion, trickling filtration</td>
</tr>
<tr>
<td>Pickles</td>
<td>Lime water; brine, alum and turmeric, syrup, seeds and pieces of cucumber</td>
<td>Variable F°, high suspended solids, color, and organic matter</td>
<td>Good housekeeping, screening equalization</td>
</tr>
<tr>
<td>Coffee</td>
<td>Pulping and fermenting of coffee beans</td>
<td>High BOD and suspended solids</td>
<td>Screening, settling and trickling filtration</td>
</tr>
<tr>
<td>Industries producing wastes</td>
<td>Origin of major wastes</td>
<td>Major characteristics</td>
<td>Major treatment and disposal methods</td>
</tr>
<tr>
<td>----------------------------</td>
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<td>----------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Fish</td>
<td>Rejects from centrifuge; processed fish, water wastes from evaporator and other wash</td>
<td>Very high BOD, total organic solids, and color</td>
<td>Evaporation of total waste; large remainder to sea</td>
</tr>
<tr>
<td></td>
<td>Bottle washing, floor and equipment cleaning; syrup storage-tank drains</td>
<td>High pH, suspended solids, and COD</td>
<td>Screening, pus discharge to municipal sewer</td>
</tr>
<tr>
<td>Bakeries</td>
<td>Washing and greasing of pans; floor washings</td>
<td>High BOD, grease, floor washing, sugarc, floor detergents</td>
<td>Amenable to biological oxidation</td>
</tr>
<tr>
<td>Water production</td>
<td>Filter backwash; lime soda sludge, brine, alum sludge</td>
<td>Minerals and suspended solids</td>
<td>Direct discharge to stream or indirectly through holding lagoons</td>
</tr>
<tr>
<td>Cane sugar</td>
<td>Spillage from extraction, clarification, etc.; evaporator entrainment in cooling and condenser waters</td>
<td>Variable pH, soluble organic matter with relatively high BOD of carbonaceous nature</td>
<td>Neutralization, recirculation, chemical treatment; some selected aerobic oxidation</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Variable origin depending upon exact source; agriculture chemicals, irrigation return flows, crop residues, and liquid and solid animal wastes</td>
<td>Highly organic and COD detergent cleaning solutions</td>
<td>Biological oxidation basins; some composting and anaerobic digestion; land application</td>
</tr>
<tr>
<td>Pulp and paper</td>
<td>Cooking refining, washing of fibers, screening of paper pulp</td>
<td>High or low pH, color, high suspended, colloidal, and dissolved solids, inorganic fillers</td>
<td>Settling, lagooning, biological treatment, aeration, recovery of by-products</td>
</tr>
<tr>
<td>Photographic products</td>
<td>Spent solution of developer and fixer</td>
<td>Alkaline containing various organic and inorganic reducing agents</td>
<td>Recovery of silver, discharge of waste into municipal sewer</td>
</tr>
<tr>
<td>Steel</td>
<td>Spent Coking of coal, washing of blast furnace flue gases, and pickling of steel</td>
<td>Low pH, acids, cyanogen, phenol, coke, lime, limestone, alkali, oils, mill scale, and fine suspended solids</td>
<td>Neutralization recovery and reuse, chemical coagulation</td>
</tr>
<tr>
<td>Metal-plated products</td>
<td>Stripping of oxides, cleaning and plating of metal</td>
<td>Acid, metals, toxic, low volume, mainly mineral matter</td>
<td>Alkaline chlorination of cyanide; reduction and precipitation of chromium; lime precipitation of other metals</td>
</tr>
<tr>
<td>Iron-foundry products</td>
<td>Washing of used sand by hydraulic discharge</td>
<td>High suspended solids, mainly sand; some clay and coal</td>
<td>Selective screening, drying of reclaimed sand</td>
</tr>
<tr>
<td>Oil fields and refineries</td>
<td>Drilling mud, salt, oil, and some natural gas; acid sludges and miscellaneous, oils from refining</td>
<td>High dissolved salts from field; high BOD, odor, phenol, and sulfur compounds from refinery</td>
<td>Diversion, recovery, injection of salts, acidification and burning of alkaline sludges</td>
</tr>
<tr>
<td>Fuel oil use</td>
<td>Spills, from fuel-tank filling waste; auto crankcase oils</td>
<td>High dissolved oils</td>
<td>Leak and spill prevention, flotation</td>
</tr>
<tr>
<td>Industries producing wastes</td>
<td>Origin of major wastes</td>
<td>Major characteristics</td>
<td>Major treatment and disposal methods</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------</td>
<td>----------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Rubber</td>
<td>Washing of later, coagulated rubber, exuded impurities from crude rubber</td>
<td>High BOD and odor, high suspended solids, variable pH, high chlorides</td>
<td>Aeration, chlorination sulfonation, biological treatment</td>
</tr>
<tr>
<td>Glass</td>
<td>Polishing and cleaning of glass</td>
<td>Red color, alkaline non settleable suspended solids.</td>
<td>Calcium-chloride precipitation</td>
</tr>
<tr>
<td>Naval stores</td>
<td>Washing of stumps, drop solution, solvent recovery, and oil recovery water</td>
<td>Acid, high BOD</td>
<td>By-product recovery, equalization, recirculation and reuse, trickling filtration</td>
</tr>
<tr>
<td>Glue manufacturing</td>
<td>Lime wash, acid washes, extraction of nonspecific protein</td>
<td>High COD, BOD, pH, chromium, periodic strong mineral acids</td>
<td>Amenable to aerobic biological treatment, flotation, chemical precipitation</td>
</tr>
<tr>
<td>Wood preserving</td>
<td>Steam condensates</td>
<td>High in COD, BOD, solids, phenolics</td>
<td>Chemical coagulation, oxidation pond and other aerobic biological treatment</td>
</tr>
<tr>
<td>Candle manufacturing</td>
<td>Wax spills, olearic acid condensates</td>
<td>Organic (fatty) acids</td>
<td>Anaerobic digestion</td>
</tr>
<tr>
<td>Plywood manufacturing</td>
<td>Glue washing</td>
<td>High COD, pH, phenol, potential toxicity</td>
<td>Settling ponds, incineration</td>
</tr>
<tr>
<td>Metal container</td>
<td>Cutting and lubricating metals cleaning can surface</td>
<td>Metal fines, lub, oils, variable pH, surfactants, dissolved metals</td>
<td>Oil separation, chemical precipitation, collection and reuse, lagoon storage, final carbon absorption</td>
</tr>
<tr>
<td>Petrochemicals</td>
<td>Contaminated water from chemical production and transportation of second generation oil compounds</td>
<td>High COD, T.D.S., metals, COD/BOD ratio, and inhibitory to biological action</td>
<td>Recovery and reuse, equalization and neutralization, chemical coagulation, settling or flotation, biological oxidation</td>
</tr>
<tr>
<td>Cement</td>
<td>Fine and finish grinding of cement, dust leaching collection, dust control</td>
<td>Heated cooling water, suspended solids, some in organic salts</td>
<td>Segregation of dust-contact streams, neutralization and sedimentation</td>
</tr>
<tr>
<td>Wood furniture</td>
<td>Wet spray booths and laundries</td>
<td>Organic from staining and sealing wood products</td>
<td>Evaporation or burning</td>
</tr>
<tr>
<td>Asbestos</td>
<td>Cleaning and crushing ore</td>
<td>Suspended asbestos and mineral solids</td>
<td>Detention in ponds, neutralization and land filling</td>
</tr>
<tr>
<td>Paint and inks</td>
<td>Solvent-based rejected materials scrubbers for paint vapors refining and / or removing inks</td>
<td>Contain organic solids from dyes, resins, oils, solvents, etc.</td>
<td>Settling ponds for detention of paints, lime coagulation of printing inks.</td>
</tr>
<tr>
<td>Chemicals</td>
<td>Dilute wash waters many varied dilute acids</td>
<td>Low pH, low organic content</td>
<td>Uplift or straight neutralization, burning when some organic matter is present</td>
</tr>
<tr>
<td>Acids</td>
<td>Washing and purifying soaps and detergents</td>
<td>High in BOD and saponified soaps</td>
<td>Flotation and skimming, precipitation with CaCl2</td>
</tr>
<tr>
<td>Detergents</td>
<td>Evaporator condensates or bottoms when not reused or recovered, syrup from final washes, wastes from &quot;bottlingup&quot; process</td>
<td>High BOD and dissolved organic matter, mainly starch and related material</td>
<td>Equalization, biological filtration, anaerobic digestion</td>
</tr>
<tr>
<td>Industries producing wastes</td>
<td>Origin of major wastes</td>
<td>Major characteristics</td>
<td>Major treatment and disposal methods</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------------</td>
<td>-----------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Explosives</td>
<td>Washing TNT and guncotton for purification, washing and pickling of cartridges</td>
<td>TNT, colored, acid, odorous and contains organic acids and alcohol from powder and cotton, metals, acid, oils, and dopes</td>
<td>Flotation, chemical precipitation, biological treatment, neutralization, absorption, alkaline chlorination.</td>
</tr>
<tr>
<td>Pesticides</td>
<td>Washing and purification products such as 2,4-D and DDST</td>
<td>High organic matter, benzene ring structure, toxic to bacteria and fish, acid</td>
<td>Dilution, storage, activated carbon adsorption, alkaline chlorination.</td>
</tr>
<tr>
<td>Phosphate and phosphorus</td>
<td>Washing, screening, floating rock, condenser bleedoff from phosphate reduction plant</td>
<td>Clay, slime and tail off low pH, high suspended solids, phosphorus, silica and fluoride</td>
<td>Lagooning mechanical clarification, coagulation and settling of refined waste.</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>Residues from manufacturing synthetic resins and from dyeing synthetic fibers</td>
<td>normally high BOD and HCHO, toxic to bacteria in high concentrations</td>
<td>Trickling filtration, adsorption on activated charcoal.</td>
</tr>
<tr>
<td>Plastics and resins</td>
<td>Unit operations from polymer preparation and use: spillo and equipment washdowns</td>
<td>Acid caustic, dissolved organic matter such as phenols, formaldehydes etc.</td>
<td>Discharge to municipal sewer reuse, controlled discharge.</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>Chemical reactions of basic elements. Spillo, cooling waters, washing of products, boiler blowdowns</td>
<td>Sulfuric, phosphorus, and nitric acids, mineral elements; P, S, K, Al, NH₄, NO₃ etc.; some suspended solids</td>
<td>Neutralization, detention for reuse, sedimentation, air stripping of NH₃, Lime precipitation.</td>
</tr>
<tr>
<td>Toxic chemicals</td>
<td>Leaks, accidental spills, and relining of chemicals</td>
<td>Various toxic dissolved elements and compounds such as Hg and PCB's</td>
<td>Retention and reuse, change in production.</td>
</tr>
<tr>
<td>Mortuary</td>
<td>Body fluids, washwaters, spills</td>
<td>Blood salt, formaldehydes, high BOD infectious diseases</td>
<td>Discharge to municipal sewer holding and chlorination.</td>
</tr>
<tr>
<td>Hospital Res Labs</td>
<td>Washing, sterilizing of facilities, used solutions, spills</td>
<td>Bacteria, various chemicals radioactive materials</td>
<td>Discharge to municipal sewers holding and blood separation in large biological facilities.</td>
</tr>
<tr>
<td>Energy</td>
<td>Cooling water boiler blowdown coal drainage</td>
<td>high volume, high inorganic and dissolved solids</td>
<td>Cooling by evaporation, storage of ashes, neutralization of excess acid wastes.</td>
</tr>
<tr>
<td>Scrubber power plant waste</td>
<td>Scrubbing of gaseous Combustion products by liquid water</td>
<td>Particulates, SO₂, impure absorbents or NH₃, NaOH, etc.</td>
<td>Solids removal usually by settling, pH adjustment and reuse.</td>
</tr>
<tr>
<td>Coal processing</td>
<td>Cleaning and classification of coal; leaching of sulfur strata with water</td>
<td>High suspended solids, mainly coal, low pH, NaOH, high H₂SO₄ and FeSO₄</td>
<td>Settling, force flotation, drainage control and sealing of mines.</td>
</tr>
<tr>
<td>Nuclear power and</td>
<td>Processing ores; Laundering of contaminated clothes, research laboratory wastes, processing of fuel; power-plant cooling waters</td>
<td>Radioactive elements, can be very acid and &quot;hot&quot;</td>
<td>Concentration and dilution and dispersion.</td>
</tr>
<tr>
<td>Non-point sources</td>
<td>Dirt, dust, combustion prod. runoff, salt runoff, organic matter runoff</td>
<td>Various but largely mineral and organic matter</td>
<td>Sealing sources, holding and treating by various means.</td>
</tr>
</tbody>
</table>
### APPENDIX C

**THE POLLUTING INDUSTRIES AND THE PROBABLE TOXIC POLLUTANTS IN BANGLADESH**

<table>
<thead>
<tr>
<th>Polluting Industries</th>
<th>Types of effluent</th>
<th>Pollutants in</th>
<th>Whether toxic or non toxic pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Leather Tanneries</td>
<td>Water borne</td>
<td>Dissolved lime hydrogen sulphide acids, chromium dyes, oils, S.S. organic matters.</td>
<td>Toxic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>H2S, SPM</td>
</tr>
<tr>
<td>ii) Electroplating</td>
<td>Water borne</td>
<td>Oil &amp; grease, chlorinated hydrocarbons, acids, alkalis H.S. cyanide, chromium, Cd, Ni, Cu, Zn, Ag.</td>
<td>Toxic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>Acid mists, vapors.</td>
</tr>
<tr>
<td>iii) Textile Industries (Dying &amp; Printing)</td>
<td>Water borne</td>
<td>Alkali, Cl₂, dyes organic matters, S.S.</td>
<td>Toxic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>S.P.M.</td>
</tr>
<tr>
<td>iv) Petroleum Oil refinery.</td>
<td>Water borne</td>
<td>hydrocarbons (Oil) Sulphide, phenol organic matters.</td>
<td>Toxic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>SO₂, NOx, HC SPM.</td>
</tr>
<tr>
<td>v) Sugar Industry.</td>
<td>Water borne</td>
<td>S.S., organic matters.</td>
<td>Non</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>S.P.M.</td>
</tr>
<tr>
<td>vi) Fertilizer Industries.</td>
<td>Water borne</td>
<td>H₂SO₄, H₃PO₄, HF fluorides, phosphates NH₃, NH₄-salts area, Amins, CH₃-OH, H₂S.</td>
<td>Toxic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gaseous</td>
<td>SPM, fluorides, NH₃, H₂S. emissions</td>
</tr>
<tr>
<td>Polluting Industries</td>
<td>Types of effluent</td>
<td>Pollutants in water to toxic pollutants</td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------</td>
<td>----------------------------------------</td>
<td></td>
</tr>
<tr>
<td>vii) H₂SO₄ plant.</td>
<td>Water borne.</td>
<td>Hg, chlorides.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CL₂, NOx</td>
<td></td>
</tr>
<tr>
<td>viii) H₂SO₄ plant.</td>
<td>Water borne</td>
<td>Acid, SO₂ Gas</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ix) Paint Industries</td>
<td>Water borne</td>
<td>Heavy metals like chromium, Pb, Cu, Cd, organic Solvents cyanides.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x) Pesticide</td>
<td>Water borne</td>
<td>Acids, organic solvents cyanides, Cl₂ Phenolic compounds, heavy metals Ph, Cu, As, Hg based compounds,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xi) shipyard.</td>
<td>Water borne</td>
<td>Oil &amp; grease acids, Heavy metals, solvents.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xii) Battery manufacturing</td>
<td>Water borne</td>
<td>Acid, lead, acid mists &amp; fumes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xiii) Car assembly &amp; Servicing</td>
<td>Water borne</td>
<td>Waste HC oil, grease, solvents, acid.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D

Table D1: Size Classification of Industrial Units.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Units</th>
<th>Ranges for Size-Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Large</td>
</tr>
<tr>
<td>i) Capital Investment</td>
<td>Lakh' Taka</td>
<td>Above 100</td>
</tr>
<tr>
<td>ii) Power Load</td>
<td>KW</td>
<td>Above 500</td>
</tr>
<tr>
<td>iii) Manpower employment</td>
<td>Numbers</td>
<td>Above 100</td>
</tr>
</tbody>
</table>

Table D2: Locational Criteria for Medium Impact Units (Category-3)

(a) Such units to be preferably located in "Industrial Estates" "Industrial Areas" or "Industrial Zones" Cleared or approved by DOE for this class of units OR

(b) Such units to be located in other places after having clearance from DOE and satisfying the following

(i) Shall not require the land-use conversion of any forest, plantation, orchard grove or Prime agricultural lands.

(ii) All processing, manufacturing, storage, stockpiling, handling and service facilities shall be concentrated together in the minimum possible land and this actively complex area shall be surrounded by a properly planed and maintained green belt of minimum 15m width of all sides, within the premises or precincts of the units;

(iii) The outer boundary of the unit shall be at least 250m away in any direction from any residential or commercial settlement of above 100 persons.

(iv) The outer boundary of the unit shall be at least 500m may (the intervening land being in no case owned by the unit itself or it’s associates) from the sea shore, river bank, lake, beel, khal, pond or other body of surface water.

(v) The outer boundary of the units shall be at least 5 kms away from a Wild-life Sanctuary, Bio-sphere Reserve or an Environmentally Sensitive Area so declared by Ministry of Environment and Forest (MEF).
Table D3: Locational Criteria for High Impact Units (Category-c)

Such units to be located after having clearance from DOE and satisfying the following:

(i) No land-use conversion of forest, plantation orchard, tree-grove, habitational or prime agricultural land should be involved. If any of these is involved, comprehensive rehabilitation compensation and confidence creation environmental proposals should be developed and submitted.

(ii) The processing, manufacturing, storage, stock piling, handling and other services should all be concentrated in the minimum possible land area which should be surrounded on all sides by a properly planned and maintained "green" belt of at least 60m width within the premises or precincts of the unit.

(iii) The outer boundary of the unit shall be at least 3 Km away in any direction and at least 5 kms away in dominant wind direction from any residential/commercial settlement of over 5000 persons. Also the total population in a 10 km radius area around it shall not exceed 10,000.00

(iv) The outer boundary of the unit premises shall be

(a) over 100m away from Highway/Railway/Airport

(b) over 500m away from a body of surface water e.g. sea shore, river, Khal, canal, beel, haor, pond etc.

(c) Over 10 kms away from wild life Sanctuaries, Bio-Reserves and other Sensitive Areas so declared by MEF.

(v) The unit shall not be located in area having critical ground-water conditions so declared by DOE/MEF. In any case whatsoever, the unit shall have to provide adequate proof that they shall not pollute ground water in any way and to any extent.

Table D4: Site Clearance NOC Requirements Classification.

<table>
<thead>
<tr>
<th>Class</th>
<th>Site Clearance Granted by Office of DOE</th>
<th>Site Clearance Application should be accommodated by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Clearance Needed</td>
<td>No Clearance Needed</td>
</tr>
<tr>
<td>2</td>
<td>DD Regional Office, DOE</td>
<td>Project Feasibility + Proforms Application.</td>
</tr>
<tr>
<td>3</td>
<td>DD Regional Office, DOE</td>
<td>Project Feasibility + Proforms Application + IEE.</td>
</tr>
<tr>
<td>4</td>
<td>Director (Enforcement), DOE</td>
<td>Project Feasibility + Proforms Application + Rapid EIA</td>
</tr>
<tr>
<td>5</td>
<td>Director (Enforcement), DOE</td>
<td>Project Feasibility + Proforms Application + Comprehensive EIA</td>
</tr>
<tr>
<td>6</td>
<td>Director General, DOE</td>
<td>Project Feasibility + Proforms Application + Comprehensive EIA</td>
</tr>
<tr>
<td>Interna-</td>
<td>Product / Process Category</td>
<td>Environmental Requirements</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>tional Code No.</td>
<td></td>
<td>For Large Units</td>
</tr>
<tr>
<td>3111</td>
<td>Slaughtering, preparing and preserving meat</td>
<td>B-4* - L</td>
</tr>
<tr>
<td>3112</td>
<td>Manufacture of dairy products</td>
<td>B-3* - L</td>
</tr>
<tr>
<td>3113</td>
<td>Canning and preserving of fruits and vegetables</td>
<td>B-3* - L</td>
</tr>
<tr>
<td>3114</td>
<td>Canning, preserving and processing of fish, crustaceans and shellfish foods</td>
<td>B-3* - L</td>
</tr>
<tr>
<td>3115</td>
<td>Manufacture of vegetable and animal oils and fats/oil-refining hydrogenation</td>
<td>B-4* - L</td>
</tr>
<tr>
<td>3116</td>
<td>Grain mill products--Rice Mills</td>
<td>B-2* - P</td>
</tr>
<tr>
<td>3117</td>
<td>Manufacture of bakery products</td>
<td>B-3* - P</td>
</tr>
<tr>
<td>3118</td>
<td>Sugar factories and refineries</td>
<td>B-4* - P</td>
</tr>
<tr>
<td>3119</td>
<td>Manufacture of cocoa, chocolate and sugar confectionery</td>
<td>A-3* - L</td>
</tr>
<tr>
<td>3120</td>
<td>Manufacture of food products not elsewhere classified</td>
<td>B-2* - P</td>
</tr>
<tr>
<td>3121</td>
<td>Manufacture of prepared animal feeds</td>
<td>B-4* - P</td>
</tr>
<tr>
<td>3122</td>
<td>Distilling, rectifying and blending spirits</td>
<td>C-4* - L</td>
</tr>
<tr>
<td>3123</td>
<td>Wine industries</td>
<td>B-4* - L</td>
</tr>
<tr>
<td>3124</td>
<td>Distilled liquors and malt</td>
<td>B-2* - L</td>
</tr>
<tr>
<td>3125</td>
<td>Soft drinks and carbonated waters industries</td>
<td>C-3* - L</td>
</tr>
<tr>
<td>3126</td>
<td>Tobacco manufacturing</td>
<td>B-4* - L</td>
</tr>
<tr>
<td>3127</td>
<td>Spinning, weaving and finishing textile</td>
<td>B-3* - L</td>
</tr>
<tr>
<td>3129</td>
<td>Knitting mills</td>
<td>B-2* - O</td>
</tr>
<tr>
<td>3130</td>
<td>Manufacture of coarse, rough and twine industries</td>
<td>B-3* - L</td>
</tr>
<tr>
<td>3131</td>
<td>Cottage rope/rope industries</td>
<td>B-4* - L</td>
</tr>
<tr>
<td>3132</td>
<td>Manufacture of textiles not elsewhere classified</td>
<td>B-3* - L</td>
</tr>
<tr>
<td>3134</td>
<td>Textiles and leather finishing</td>
<td>C-4* - L</td>
</tr>
<tr>
<td>3135</td>
<td>For dressmaking/dyeing industries</td>
<td>C-4* - L</td>
</tr>
<tr>
<td>3136</td>
<td>Manufacture of leather products and leather substitutes</td>
<td>B-3* - L</td>
</tr>
<tr>
<td>3137</td>
<td>Manufacture of footwear, except embroidered, beaded rubbers or plastic footwear</td>
<td>A-4* - L</td>
</tr>
<tr>
<td>3138</td>
<td>Manufacture of footwear, except embroidered, beaded rubbers or plastic footwear</td>
<td>A-4* - L</td>
</tr>
<tr>
<td>3139</td>
<td>Sawnlire, planing and other wood mills</td>
<td>B-2* - P</td>
</tr>
<tr>
<td>3140</td>
<td>Manufacture of wooden and fibre containers and small wood ware</td>
<td>A-3* - P</td>
</tr>
<tr>
<td>3141</td>
<td>Manufacture of furniture and fixtures, except primarily of metal</td>
<td>A-3* - P</td>
</tr>
<tr>
<td>3142</td>
<td>Manufacture of pulp, paper and paperboard</td>
<td>C-3* - P</td>
</tr>
<tr>
<td>3143</td>
<td>Manufacture of containers and boxes of paper and paperboard</td>
<td>B-3* - L</td>
</tr>
<tr>
<td>3144</td>
<td>Manufacture of pulp, paper and paperboard articles not elsewhere classified</td>
<td>B-3* - L</td>
</tr>
<tr>
<td>3145</td>
<td>Printing, publishing and allied industries</td>
<td>B-3* - L</td>
</tr>
</tbody>
</table>

Table D5: Environmental Requirements for Different Types & Sizes of Industrial Units (Proposed)
<table>
<thead>
<tr>
<th>Internal Code No.</th>
<th>Product / Process Category</th>
<th>Environmental Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>3511</td>
<td>Manufacture of basic industrial chemicals except fertilizers</td>
<td>C-6+0</td>
</tr>
<tr>
<td>3512</td>
<td>Manufacture of fertilizers and pesticides</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3513</td>
<td>Manufacture of synthetic resins, plastic materials, and man-made fibers except glass</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3521</td>
<td>Manufacture of paints, varnishes, and lacquers</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3522</td>
<td>Manufacture of drugs and medicines</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3523</td>
<td>Manufacture of soap and cleaning preparations, perfumes, cosmetics, and other toiletries</td>
<td>B-4+0</td>
</tr>
<tr>
<td>3529</td>
<td>Manufacture of chemical products NEC</td>
<td>C-6+0</td>
</tr>
<tr>
<td>3530</td>
<td>Petroleum refineries</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3546</td>
<td>Manufacture of miscellaneous products of petroleum and coal</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3551</td>
<td>Tire and tube industries</td>
<td>B-4+0</td>
</tr>
<tr>
<td>3559</td>
<td>Manufacture of rubber products NEC</td>
<td>C-6+0</td>
</tr>
<tr>
<td>3560</td>
<td>Manufacture of plastic products NEC</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3610</td>
<td>Manufacture of pottery, china, and earthenware</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3620</td>
<td>Manufacture of glass and glass products</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3691</td>
<td>Manufacture of structural clay products (e.g., bricks, tile)</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3692</td>
<td>Manufacture of cement, lime</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3699</td>
<td>Manufacture of non-metallic mineral products not elsewhere classified</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3710</td>
<td>Iron and steel basic industries</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3720</td>
<td>Non-ferrous metal basic industries</td>
<td>C-5+0</td>
</tr>
<tr>
<td>3811</td>
<td>Manufacture of cutlery, hand tools, and except hardware</td>
<td>B-4+0</td>
</tr>
<tr>
<td>3812</td>
<td>Manufacture of furniture and fixture primarily of metal</td>
<td>B-4+0</td>
</tr>
<tr>
<td>3813</td>
<td>Manufacture of structural metal products</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3819</td>
<td>Manufacture of fabricated metal products except machinery and equipment NEC</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3821</td>
<td>Manufacture of engines and turbines</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3822</td>
<td>Manufacture of agricultural machinery and equipment</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3823</td>
<td>Manufacture of metal and wood working machinery</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3824</td>
<td>Manufacture of industrial machinery except metal and wood working machinery</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3825</td>
<td>Manufacture of computing and accounting machinery</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3829</td>
<td>Machinery and equipment except electrical NEC</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3831</td>
<td>Manufacture of electrical machinery and apparatus</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3832</td>
<td>Manufacture of radio, television and communication equipment and apparatus</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3933</td>
<td>Manufacture of electrical appliances and instruments</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3935</td>
<td>Manufacture of electrical apparatus and supplies NEC</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3940</td>
<td>Ship building and repairing</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3942</td>
<td>Manufacture of railroad equipment</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3945</td>
<td>Manufacture of motor vehicles</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3944</td>
<td>Manufacture of motorcycles and bicycles</td>
<td>B-5+0</td>
</tr>
<tr>
<td>3949</td>
<td>Manufacture of transport equipment NEC</td>
<td>B-5+0</td>
</tr>
<tr>
<td>International Code No.</td>
<td>Product / Process Category</td>
<td>Environmental Requirements</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>3951</td>
<td>Manufacture of professional and scientific, ad measuring and controlling equipment, NEC</td>
<td>For large units: B-4-P For medium units: B-3-P For small units: A-2-P</td>
</tr>
<tr>
<td>3952</td>
<td>Manufacture of photographic and optical goods</td>
<td>B-4'-P B-3'-P A-2'-P</td>
</tr>
<tr>
<td>3953</td>
<td>Manufacture of watches and clocks</td>
<td>B-4'-P B-3'-P B-2'-P</td>
</tr>
<tr>
<td>3991</td>
<td>Manufacture of jewellery and related articles</td>
<td>B-4'-P B-3'-P A-2'-P</td>
</tr>
<tr>
<td>3992</td>
<td>Manufacture of musical instruments</td>
<td>B-4'-P B-3'-P B-2'-P</td>
</tr>
<tr>
<td>3993</td>
<td>Manufacture of sporting and athletic goods</td>
<td>B-4'-P B-3'-P A-2'-P</td>
</tr>
<tr>
<td>3999</td>
<td>Manufacturing industries NEC</td>
<td>B-4-O B-4'-P B-3'-P</td>
</tr>
<tr>
<td></td>
<td>Electroplating industry</td>
<td>C-4'-P B-3'-P A-2'-P</td>
</tr>
<tr>
<td></td>
<td>Power Plant using atomic reactor</td>
<td>C-4'-P B-3'-P A-2'-P</td>
</tr>
<tr>
<td></td>
<td>Gut Mills</td>
<td>B-4'-P B-3'-P A-2'-P</td>
</tr>
<tr>
<td></td>
<td>Processing of Shrimp and Irap legs</td>
<td>A-2-0 A-2-0 A-2-0</td>
</tr>
<tr>
<td></td>
<td>Manufacture of Sodium Silicates</td>
<td>B-2-L A-2-L A-2-L</td>
</tr>
<tr>
<td></td>
<td>Manufacture of Tin</td>
<td>B-2-P B-2-P B-2-P</td>
</tr>
<tr>
<td></td>
<td>Manufacture of Safety Matches</td>
<td>A-2-L A-2-L A-2-L</td>
</tr>
<tr>
<td></td>
<td>Ordnance Factory</td>
<td>C-4'-P B-3'-P B-2'-P</td>
</tr>
<tr>
<td>3999</td>
<td>Manufacture of Salt</td>
<td>A-2'-P A-2'-P A-2'-P</td>
</tr>
<tr>
<td></td>
<td>Manufacture of Batteries</td>
<td>A-2'-P A-2'-P A-2'-P</td>
</tr>
<tr>
<td></td>
<td>Manufacture of edible items</td>
<td>C-4'-P B-3'-G B-3'-P</td>
</tr>
<tr>
<td></td>
<td>Foundry</td>
<td>C-4'-P B-3'-P B-3'-P</td>
</tr>
<tr>
<td>4101</td>
<td>Electric light and power</td>
<td>C-4'-P B-3'-P B-3'-P</td>
</tr>
<tr>
<td></td>
<td>Acid/Alkali</td>
<td>C-4'-P B-3'-P B-3'-P</td>
</tr>
</tbody>
</table>

**NEC** - Not Elsewhere Classified

* Indicates that detail design of the pollution control/treatment system and environmental management plan along with the application of site clearance is needed for those units, else, the same is likely to be rejected.
Table D6: Environmental Consent Order Requirements

The last letter of the Table D5 indicate, the requirements of consent order to be obtained from DOE for commissioning and for continued operation of the units. The pollutant load limits, standards equipments for treatments plants, disposal systems etc. shall be as laid down in the consent order. (This consent order can be obtained later and is not necessary at the time of site clearance). The legend used in Table D5 is as follows.

0- No consent order needed.
L- Consent order needed in respect of the disposal of liquid and/or solid wastes.
G- Consent order needed in respect of the emission of gaseous waste.
P- Consent order needed in respect of discharge of solid, liquid and gaseous wastes.
H- Consent order needed in respect of storage, handling and disposal of hazardous materials/wastes.
Q- Comprehensive environmental consent order needed.
APPENDIX E

Table E1: Industrial Effluent Discharge Standards in Natural Stream of Different Countries.

<table>
<thead>
<tr>
<th>Standards</th>
<th>pH</th>
<th>BOD</th>
<th>Suspended solids mg/l</th>
<th>Toxic Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royal Commission</td>
<td></td>
<td>20</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>U.S. Environmental Protection Agery</td>
<td>6.0 - 9.0</td>
<td>45</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Indian (ISI)</td>
<td>5.5 - 9.0</td>
<td>30</td>
<td>100</td>
<td>Chromium 0.1 Arsenic -0.2</td>
</tr>
<tr>
<td>Bangladesh (DOE, 1992)</td>
<td>6.0 - 9.0</td>
<td>50 Max (100)</td>
<td>150</td>
<td>Chromium -0.5 Ammonia -5.0 Arsenic -8.2</td>
</tr>
</tbody>
</table>


Table E2: Characteristic Quality Leachate of Dhaka.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Typical</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td></td>
<td>4.75</td>
<td>4.5-5.75</td>
</tr>
<tr>
<td>Suspended Solid</td>
<td>mg/l</td>
<td>10000</td>
<td>3000 to 14000</td>
</tr>
<tr>
<td>Total Solid</td>
<td>mg/l</td>
<td>16000</td>
<td>13000 to 30000</td>
</tr>
<tr>
<td>Chloride</td>
<td>mg/l</td>
<td>1400</td>
<td>1300-5000</td>
</tr>
<tr>
<td>Nitrate</td>
<td>mg/l</td>
<td>50</td>
<td>0 to 200</td>
</tr>
<tr>
<td>Phosphate</td>
<td>mg/l</td>
<td>5</td>
<td>0 to 15</td>
</tr>
<tr>
<td>BOD</td>
<td>mg/l</td>
<td>9000</td>
<td>5000 to 15000</td>
</tr>
<tr>
<td>COD</td>
<td>mg/l</td>
<td>14000</td>
<td>5000 to 17000</td>
</tr>
</tbody>
</table>

### Table E3: Characteristics of Waste Water of Typical Bangladeshi Textile Dyeing Industry

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.85</td>
</tr>
<tr>
<td>Color, mg/l</td>
<td>6600</td>
</tr>
<tr>
<td>Turbidity, mg/l</td>
<td>1110</td>
</tr>
<tr>
<td>Acidity, mg/l</td>
<td>280</td>
</tr>
<tr>
<td>T.S., mg/l</td>
<td>6360</td>
</tr>
<tr>
<td>D.S., mg/l</td>
<td>1730</td>
</tr>
<tr>
<td>S.S., mg/l</td>
<td>4630</td>
</tr>
<tr>
<td>BOD at 20°C, mg/l</td>
<td>180</td>
</tr>
<tr>
<td>COD, mg/l</td>
<td>395</td>
</tr>
</tbody>
</table>


### Table E4: Characteristics of Waste Water of Typical Bangladeshi Pharmaceutical Industry (I.C.I.)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature, °F</td>
<td>79 to 89</td>
</tr>
<tr>
<td>pH</td>
<td>5.7 to 7.2</td>
</tr>
<tr>
<td>Electrical Conductivity, micro.mohs/cm</td>
<td>150 to 650</td>
</tr>
<tr>
<td>Chloride, mg/l</td>
<td>5.3 to 15.5</td>
</tr>
<tr>
<td>Turbidity, mg/l</td>
<td>0 to 25</td>
</tr>
<tr>
<td>T. Alkalinity, mg/l</td>
<td>44 to 120</td>
</tr>
<tr>
<td>S.S., mg/l</td>
<td>6 to 105</td>
</tr>
<tr>
<td>D.O, mg/l</td>
<td>1.5 to 6.5</td>
</tr>
<tr>
<td>BODs, mg/l</td>
<td>1.2 to 6.2</td>
</tr>
<tr>
<td>COD, mg/l</td>
<td>--------</td>
</tr>
<tr>
<td>Ammonia, mg/l</td>
<td>0 to 1.8</td>
</tr>
<tr>
<td>Nitrate, mg/l</td>
<td>0 to 1.4</td>
</tr>
</tbody>
</table>

Source: DEPC (1984)
Table E5: Tolerance Limit of Industrial Effluents in Public Sewer and Inland Surface Water.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Imlamd Surfacewater</th>
<th>Public Sewer</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.5 - 9.0</td>
<td>5.5 - 9.0</td>
</tr>
<tr>
<td>Color mg/l</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chloride mg/l</td>
<td>-</td>
<td>600</td>
</tr>
<tr>
<td>Alkalinity mg/l</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Turbidity mg/l</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T.S. mg/l</td>
<td>100</td>
<td>600</td>
</tr>
<tr>
<td>T.D.S. mg/l</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S.S. mg/l</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D.O. mg/l</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BOD₅ mg/l</td>
<td>30</td>
<td>500</td>
</tr>
<tr>
<td>COD mg/l</td>
<td>250</td>
<td>-</td>
</tr>
<tr>
<td>Ammonia mg/l</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chromium mg/l</td>
<td>0.1</td>
<td>2.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Months</th>
<th>Location</th>
<th>Total Observer (SPM)</th>
<th>Maximum Observer (SPM)</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Number of observations higher than the following concentrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Motijheel</td>
<td>16</td>
<td>570</td>
<td>330</td>
<td>119</td>
<td>16 15 12 3</td>
</tr>
<tr>
<td></td>
<td>Tejgoan</td>
<td>5</td>
<td>478</td>
<td>401</td>
<td>74</td>
<td>5 5 5 0</td>
</tr>
<tr>
<td></td>
<td>Lalmitia</td>
<td>5</td>
<td>362</td>
<td>207</td>
<td>68</td>
<td>5 4 3 0</td>
</tr>
<tr>
<td>February</td>
<td>Motijheel</td>
<td>14</td>
<td>461</td>
<td>311</td>
<td>85</td>
<td>14 11 11 0</td>
</tr>
<tr>
<td></td>
<td>Motijheel</td>
<td>14</td>
<td>399</td>
<td>267</td>
<td>75</td>
<td>14 12 8 0</td>
</tr>
<tr>
<td>March</td>
<td>Lalmitia</td>
<td>16</td>
<td>459</td>
<td>255</td>
<td>103</td>
<td>15 10 0 0</td>
</tr>
<tr>
<td></td>
<td>Motijheel</td>
<td>14</td>
<td>267</td>
<td>166</td>
<td>35</td>
<td>14 2 1 0</td>
</tr>
<tr>
<td>April</td>
<td>Lalmitia</td>
<td>14</td>
<td>351</td>
<td>211</td>
<td>82</td>
<td>14 7 5 0</td>
</tr>
<tr>
<td></td>
<td>Tejgoan</td>
<td>5</td>
<td>210</td>
<td>157</td>
<td>28</td>
<td>3 1 0 0</td>
</tr>
<tr>
<td></td>
<td>Motijheel</td>
<td>12</td>
<td>268</td>
<td>135</td>
<td>50</td>
<td>8 1 1 0</td>
</tr>
<tr>
<td>May</td>
<td>Lalmitia</td>
<td>12</td>
<td>308</td>
<td>183</td>
<td>61</td>
<td>11 4 1 0</td>
</tr>
<tr>
<td></td>
<td>Tejgoan</td>
<td>12</td>
<td>178</td>
<td>112</td>
<td>30</td>
<td>6 0 0 0</td>
</tr>
<tr>
<td></td>
<td>Motijheel</td>
<td>19</td>
<td>104</td>
<td>60</td>
<td>61</td>
<td>6 0 0 0</td>
</tr>
<tr>
<td>June</td>
<td>Lalmitia</td>
<td>10</td>
<td>254</td>
<td>123</td>
<td>50</td>
<td>11 2 0 0</td>
</tr>
<tr>
<td></td>
<td>Tejgoan</td>
<td>10</td>
<td>196</td>
<td>89</td>
<td>39</td>
<td>0 0 0 0</td>
</tr>
</tbody>
</table>

Note: (1) Indian Standards Values are to fall below limits 95% of time.

(2) US EPA standard states that SPM should not exceed 260 \( \mu g/m^3 \) more than once a year and 24 hour annual geometric mean should not exceed 75 \( \mu g/m^3 \).

(3) Sources: Islam and Islam (1983)
## Table E7: Sulfurdioxic: Concentrations in Dhaka (All Concentrations in Microgram/Cubic Meter)

<table>
<thead>
<tr>
<th>Months of 1990</th>
<th>Location</th>
<th>Total Samples (No.)</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Number of observations higher than the following concentrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Motijheel</td>
<td>10</td>
<td>312</td>
<td>90.9</td>
<td>88.7</td>
<td>2 5 7 7</td>
</tr>
<tr>
<td></td>
<td>Lalmatia</td>
<td>2</td>
<td>9.4</td>
<td>6.7</td>
<td>2</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>Tejgoan</td>
<td>3</td>
<td>339</td>
<td>105.2</td>
<td>116.2</td>
<td>2 3 3 3</td>
</tr>
<tr>
<td>February</td>
<td>Motijheel</td>
<td>13</td>
<td>43.2</td>
<td>7</td>
<td>10.5</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td>March</td>
<td>Motijheel</td>
<td>14</td>
<td>55.3</td>
<td>7.5</td>
<td>14</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td></td>
<td>Lalmatia</td>
<td>14</td>
<td>65.6</td>
<td>12.9</td>
<td>19.3</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td></td>
<td>Motijheel</td>
<td>14</td>
<td>107.3</td>
<td>16.7</td>
<td>50.7</td>
<td>0 1 2 2</td>
</tr>
<tr>
<td>April</td>
<td>Lalmatia</td>
<td>14</td>
<td>38.7</td>
<td>8.1</td>
<td>10.3</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td></td>
<td>Tejgoan</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>Motijheel</td>
<td>12</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>May</td>
<td>Lalmatia</td>
<td>12</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>Tejgoan</td>
<td>12</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>June</td>
<td>Lalmatia</td>
<td>19</td>
<td>28.8</td>
<td>5.3</td>
<td>5.5</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>Tejgoan</td>
<td>19</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0 0 0 0</td>
</tr>
</tbody>
</table>

### Notes:
1. Indian Standards:
   - Values are to fall below limits 95% of the time.
2. US EPA standard states that SO2 should not exceed 3/5 μg/m³ more than once a year and the 1-year average should not exceed 80 μg/m³.

Source: Islam and Islam (1986)
Table 48: Nitrogen Oxides Concentrations in Dhaka (All concentrations in Microgram/Cubic Meter)

<table>
<thead>
<tr>
<th>Months of 1990</th>
<th>Location</th>
<th>Total (No.)</th>
<th>Maximum Observed</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Number of observations higher than the following concentrations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>120   80  60  30</td>
</tr>
<tr>
<td>January</td>
<td>Motijheel</td>
<td>16</td>
<td>34.7</td>
<td>26.1</td>
<td>13.7</td>
<td>0 0 0 5</td>
</tr>
<tr>
<td></td>
<td>Lalmatia</td>
<td>3</td>
<td>40.4</td>
<td>26.1</td>
<td>10.9</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td></td>
<td>Tejgani</td>
<td>5</td>
<td>17.6</td>
<td>10.6</td>
<td>2.7</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>February</td>
<td>Motijheel</td>
<td>12</td>
<td>46.0</td>
<td>17.4</td>
<td>10.1</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td></td>
<td>Lalmatia</td>
<td>14</td>
<td>58.3</td>
<td>12.5</td>
<td>8.1</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td></td>
<td>Tejgani</td>
<td>16</td>
<td>26.5</td>
<td>9.7</td>
<td>7</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>March</td>
<td>Motijheel</td>
<td>14</td>
<td>31.5</td>
<td>7.4</td>
<td>7.1</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td></td>
<td>Lalmatia</td>
<td>14</td>
<td>10.1</td>
<td>5.6</td>
<td>2</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>Tejgani</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>April</td>
<td>Motijheel</td>
<td>12</td>
<td>9.2</td>
<td>5.6</td>
<td>1.5</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>Lalmatia</td>
<td>12</td>
<td>87.5</td>
<td>10.8</td>
<td>11.4</td>
<td>0 0 0 1</td>
</tr>
<tr>
<td></td>
<td>Tejgani</td>
<td>12</td>
<td>10.4</td>
<td>5.7</td>
<td>2</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>May</td>
<td>Motijheel</td>
<td>12</td>
<td>11.1</td>
<td>9.3</td>
<td>7.2</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>Lalmatia</td>
<td>12</td>
<td>20.1</td>
<td>6.8</td>
<td>5.1</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>Tejgani</td>
<td>5</td>
<td>6.5</td>
<td>5</td>
<td>1</td>
<td>0 0 0 0</td>
</tr>
</tbody>
</table>

Note: (1) Indian Standards Values are to fall below limits 95% of time.

(2) US EPA standard states that the 1 year arithmetic mean should not exceed 100 µg/m³.

Source: Islam and Islam (1990)
APPENDIX F

List 1 : List of Medium / Lower Medium Sized Units in TIA Responsible for Gaseous Emission

1. Phoenix Textile
2. Sonargaon Dyeing and Printing
3. Eastern Dyeing
4. Essential Drugs Co.
5. Kohinoor Chemical Industries.
6. Bangladesh Rubber Industries
7. Rahman Metal Industry.
8. Apollo Steel Mills Ltd.

List 2 : List of the Industries Surveyed for the Present Study.

1. Nabisco Biscuits and Bread Factory.
2. Haque Brother’s (Industries) Ltd.
3. Nazneen Textile and Dying Ind.
4. Eastern Dyeing and Calendering Works.
5. Phoenix Textile
6. Janless and General Mills Ltd.
7. Modern dyeing and Printing.
8. Tiger Wire Products.
10. Kohinoor Chemical Co (Bangladesh) Ltd.
11. Gaco- Pharmaceutical Ltd.
12. Farooge Chemical Works.
13. Bengal Plastic Industries Ltd.
14. Metal Packages Ltd.
15. M/S Amico Laboratories ltd.
16. Comander Soap Co. Ltd.
17. Orion Laboratory Ltd.
List 3: List of Major Wastewater Discharger Industries in

1) National Printing and Processing Industries.
2) Phoenix Textile Mills Ltd.
3) Eastern Dyeing and Calendering Works.
4) Goco Pharmaceuticals and Research.
5) Kohinoor Chemical Industries.
6) Farooq Chemical Industries.
7) Janless and General Mills Ltd.
8) Bangladesh Cycle Industries.
9) Bengal Steel Works Ltd.
10) Apollo Steel Mills Ltd.
11) Modern Dyeing and Printing.
12) Sonargaon Dyeing and Printing.
13) Remo Chemicals.
### List 4: List of Industries Located in TIA

<table>
<thead>
<tr>
<th>ICN</th>
<th>NAME OF THE INDUSTRY</th>
<th>WD</th>
<th>S &amp; I</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Common Bangladesh Ltd.</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>002</td>
<td>Hay Electrical Industries Ltd.</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>003</td>
<td>Apex Ltd.</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>004</td>
<td>Government Pharmaceutical Laboratory</td>
<td>Y</td>
<td>I</td>
</tr>
<tr>
<td>005</td>
<td>BC Laboratory Ltd.</td>
<td>Y</td>
<td>I</td>
</tr>
<tr>
<td>006</td>
<td>Mac Gragor and Balfour (DB) Ltd.</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>007</td>
<td>National Wire and Nail Industries</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>008</td>
<td>Disel Motor and Services Bangladesh ltd.</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>010</td>
<td>Bengal Steel Works</td>
<td>Y</td>
<td>I</td>
</tr>
<tr>
<td>011</td>
<td>AEG Engineering Industries</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>012</td>
<td>Government Laundry Plants</td>
<td>Y</td>
<td>I</td>
</tr>
<tr>
<td>013</td>
<td>National Printing and Processing Industries</td>
<td>S</td>
<td>Y</td>
</tr>
<tr>
<td>014</td>
<td>Phoenix Textile Mills Ltd.</td>
<td>S</td>
<td>Y</td>
</tr>
<tr>
<td>015</td>
<td>Eastern Dying and Calendering Works</td>
<td>S</td>
<td>Y</td>
</tr>
<tr>
<td>016</td>
<td>BRTC Central Repairing Workshop</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>017</td>
<td>Warehouse of Medicine of TCB</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>018</td>
<td>Central Repairing Workshop, BWDB</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>019</td>
<td>Tiger Wire products</td>
<td>Y</td>
<td>I</td>
</tr>
<tr>
<td>020</td>
<td>Eastern Tube Ltd.</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>021</td>
<td>Bangladesh Steel Corporation</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>022</td>
<td>Sikander Industries</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>023</td>
<td>Fabrication, Foundry and Works Ltd.</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>024</td>
<td>Ittefaq Industries Corporation</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>025</td>
<td>Omar Sons Ltd.</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>026</td>
<td>Bangladesh Stationery Office</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>027</td>
<td>Printing and Stationery Divisions</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>028</td>
<td>Gaco Pharmaceuticals and Research Ltd.</td>
<td>S</td>
<td>Y</td>
</tr>
<tr>
<td>029</td>
<td>Army Form Stores</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>030</td>
<td>Bangladesh Civil and Military Boot Factory</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>031</td>
<td>Taher Engineering Glass Works</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>032</td>
<td>Eastern Pharmaceutical Ltd. and Lailoc Paints</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td>033</td>
<td>Eastern Steel Private Ltd.</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>034</td>
<td>Beg Rubber Industries</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>035</td>
<td>Abdul Mabud and Brothers Ltd.</td>
<td>I</td>
<td>Y</td>
</tr>
<tr>
<td>036</td>
<td>Taj Industries</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>037</td>
<td>Albert Devid (Bangladesh) Ltd.</td>
<td>I</td>
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<tr>
<td>038</td>
<td>Central Laboratory</td>
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</tr>
<tr>
<td>039</td>
<td>Kamal and Company Ltd.</td>
<td>M</td>
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<tr>
<td>040</td>
<td>Young Press</td>
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<tr>
<td>ICN</td>
<td>NAME OF THE INDUSTRY</td>
<td>WD</td>
<td>S &amp; I</td>
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<td>042</td>
<td>Bengal Plastic Industries Ltd.</td>
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<tr>
<td>043</td>
<td>Steel Man Industries</td>
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<tr>
<td>044</td>
<td>Bangal Light Casting Company Ltd.</td>
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<td>Metal Industries</td>
<td>Y</td>
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<td>046</td>
<td>Prantik Traders</td>
<td>Y</td>
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<td>Kaiser Industries Corporation</td>
<td>Y</td>
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</tr>
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<td>048</td>
<td>Maq Industries Limited</td>
<td>Y</td>
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<td>Haq Brathers</td>
<td>Y</td>
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<td>050</td>
<td>Kohinoor Chemical Industries</td>
<td>Y</td>
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<td>Bangladesh Oxygen Ltd.</td>
<td>Y</td>
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<td>052</td>
<td>Amico Laboratory</td>
<td>Y</td>
<td>I</td>
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<td>053</td>
<td>Bangladesh Enterprise</td>
<td>Y</td>
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<td>057</td>
<td>Noorani Flour Mills Ltd.</td>
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<tr>
<td>058</td>
<td>New Dhaka Bred Factory</td>
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<td>059</td>
<td>Orion Laboratories Ltd.</td>
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<td>060</td>
<td>National Metal Industries</td>
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<tr>
<td>061</td>
<td>Pragati Industries Ltd.</td>
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<td>062</td>
<td>Modern Industries Corporation (Pvt.) Ltd.</td>
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<td>063</td>
<td>Roads and Highway Workshop</td>
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<td>064</td>
<td>Swantex Waterproof Works</td>
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<td>065</td>
<td>Rangs Limited</td>
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<tr>
<td>066</td>
<td>Shamco Industries</td>
<td>M</td>
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<td>067</td>
<td>Bengal Friends and Company Ltd.</td>
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<td>068</td>
<td>Dhaka Beverage Industries Ltd.</td>
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<td>071</td>
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<td>072</td>
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<td>Farooq Chemical Industries</td>
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<td>077</td>
<td>Essential Agency (Pvt.) Ltd.</td>
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<td>Coca Cola</td>
<td>Y</td>
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<td>079</td>
<td>Nabisco Biscuit and Bred Factory</td>
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<td>080</td>
<td>Noor Oil Mill</td>
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<td>081</td>
<td>Bangladesh Iron Industries</td>
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<td>082</td>
<td>Sirko Soap and Chemical Industries</td>
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<td>083</td>
<td>Tejgaon Engineering and Construction Co. Ltd.</td>
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<td>084</td>
<td>Monwar Industries</td>
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<td>085</td>
<td>Mimi Chocolate Ltd.</td>
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<td>Anwar Textile Mills Ltd.</td>
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<td>087</td>
<td>Kamal Industries (Pvt.) Ltd. (Unit 2)</td>
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<td>088</td>
<td>Janless and General Mills Ltd.</td>
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<td>089</td>
<td>Rahim Metal Industries Ltd.</td>
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<td>Metal Package Ltd.</td>
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<td>Tejgaon Re-Rolling Co. Ltd.</td>
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<td>Zaiber Industries Ltd.</td>
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<td>Bangladesh Petroleum Exploration Co. Ltd. (BAPEX)</td>
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<td>096</td>
<td>Naznin Fabrics Ltd.</td>
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<td>Shalobin Industrial Co.</td>
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<td>098</td>
<td>Lion wire Steel</td>
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<td>099</td>
<td>Star Iron and Steel Industries</td>
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<td>ATJ Industries Co.</td>
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<td>Lucky Wire Nail Industries Ltd.</td>
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<td>S. A. Industries</td>
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<td>103</td>
<td>Meco Metal Industries</td>
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<td>Bangal Industries Trading Company Ltd.</td>
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<td>New Bhan Oil Mill</td>
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<td>106</td>
<td>Khurshid Industries Corporation</td>
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<td>Finix Fabrix Ltd. and Noor Mohammad Industries</td>
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<td>Lalbagh Chemical and Refinery Works</td>
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<td>109</td>
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<td>114</td>
<td>Metal Products (Pvt.) Ltd.</td>
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<td>116</td>
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<td>117</td>
<td>Shamha Razor and Blade</td>
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<td>118</td>
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<td>119</td>
<td>Popular Polish Industries</td>
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<td>120</td>
<td>Syntho Laboratories Ltd.</td>
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<td>Goodluck Industries Corporation</td>
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<td>122</td>
<td>Bangladesh Cycle Industries</td>
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<td>125</td>
<td>Ittefaq Industries Corporation</td>
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<td>Sonar Bangla Re-Rolling Mills Ltd.</td>
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<td>Kallol Industries Ltd.</td>
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<td>129</td>
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<td>130</td>
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<td>131</td>
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<td>132</td>
<td>Tobacconi (Bangladesh) Ltd.</td>
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<td>Purbodesh Cycle Industries</td>
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<td>Ramjan Pipe Industries</td>
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<td>Imperial Paint and Chemicals</td>
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<td>144</td>
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<td>145</td>
<td>Fecto Industries Ltd.</td>
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<td>New United Industries</td>
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<td>147</td>
<td>Bangladesh Packing</td>
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<td>148</td>
<td>Comilla Tin and Iron Factory</td>
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<td>Framix Industries</td>
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<td>Capital Pipe Industries</td>
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<td>152</td>
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<td>153</td>
<td>Polar Ice Cream</td>
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<td>154</td>
<td>Modern Dying and Printing</td>
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<td>Sonargaon Dying</td>
<td>Y</td>
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<td>156</td>
<td>Remo Chemicals</td>
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</table>

Note:
- Y - Discharge waste water
- N - Donot Discharge waste water
- M - May Discharge waste water
- S - Significant
- I - Insignificant
- WD- Waste Water Discharge
List 5 : Industries Which do not Require Any Type of EIA (IEE/REIA/CIA)

1. Flour mills upto 20 H.P.
2. Book binding Factory.
3. Cinema hall.
4. Small scale clinic / hospitals.
5. Small Ice cream manufacturing Units.
6. Dry Cleaning.
7. Shoe factory (not mechanized)
8. Small scale car servicing centers / Engineering work shops.
9. X-ray, photography, Color processing Microfilm Processing Units.
10. Printing Press (small and Medium)
12. Wrist watch and wall clock assembling and production Units.
15. Tobacco Processing units (small)
16. Fruits and vegetables preservation and processing units.
17. Chocolate manufacturing Units (Large & Medium).
18. Food stuff manufacturing Units not mentioned elsewhere.
19. Tailor shops.
20. Paper Box/Cartoon manufacturing Units (Medium and Small).
21. Wood, Cane and Cork products manufacturing Units (Medium).
22. Saw Mills and furniture manufacturing Units (Medium).
23. Bread/Biscuits manufacturing Units (Medium).
24. Soft/Carbonated drinks manufacturing Units (Medium).
25. Rope manufacturing Units (Small & Medium).
26. Spinning and Textile mills (Small and Medium).
27. Edible Oil factories (Small).
28. Metallic furniture manufacturing Units.
29. Soap and Cosmetic manufacturing Units (Small).
30. Metallic Construction equipment manufacturing Units (Small).
31. Agriculture machinery/Industrial machinery/Measuring machinery/Electrical ware/Rail Road related machinery/Transportation related machinery manufacturing units (Small).
32. Radio-T.V. manufacturing Units (Small).
33. Motor Vehicle manufacturing Units (Small).
34. Motor Cycle and Bi-Cycle manufacturing Units (Small).
35. Shrimp and Frog’s leg processing Units.
36. Sodium Silicate manufacturing Units.
37. Tea manufacturing Units.
38. Ordinance Factories (Small).
39. Match Factories (Small & Medium).
40. Coal Tar manufacturing Units (Small & Medium).
41. Foundry shops.
42. Battery manufacturing Units.
43. Asbestos material Production Units (Small * Asbestos can not be manufactured only Asbestos ware can be produced from Asbestos).
44. Drinking water (mineral water) bottling Units.
45. Salt production Units.
46. Electrical Cable manufacturing Units (Small & Medium).
47. Ship manufacturing and servicing Units (Small).
48. Electrical bulb manufacturing Units (Small).

List 6: Industries Which do not Require Site Clearance NOC of Anykinds

1. Small biscuit/bread factories.
2. Small chocolate factories.
3. Small soft drinks/carbonated drinks manufacturing units.
4. Small saw mills/wooden furniture manufacturing units.
5. Wooden and caned containers and furniture manufacturing units.
7. Cone ice-cream manufacturing units.
8. Small warehouse
APPENDIX G

The Organization Chart of DOE
ORGANIZATION CHART OF DHAKA CITY CORPORATION (1980)

MAYOR

- Public Health and
  Protection Officer

Chief Executive

Audit

Chief Eng.

Chief Assn.

Chief Accounts

Chief Health

Estates

Zone 3

Zone 4

Zone 5

Zone 6

Zone 7

Zone 8

Zone 9

Zone 10

Sanction: Strength: 4678
Existing Strength: 3900
Register Roll: 6222
# APPENDIX H
## QUESTIONNAIRE SURVEY ON PLANNING IMPLICATIONS OF INDUSTRIAL WASTE MANAGEMENT IN TEJGAON INDUSTRIAL AREA OF DHAKA CITY
(For inhabitants of TIA)

Dept. of Urban and Regional Planning, BUET, Dhaka.

<table>
<thead>
<tr>
<th>Case no:</th>
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<tbody>
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<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Occupation</th>
<th>Qualification</th>
<th>Duration of stay in the area</th>
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<tbody>
<tr>
<td>1  15-17</td>
<td>1. Male</td>
<td>1. Govt. service</td>
<td>1. Uneducated.</td>
<td>1. less than a</td>
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<tr>
<td>2  18-34</td>
<td>2. Female</td>
<td>2. Private service.</td>
<td>2. Upto</td>
<td>Year.</td>
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<tr>
<td>4  60+</td>
<td>4. Female</td>
<td>4. Student.</td>
<td>2. 1-3 Years.</td>
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<td>5. Housewife</td>
<td>3. Upto</td>
<td>Year.</td>
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<tr>
<td></td>
<td></td>
<td>6. Worker.</td>
<td>3. 4-6 Years.</td>
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<tr>
<td></td>
<td></td>
<td>7. Retired.</td>
<td>4. 7-9 Years.</td>
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<td>8. Others.</td>
<td>5. 10 Years and above.</td>
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<td></td>
<td></td>
<td></td>
<td>6. Graduate and above.</td>
<td></td>
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</tbody>
</table>

1. What are the reasons for your living in TIA?

   Code no.
   1. Due to Ancestral residence.
   2. As Govt. quarter is situated in this area.
   3. Due to the trade links with the factories of this area.
   4. Due to own business in this area.
   5. Due to the easy availability of housing in this area.
   6. Due to the job in the factory in this area.
   7. Others.
2. Where do you work?

   Code No.
   1. Inside the industrial Area.
   2. Outside the industrial Area.

3. How would you rate the condition of living environment in TIA?

   Code No.
   1. Very good.
   2. Good.
   3. Average.
   4. Not satisfactory.

4. If not satisfactory, What are the reasons?

   Code No.
   1. Bad social environment.
   2. Industrial Pollution from the industries.
   3. Frequent Power failure in the area.
   4. Inconsistent supply of drinking water.
   5. Bad conservancy operation of DCC in the area.
   6. Bad sewerage system in the area.
   7. Shortage of open spaces/play fields.
   8. Others.

5. Do you think industries of this area is polluting the environment?

   Code No.
   1. Yes
   2. No

6. If Yes, How?

   Code No.
   1. By haphazard dumping of industrial wastes.
   2. By polluting the air.
   3. By creating huge sound.
   4. BY discharging liquid wastes haphazardly.
   5. Others.
7. "People living in the industrial area can be affected by industrial pollution". Do you agree?

Code No.
1. Yes
2. No

8. If Yes, what steps do you think would be necessary to stop pollution?

Code No.
1. Industrial area has to be shifted elsewhere.
2. Residential areas have to be shifted elsewhere.
3. Polluting industries should be closed.
4. By strictly enforcing the pollution control laws so that polluting industries are compelled to adopt measures to control pollution.
5. Others.

9. Are the solid wastes from the industries dumped around your residence?

Code No.
1. Yes
2. No

10. If Yes, where are the wastes dumped?

Code No.
1. In open dustbins.
2. In open fields and open spaces.
3. Road side.
4. In ponds and ditches.
5. Others.

11. Are there sufficient dustbins in the area?

Code No.
1. Yes
2. No
12. Are the wastes from the factories and from the household dumped together?

Code No.
1. Yes
2. No

13. If Yes, do you face any problem in dumping your household wastes in the same bins?

Code No.
1. Yes
2. No

14. If Yes, What types of problem do you face?

Code No.
1. Shortage of space for household waste disposal
2. Bad odor from the bins.
3. Birds and animals scatter wastes from the bins.
5. Others.

15. Do you think industrial wastes should be disposed of separately?

Code No.
1. Yes
2. No

16. Are the liquid wastes from the factories discharged around your residence?

Code No.
1. Yes
2. No
17. If Yes, where are those discharged?

Code No.
1. In open drains.
2. In ponds and ditches.
3. In open spaces.
4. In canals.
5. In sewer lines.
6. In agricultural lands.

18. Is there any factory in the area which cause air pollution?

Code No.
1. Yes
2. No

19. If Yes, How?

Code No.
1. By bad odor.
2. By emitting huge particulate matters.
3. By creating eye irritation/or any other type of physical trouble.

20. Does any factory of the area produce huge sound?

Code No.
1. Yes
2. No

21. If yes, Name the factory?

22. Is water logging created in the area after a short rain?

Code No.
1. Yes
2. No
23. If yes, What do you think the probable reasons of water logging ?

Code No.
1. Drain blockages due to disposal of solid wastes in drains by the industries of this area.
2. Construction of new industries in the area by filling up the ditches (retention ponds).
3. For filling up the low lands in the area for creating new residential plots.
4. For blocking the mouth of the canals in the area.
5. For inadequate sewer lines in the area.

24. Is there any open drains in your area?

Code No.
1. Yes
2. No

25. Are those cleaned regularly?

Code No.
1. Yes
2. No

26. How would you rate the quality of drinking water in your area?

Code No.
1. Good
2. Average
3. Bad

27. How would you rate the quality of water in the ponds and open water bodies in your area?

Code No.
1. Good
2. Average
3. Bad
28. Do you think there sufficient play fields /parks in the area?

Code No.
1. Yes
2. No

29. Are there sufficient trees in your area?

Code No.
1. Yes
2. No

30. Do you think the inhabitants of your area are sufficiently aware about the harmful effects of industrial wastes?

Code No.
1. Yes
2. No

31. If no, how can they be made more aware in this regard?

Code No.
1. By posters and leaflets
2. by newspapers
3. by telecasting programs in T.V
4. by the programs in radio
5. by giving relevant teaching in the schools and colleges.

32. What steps do you think should be taken by the Government to improve the environmental condition in TIA?
PLANNING IMPLICATIONS OF INDUSTRIAL WASTE MANAGEMENT IN TEJGAON INDUSTRIAL AREA OF DHAKA CITY

INDUSTRY INSPECTION REPORT

(To be prepared by the surveyor)

Dept. of Urban and Regional Planning,
BUET, Dhaka.

1. Name of the factory:

2. Address:

3. Code no.:

4. Plot size of the factory: __ __ __ Acres

5. Permanent structure coverage of the plot:

6. Are there Sufficient trees around factory? Yes/No

7. Are the Wastes seen in the open drains around factory? Yes/No

8. Is dustbin available around factory? Yes/No

9. Distance of the dustbin from the factory ---- yds.

10. Are the Wastes seen haphazardly dumped in any other place excluding dustbins Yes/No

11. Are there sufficient open spaces around the factory? Yes/No

12. Is there any traffic Jam in the entrance of the factory? Yes/No

13. Is there any smoke emission from the factory? Yes/No

14. Are wastes seen haphazardly dumped inside factory? Yes/No
15. Where the waste water from the factory is emptied?

Code No.
1. Nearby open space.
2. Nearby ditches.
5. Nearby agricultural lands.

16. Is there any complain of the inhabitants regarding the operations of the factory?  Yes/No

17. If Yes, What type of complain?

Code no.
1. For air pollution.
2. For haphazard disposal waste.
3. For creating huge sound.
4. Others.

18. Does the factory generate huge dust from its production process?  Yes/No

19. Do the workers of the factory use gloves, Masks etc?  Yes/No

20. Assessment of the working environment inside the factory:

a. Light  good/Average /Bad.
b. Ventilation  good/Average /Bad.
c. General cleanliness  good/Average/Bad.
QUESTIONNAIRE SURVEY ON
PLANNING IMPLICATIONS OF INDUSTRIAL WASTE
MANAGEMENT IN TEJGAON INDUSTRIAL AREA
OF DHAKA CITY
(For Managers/owners)

Dept. of Urban and Regional planning,
BUET, Dhaka.

1. Name of the interviewee:
2. Designation:
3. Name of the Industrial Unit:
4. Address of the Industrial Unit:
5. Main Products:
6. Approved production capacity: (Yearly)
7. Present production capacity (Yearly):
8. Main raw materials used for the products:

<table>
<thead>
<tr>
<th>Name materials</th>
<th>quantity (per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>

9. Where are the raw materials stored?

Code No.
1. In open spaces of the factory premises.
2. In open spaces outside the factory premises.
3. In side own warehouses of the factory.
4. Under the sheds inside factory.
10. How are the raw materials of your factory stored?

Code No.
1. Kept open inside factory premises.
2. Kept in poly bags and gunny bags in factory premises.
4. Others.

11. Is there any possibility of pollution from the raw materials?

Code No.
1. Yes
2. No

12. What is the amount of annual sales of the factory? - taka

13. What is the amount of invested capital of the factory? - taka

14. Does the unit produce any type of industrial waste?

Code No.
1. Yes
2. No

15. If yes, what are the quantities of the produced waste?

<table>
<thead>
<tr>
<th>Types of waste</th>
<th>quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid</td>
<td></td>
</tr>
<tr>
<td>Liquid</td>
<td></td>
</tr>
<tr>
<td>Gaseous</td>
<td></td>
</tr>
<tr>
<td>Semi-solid</td>
<td></td>
</tr>
</tbody>
</table>

16. Is there any safe storage facility of the produced waste in your factory?

Code No.
1. Yes
2. No
17. Are the wastes from your factory disposed of in municipal waste bins?

   Code No.
   1. Yes
   2. No

18. If Yes, What is the daily quantity?

   Type of waste
   
   1. 
   2. 
   3. 

19. Are the wastes produced from the factory sold to any other factory or person?

   Code No.
   1. Yes
   2. No

20. If Yes,

   To whom these are sold?

21. What type of problems do you face for disposing wastes in the municipal wastebins?

   Code No.
   1. Smaller size of wastebins.
   2. Wastebins are distantly placed.
   3. Insufficient numbers of wastebins.
   4. Wastebins are not cleaned regularly.

22. Excluding municipal wastebins, where are the wastes from your factory dumped?
23. Is recycling of the wastes from your factory possible?

Code No.
1. Yes
2. No

24. If Yes, How?

25. What types of fuel are used in your factory?

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Types of fuel</th>
<th>Monthly Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Natural Gas</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Electricity</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Others</td>
<td></td>
</tr>
</tbody>
</table>

26. Is there any boiler/furnace in your factory?

Code No.
1. Yes
2. No

27. Is there any chimney in your factory?

Code No.
1. Yes
2. No

28. If yes, what is the height of the chimney?

- - - - - - - - - - - ft.

29. Does your factory undertake any production process which may generate huge dust?

Code No.
1. Yes
2. No
30. What is the daily amount of liquid wastes produced from your factory?

31. What are the major constituents of the liquid wastes from your factory?

32. Is there any arrangements in your factory to measure the quantity and strength of the liquid waste?

Code No.
1. Yes
2. No

33. If no, What are the reasons for not having the arrangements?

Code No.
1. Quantity of the wastes is insignificant
2. No idea about the technology and arrangements necessary for this purpose.
3. In sufficient knowledgeable manpower for this purpose.
4. Lack of necessary laboratory facilities.

34. Where are the liquid wastes from your factory emptied?

Code No.
1. In septic tank inside factory.
2. In open drains around factory.
3. In sewerage lines.
4. In the ditches near factory.
5. In the open spaces near factory.

35. Is there any treatment facility for the liquid of wastes in your factory?

Code No.
1. Yes
2. No
36. If no, What are the reasons for not having the facilities?

Code No.
1. Wastes produced from the factory are harmless.
2. No place for setting up treatment units inside factory.
3. Lack of trained manpower.
4. Lack of knowledge about treatment technology.

37. What is the daily requirement of water in your factory?
   For production purpose - - -
   For household work - - -
   Others - - -
   ----------------------------
   Total

38. What are the sources of water supply in your factory?

   Code No.
   1. Own arrangement (pump etc)
   2. WASA supply

39. What are the uses of water in the production process of your factory?

   Code No.
   1. For washing raw materials
   2. Constituent of the product
   3. For washing the finished product
   4. Heat absorbent of the machine
   5. Others

40. Is there any sufficient green belt(trees, parks, open space, play grounds etc) around your factory?

   Code No.
   1. Yes
   2. No
41. Is there any industrial units whose production processes hamper your production process or quality of your products?

Code No.
1. Yes
2. No

42. If Yes, i. What is the name of the factory?
   ii. How is it hampering your process?

43. Does your factory possess sufficient safety measures for the workers?

Code No.
1. Yes
2. No

44. Do you think that Government help is necessary to improve the waste management system of your factory?

Code No.
1. Yes
2. No

45. If Yes, How?

46. Is there any future plan to adopt new technology which would produce less waste in your factory?

Code No.
1. Yes
2. No
47. Is there any plan to produce new products in your factory?

Code No.
1. Yes
2. No

48. How will this affect the present waste generation quantity of your factory?

Code No.
1. Will increase waste
2. Will decrease waste
3. Will keep the waste same

49. What steps do you think would be necessary for improving the waste management system of TIA?

Code No.
1. DCC should make solid waste cleaning up operation more dynamic and regular.
2. Separate waste bins should be given for the disposal of industrial solid wastes.
3. Government should establish a joint treatment plant in TIA.
4. Government should financially and technically help the industrial units to establish treatment plants in respective units.
5. Pollution control laws and standards should be updated.
6. Pollution control laws should be strictly enforced.
7. Waste disposal permitting system should be initiated.
8. Others.