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PROGRAMME OBJECTIVE SERIES :
PROBES/43/1989-90

GUIDELINES
ON
ENVIRONMENTAL MANAGEMENT
IN
INDUSTRIAL ESTATES

CENTRAL POLLUTION CONTROL BOARD

July, 1996

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CENTRAL POLLUTION CONTROL BOARD
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FOREWORD

Central Pollution Control Board focussed the attention of the promoters of Industrial Estates in the country on the pollution problems of the Estates through a symposium held at Jaipur, Rajasthan during December 27-28, 1979. The symposium recommended a set of principles in order to improve the environmental conditions in existing industrial estates and for planning of new industrial estates. Since then many attempts have been made to control pollution caused by industrial estates. The experience out of these attempts pointed to the need for development of comprehensive guidelines for the waste management in industrial estates.

This report is an attempt in this direction. The present publication, I hope, will meet the the need. The inputs from Dr. G. Werner and Mr. H. Kraft, Consultants from Federal Republic of Germany in the formulation of the guidelines are gratefully acknowledged.

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1.0 INTRODUCTION

1.1 The objective

The Objective of this report is to frame guidelines for environmental protection for new industrial estates and upgradation of pollution control systems for existing industrial estates so as to save and restore the quality of natural resources like water, air and land, and the quality of life.

1.2 Industrial estates — perspectives

Promotion of Industrial Estates was given a boost by the Government of India towards the end of the first five-year plan period (1952—1957). To organise industrial growth by small enterpreneurs infrastructural facilities were provided to curb unplanned growth of small industries in urban centres and to avoid mixed land use. The objectives of the programme were : (a) to provide well-planned accommodation to small industries at suitable sites with facilities of water, electricity, transport, banks, canteen, watch and ward and communication, (b) to bring a number of units together and thereby facilitate establishment of common service centres, introduction of modern technology, collective purchase of raw materials and sale of finished goods, and joint publicity, thus enabling the small enterpreneurs to avail of external services at the door-step and counteracting to some extent the disadvantages resulting from the smallness of their sizes, and (c) to enable the enterpreneurs to avail of the goods and services of each other, so as to make them complementary and inter-dependent.

With these initiatives, significant growth of industrial estates are in the offing. According to the information available, the statewise distribution of industrial estates presented in Table 1.1 reveals that the growth of industrial estates is more in the States of Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Rajasthan, Uttar Pradesh and Maharashtra.

TABLE 1.1 : DISTRIBUTION OF INDUSTRIAL ESTATES

Name of State/ Union Territories	Number
Andhra Pradesh	103
Assam	08
Bihar	52
Chandigarh	01
Dadra & Nagar Haveli	02
Daman & Diu	02
Delhi	07
Goa	08
Gujarat	140
Haryana	12
Himachal Pradesh	08
Jammu & Kashmir	20
Karnataka	67
Kerala	30
Madhya Pradesh	78
Maharashtra	69
Manipur	01
Meghalaya	03
Mizoram	02
Nagaland	02
Orissa	18
Pondicherry	04
Punjab	30

Rajasthan	54
Tamil Nadu	47
Tripura	05
Uttar Pradesh	86
West Bengal	06
Total	867

Source : Kothari's Industrial Directory of India, 1990

1.3 Industrial estates : site selection and organisation

The role of the Central Government in the establishment and up-keep of industrial estates in India has been mainly that of laying down the guidelines for the State Governments, and coordination, review and monitoring of the industrial estates development programmes. The selection of sites for location of industrial estates, development of areas, construction of factory sheds, and provision of requisite infrastructural facilities lie within the jurisdiction of the State Government. Consequently, organisations of State Government undertakings like State Industrial Development Corporations came into existence.

The present scenario in industrial estates in terms of sanitary services is very grim.

The provision of wastewater collection, treatment and Solid Waste disposal are noteworthily absent. Even in selection of site, major environmental considerations associated with industrial estate like natural resources, human uses and quality of life are lost sight of by the promoters. As a result, quality of natural resource like air, water and land are degraded. Natural water bodies used for drinking water supply and fisheries are under serious threat of pollution within the vicinity of industrial estates. The health of residents in nearby area is under risk. Social changes brought about by industrial estates were never assessed in the light of quality of life. It is, therefore, imperative to incorporate environmental impact assessment from the beginning of the planning stage.

While selecting the sites for establishment of industrial estates, the motive force, for curbing unplanned growth of industries in urban centres and streamlining the land use pattern, are as follows :

- to identify an optimum geographical location which is centrally linked by transport, communication, water and power supply in order to quicken the development of new industrial units;
- to serve as work place for the unemployed and those who are residing in the nearby vicinity of the estates, especially in backward and rural areas ; and
- to promote inter-industry transaction within the small units in order to encourage business environment along with industrial activity. This also aims at preventing interference of middle men, establishing units in a single cluster so that geographical distance between units are kept minimum and linkages of industrial units are strengthened.

2.0 ASSESSMENT OF POLLUTION OF INDUSTRIAL ESTATES

2.1 Nature of pollution

In India, there are industrial estates which house industries of same kind but with a variation in scale of operation. However, existence of industrial estates with a wide variation of industries with respect to product and also scale of operation are there. The former type of industrial estates does not suffer from any constraint with respect to variation in wastewater quality ; only the hydraulic load fluctuates. Whereas, industrial estates with variation in quality of wastewater which comprises toxic waste, biodegradable waste, persistent waste, pose technological as well as administrative problems in pollution abatement programme. The product spectrum, though very wide, can be grouped on the basis of similarity in nature of manufacturing process with unit operation. An attempt is, therefore, made to classify the industries in Table 2.1 indicating quality of waste. A close examination of the Table 2.1 reveals that industrial estates comprising different kind of industries generate wastes of complex nature when the effluents mix together. However, the industries of same kind, when housed in an industrial estate, the variation with respect to quality is minimum. Besides the liquid wastes, there are problems associated with solid waste disposal. In the absence of proper collection and disposal, solid waste are mostly heaped at sixes and sevens in industrial estates. The principal source of air pollution in industrial estates is the boiler and furnace. In some occasions, air pollution from manufacturing process also takes place. In order to abate pollution generated from industrial estates, it is, therefore, necessary to have qualitative and quantitative assessment of pollution as a first step which can be done on the basis of scientifically-sound inventories.

2.2 Pollution assessment — methodology for survey

Absence of appropriate data-base often stands in the way of planning the right course of action. To evolve an appropriate plan of action for environmental management, it is imperative to obtain reliable information on the following :

- Physical location of industrial estates within the urban or regional perspective. With the aid of maps, showing the point/mode of disposal of liquid waste, surrounding land use pattern etc. ;
- Detailed layout planning of industrial estate;
- Number of industries in the industrial estate generating pollution ;
- Classification of industries based on nature of products and scale of operations;
- Quality, nature and mode of disposal of industrial effluents of both individual industrial units and combination of waste thereof;
- Type of fuel used in boiler and furnace, and nature of emission emerging out from them;
- Nature of solid wastes generated from each industrial unit and their collection and disposal system; and
- In order to achieve the above objective, a thorough investigational programme, through on-the-spot survey needs to be initiated.

2.3 Design of survey

Design of survey consists of two steps, e.g. the dry inventorisation through physical observation and wet inventorisation through field monitoring of pollution. In case of dry inventory, the areas covered are classification and categorisation of industry with respect to product, wastewater generation, fuel consumption etc. The detailing of study area include the physical location of the industrial estate, the mode of disposal of wastewater, solid waste generation, collection and disposal, the green belt development in the surroundings etc.

Principally, dry inventory is collection, collation and retrieval of information. The information more often than not are available with the State Pollution Control Boards in the form of consent application. These alongwith questionnaire survey and reconnaissance survey provide the necessary information.

For the layout plan of the industrial estate, the source of information is the promoting agency of industrial estate.

The need for wet inventory is deemed to study the variation in waste load generation, the characterisation of waste, and the probable treatability of the wastewater of individual industry and the combined waste. The waste load may also be assessed from the dry inventory to a great extent. However the wet inventory support will ensure the reliability. The information collection, collation and retrieval for pollution assessment is shown in Figure 2.1. It may be observed, that the users of the information are many. Moreover, from the survey of several industrial estate, there is a possibility to have a data bank of wastewater generation, air pollut-

TABLE 2.1 : CLASSIFICATION OF INDUSTRIES AND THEIR NATURE OF EFFLUENT QUALITY IN INDUSTRIAL ESTATES

Nature of Industries →	Organic Industries	Food & Fruit processing	Plastics & Polymer Rubber	Paper & Paper Product	Electroplating and Pickling Inorganic Chemicals	Soap and Detergent	Agro-based and Live Stock	Textile
	* Basic organic Manufacturing Industry	* Food Processing unit	* Finished Product for house hold consumption	* Handmade paper	* Acids * Electroplating	* Soap formulation	* Agro-baded chemicals	Textile
	* Dye & Dye stuff	* Cold drink bottling		* Paper from waste	* Pickling	* Detergent formulation	* Tanneries	
	* Pesticides (formulation)						* Woollen product	
	* Pharmaceuticals (formulations)	* Fruit processing	* Wire	* Board				
Effluent characteristics ↓	* Paints							
Liquid waste								
* Biodegradable	+	++	—	++	—	+	+	+
* Persistent organic	++	+	—	+	—	+	—	+ (Dyeing Unit attached)
* Toxic waste organic	+	—	—	—	—	—	+ (Agro-based chemical)	+
* Inorganic (metal)	—	—	—	—	++	—	++ (chromium in case of of tanneries)	—
* solids	+	—	—	—	—	+	+	+
* Dissolved solids	+	—	—	+	+	—	+	+
Solid waste Generation	—	—	Plastic scrap & refuse	Refuse paper	Scrap of metalic product	Refuse of soap	Refuses	—
Air pollution emmission	+ (Dust in case of pesticides)	—	—	—	Fugitive emmission	Emmission of SO_2		

Note : — insignificant, + moderate, ++ high ants and solid wastes for a wide range of products which will help to plan pollution control programme in advance for a new industrial estate.

2.3.1 Questionnaire survey

While developing a questionnaire, it is to be borne in mind that it is simple to understand, easy to handle and very brief to report. Too lengthy a questionnaire often yields no response from the concerned organisation. Personal visits improvise the questionnaire survey to a great extent. A typical questionnaire is presented in Appendix A for convenience and guidance.

2.3.2 Processing of data and retrieval system

Processing of the data to the desired level is very much dependent on data collection. Processing of the data indeed is linked with what is to be retrieved. Retrieval in the same way is associated with question to be asked, which may often be on classification and categorisation of data with respect to product (Table 2.2) wastewater flow (Table 2.3) or a combination of the two (Table 2.4). The data shown in Table 2.2 through 2.4 are from the various surveys conducted by the Central Pollution Control Board. Wastewater load may be ascertained from the dry inventory. The assessment of sulphur dioxide emission from different types of industry can be done on the basis of dry inventory. An example is cited at Table 2.5.

2.3.3 Wet inventory

Pollution load can be assessed from dry inventory. However, to ensure reliability of data and also to study the variation, wet inventory becomes imperative.

In most of the small scale units the manufacturing process involve batch operations leading to batch discharges. The wastewater volume is computed by recording the time for which each operation is carried out and the waste volume generated (based on reactor volume) on each occasion. Based on these volumes, a mass flow diagram is generated. The instantaneous flow rates are calculated from the slope of the mass diagram curves at every half an hour interval. An illustrative example of the above procedure is given in Appendix B.

In order to arrive at wastewater generation, and characterisation of waste from an industrial unit, it is essential to have wastewater generation from each unit operation and characterisation thereof. An example for textile industry is illustrated for better understanding the main operations which contribute to generation of wastewater are mercerizing, kiering, dying and washing. Fig. 2.2 shows schematically the sequence of these operations in a textile industry. A typical example of wastewater characterisation of textile units with respect to different unit operations and final discharge point is shown in Table 2.6. Similarly an attempt may be made for various types of industries to have well-established flow rates. Combination of wastewater from different units leading to combined waste is the summation of discharge loads of all categories of industries. An example of such an attempt is shown in Fig. 2.3 with respect to an industrial estate.

TABLE 2.2: **PRODUCTWISE CLASSIFICATION OF INDUSTRIES IN A TYPICAL INDUSTRIAL ESTATE**

S.No.	Type of industry	No. of industries
1.	Textile industry including dyeing, finishing, drycleaning	23
2.	Chemical industry including fertilizer and pesticides	4
3.	Engineering industry including printing, electroplating etc.	13
4.	Miscellaneous industry including soap, food products, rubber, plastic and oil	26
	Total	66

Source : Industrial Survey—Union Territory of Delhi; Central Pollution Control Board Publication,CUPS/3/1978-79

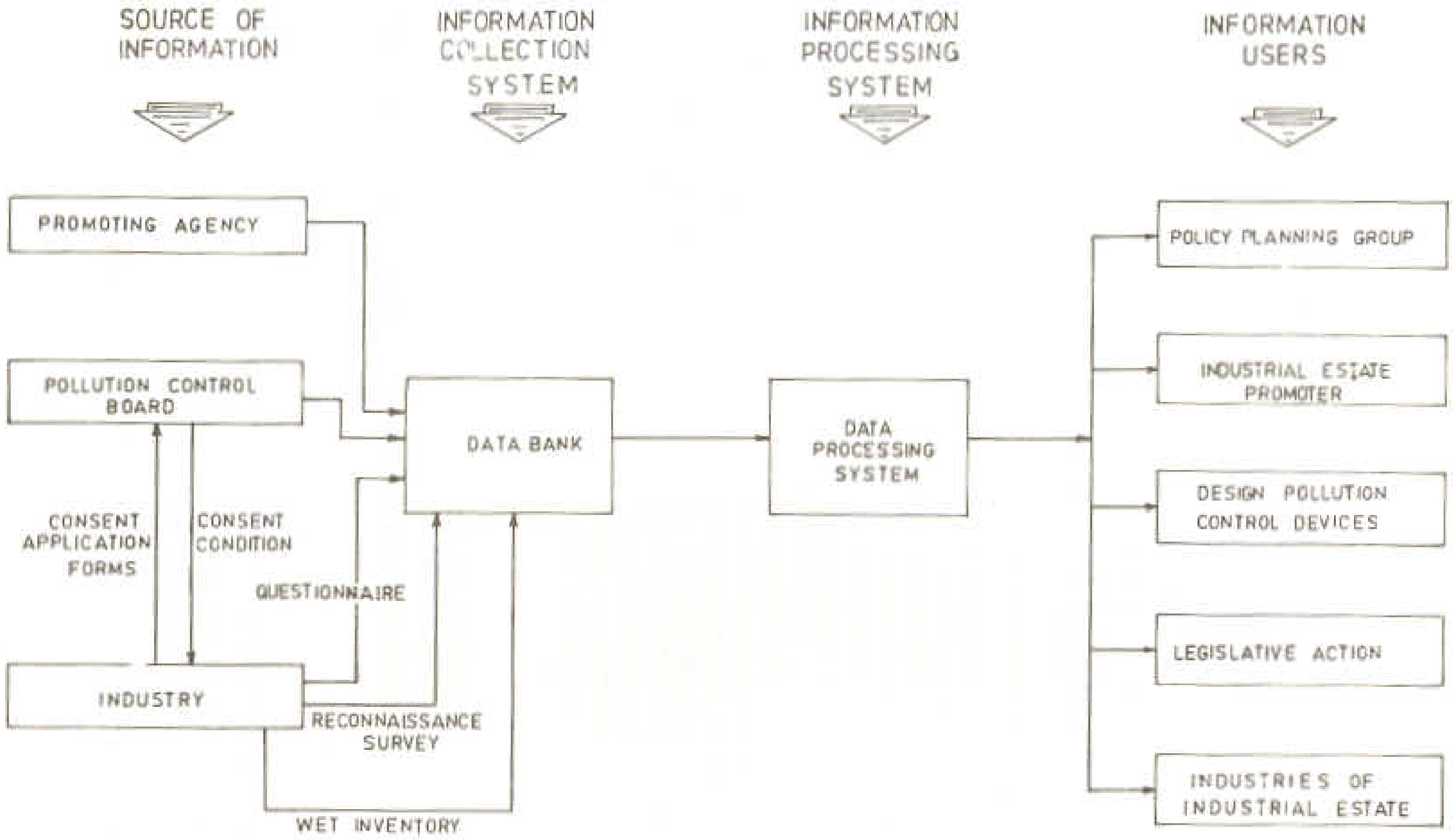


FIGURE 2.1 : POLLUTION ASSESSMENT : INFORMATION COLLECTION, COLLATION AND RETRIEVAL SYSTEM

TABLE 2.3 : **EFFLUENT FLOW-WISE CLASSIFICATION OF INDUSTRIES IN A TYPICAL INDUSTRIAL ESTATE**

S.No.	Effluent flow range, KLD	Number of industries
1.	25 and less	26
2	25 and 50	11
3.	50 and 100	12
4.	100 and 200	7
5.	200 and 400	1
6.	400 and 800	2
7.	More than 800	1
8.	Flow figures not available	6

Source : Industrial Survey—Union Territory of Delhi; Central Pollution Control Board Publication,CUPS/3/ 1978-79

TABLE 2.4 : **WASTEWATER VOLUME AND PRODUCTWISE CLASSIFICATION OF INDUSTRIES IN A TYPICAL INDUSTRIAL ESTATE**

		Effluent Discharge			
S.No.	Type of Industry	Figures. not available	Less than 25 KLD	25 to 50 KLD	More than 50 KLD
1.	Textile industry including dyeing, finishing and drycleaning	2	6	2	13
2.	Chemical industry including fertilizer and pesticides	0	0	1	3
3.	Engineering industry including printing, electroplating etc.	0	5	6	1
4.	Miscellaneous industry, including soap, food, papers, rubber etc.	4	15	2	5

Source : Industrial Survey—Union Territory of Delhi; Central Pollution Control Board Publication,CUPS/3/ 1978-79

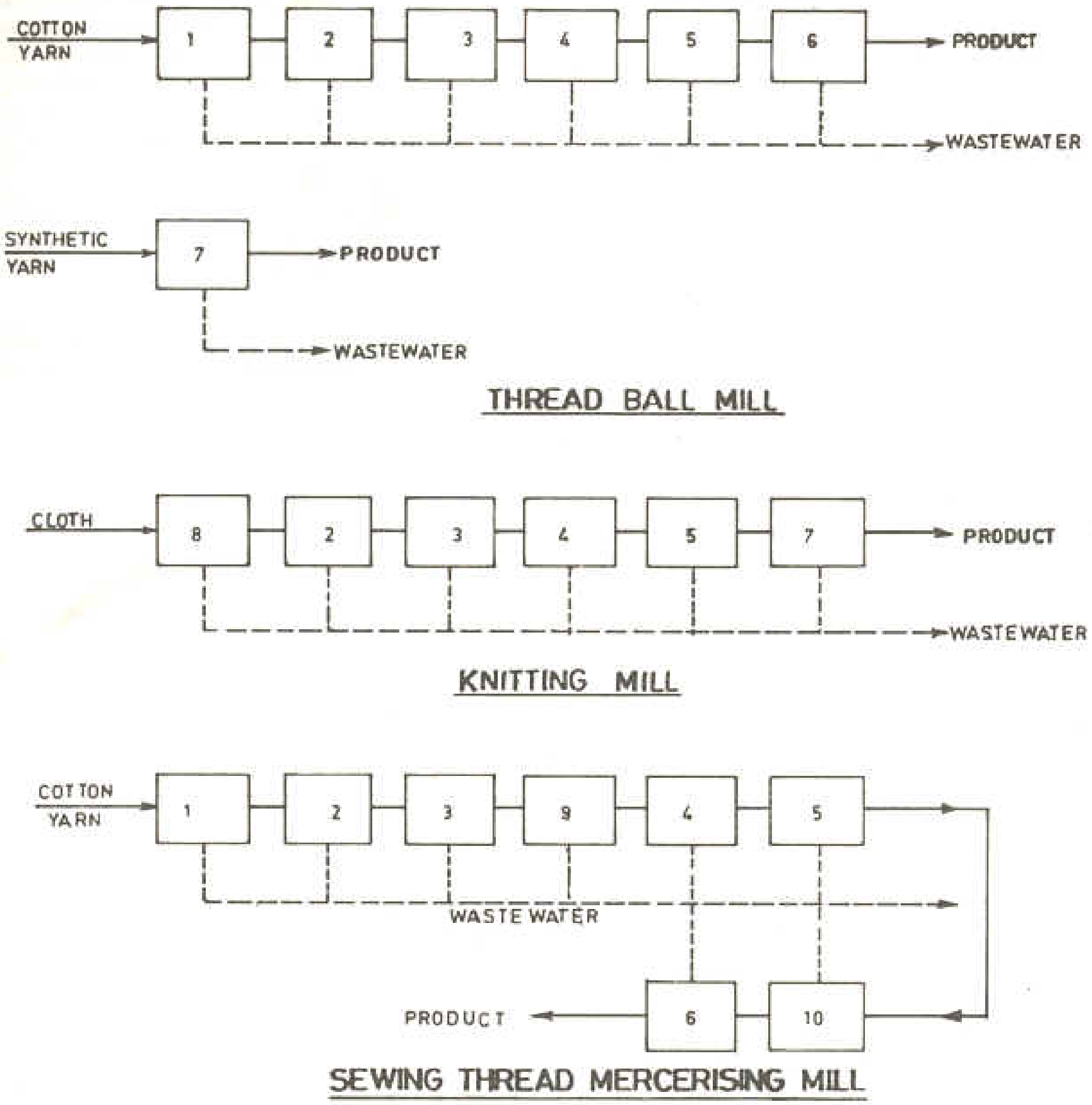
TABLE 2.5 : **ASSESSMENT OF SULPHUR DIOXIDE EMISSION FROM EACH CATEGORY OF INDUSTRY IN AGRA**

Industry category	Total fuel used, tonne per month	Sulphur content, kg. per tonne of fuel	Emission of sulphur from fuel, tonne per month*	Sulphur-dioxide		Percent contribution of SO_2 by each category of industry
				tonne per month	tonne per day	
Foundry	8598	5	34.24	68.48	2.28	62.74
Ferro-alloy	1105	5	3.50	11.00	0.37	10.14
Rubber	254	7	1.80	3.60	0.12	3.29
Lime processing	785	0.2	0.16	0.32	0.01	0.27
Engineering	359	7	2.51	5.03	0.17	4.66
Chemicals	1012	7	7.08	14.16	0.47	12.88
Brick Refractory	480	7	3.36	6.72	0.22	6.02
Total	12,593		54.65	109.31	3.64	100.00

*excluding the amount absorbed in the process.

TABLE 2.6 : **CHARACTERISTICS OF WASTERWATER GENERATED FROM VARIOUS OPERATIONS OF A TEXTILE MILL**

Operation	Volume, m^3/day	pH	Alkalinity/ Acidity, mg/l	SS, mg/l	COD mg/1
Mercerising	4.09-6.25	9.8-11.1	5526-21,100	770-1294	806-1025
Kiering	4.05	11.2	22814	804	9641
Plainwash (initial/final)	1.92-6.21	9.9-10.2	744-1052	875-1058	241-378
Hand wash	1.50-2.40	1.8-2.2	5152-5465	78-286	238-418
Bleaching	0.5-0.6	6.1-7.1	134-246	147-626	273-2042
Dyeing	25.80	7.4	418	21	159
Composite sample	10.57-42.25	11.3	3322-6875	1430	722-1297



1. MERCERIZING
2. KIERING
3. INITIAL/ACID WASH
4. BLEACHING
5. FINAL WASH
6. ULTRAMARINE/TINOPAL
7. DYEING/WASHING
8. CLOTH BATH
9. SODA WASH
10. H_2O_2 WASH

FIGURE 2.2: WASTEWATER GENERATION FROM TEXTILE MILL OPERATIONS

2.3.4 Combined wastewater—wet study

Characterisation of combined wastewater from an industrial estate is very important, as it not only imparts impact to the receiving water body but also dictates about the probable design of effluent treatment plant and overall plan on water pollution control management in the industrial estate.

It is, therefore, necessary to have flow data with varying degree of fluctuation. The flow data of a combined wastewater stream is shown in Fig. 2.3. From the figure it is observed that the discharge in the drain do not show the wide variations in flow rates noted for individual industries. The ratios of maximum to average, and minimum to average flow rates, are 1.26 and 0.81 respectively. The average flow was 9,260 cubic meter per day.

In characterisation of wastewater it is to be seen that the sample analysed is composed of the supernatant of the thoroughly mixed wastewater. This is required to facilitate the design of effluent treatment plant. If the settling load of wastewater is high, the cost of treatment will be lower as primary treatment may suffice to meet effluent standard. The results of analysis of the two 24-hour flow-based composite samples are shown in Table 2.7. The supernantant of the wastewater composite samples after allowing it to settle for one hour is also analysed. From this table it is understood that the waste does not have a high concentration of organic matter as indicated by the COD value. The rather high COD to BOD ratio may be due to the presence of high heavy metals concentration in the wastewater compared to low biodegradable organic matter. Hence this wastewater needs physico-chemical treatment.

2.4 Solid waste assessment

2.4.1 Solid waste characterisation/Solid waste in industrial estates can be classified into following categories :

i) Those generated during effluent treatment ;

ii) Those generated as scrap materials

iii) Those generated as product reject.

The above classification can be further divided into sub-classes on the basis of physico-chemical properties. Quantitative figures can be obtained from dry inventory. Quantitative figure, and nature of solid wastes can be combined to form a matrix. In addition to this matrix, the scale value, re-use value etc. will lead to management issues related to collection and disposal problems. However, chemical characterisation of the solid wastes is required for a common disposal system. Of course, dry inventory alone can render the problem near to a solution.

TABLE 2.7 : **CHARACTERISTICS OF COMBINED WASTEWATER FROM AN INDUSTRIAL AREA**

Parameter	Characteristics of Mixed sample
pH	4.9—9.2
Acidity	46.8—52.7
Alkalinity	230.3—381.6
Conductivity (μmho/cm)	2000—2300
Suspended solids	482—556
COD	308—328
BOD	33—48
Oil & Grease	34—63
CN	1.2—2.4
TDS	1893—2101
Fe	45.2—50.4
Cr	4.7—6.4
Pb	0.03—0.05
Zn	1.5—1.7
Cu	1.1—1.2
Ni	9.8—12.9

Note : Concentrations are in mg/l except for pH and Conductivity

Source : Characterisation of Wastewater from Wazirpur Industrial Area, Central Pollution Control Board Publication, PROBES/35/1986-87

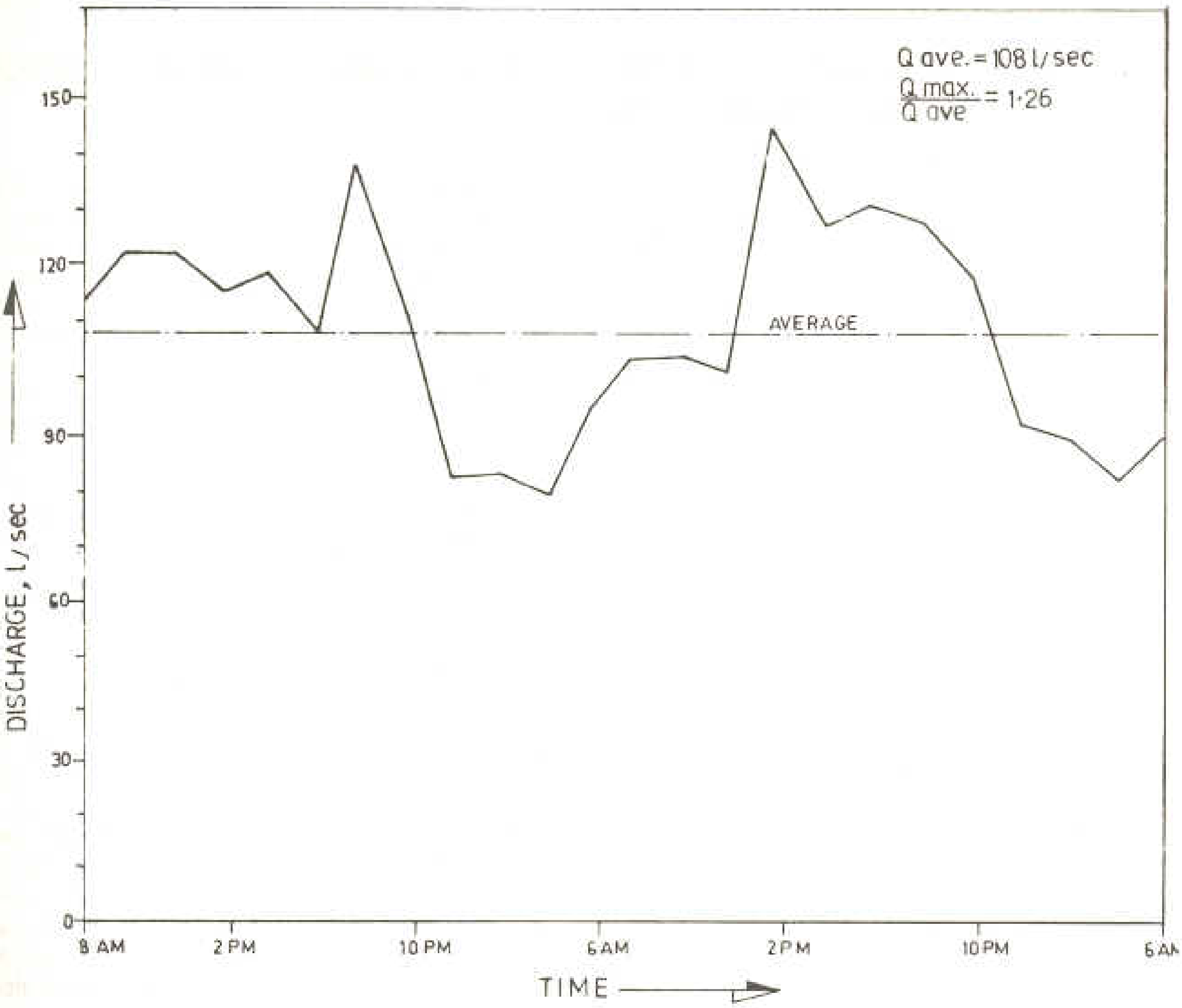


FIGURE 2.3 : WASTEWATER DISCHARGE FROM WAZIRPUR INDUSTRIAL AREA AT DELHI

2.5 Air quality assessment

2.5.1 Unlike the wastewater and solid wastes, the combined effect of air pollution cannot be assessed. However, evaluation of the impact of air pollution from an industrial estate can be made with the aid of multiple stack modelling. Wet study in this regard is to be done with the help of continuous monitoring of air quality data in association with meteorological data. Stack monitoring is required for comparison between the assessed data and the observed data. This modelling effort will help to control emission by optimising the stack height with respect to individual case, and design green belt as a combined effort.

3.0 TECHNICAL, LEGAL AND MANAGEMENT ASPECTS OF POLLUTION CONTROL IN INDUSTRIAL ESTATES

3.1 Present approach :

The problem with respect to liquid effluent may be approached for solution in the following manner :

- classification of industries based on compatibility of their wastewater ;
- assessment of volume and quality characteristics of the wastewaters from individual industries ;
- assessment of the effect of treated wastewaters on any of the available recipient bodies ;
- selection of the appropriate disposal site with minimum impairment of the same ; and
- establishment of the characteristics of pretreated wastewaters and final effluent from the common effluent treatment facility.

With the data available, the approach to effluent treatment facilities have the following alternatives :

- individual approach ;
- sectorwise approach ;
- combined approach with pretreatment ; and
- combined approach without pretreatment.

3.2 Individual approach

This alternative is most suited where only a few industries in the estate warrant effluent treatment. It has the merit that the pollutants are contained at the source itself and the units are directly responsible for the treatment, from investment to operation. The only issue left to the "combined effort" is the disposal of treated effluent, if necessary, through a polishing pond depending upon the demand of the receiving stream. Remaining small-scale industries are left with the responsibility of neutralising their effluents before discharge to protect the sewers against corrosion. A scheme for this alternative is shown in Fig. 3.1

While studying to explore the possibilities of liquid effluent treatment at Gujarat Industrial Development Corporation (GIDC) at Vapi, it is observed (CPCB, 1979-80) that 11 major units in the estate have to provide their own primary treatment plants comprising equalisation followed by removal of oils and grease, neutralisation and sedimentation in the first stage. If warranted, secondary treatment may be provided by these individual units. Remaining 114 units have to neutralise their effluents to protect the sewer. The responsibility of the GIDC is left with is to provide proper collection system for treated effluent and terminal treatment before disposal to the estuary.

3.3 Sectorwise approach

The wastewaters from any unit may be alkaline organic, acidic, toxic, orgnic toxic, acidic inorganic and so on. Segregation of these various categories of wastewaters is desirable for accomplishing effective treatment and economy.

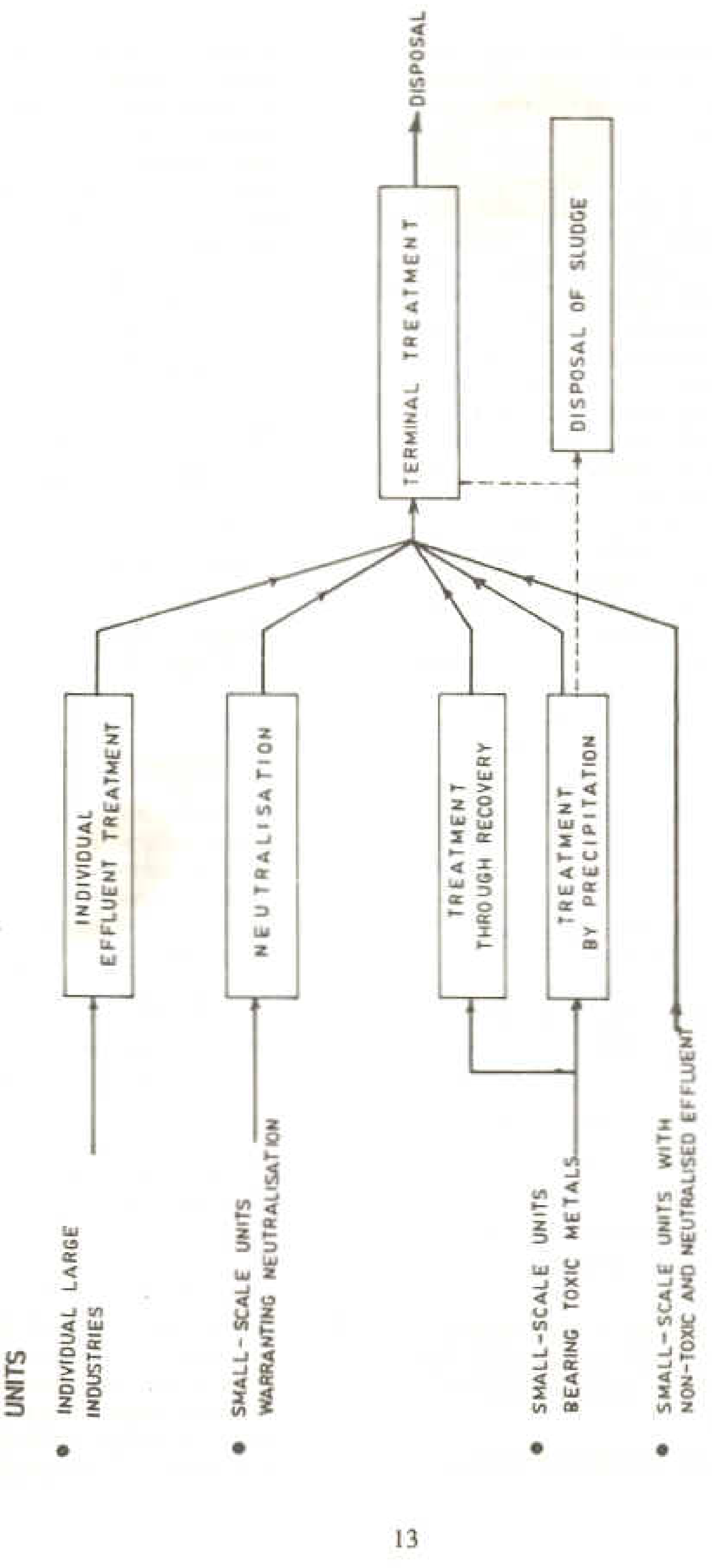


FIGURE 3.1 : INDIVIDUAL TREATMENT APPROACH

The primary consideration for segregating the various streams is the enhancement of treatability. The associated economy remains a secondary consideration.

Segregation of waste streams is relatively simple in case of a single large industry as illustrated in Fig. 3.2. Similar attempt in an existing industrial estate may cause laying of extensively lengthy sewerage systems as illustrated in Fig. 3.3. In this case the sewerage system becomes elaborate as the estate requires as many parallel sewers as the categories of wastewaters in a well laid-out network throughout the estate area. The cost and difficulty in laying such an elaborate network of sewerage comprising several parallel lines completely upset the advantage derived by enhancing the treatability through segregation of various categories of waste streams. Such an approach could have been better if the units in the estate are zoned on the basis of characters of the waste streams. Such zoning facilitates sectorwise treatment and thereby eliminates elaborate laying of sewerage network. However, zoning of industries as illustrated in Fig. 3.4 could only be considered in the planning or under construction stage to make the system cost effective.

3.4 Combined approach

The characteristics of wastewaters from the industrial units have a bearing on the types of treatment while its volume has on the economics. The combined treatment of all the wastewaters is an often envisaged proposition and has the following merits :

- economy of scale may be achieved ;
- better control over treatment can be exercised ;
- small units may not have to bother about installation, operation and maintenance of treatment units ;
- the hydraulic stability of small treatment units being far from satisfactory, the combined treatment would eliminate such instability ; and
- conditioning and equalisation of wastewater.

Of course, escape into the environment of toxic compounds and elements to be biomagnified in the environmental waters under the camouflage of dilution offered by the combined treatment scheme may be noted. Furthermore, any proposal of conveying, at a huge cost, the entire wastewater generated in the estate to a terminal point when only a few industries in the estate need to treat their wastewaters, and non-polluting wastewaters of others can be disposed of without treatment, requires to be examined. Combined treatment remains the most ideal choice where all the units in the estate are engaged in similar operations. Such situation may occur with dyeing and printing of textiles, tanneries, electroplating and such other types of industries where the units tend to flock together for reasons other than pollution control otherwise, in case of mixed waste pretreatment is necessary.

A typical example of common effluent treatment plant with mixed waste is shown in Fig. 3.5.

3.5 Choice of technology

The choice of technology is site-specific. It depends on characterisation of waste, the mode of disposal and the burden with respect to investment. It is, therefore, necessary to consider the following aspects in the choice of appropriate technology :

- treatability ;
- operation and maintenance to be easy cost and energy effective ;
- effluent quality and mode of disposal ;
- resilience to absorb shock load and variation in flow ; and
- resource recovery through recycling, renovation and re-use.

3.5.1 **Treatability.** The most important aspect of designing effluent treatment plant at the terminal point of an industrial estate is the treatability of wastewater. The parameter which governs the treatability is the BOD : COD ratio. If the ratio is more than 0.5, biological treatment is favour-

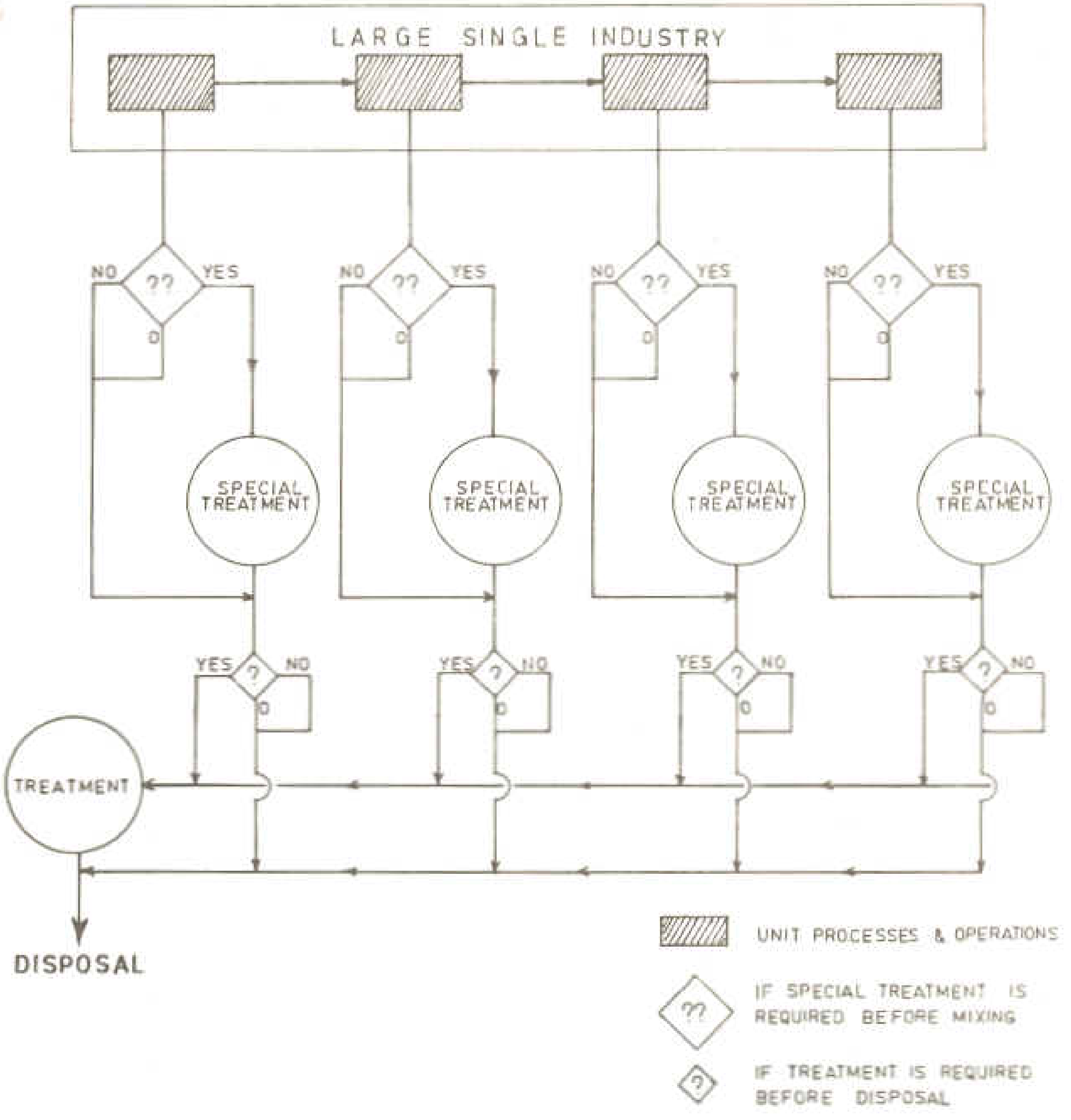


FIGURE 3.2 : COLLECTION, TREATMENT & DISPOSAL FOR SINGLE LARGE INDUSTRY

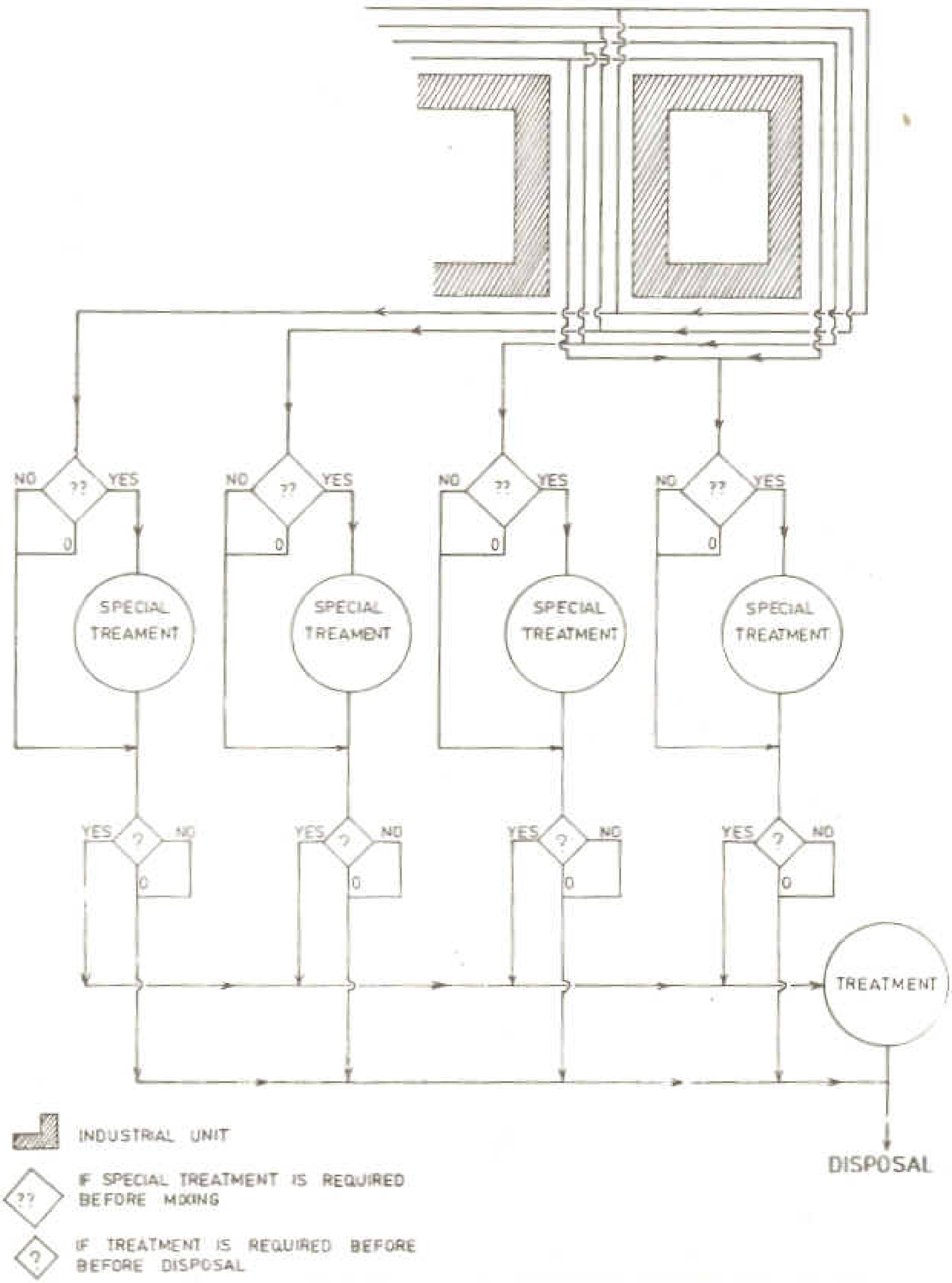


FIGURE 3.3 : COLLECTION, TREATMENT & DISPOSAL OF SEGREGATED WASTEWATERS FROM UNPLANNED INDUSTRIAL ESTATES

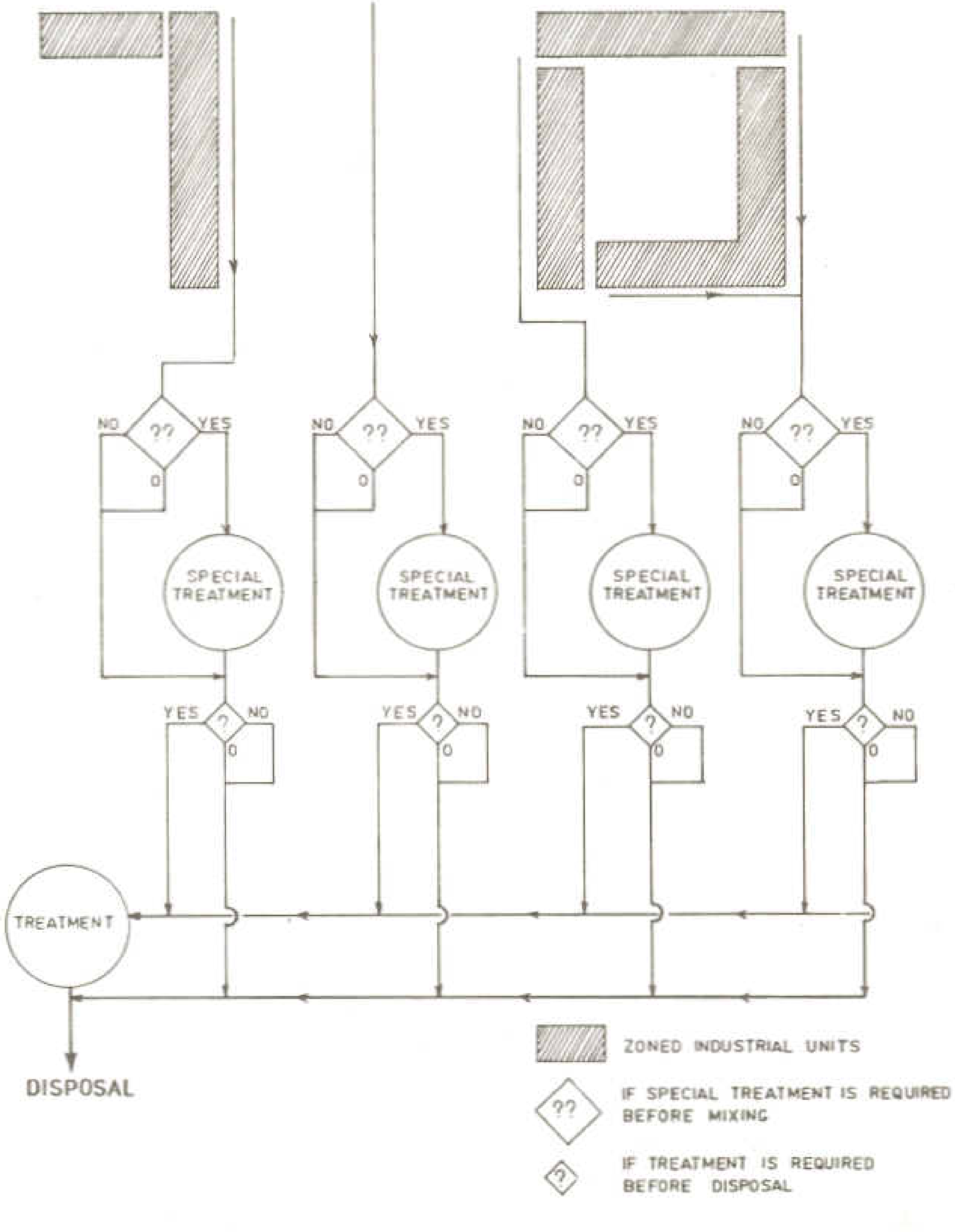


FIGURE 3.4 : COLLECTION, TREATMENT & DISPOSAL OF SEGREGATED WASTEWATERS FROM ZONAL INDUSTRIAL ESTATES

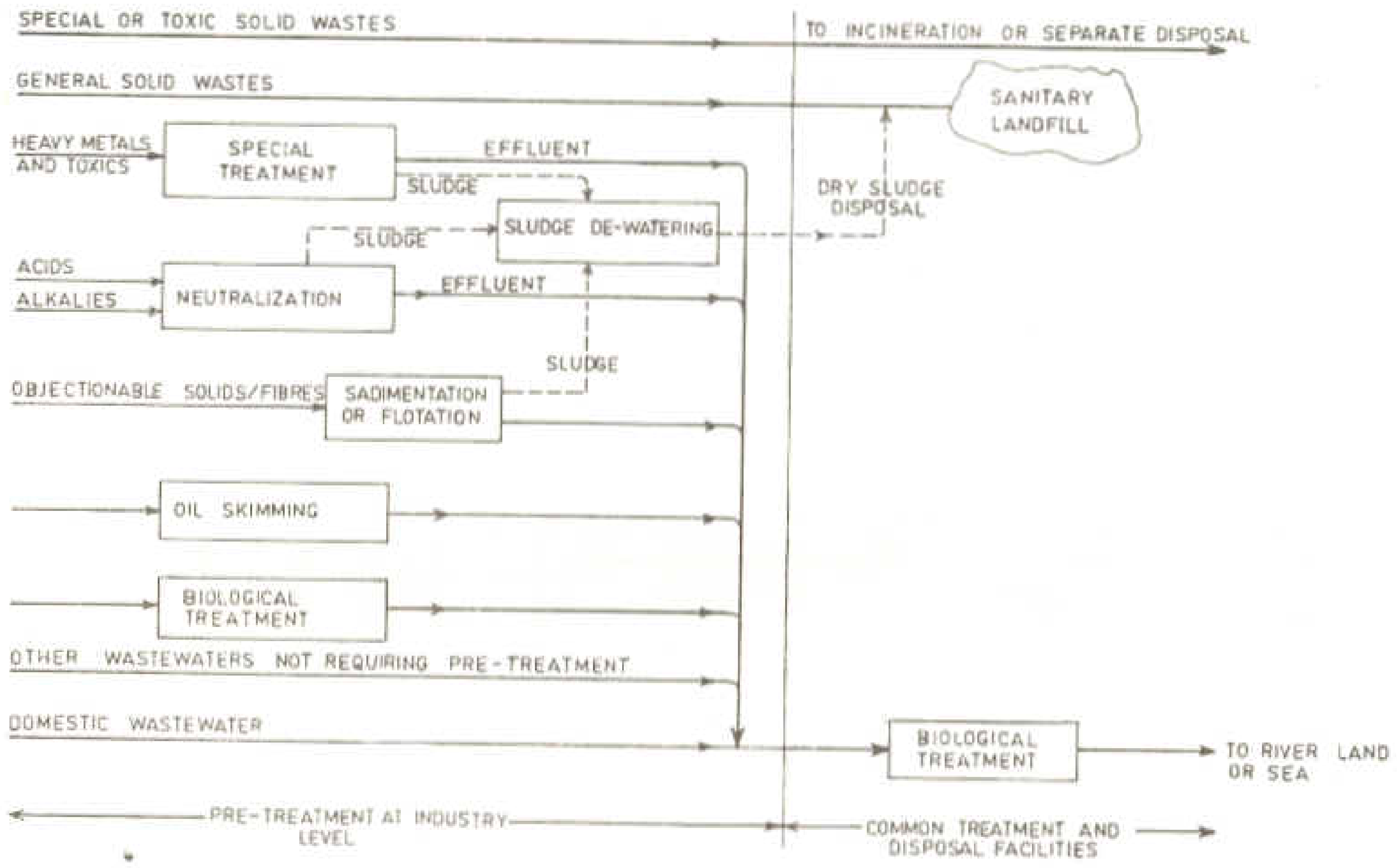


FIGURE 3.5 : TYPICAL WASTEWATER SEGREGATION AND TREATMENT SYSTEM IN AN INDUSTRIAL ESTATE

able. Otherwise, it is advisable to mix the waste-water with the sewage of nearby town wherever feasible to enhance the treatability. During a study at Pali and Balotra in Rajasthan, the Central Pollution Control Board study group observed this possibility (CPCB, 1987-88). Mixing domestic sewage to enhance the treatability is probably the best way with respect to industrial estates comprising chemical industry. However, it is imperative pilot plant study before designing the full-scale ETP. Otherwise the wide fluctuation in flow and quality of waste may upset the treatment plant as has happened at Pali.

3.5.2 **Operation and maintenance cost.** Operation and maintenance cost of an effluent treatment plant includes cost of electricity consumption, salaries of the staff, cost of chemicals and cost of maintenance, repairs and depreciation. Cost can, therefore, be minimised if the design avoids use of chemicals and offers simplicity in operation. With the constraints on power availability in our country, it is desirable to have less energy consuming effluent treatment plant. Biogas generation from the settled sludge wherever feasible should be adopted.

An exercise of trade off must be considered between resource recovery from the waste and degree of sophistication in designing the effluent treatment plant, air pollution equipment and solid waste disposal.

3.5.3 **Effluent quality and mode of disposal.** The most important governing factor to design an effluent treatment plant is the treated effluent quality, and that is indirectly dependent on the mode of its disposal. It is the recipient component of environment which warrants the degree of treatment, and in turn the cost of the treatment. If the recipient body is municipal sever, primary treatment followed by removal of toxicity will suffice, as in the case of proposed effluent treatment plant of Wazirpur Industrial Area, Delhi, where neutralisation followed by flocculation-and-precipitation will be sufficient to meet the purpose (CPCB, 1986-87). If land is available, primary treatment followed by land treatment may be advantageous. In case of estuary, the dilution factor with respect to tidal prism will lower the degree of treatment required. However, the degree of treatment will be more rigorous, if effluent is discharged to sensitive areas like upstream of drinking water source, religious bathing place, estuary of coastal areas being used for salt pans or pisciculture. Hence, situation with regard to degree of treatment and cost effectively.

3.5.4 **Resilience to absorb shock.** In industrial estate, the fluctuation of flow and quality of effluent is inevitable. It is, therefore, expected that treatment plant is so designed that it can absorb certain shock load.

3.5.5 **Resource recovery.** Resource recovery can be done at two places : one at the source itself, i.e. within the industry premises, and the second at the terminal point i.e. at the end of common effluent treatment plant. The former can be considered as pretreatment unit of individual industry. Control of pollution at source to the maximum extent possible, with due regard to techno-economic feasibility, would necessitate recycling of wastes at every stage of production. In case of metal processing industries, the effluent mainly contains the recoverable metals which, if not extracted, are left in aqueous solution, resulting in pollution. In electroplating industry, practising simple counter dragout system, the metals can be recovered and re-used. In case of manufacture of organic chemicals, recovery is possible. Recovery of dilute acetic acid, resorcinol and meta aminophenol, cumene, alphamethyl stryrene etc. is being done in India. Recoverable matter from industrial wastewater is given in Table 3.1. The process industries are the major users of water and can recycle or re-use it for some secondary utilities.

3.6 **Solid waste management.** If the industrial estates stand within the urban municipal area, it is possible to utilise municipal service for solid waste disposal, provided that the solid wastes contain no hazardous material. Here the problem lies with the collection of refuse. However, if industrial estates are located at isolated places, it is quite natural that disposal problems would arise and have to be taken care of. There are several options in the selection of technology. However, resource recovery remains the best option in solid waste management. In case of hazardous wastes, incineration may be the best choice. The choice of appropriate technology is dependent on characterisation of wastes. Industries of same character when housed in an industrial estate, common facility of solid waste management becomes easier, but in case of mixed industrial estates, the option of separation of waste becomes the prime concern. Probable methods of management of solid waste of an industrial estate are illustrated in Fig. 3.6.

3.7 **Air pollution control.** In case of air pollution, an approach like combined effluent treatment is not feasible. Hence the responsibility lies with the individual unit to control the emission. It was observed that air pollution occurs in industrial units mostly from :

- boiler and furnace ; and
- diesel generated (DG) set to combat frequent interruption of electricity supply.

Improved design of boiler and furnace may lower air pollution to great extent. Like the common sewer, facilities of common DG set will minimise the source of emission to a unit and can be controlled efficiently. Indirectly, provision of green belt surrounding the industrial estate may filter the pollutants to a great extent.

3.8 **Augmentation of existing facilities.** It is observed that in an industrial estate industries fill-up the designated plots and start their works in progression. It is, therefore, difficult at the beginning to assess the design load for the common effluent treatment plant. Hence package module of treatment and upgradation of effluent treatment plant will be an appropriate step. An indicative suggestion of such concept is placed in Fig. 3.7, which may be suitable for future industrial estate planning.

Management aspect. Management aspect can be classified in two classes: (1) Organisational approach ; and (2) financial resource mobilisation.

Organisation approach. More often than not there arises the question as to who is to take over the administrative and financial burdens of the combined effluent treatment plant. It is often answered that the promoter of industrial estate, i.e. the state industrial development corporation (SIDC) is the best suited organisation for the said purpose.

The limitations of SIDC or municipalities to be sole proprietor of common effluent treatment plant are :

a) Scope of participation and responsibilities of individual unit are low.
b) Agencies need to be empowered to levy the individual unit for operation and maintenance costs; and
c) SIDC/municipalities have to be extended necessary facilities and qualified staff to design, processs, implement, operate, maintain and perform quality control functions of these systems.

TABLE 3.1 : **RESOURCE RECOVERY IN INDUSTRY**

Name of Industry	Technique	Resource recovered
1. Electroplating	Counter drag out technique & precipitation	Trace metals and water
2. Textile	Counter drag out	Caustic Soda
3. Pulp and Paper	Reverse osmosis, ultrafiltration and electrodyalysis	Pulp, paper and water
4. Organic chemical manufacturing industries	Distillation (extractive, vacuum, semi-continuous and batch distribution)	Organic solvent
5. Rayon manufacturing industries	Precipitation	Zinc sulphate
6. Pickling	Hydrolysis of ferrous chloride	Hydrochloric acid

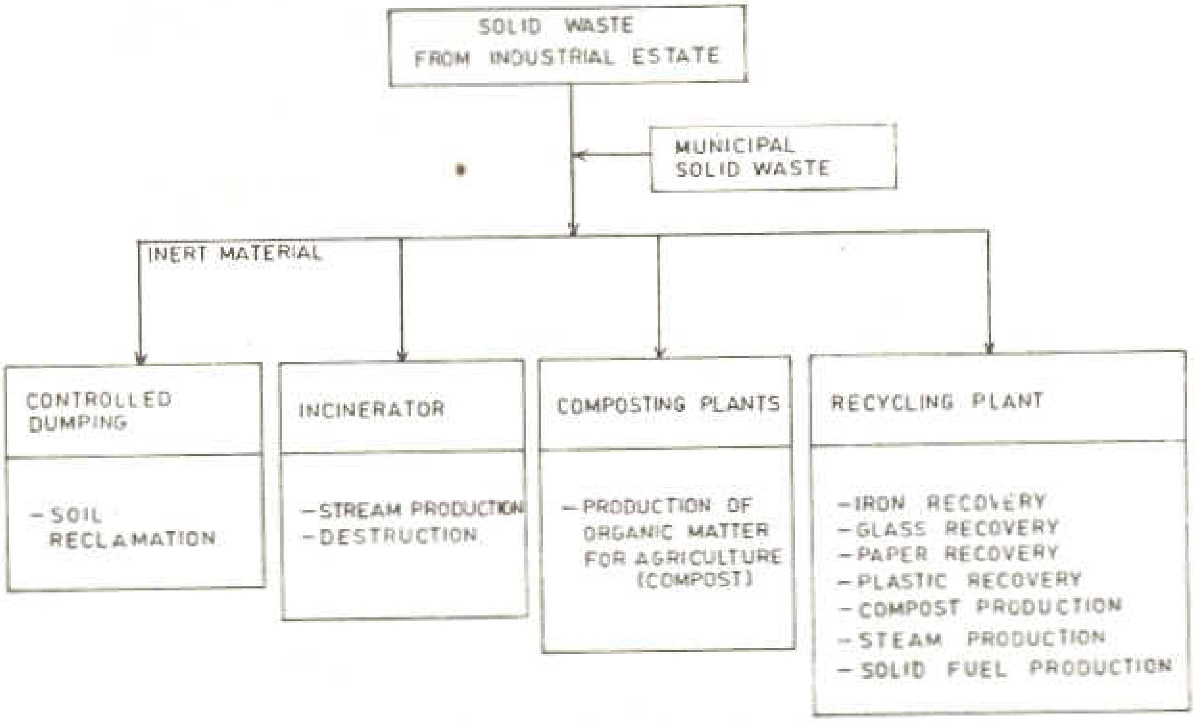
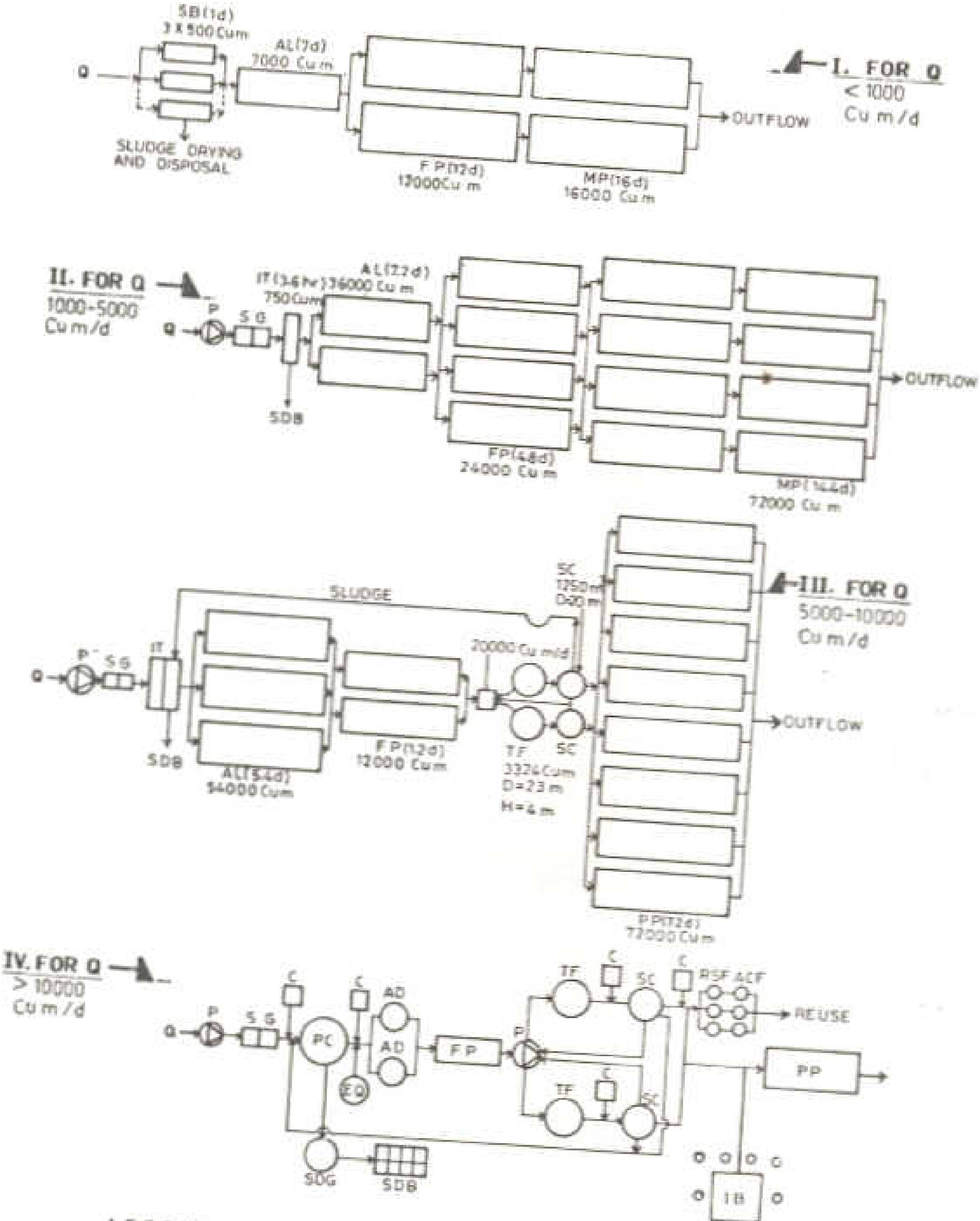


FIGURE 3.6 : SOLID WASTE MANAGEMENT IN INDUSTRIAL ESTATES



LEGEND

Q — Wastewater dischage
P — Pump
RSF — Rapid sand filtration
ACF — Activated carbon filtration
IB — Infiltration basin
OW — Bore well
PP — Polishing ponds
SDG — Sludge digester
SDB — Sludge drying beds
AL — Anaerobic lagoon
SB — Settling basin

S — Screen
G — Grit chamber
PC — Primary clarifier
C — Chemical treatment
EQ — Equalisation tank
AD — Anaerobic reactor
FP — Faculative pond
TF — Trickling filter
SC — Secondary clarifier
MP — Maturation pond
IT — Imhoff tank

Figures in parentheses indicate detention period in day

FIGURE 3.7 : CONCEPTUAL WASTEWATER TREATMENT SCHEMES FOR VARYING WASTELOADS

Keeping this in view and the field experiene gained in several industrial estates like Vanyambadi at Tamilnadu, the best solution would be to form a wastewater cooperative. In the same breath, this cooperative may take care of solid waste management and other aspects of environmental management like green belt development.

3.9 **Financial resource management.** This aspect is based on the concept of least cost solution, subject to meeting a prescribed set of performance standards. The least cost control process might comprise a wide variety of on site controls as well as off-site controls. The concept can be well adopted even in sites where

- industrial estates are zoned ;
- industrial estate is conglomerated with some large and small units; and
- a few industrial estates with central municipal treatment plant as on-site treatment. A simple approach adopted by Northwest Water Authority (UK) for taxation of common effluent plant is illustrated below (CPCB, 1989). It is the authority's view that the cost of treatment, reception into drains/sewers and conveyance for trade effluents will be charged and this cost should be covered from the discharger by a charge for each cubic meter of trade effluent discharged.

The charge per cubic meter shall be derived from the following formula :

$$C = R + V + M + \frac{O_t}{O_s} B + \frac{S_t}{S_s} s,$$

where

C = Total charge in rupee for per cubic meter of trade effluent

R = Reception and conveyance cost per cubic metre of sewage

V = Primary treatment cost per cubic metre of sewage treatment

M = Cost of providing and operating sea out falls per cubic metre of sewage so disposed (if applicable)

O_t = The Chemical Oxygen Demand (mg/l) of the trade effluent after one hour quiscent settlement at pH 7.0 or at the pH of the mixed sewage

O_s = The chemical oxygen demand (mg/l) of average strength settled sewage

B = Biological oxidation cost per cubic metre of the settled sewage (including the cost of secondary sludge disposal)

S_t = The total weight of SS (mg/l) of the trade effluent at pH 7.0 or at pH of the mixed sewage

S_s = The total weight of SS (mg/l) of average strength crude sewage

s = Treatment and disposal cost of primary sludge for cubic metre of sewage.

3.10 **Legal aspect.** The question of identifying the authority responsible for maintaining the stipulated standards for wastewater discharges has to be resolved. Section 2(d) - of the Water (Prevention and Control of Pollution) Act, 1974 defines occupier in relation to any factory or premises as the person who has control over the affairs of the factory or the premises and where the said affairs are entrusted to a managing agent, such agent shall be deemed to be occupier of the factory or the premises. If this were so then can the promoter of an industrial estate or wastewater cooperative be consented? By the same token in estates where combined and sector-wise treatment schemes are adopted should individual units be consented?

By consenting only the promoter agency or wastewater cooperatives, the role of controlling the discharges from various units would be automatically thrusted on the agency or cooperatives. This might involve legal complications for the promoter agency vis-a-vis the units. At the same time if only the individual units are consented, the final discharge from the estate will be nobody's responsibility. With a view to meeting the objectives of the Water Act, it logically appears sound that both the promoting agency and individual units have to be consented for the final discharge and discharges for the units respectively. While framing the consent conditions the availability of combined, sectorwise or individual treatment schemes will have to be taken into account.

4.0 GUIDELINES FOR DEVELOPMENT OF NEW INDUSTRIAL ESTATES

4.1 Approach

4.1 Experiences gathered during investigations reveal that the environmental problems associated with existing industrial estates could have been avoided, if the problems were given due considerations at planning stage. It is, also observed that industrial estates are inevitable, and in-coming decades more new industrial estates will be established. It is, therefore, necessary to evolve guidelines for development of new industrial estates for the promoting a agencies like the state industrial development corporation, town and country planning development, State Pollution Control Board etc. Guidelines can be framed on the basis of following considerations :

- Site evaluation ;
- Infrastructural facilities for environmental pollution ; and
- Organisational support to environmental management.

4.2 Site evaluation

It is observed that proper siting of newly planned industrial estates not only minimise adverse environmental impacts, but also lower the cost of treatment and on pollution control devices. The site will ultimately decide which water bodies might be affected by effluents from the estates, which air sheds might receive air pollutants from the industries, or which sensitive ecosystems might be irreversibly affected. Site selection based on environmental criteria is, therefore, an important step in assuring the environmental soundness of newly developing industrial estates.

The basic environmental objectives of site selection are the following :

— Site selection should assure that environmental impacts resulting from the industrial estate are minimised (down stream inter-relations).

— The selected site, in addition, should assure that provision of the necessary inputs (raw materials, water etc.) might not lead to resource depletions or to severe conflicts with other user groups (upstream inter-relation). Their relation is shown in Fig. 4.1.

There are two principal approaches conceivable to select a site which might be considered as acceptable from environmental angle—the negative selection and the positive selection. The negative selection approach basically means that environmental criteria are identified and set which should be (fully and/or partly dependent on the considered factor) met by the alternative sites. Unsuitable sites might thus be sorted out. Negative selection, in other words tries to avoid the most obvious and striking environmental failures, without, however, being able to pinpoint the best site within a considerable planning area. Identification of the best site, considered from the environmental viewpoint, is possible by positive selection, which is, however, a more complex procedure, requiring better baseline data. Positive selection, is in short, a procedure to evaluate an area with respect to its suitability to accommodate environmentally sound industrial estates.

4.2.1 Negative selection

Environmental implications of industrial estates are characterised by two major components : by downstream impacts, i.e. impacts of the estate on the environment, and by upstream impacts, i.e. dependency of the estate on environmental input factors. The objective of environmentally sound siting is, therefore, two fold. Firstly, to select a site where emissions and effluent emanating from the site might not cause unacceptable deterioration of environmental quality or harm to man. Secondly, sites, where provision of input factors might not lead to indiscriminate exploitation of natural resources or environmentally related hazards. It must be noted, however, that in a densely populated country each site will eventually affect man and

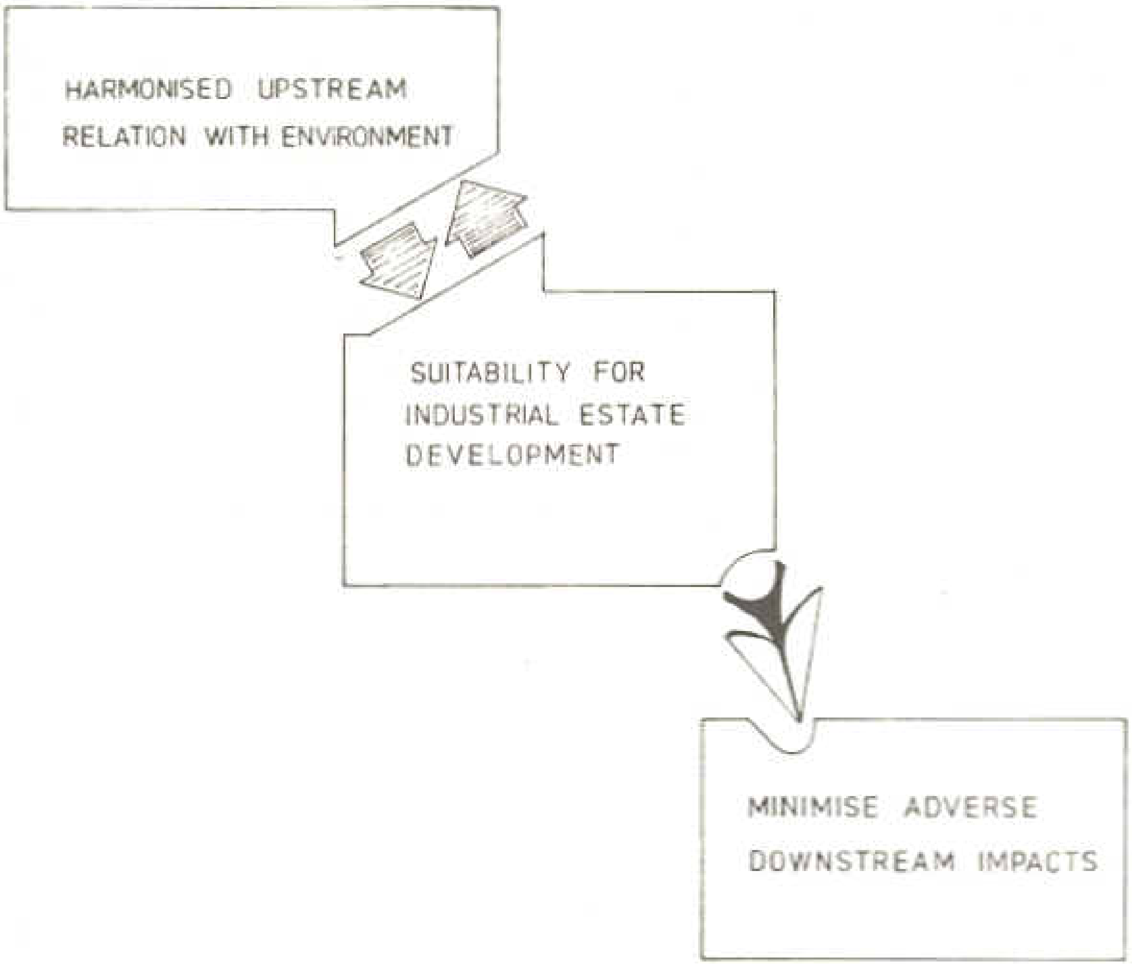


FIGURE 4.1 : RELATIONSHIP OF UPSTREAM-DOWNSTREAM EFFECTS ON ENVIRONMENT

nature to a certain extent : minimising environmental impacts here does not mean that no adverse effects at all will occur but that the effects are within acceptable limit considering the options (i.e. sites) available. Evaluation criteria, therefore, have to be selected pragmatically, reflecting the environmental conditions of the country.

In order to frame the methodology, the most important aspect is the classification of industrial estates (IE) with respect to pollutants generation and categorisation of sites on the basis of environmental sensitivity. The classification of sites may be as follows :

areas, unsuitable to accommodate IEs either as prohibited by legal regulations (e.g. in forest lands or national parks) or based on environmental considerations ;

areas, less suitable to accommodate IEs. Establishment of an IE might be considered environmentally acceptable provided that operation of the industries does not cause adverse environmental impacts. This should be subject to individual assessment ; and

areas, suitable to accommodate IEs.

The interaction between site classification and area classification provides the site evaluation and suitability matrix (Tables 4.1 and 4.2).

4.2.2 Positive selection—Evaluating the suitability of an area for siting industrial estates

The term "suitability" is operationalised by identifying its main constituents. Suitable factors and indicators which allow easy quantification are then identified, and their spatial distribution in the delineated planning area computed. The identified factors and indicators are evaluated with respect to their relative importance to characteristics the environmental suitability for industrial estate development. The results are partly aggregated (overlayed) and presented in maps which allow to delineate sites particularly suitable for industrial estate development. These maps are the basis from which decisions might be arrived.

TABLE 4.1 : CLASSIFICATION OF INDUSTRIAL ESTATES

S. No.	Class	Characters	Industries
1.	IE 1	With high emission of air pollutants, area exposed to the pollutants exceeds 5 km from the source	Primary metallurgical industries, refineries, fertilisers, cement and thermal power plant
2.	IE 2	IEs with moderate emission of air pollutants	Paints, foundry, acids/ alkalies, asbestos, rubber-synthetic
3.	IE 3	Generating toxic and/or highly polluting effluents	Pulp & paper, refineries, fertilizers, pesticides/insecticides, paints, dyes, leather tanning, sodium/ potassium cyanide, basic drugs, storage batteries (lead acid type) acids/alkalies, fermentation and electroplating
4.	IE 4	Where accidents causing emission or spillage of toxic substances with disastrous environmental implications are possible	Pesticides/insecticides , refineries, fertilisers
5.	IE 5	IEs generating toxic residue, wastes and sludges in need of proper disposal	Lead or aluminium producing industries, leather

6.	IE 6	IEs with high water consumption (this depends largely on the capacity of installed industries)	Pulp and paper, fermentation
7.	IE 7	IEs likely to generate low or only moderate pollution comparable to the pollution caused by a commercial area	

TABLE 4.2 : **SITE EVALUATION AND SUITABILITY MATRIX**

ENVIRONMENTALLY CRITICAL AREAS	LOCATION OF IE: Within	< 1 km	1—5 km	> 5 km
Declared Forest Land	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Declared Prime Agricultural Land	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Agricultural land*	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Watersheds supplying Public water systems*	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Areas with high yield aquifer*	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Flood prone areas*	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Seismic risk areas	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Urbanized areas*	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Densely populated rural areas*	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Declared or non-declared sensitive ecosystems*	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Cultural monuments of national significance*	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Cultural monuments of local significance	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

(red) = areas not suitable for IE

(blue) = areas conditionally suitable for IE after individual assessment

(green) = areas suitable for IE

Agricultural land :	Lands which are agriculturally used but not declared as prime agricultural land
Watersheds supplying public water systems :	Watersheds which serve springs or surface waters used for public water supply systems or highly suitable to be used in future
Areas with high yield aquifer :	High yield aquifer used for agricultural and domestic purposes
Flood-prone areas :	Areas, subject to periodical or occasional flooding with a flow height exceeding 1 metre
Urbanized areas :	Built-up areas in cities with a population over 3,00,000
Densly populated rural areas :	Areas where the population density exceeds the average density for rural areas on state level
Declared or non-declared sensitive eco systems :	Areas, specified in the Ministry of Environment's publication entitled Environmental Guidelines for Siting of industry
Cultural monuments of national significance	Areas like Taj Mahal

The three basic features of the method are :

- the indicator approach ;
- the overlaying approach ; and
- the evaluation procedure

Indicator approach refers to the pragmatic use of all data available. If primary baseline data are unavailable (e.g. water and air quality or ecological details) secondary data or indicators are employed to fill the data gaps. Land use, for example, is an important indicator characterising certain aspects of environmental quality. It is thus not always necessary to gather new base line data.

Overlaying or aggregation means the combination of certain factors to provide a synoptic overview on more complex factors of influence. For example, the risk of natural hazards might severally impede industrial development. Here it is useful to overlay flood risk, seismic risk etc. and to derive a map assessing all relevant natural hazards or risks thus providing a synoptic overview on this aspect.

In order to obtain meaningful and usable result, it is necessary to evaluate the computed data with respect to their suitability (or unsuitability) to allow industrial estate development. Evaluation is needed to transform physical data, for example, on water availability, drainage capacity or flood risk into statements on the suitability of an area for industrial estate development. Evaluation is also needed to facilitate aggregation or overlaying of data having different dimensions. In short, evaluation judges the planning relevance of data characterising environmental features. Such an approach has presently been tested in Hassan district in Karnataka.

4.3 Infrastructural Measures for Environmental Pollution Control

Once the site is evaluated, through environmental impact assessment, as discussed earlier, infrastructural measures for environmental pollution control in an industrial estate need to be taken care of. Infrastructural measures for pollution control in an industrial estate include :

- Storm water collection, treatment and disposal ;
- Sanitary and industrial wastewater collection, treatment and disposal ;
- Solid waste collection and disposal ;
- Emission control ;
- Noise and odour control ;
- Recycling and reuse of waste ;
- Emergency electricity supply ; and
- Creation of buffer zones of tree plantation.

4.3.1 Storm water collection, treatment and disposal

Storm water preferably be collected in underground sewers. Open road storm water drains are regularly misused as open sewers for discharge of industrial and domestic wastewater as well as dumps for said waste. Furthermore, it creates obstacle to the access of industries.

Storm water run-off contains an acknowledgeable pollution, through dust, garbage and unprotected solid waste. Primary treatment in settling tanks or ponds before disposal into the environment can reduce the pollution significantly.

4.3.2 Sanitary and industrial wastewater collection, treatment and disposal

4.3.2.1 **Wastewater generation.** In order to establish an industrial estate from the point of liquid waste, the objective should be to generate wastewater which is more equalised in its flow and characteristics so that its treatability will be enhanced and additional pretreatment, neutralisation can be avoided. This can be achieved by accommodating small-scale, medium-scale and large-scale industries in the IE. It is also desirable to invite domestic sewage of nearby residences. Hence it is appreciable to make a growth centre comprising industrial, social and residential infrastructure instead of a mere industrial estate for enhancing treatability and consequently lowering the cost of treatment.

4.3.2.2 **Wastewater collection.** The underground sewer system should be considered as an essential infrastructure of an industrial estate, like the water supply system, electricity and roads.

The underground sewer system should be designed

- for self cleansing velocity
- in a minimum depth ;
- to minimise operation and maintenance cost ; and
- to minimise pre-treatment at the individual industry.

The sewer system should be the first infrastructure facility to be executed in the new estates. However, effluent treatment/outfall facility should be ready at the terminal end before the sewer reaches the point.

4.3.2.3 **Wastewater treatment.** The industrial and domestic wastewater shall be treated in a common wastewater treatment plant, which should be developed in stages with the growth of industrial estate to treat the effluent with the beginning of its generation. The treatment plant should be upgradable, appropriate to the quantity of the generated wastewater and the desired quality of treatment.

The choice of treatment technology should take advantage of the favourable climatic conditions in India, and consider the disadvantages of discontinuous power supply, and the non-availability of skilled and experienced staff for operation and maintenance. Preference should be given to anaerobic treatment technologies, oxidation ponds, land treatment systems and trickling filter over more sophisticated systems. The necessary pretreatment at the individual industry should be minimised. Hazardous effluents should be segregated in the production process, collected and separately treated and disposed.

4.3.3 Solid waste collection and disposal

Domestic, industrial and hazardous wastes should be separately collected, treated and disposed. Resource recovery from the solid waste should be given priority.

Incinerator for thermal treatment of hazardous waste, if needed, should be a common facility to optimise the cost and easy to maintenance.

For safety and lowering of cost for transportation, the solid waste disposal is preferred to be near to industrial estate with monitoring facility both from the point of view of surface run-off and ground water protection.

4.3.4 Emission control measures and buffer zone

Emission as well as noise and odour control measures by zoning civil works, buffer zones, green belts and other plantations should be part of design. The use of vegetation should be evaluated in view of the aesthetic appearance of the industrial estate.

4.3.5 Green belt development

Eco-development conservation and pollution abatement through green belt are the two major components so vital for industrial activity, whether proposed, existing or under expansion stage. Green belt development plan for industrial estate depends upon in :

i) climatic factors ;

ii) soil and water quality ;

iii) nature and extent of pollution lc .d ; and

iv) assimilation capacity of the eco-system.

Nature of plants should be as follows :

i) fast growing ;

ii) high and thick canopy cover ;

iii) preferably perennial and evergreen ;

iv) have large area index ;

v) indigenous ;

vi) resistant to specific air pollutants ; and

vii) should maintain the ecological and hydrological balance of the region.

The principles to optimise the design of green belt are :

i) height and canopy area of trees (maximum) ;

ii) mean wind velocity ;

iii) distance from source ;

iv) pollutants concentration ; and

v) dry deposition velocity of plants.

The effectiveness of a green belt in attenuating the pollution is given by the value of attenuation factor which is defined as the ratio of mass flux of pollutants reaching a distance in the absence of green belt to the mass flux reaching the same distance in presenc. of green belt.

5.0 ORGANISATIONAL ASPECT TO ENVIRONMENTAL MANAGEMENT

From the very beginning there are various agencies involved to promote industrial estates. Besides the government, there are town and country planning department, state industrial development corporation, and financers like banks. The appearance of State Pollution Control Board is the latest one not directly involved in development but to harmonise the development with the surrounding eco system. So far no department or agency is coming forward or identified to operate and maintain the pollution control measures. Apparently it is preferred that the agency which is responsible for the planning and commissioning of the common facilities should also be responsible for the operation and maintenance (O&M). As observed earlier, that the State Industrial Development Corporation (SIDC) with its present infrastructure cannot be successful to operate and maintain common facilities. It is, therefore, desirable to have an environmental management cooperative to accomplish the task of O&M of common facilities. This co-operative, therefore, needs to have a legal status to environmental protection charge, and to safeguard common facilities and to guarantee the limits it must be empowered to execute the vigilance of the compliance with consent conditions at the individual industries. This must be mentioned in the consent conditions laid down by the Pollution Control Boards. It is preferred that representatives of State Government and State Industrial Development Corporation will be the members of this co-operative. Suggested articles of memorandum of a cooperative set-up is presented in Appendix C. The progress of the work in establishing the new industrial estates alongwith the interaction of agencies are shown in Fig. 5.1.

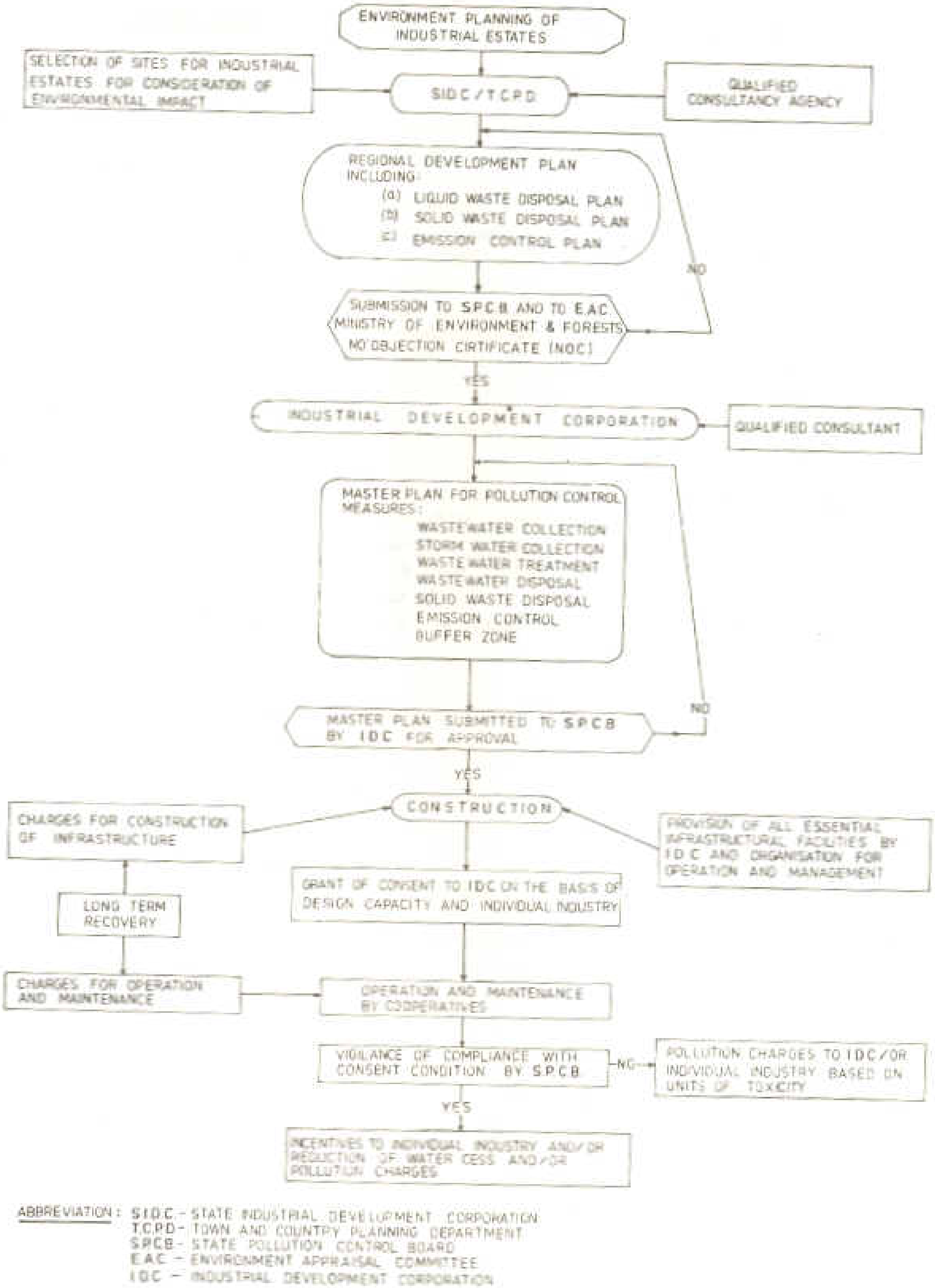


FIGURE 5.1 : ENVIRONMENTAL PLANNING FLOW DIAGRAM

Appendix A

Typical Questionnaire for Industrial Survey in an Estate

A. General

1. Name of the factory / industry
2. Address
3. No. of people employed
4. How many shifts do you work per day?

   One Two Three

5. Could you give the following data for your production?

Name of the product	Installed capacity per annum	Last year's production	Expected production in current year / Installed production % increase

6. Could your briefly describe the process used by you to manufacture your goods (please show the process by means of a flow diagram).

B. **Consumption**

1. Raw materials used

S.No	Name	Quantity/Unit time

C. **Water usage**

1. What is the source of water used in your premises

Municipal Tubewell

2. What is the quantity of water used

Usage	(Source in m³/day)			
	Municipal	Tubewell	Other	Total
(i) Domestic/ toilet requirement				
(ii) Industrial consumption				

D. **Utilities/facilities other than usage**

1. Melting furnace

Pot [ ] Reverberatory [ ] Electric induction [ ]

Other metallic [ ] Electric Arc [ ]

2. No. of such furnace and capacity

3. No. of boiler, its type and capacity

4. Quantity and type of fuel used

E. Stack detail

S.No.	Stack attached to	Is wheather cap existing	Stack Diametre in metres		Flow rate Nm³/hr	Height metre		Temp °C
			Top	Bottom		above the roof	above the ground	

F. Effluents

Total quantum of effluent discharge

a. Domestic............................ m^3/Day

b. Industrial............................ m^3/Day

G. Mode of final discharge of wastewater

H. Characterisation of Wastewater

1. Effluent Characteristics

Parameters	Industrial	Domestic	Total
pH			
Colour			
Odour			
Suspended solids			
Heavy metals			
Organic chemical			
Other			

2. Emission characteristics
Process emissions

Stack and other process unit to which connected	Sulphur Dioxide		Particulate matter		Others
	Kg/hr	mg/m³	Kg/hr	mg/m³	

I. Treatment status : a) Is there any pollution control devices (Air)? Describe briefly.

b) Is there any effluent treatment facility (water)? Describe briefly.

J. Solid Waste disposal

1. Type of solid waste : a) Ash b) paper scrap c) Rubber d) Wood scrap and saw dust e) Wet garbage f) Others

2. Quantity of solid waste :

Tonne/months

3. Method of disposal : a) Incineration
b) Land filling
c) City pickup
d) Sale

Appendix B

Table A-1	Gives the data and computations for obtaining cumulative flow for a hypothetical industry which generates wastewater through batch discharges from reactors and through a continuous washing operation
Column 1	Clock time at half hour interval, and also when a batch reactor emptied, if at a different time.
Column 2	Reactor identification, number and volume at times when it is emptied.
Column 3	Volume contributed due to a continuous discharge of 6 m^3/h between indicated time intervals. The continuous discharge started at 1030 and continued till 1430 hours.
Column 4	Cumulation of volumes, 2 and 3.
Figure A-1	Shows a plot of cumulative flow versus time. The instantaneous flow rates for 1/2 h interval were calculated from column 4. For example between 1030 and 1100 hrs, the flow was (25.2—13.7) 1000/30 = 383 lit/min.
Figure A-2	Shows a plot of the calculated instantaneous flow rates.

TABLE A-1 : **CUMULATIVE FLOW FOR A HYPOTHETICAL INDUSTRY**

Time	Reactor No.	Reactor Volume, m^3	Continuous discharge, m^3/h	Cumulative flow, m^3/h
1	2		3	4
0800	—	—	—	0
0830	1	3.5	—	3.5
0900	—	—	—	3.5
0930	—	—	—	3.5
0945	2	4.0	—	7.7
1040	1	3.5	1	18.2
1045	4	5.0	0.5	23.7
1100	—	—	1.5	25.2
1130	2	4.0	3.0	32.2
1200	—	—	3.0	35.2
1230	—	—	3.0	38.2
1300	5	3.8	3.0	45.0
1330	4	5.0	3.0	53.0
1400	—	—	3.0	56.0
1410	1	3.5	1.0	60.5
1430	—	—	2.0	62.5
1440	3	6.2	—	68.7
1500	—	—	—	68.7
1530	—	—	—	68.7

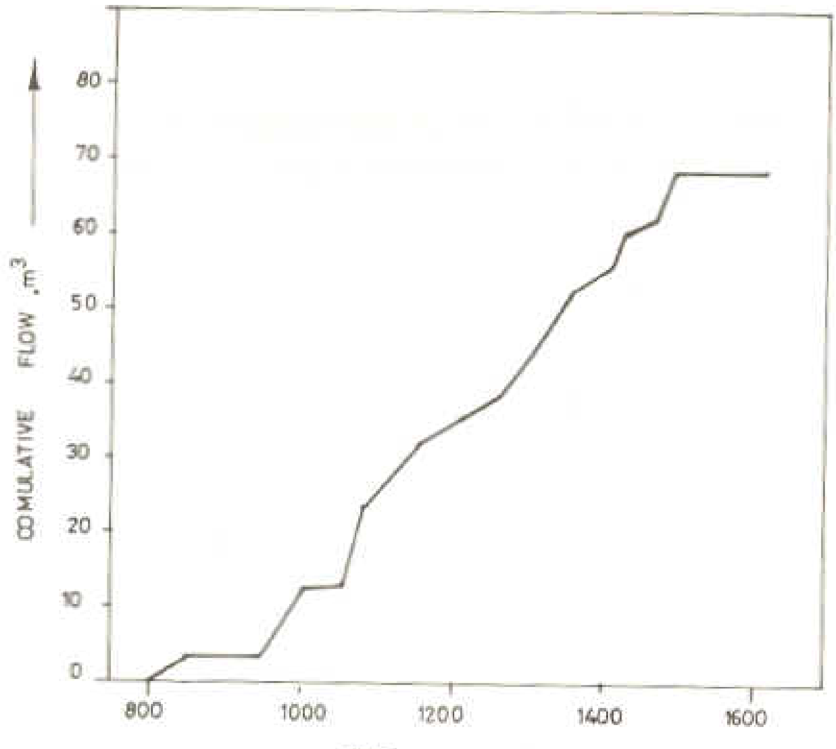


FIGURE A.I : CUMULATIVE FLOW

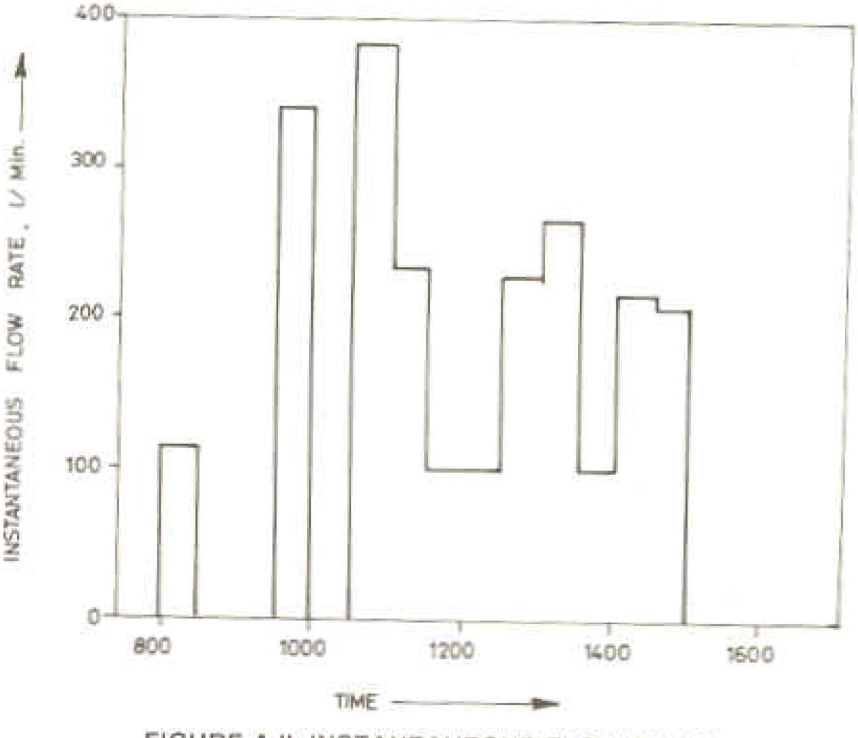


FIGURE A.II: INSTANTANEOUS FLOW RATES

Appendix C

Suggested Articles of Memorandum of Environment Protection Cooperatives

I	**Purpose, extent and legal status**
Art I	Area of jurisdiction of the Association
Art 2	Tasks and duties
Art 3	Extension of Association's area of jurisdiction
Art 4	Legal Status
Art 5	Members of the Association
Art 6	Status
Art 7	Status amendment
Art 8	Organisation of the Association
Art 9	Assembly of the Association
Art 10	Executive Board
II	**Mobilisation of funds and drawing up of subscription list**
Art 11	Assessment, minimum subscription (cess)
Art 12	Subscription list
Art 13	Objections to subscription list
Art 14	Determination of subscription list
Art 15	Order of assessment
Art 16	Collection of subscription
Art 17	Supplementary list
Art 18	Assembly policy
Art 19	Subscription (cess) from industrial development agency
III	**Appeal**
Art 20	Objection procedure