OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

18571

Distr.
LIMITED
ID/WG.507/5(SPEC.)
10 September 1990
ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Regional Meeting on Management of
Industrial Waste Water

Paris, France, 10-14 December 1990

PROGRAMME ON PURIFICATION OF INDUSTRIAL WASTE WATER

COUNTRY PAPER: ETHIOPIA*

Prepared by

D. Mebratu
UNIDO National Expert

*The views expressed in this document are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. This document has not been edited.

V.90-87610

TABLE OF CONTENTS

LIST OF TABLES

* These are tables obtained from different sources while the rest are compiled by the National Expert.

INTRODUCTION

It is beyond doubt that, critical to any nations economic development is its growth in the industrial sector which is generally accompanied by a shift of population from rural to urban areas and by the creation of environmental hazards.

Apparently, beside other factors, industry is attracted by the availability of water and land. Unless steps are taken to protect the environment in parallel with industrial growth, then the water, air and land resources will generally suffer substantial degradation.

Past experience in many of the developed countries has shown that when little or no consideration was given to environmental protection during the industrial development period, the correction of damages to the environment has been both slow and costly. This experience is particularly important for the developing countries like Ethiopia, which have the potential for a rapid growth in their industrial economy.

This paper as a prelminary country paper for the UNIDO's programme on Industrial waste water purification, which embraces eight countries from Africa, is prepared in such a way that it could serve as source material for the programme's implementation in the country.

The program's main objective being "developing the most appropriate and effective means to deal with long term problems associated with generation and treatment of industrial waste water influence.", every effort is made to present what ever relevant informations pertaining to the program's objective and goal.

To this end, the first chapter delivers general back ground information about the countries natural resource and the prevailing industrial feature, while the second chapter deliberates on the results of the investigation and evaluation of the selected subsectors and factories from the industrial sector. Finally, an overview of other side factors which could possibly have effects on the project's activity is presented in the third chapter.

Though, it would be hard to say that the research done and the paper produced is free of loose ends, It can however be said that, considering the time constraint with respect to the wide area of coverage, this paper is sufficient enough for the intended purpose.

1.1 Location and Topography

Ethiopia is situated in the North Eastern Africa, Popularly known as the Horn of Africa. It extends from latitude 3° N to 18° N and from longitude 33° E 48° E.

The neighboring countries in the East are Djibouti and Somalia, in the West the Sudan, in the South Kenya and in the North its Red Sea coastline which is about 1200 kilometers long.

Ethiopia has a total land area of 1,233,600 sq. km. comprising of a central highland mass surrounded by lowlands. The heart of the country is formed by a vast highland plateau, lying at an altitude of 1500-3000 meters with some peaks rising up to 4500 meters. Ras dashen - 4620 meters - in the semien mountain range is the highest mountain in Ethiopia and the Dallol depression is the lowest which is 100 meters below sea level.

The massif is divided by the deep rift valley in which lie, in the west several lakes and in the east the Awash river, the flooding of which during the rainy season is vital for the irrigation of the extensive plains leading to the afar plains in Eastern Ethiopia.

1.2. Natural Resource

1.2.1 Land Resource

Ethiopia is the tenth largest country in Africa. The land is composed of 840,700 sq.km. of Agricultural land, 88,200 sq.km of forest, 174,800 sq.km. of barren land and built up areas and 120,900 sq.km. of water and water courses.

Ethiopia generally has a torpical climate but temperate on the central plateau and hot in the low land regions. Lying within the tropics, the country has a range of altitudes which produces variation in temperatures. for the most parts of the central highlands, the annual average rainfall is well over 1000 mm. Rains are the heaviest in the southeast, where they reach 2,640 mm a year. Most parts of the lowland regions get below 500 mm of average rainfall annually. Humidity in the country varies between 50 to 80 % through out the year.

Ethiopia's principal natural resource is its rich agricultural land. According to the existing studies, over two million hectares of irrigable land is identified and the total annual flow of the rivers is believed to be 102 billion cubic meters of water per year.

However, only about 13% of the total land area is actually under crops and 54.1% of the total is pastoral land. And the present agricultural production is mostly of subsistence nature, with only about 25% of a total production being marketed.

1.2.2 Animal Resource

On the other hand, Ethiopia stands first in Africa and tenth in the world in its size of live stock resources. There are several millions heads of cattle, sheep, goats, horses, mules, donkeys and camels. However, the benefit derived form this resource upto now is very minimal. Hides and skins constitute only 12% of total Ethiopia exports. Hence, commercial live stock and live stock based industries are still believed to be one of the outstanding potentials of the country.

1.2.3. Mineral Resource.

In an effort to determine the mineral resources of the country, about 11% of the country is geologically mapped at a scale of 1:250,000 and detailed geological investigations have been under taken in very few places in the northern and southern part of the country. These studies have shown significant potential as sources of base, rare earth, and precious metals.

Significant discoveries of copper, Zinc, lead and nickel deposits have already been made. Gold is being exploited from placer sources and vein gold deposits have also been discovered in the past few years.

Exploitable deposits of marble, Iodine, silica, talc, graphite and other industrial minerals have also been encountered. The Ethiopian Rift valley is endowed with known deposits of industrial minerals such as potash, soda ash, diatomite and bentonite.

The Rift is also well known for its great potential as a source of geothermal power. The potash deposit located only 90 kilometers form the Red Sea is believed to be the the future source of potash for the Eastern and Southern Africa region as well as the Indian subcontinent and south East Asia.

1.2.4 Human Resource

According to the national population census, carried out in 1985, by the central statistics office, the total population is estimated to be 42 million, and is the third largest in Africa. Some 86% of the total population live in the rural areas. About 54% of the population is below 20 years of age. The growth rate is estimated to be 2.9% perannum and the density 34.3 inhabitants per sq.km.

Ethiopia has two Universities and various Colleges of higher learning aimed at upgrading the human resource by creating the required professionals at various levels. The oldest and the biggest of the universities, the Addis Ababa University, consists of department of public health, faculities of technology, social sciences, law, medicine, natural science and the school of social work.

There is one high level polytechnic Institute and eleven technical and vocational schools in the country training students for practical work in the fields of metal work technology, electricity, industrial chemistry, textiles, auto mechanics, general mechanics, accounting and secretarial science.

On top of all these, owing to the rich culture and life style of the people, Ethiopians are believed to be as industrious as it could be desired, which is supported by the historical records of the country which witnesses that it has nurtured notable civilization at various stages of its existence.

1.2.5. Water Resource

Ethiopia is bestowed with a great potential of untapped water resources for irrigation and hydro electric generation. It is estimated that Ethiopia can produce 60 billion kwh of electricity from its water resources of which only 1.2 billion is exploited.

The major rivers in Ethiopia together with their drainage area and annual flow is given by the following table.

Table 1.2.5.1

Rivers	Drainage area in sq. km.	Annual flow $m^3 x 10^9$
1. Awash	113,700	2.6
2. Wabi Shebelle	205,400	2.5
3. Genale/Dawa	168,100	4.0
4. Omo	77,200	16.1
5. Baro/Akobo	75,700	13,4
6. Blue Nile	195,500	53.0
7. Atbara/Tekeze	87,800	8.0
8. Mereb/Gash	23,500	0.6
9. Barka	41,400	1.3

(Source:- National water resources commission).

Ethiopia has fourteen main river basins of which the Wabi Shebelle river basin is the biggest followed by the Blue Nile basin. The Awash Basin is however the most developed of all the basins both in irrigation and power.

The major lakes are Lake Tana-source of the Blue Nile (3600 sq km), Abaya (1160 sq km), Chamo (551 sq km), Zwai (434 sq km), Shala (409 sq km), Langano (230 sq km) and Abiyata (205 sq km).

With the exception of Lake Tana, all of the lakes are located in the Southern end of the rift valley in Southern Ethiopia. However, it can be said that, the rivers are evenly distributed through out the country.

1.3. Industry in Ethiopia

Even though Ethiopia has had long tradition of handicraft and various types of small scale processing which use traditional techniques based on manual labors and simple tools, it was mainly of subsistence nature concerned with food processing, weaving, production of agricultural implements and leather making.

Modern Industry in Ethiopia is a recent phenomenon, introduced during the early years of the 20th century. In general, it can be said that, industrialization in Ethiopia started through inward oriented strategy based on import substitution of consumer goods.

Till February 1975- until medium and large scale industries are nationalized -the section was dominantly of private nature in which almost all of the factories are established by private investors, mainly foreigners.

At present, there are 227 manufacturing establishment in the organized sector under the control of the government. Out of these, 170 are administered by the ministry of Industry while the rest are under the administration of various ministries.

Table 1.3.1.

Administering Body	Number of factories	Processing
1. Ministry of Industry	170	Diversified
2. Ministry of State Farm	19	Meat, Dairy and Fruit
3. Ministry of Agriculture	15	Forest Woods
4. Ministry of Mine and Energy	1	Petroleum
5. Ministry of Construction	10	Construction Materials
6. Ministry of Interior	1	Bakery
7. Ministry of Public Health	1	Pharmaceutical
8. Ministry of Education	3	Teaching Materials
9. Addis Ababa City Council	1	Abattoire
Total	**227**	

Source:- Directory of Manufacturing establishments, MOI,...

Addis Ababa, May 1987 (up dated by National Expert)

The industrial sector consists approximately 85% of light industries and 15% of heavy industries. The regional distribution of industries show that most industries are concentrated in the Administrative Regions of Addis Ababa and Eastern Shoa and Autonomous Regions of Dire Dawa and Eritrea. The reason for the concentration of industries around a few regions had been the fact that these regions have relatively better developed infra structure and large markets.

The Manufacturing sector, despite its small share in GDP, plays an important role in supplying consumer goods to the domestic market, in absorbing agricultural raw materials and in generating government revenues. The main products of the manufacturing sector are textile, food stuffs, tobacco, beverages cement, leather and footwear, wood, metallic and non metallic products, paper, plastic and tyres.

Addording to the structural analysis of the state owned manufacturing industry for the year 1983/84 the total gross output is found to be 2,087.398 million and the distribution by branch is as follows.

Table 1:3:2

	Branch	Value in million	%
1.	Food	573.084	27.5
2.	Beverages	335.361	16.1
3.	Tobacco	94.593	4.5
4.	Textile	403.674	19.3
5.	Leather	167.204	8.0
6.	Wood works	31.702	1.5
7.	Non Metal	52.647	2.5
8.	Paper Printing	87.567	4.2
9.	Chemicals	151.601	7.3
10.	Metals	189.905	9.1
	Total	2,087.398	100

Source:- Proceeding of the first National symposium on Industrial Development,volume. ..

* Note that the major contribution of the food subsector comes from the sugar stries.

As it can be seen from the above table:

- Food, Textil and Beverages produces 63% of the total output.
- The other six branches produce only 37% of the total output.
- The industrial sector is mainly based on agricultural inputs.

Besides this, the total export value by manufacturing sector was Birr 105.678 million, which was 5.1% of total manufacturing output.

Table 1.3.3 Composition of export

	Branch	Value in million	%
1	Food	39.512	37.4
2	Beverages	0.728	0.7
3	Textiles	3.012	2.9
4	Leather	62,426	59.0
		105,678	100.0

Source:- Ibid

From what is seen upto now, the major line of activities in the industrial sector and also the major contributors both to the GDP and the foreign Trade are based on agricultural inputs. Considering the yet untouched agricultural resource the country endowed with, this trend is believed to be the dominating character of the industrial sector for the near time to come.

Concerning the projection of the industrial development under the Ministry of Industry, there are a number of projects under different stages of development, (see table 1.3.4) which are expected to strengthen the countries industrial sector in all aspects.

Beside the large and medium size factories which are state owned, there are a considerable number of privately owned small scale industries which are involved in production activity.

Table 1.9.4 Numbers of Industrial Development Projects at Various Stages of Work Progress by Corporation

No.	Implementing Corporation	No. of factories	A	B	C	D	E	F	G	H	Total
1	Ethiopian Food	36	-	-	-	1	-	4	1	1	7
2	Ethiopian Sugar	6	1	1	-	1	2	1	1	2	9
3	Ethiopian Beverage	27	-	-	1	2	-	3	-	3	9
4	National Tobacco & Matches	3	-	1	1	-	1	1	-	-	4
5	National Textiles	30	-	2	2	3	1	3	-	-	11
6	National Leather and Shoe	15	-	-	1	2	1	3	-	2	9
7	Ethiopian Printing	11	-	-	-	1	-	-	-	1	2
8	National Chemical	16	1	-	1	-	-	7	1	3	13
9	Ethiopian Cement	6	1	1	1	-	-	1	1	1	6
10	National Metal Works	24	2	3	1	2	2	10	-	3	23
11	Share Companies	6	-	1	2	1	1	-	-	-	5
	Total	170	5	9	10	13	8	33	4	16	98

Source: Statistical pocket book, Ministry of Inudstry, Addis Ababa, May 1988
(partially updated by the National Expert)

*Note that the sideway total doesn't include the existing number of factroies.

A: Construction
B: Design
C: Tendering
D: Financing
E: Appraisal
F: Feasibility
G: Profeasibility
H: Identified

Here also, one observes the dominating pattern of development to be the same as that observed in the government sector. However, the status of the leather based industries in the private sector seems to be the leading sub sector.

Due to the recent policy support given from the government to private investors in the country based on the acceptance of mixed economy as the country's guiding economic policy, it is expected that the private sector which was restricted to small scale production will show a considerable rate of expansion both in terms of number and capacity as well.

To sumerise, Ethiopia is a country endowed with an abundant natural resource of all kinds which places it in the foremost line of countries with relatively untouched potential for development.

Besides the factors mentioned in this chapter, Ethiopia is found to be one of the few numbered countries which are known to have a natural biotic system of rich biodiversity. This in turn calls for the preservation of the natural biotic system by counter ; maiding the adverse effect of man's intervention.

In general, although industry is still at its initial stages of development, considering its future leading role in the economic development of the country, it would be timely to take the necessary steps in the direction of environmental consideration if the country's development is desired to be of sustainable nature.

2. Selection, Investigation and Evaluation

2.1 Background of Selection

As required by the project documents, the first step for the evaluation and investigation is the selection of the sub-sectors and factories which should be the focal points for the investigation and evaluation activity. The selection is done following the principle of simple scoring model using appropriate criteria, for the group under consideration, which are generated based on the programm's objective elaborated in the project document.

Accordingly, the following criteria are used for the selection of the subsectors.

- The degree of the adverse pollution impact of the sub sectors waste on the environment.
- Existing number of factories in the sub-sector.
- The country's agro-industrial potential for the sub-sectors future expansion.
- Existing status of projection of the industrial sub sector.

Using the above criteria, all of the industrial subsectors organized under the Ministry of Industry are analyzed and the result of the simple scoring model shows that the following subsectors should get the priority of concern in order of their listing.

1. Tannery and leather
2. Textiles
3. Breweries and distilleries
4. Sugar

Similarly all of the manufacturing establishments with in the selected four sub sectors are investigated using the following criteria as a guide line.

- The location of the specific industry in connection with the population density of the area.

- The specific characteristics of the effluent discharged in connection with its pollution impact.

- The stream assimilative capacity of the potential body which recives the effluent of the respective factories under consideration.

- The role and range of utility of the potential body by the surrounding community.

- Quantity of effluent discharged from the factory.

- Frequency of effluent discharged from the factory.

From the sixty seven factories, which are organized under the selected four subsectors, only twenty six of them are found to be of primary interest to this paper.

The Tannery and leather sub sector embraces fifteen manufacturing establishments which are aimed at producing leathers of different qualities from different type of hides and goat skins. The other is group of establishments which are producing leather based products of different types. Out of these two groups, the first one is the one which discharges effluent of strong pollutant loads. Hence all of the tanneries are considered in the effluent profile preparation.

The Textile sub sector is composed of twenty establishments which are involved in natural fiber based products. Out of these, nine are involved in the processing and finishing of cotton and wools, which results in considerable amount of effluent which could have an adverse effect on the environment.

Out of the twenty six establishments categorized under beverage, four breweries, one distillery and one winery are selected for the investigation and profile preparation. On the other hand, there are six factories in the sugar sub sector, out of which three are sugar producing agro-industrial establishments and are selected for the profile preparation.

In order to give a birds eye view of the status of the selected factories, characterizing information of the factories is presented in the form of a profile. (See Table 2.1.1).

Table 2.1.1 Profile of the Selected Factories

No.	Name of the Factory	Location	Year of Commencement	Starting Capital [mill.Birr]	Starting Capacity [mill.]	Year of Renovations	Present Capital [mill.Birr]	Present Capacity [mill.]
1.	Addis Brewery	Addis Ababa	1935	5.200	0.070lit/yr.	-	8.761	18.5lit/yr
2.	Addis Tannery	Addis Ababa	1968	0.750	0.480kg/yr.	1985	2.622	1.384kg/yr
3.	Akaki Textile	Akaki	1980	4.500	9Bir/yr.	-	29.500	6Bir/yr
4.	Asmara Brewery	Asmara	1939	0.500	0.005lit/day	1964	11.300	21.5lit/yr.
5.	Asmara Tannery	Asmara	1965	0.100	N.A.	-	1.060	1.12pcs/yr
6.	Asmara Textile	Asmara	1964	1.100	9.49sq.m/yr.	1986	30.173	6.28Bsq.m/yr
7.	Awash Tannery	Addis Ababa	1937	N.A.	N.A.	1957	1.854	1.0kg/yr
8.	Awash Winery	Addis Ababa	1936,47,50	0.225	N.A.	-	3.900	N.A.
9.	Awassa Textile	Awassa	1989	126.240	11.1sq.m/yr.	-	126.240	11.1sq.m/yr
10.	Bahir Dar Textile	Bahir Dar	1961	9.600	21.25sq.m/yr.	1987	19.691	19.67sq.m./yr
11.	Combolcha Tannery	Combolcha	1979	1.100	1.12pcs/yr.	-	1.190	1.12pcs/yr
12.	Combolcha Textile	Combolcha	1985	222.000	22sq.m./yr	-	75.080	22sq/m./yr
13.	Debre Birhan Wool	Debre Berhan	1965	4.622	N.A.	-	3.628	N.A.
14.	Dire Dawa Textile	Dire Dawa	1943	0.500	0.00824spin.	1966-1984	42.900	0.067spin.
15.	Eritrea Textile	Asmara	1964	2.507	2.48knit.	-	5.368	2.381knit/yr.
16.	Ethiopian Pidling	Addis Ababa	1971	0.210	0.000Bpcs/d.	1974	1.784	0.000Bpcs/d
17.	Ethiopian Tannery	Modjo	1976	29.250	0.004pcs/d.	1980	30.510	0.01pcs/d
18.	Ethiopian Textile	Asmara	1964	0.500	4.3sq.m/yr.	-	7.086	8.5sq.m/yr
19.	Harar Brewery	Harar	1984	38.600	19lit./yr.	-	38.600	19lit/yr.
20.	Melanisa Distillery	Addis Ababa	1906	0.880	o.002lit/d.	-	1.906	0.006lit/d.
21.	Meta Brewery	Sebeta	1967	2.000	2.37lit/yr	1970	9.258	25lit/yr
22.	Metehara Sugar	Metehara	1969	50.230	1.9kg/d.	1971,75,81	180.400	8kg/d.
23.	Modjo Tanning	Modjo	1969	N.A.	0.012pcs/yr	-	N.A.	1.4pcs/yr
24.	Ray Bahir Tannery	Asmara	1946	0.570	N.A.	-	1.612	0.11pcs/yr
25.	Shoa Sugar	Shoa	1962	24.000	1.45kg/d.	-	38.770	N.A.
26.	Wonji Sugar	Wonji	1953	26.400	0.1quin/d.	1970	54.000	1.42kg/d

N.A. : Not Available

As it can be seen form the profile table, most of the factories share the following common features.

- Low fixed capital
- Absence of continuous rehabilitation aimed at updating the process technology applied.
- Located in the major cities and towns of the country where the density of population is very high.
- Most of them are of old age.

One of the major information source for this paper preparation is the on site investigation done on the number of factories from the selected twenty six.

The factories investigated on site are selected with the condisderations of the following conditions.

. Seriousness of the pollution impact of the waste waters discharged from the factories both from the point of view of the amount and hazardous content.

. The degree of utility of the potential body to the local community.

. The presence of waste water treatment facility which needs to be assessed.

. Accesability and suitability of the location of the factory to the time table of the research phase.

Based on the above points of consideration, five from Tanneries, four from textiles, four from beverage, and three from sugar factories are investigated on sight. The others are covered up through formal questionaire.

2.2 Evaluation of Technology

Evaluation of technology to a large extent is dependent on the specific technology to be evaluated. While in most cases, the core of a given technology might be the machinery, its efficient utilization involves several other factors of which technical skill, orgaizational and managerial efficiency, infrastructural facilities are the most important. These are manifested in an industrial set up by the location , plant lay out, process development, process control and other aspects of plant design.

In this context, the spontaneous nature of the start of industrialization process in the country and the subsequent negligence of the sector's appropriate development has played a retrogressing role on the sector's progress. As it is mentioned earlier the sector was started either to meet local demand for consumer goods or construction material and the main driving theme behind the project development was the interest and desire of private investors, mainly expatriates.

On Top of that, there were no clear policies and strategies concerning the development of industry from the government, with the exception of the 1950's, when some rudiments of industrial policies were formulated.

Although there is a considerable change in terms of policies and strategies since the 1975 nationalization of heavy and medium industries, the sector is still plagued with the inherited characteristic features of the pre 1975 period.

Machineries:-

Most of the factories under consideration are of age between 16 and 65 years. Due to this fact, most of the machineries are of oldage. Hence, poor operating conditions, obsolecense, frequent break down and under capacity performance are the common features of most of the factories.

Location

Nowadays, it is becoming increasingly evident that each plant is part of an ecological system extending well beyond its boundaries. Thus, prudent and proper location of a plant is getting more and more attention. Most of the factories under study are located in congested residential areas which results in a very disordered plant layout with a limited degree of freedom for further extensions. In most cases, the impact of the pollutant loads of an effluent is agravated by the inappropriate location of the factory.

Process Development:-

Since the process development is strictly dependent on the choice of technology, it is appropriate to see this point with respect to each subsector under consideration. Although all of the subsectors are considered to be of static nature in terms of technology as compared to the chemical and Engineering industries, the recent rapid changes in process control appliance of electronics in th field of production has giventhem all the possibilities of becoming a dynamic nature, hence we observe a distinct variation in technology especially between those which are erected in the past ten years and the others

Tanneries:-

There are three basic steps in the tanning of hides that builds up the tanning industry, namely; the beamhouse operations, the tanhouse operations and finishing operation. The basic operations behind all these steps are the same almost everywhere. The major difference arises from the specific material handling for which the plant is designed and the recycle and reuse options considered during the plant design.

Since most of the factories in this sub - sector are of relatively old design, almost all of the factories materials handling is predominantly manual. Thus it is observed to be the cause of a lot of spillages and materials mis handling. The process is almost completely of batch system in combination with a fully open circuit of flow system. Hence one can conclude that the sub - sector industry is of a relatively old age technological set up. The only exception to this conclusion might be the Ethiopian Tannery which have an efficient process arrangement with a relatively modern control system.

Textiles:-

The textile industry is a processing of raw cotton, raw wool and synthetic materials produced by petro - chemical industries with the aim of transforming them into textiles suitable for use in finished products. The major process steps in the textile industry which manifest a relatively dynamic nature are spining, weaving, finishing and printing.

In the production of yarn,two alternatives are available for spining; open end and ring spining. In weaving. the three principal options are ordinary, conventional automatic shuttle and shutheless looms. The finishing process is mainly of two types; batch and continuous bleaching and dyeing. Finaly, the printing process is of two types; rotational and side ways printing. concerning the textile industries in Ethiopia, the following are the different techniques implemented in the investigated factories.

Table 2.2.1

	Name of the Factory	Spining Technique	Weaving technique	Finishing technique	Printing technique
1.	Akaki Textile	ring	Shuttle	Batch	-
2.	Awassa "	ring	Shuttless	Continuous	Rotational
3.	Dire Dawn "	open end	shuttle	continuous & Batch	sideways

As we can see from the above table, only Awassa Textile is implementing the most recent combination of technologies in all steps of the process.

Sugar Industry:-

Essentially sugar processing consists of a series of liquid solid separations to isolate the sucrose formed by photosynthesis in living plants. There are four basic steps involved in the process: juice extraction, purification, evaporation, crystallization. There are three main type of cane processing technologies.

- Open pan (op) Non centrifugal
- Open pan (op) centrifugal
- Vacuum pan (VP) centrifugal

All of the three sugar industries in the country follows the technology of vacume pan centrifugal, which is believed to be the most efficient and fairly sophisticated unit. However, the Metahara Sugar factory is equipped with relatively modern process control and better degree of automation than the others.

Beside this, all of the sugar factories are operating in an agricultural environment of a long season of 270 days of cane crushing per year excluding down time .

Beverages:-

The majority of the factories which are embraced in this study from the Beverage sub - sector are breweries with the exception of one distillery and one winery. As it is case, emphasis is given to the breweries during the technology evaluation.

The main process steps in beer production are wort preparation and fermentation. There are two widely applied methodology of wort preparation; namely:

- infusion method of mashing
- single and double decoction method

Out of the two breweries investigaed on sight, Addis Ababa brewery has shifted its wort preparation from the infusion method of mashing to the single decoction method while the Harar Brewery implements the Double decoction method. However, there are other breweries which follows the infusion method of mashing for the wort preparation.

Both of these operations have got their own advantages. The infusion method of mashing enables a better energy utilization, while the single decoction method results in a better Utilization of malt oroma.

The fermentation process is the most sensitive stage of processing, which is mostly affected by controlling the operating conditions.

Process Control

This is considered as one of the major components of a Technology and is found to be of the most dynamic nature. Process control is the major influencing factor in the process development and also the effectiveness of a given technology. Due to the recent unprecedented development in the field of electronics, the process control sector of technology has become the key point in the dynamism of production technology.

In this context, when we consider the factories embraced in this study, we observe two distinct groups of factories. Those of the factories which are erected in the past ten years are equipped with a relatively good standards of modern process control, while those which are built before that are almost completely devoided of such process controll.

This fact is believed to have an indirect effect on the condition of rate of productivity and also industrial waste status.

2.3. Characteristics of the Effluents:-

Tanneries:-

As in most of industries, water is a key input in almost every step of the tanning process. It is used either directly in rinsing and washing or as a solvent for various chemical baths through which the hides are passing through.

Since no water is expected to be consumed during the process, the major portion of the in-coming water leaves the plant as an effluent carrying various elements of pollution from the beam house, tanning and finishing operations.

Textiles:-

The major demand for water as utility in the textile industry stems from the transformation of the fibre into yarns, from the weaving of the fibre into fabric and finishing of the fabrics. There also the consumptive use of water is very low in average.

In the textiles industry, the primary source of wastes come from the extraction of natural impurities in the fibers. Beside this, other process such as bleaching , dyeing and printing contribute their own share of elements of pollution, which are considered as serious pollutants owing to the different types of dyeing and bleaching chemicals utilized.

Table 2.3.1 Sub-Sectoral Characteristics of the Waste Water

Industrial sub-sector	Chemicals involved in the process	Chemicals generated during process	Characteristic pollutants of the effluent	Possible line of activities
Tannery and Leather	Na_2S, NaOH, $Ca(OH)_2$ $(NH_4)SO_4$, $NaHCO_3$, NaCl H_2SO_4, HCOOH, $Cr_2(SO_4)_3$ Tanning Chemicals, Synthetic Oils	$Ca(SH)_2$, NaOH, NH_3 SO_2, $CaSO_4$, H_2S, Na_2SO_4, Cr_2O_3	BOD, SS, DS, Sulphides PH, Dyes, Pigments, Oils, Chromium	- Segregation of waste streams - Possibility of recycling tanning liquor
Textile	Vat, Reactive, and Sulphur Dyestuffs CH_3COOH, NH_4OH, $Al_2(SO_4)_3$ NaOH, HCOOH, H_2O_2, Na_2CO_3, Na_2SO_4, Cr_2O_7 Na_2S, CH_3COOH, H_2SO_4	Salts, Acids, Esters, Amines, Unsaturated Hydrocarbons	PH, BOD, SS, TDS, Oil, Detergents, Dyestuffs	- Segregation of waste streams - Recycling of low polluted rinse water - Rinse options
Breweries and Distilleries	Cleaning and disinfecting chemicals: NaOH, H_3PO_4, $Ca(OCl)_2$ CH_3COOH, H_2O_2, NaCl Na_3PO_4, H_2SO_4, HCl	All the utilized chemicals and brewery yeast and diatomaceous earth	BOD, SS, TDS, PH	- Segregation of waste streams - Recycling of pasteurization water - Rinse of low pollute water
Sugar	Lime, Sulphur, Triple Super Phosphate, Trisodium Phosphate Caustic Soda, H_2SO_4	SO_2, CO_2, CO, Filter Cake, $CaCO_3$, Different Organic Compounds of the Molasses	BOD, SS, TDS, PH	- Devising anadequate contingency plan for the accidental flash of molasses into the drainage system due to technical or mechanical failure

BOD - Biochemical Oxygen Demand; SS - Suspended Solids; TDS - Total Dissolved Solids; Dissolved Salts; PH - acidity and alkalinity

Breweries:-

As an industry grouped in the agro-industrial sector, they are characterized by a relatively considerable amount of water use in the form of consumable water.

Agro industrial processing usually involves the coming into contact of raw materials, product in progress or finished products with water. This contact results in wastes containing organic matter, in dissolved or colloidal states and in varying degrees of concentrations. The large amount of effluents discharged from Beverage industries results from the various types of washing and cleaning.

Sugar Industries:-

These industries are typical examples of a well developed agro-industrial sector which aims at producing sugar for human consumption from raw agricultural products, sugar cane in our case.

The main sources for waste water in this industry are water that contacts spoiled raw material or finished products, rinsing or washing water, transporting water, cooling water, process water, spillages and water used for cleaning equipment. The major components of the waste (pollutants) is of organic origin.

The other component which needs due consideration is the back tail water that comes out of the plantation area which can carry various types of Agricultural pesticides and herbicides.

In order to give a synoptic view of the situation concerning industrial waste water management, all of the factories which are selected for this study are investigated using different parameters which can give an indicative information of the situation there of. The following tables presents the results obtained from these investigations.

As it could be seen from the tables most of the factories share the following common features.

Since most of the factories involve a water intensive process, they discharge a prodigious amount of effluent.

- The frequency of discharge in most cases is continuous.

Table 2.3.2 Profile of the Factories Effluent (Tanneries)

Name of the Factory	Volume of Effluent [cu.m/d]	Temperature of Effluent[OC]	Frequency of Discharge	Treatment Before Discharge	Mode of Discharge	Effluent Discharged into	Utility of Potential Body
1. Addis Tannery	155	15-25	Continous	No	Open	Akaki	A.P.
2. Asmara Tannery	75 cu.m/hr.	25-30	every 3 hrs.	No	Open	MaiBela(TR)	A.P.
3. Awash Tannery	1000	15-24	Continous	No	Open	Akaki	A.P.
4. Combolcha Tannery	300	25-30	Continous	No	Open	Borkena(TR)	A.P.
5. Ethiopian Pickling	380	20	Continous	No	Open	Akaki	A.P.
6. Ethiopian Tannery	N.A.	25	Continous	Yes	Open	Awash Lake	A.P.
7. Modjo Tannery	N.A.	23-28	Continous	No	Open	Modjo(TR)	A.P.
8. Dey Bahir Tannery	N.A.	25-30	Continous	No	Open	MaiBela	A.P.

TR : Tributary River P.P. : Partial Purpose
SS : Seasonal Stream N.P.: No Purpose
A.P.: All Purpose

Table 2.3:3 Profile of the Factories Effluent (Textiles)

Name of the Factory	Volume of Effluent [cu.m/d]	Temperature of Effluent[DC]	Frequency of Discharge	Treatment Before Discharge	Mode of Discharge	Effluent Discharged into	Utility of Potential Body
1. Akaki Textile	960-1440	25-30	Continous	Partial	Open	Akaki	A.P.
2. Asmara Textile	360	20-22	intermittent	No	Open	Godaif(SS)	P.P.
3. Awassa Textile	1344	38	Continous	Yes	Closed	Swampy area	N.P.
4. Bahir Dar Textile	N.A.	N.A.	Continous	Yes	Open	N.A.	-
5. Combolcha Textile	3160	30	Continous	Yes	Open	Borkena	A.P.
6. Debre Brehan Wool	216	Ambient	Continous	No	Open	Shinelle(SS)	P.P.
7. Dire Dawa Textile	1920	30-50	Continous	No	Open	MaiBela	P.P.
8. Eritrea Textile	N.A.	N.A.	Continous	No	Closed	Drainage	N.P.
9. Ethiopia Textile	192	30	Continous	No	Closed	Bore well	N.P.

Table 2.3:4 Profile of the Factories Effluent (Beverage and Sugar)

Name of the Factory	Volume of Effluent [cu.m/d]	Temperature of Effluent[DC]	Frequency of Discharge	Treatment Before Discharge	Mode of Discharge	Effluent Discharged into	Utility of Potential Body
1. Addis Ababa Brewery	690	ambient	Continous	No	open	Alkaki(TP)	A.P.
2. Asmara Brewery	640	ambient	Continous	No	closed	Sewage	N.P.
3. Awash Winery	N.A.	ambient	Continous	No	open	Alkaki	A.P.
4. Harar Brewery	700	ambient	Continous	Yes	open	Stream	P.P.
5. Melanniea Distiller	72	70	Intermittent	No	open	Alkaki	A.P.
6. Meta Brewery	560	30	Continous	No	closed	Sebeta(SS)	P.P.
7. Metahara Sugar	9000	ambient	Continous	No	open	Ponds	irrigation
8. Shoa Sugar	5000	30	Continous	No	open	Ponds	irrigation
9. Wonji Sugar	5000	25-40	Continous	No	open	Ponds	irrigation

- Most of the factories discharge their effluent with out any treatment either due to absence of treatment facilities or lack of treatment chemicals and some times skill in case of those which have treatment facilities.
- The majority of the factories employ an open discharge system to flowing streams and rivers.
- Almost all of the potential bodies which receives the effluents from the factories are all purpose water bodies in terms of their utility.

Obviously, the time given for this paper preparation is not sufficient enough to carry out analytical investigations as to the detailed characteristics of the waste waters.

And since almost all of the factories don't have the access of analytical facilities, no data was available concerning the detailed characteristics of the effluent. The one or two factories which have got sufficient laboratory set up for basic analysis were not even able to use the set up due to lack of either know how or initiativity.

Never the less, wishing to leave a brief impression of the condition, here are results of analytical investigation of the three factories which are part of this study. This analytical investigation was done during another research, using the limited facilities made available by the Chemical Engineering Department of Addis Ababa University.

Table 2-3-6

	Name of the Factory	PH (1)	TSS (mg/l)	BOD (mg/l)	COD (mg/l)
1.	Awash Tannery	11.94	3424	1785	3000
2.	Akaki Textile	11.87	805	675	1500
3.	Mekannisa Distillery	4.69	504	855	1490

Source:- Industrial waste: Its management and pollution impact in Ethiopia, by DESTA MEBRATU, 1989, Page 18.

The result of the analytical investigation shows that, in all cases of the parameters, the effluents have by far greater values than the internationally accepted standards.

2.4 Evaluation of the Industrial waste water Treatment facilities

Out of the twenty six factories covered up in this study, only five are reported to have a waste water treatment faciiities. Out of these five, one is from Tanneries and one from Breweries while the rest are all from the Textile subsector.

However, as it was observed during the on site investigation, almost all of the tanneries and some of the textiles originally had some form of treatment before discharging the effluent and this is supported by the still existing remnants of the civil construction of the treatment plant.

From the number of reasons raised for the closing down of the treatment plants, the common ones are the following.

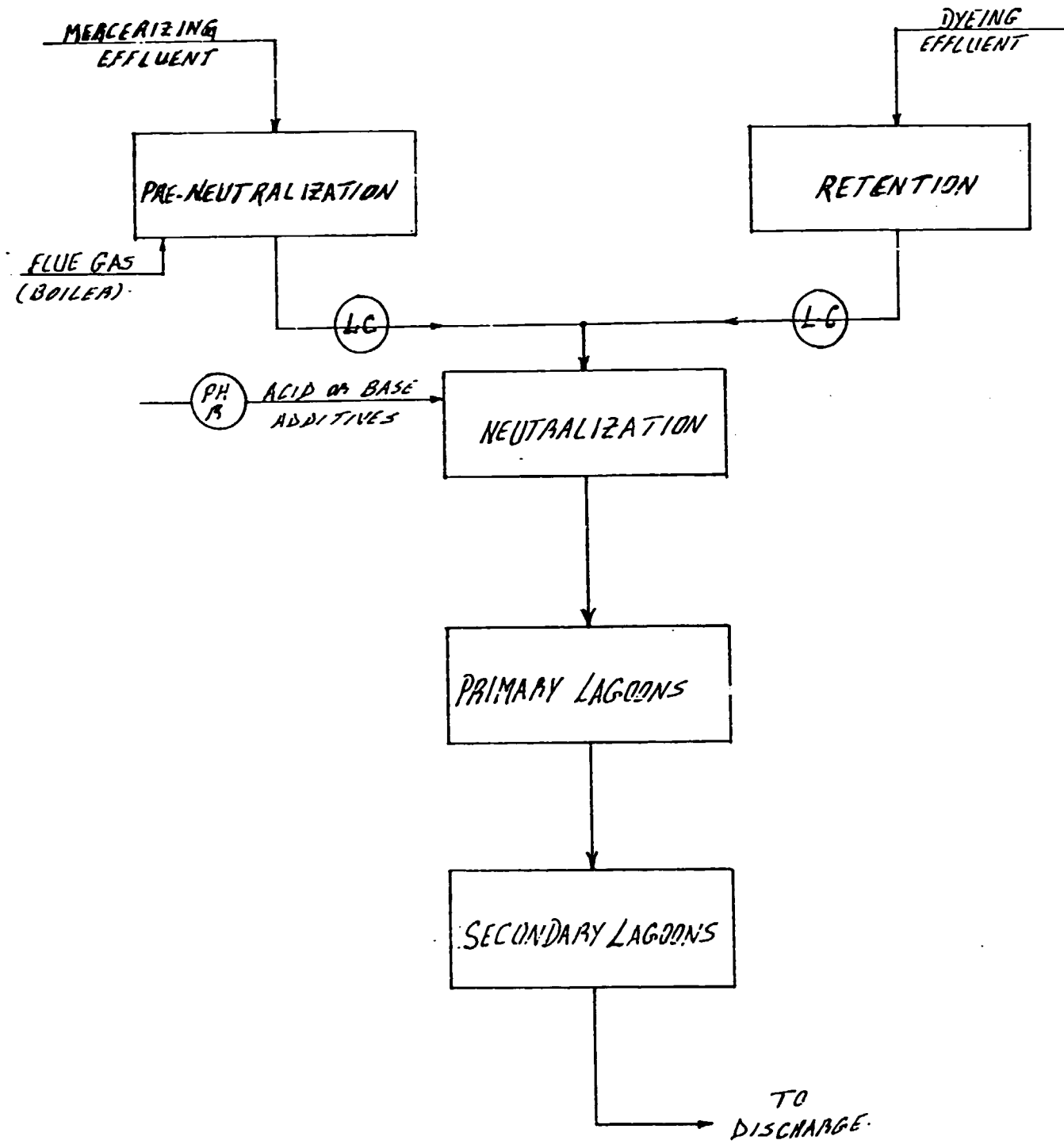
- Absence of enforcing institution or authority for meeting environmental standards.
- The increasing of the amount of effluent beyond the capacity of the treatment plant.
- Shortage of chemical additives.
- The demand for a relatively large amount of operation cost for the treatment plant.
- Lack of adequate skill and know how.
- Lack of support from the management side.

The common feature of the factories with existing treatment plants is that all of them are factories with an age between 1-15 years. Out of the five factories with treatment plants, three of the factories are investigated on sight.

Awassa Textile Factory:-

This is a factory which is built and started operation very recently (June 1989). The plant as it is mentioned earlier is of a very modern type with a relatively high degree of automation both in its production and control mechanism.

FLOW CHART OF AWASSA TEXTILE TREATMENT PLANT



The factory has a treatment plant which is built at the cost of Birr 1,865,506.04. The plant is mainly composed of a neutralization plant and aerating lagoons.

The neutralization plant has two basin receiving mainly from the mercerizing and dyeing section.

Both of the effluent are of different PH. one is of PH 12 while the other is of PH 7.

The dyeing line includes the effluent coming out of the washing troughs. The sanitary waste comes in a separate line and gets mixed up in the neutralization basin.

The mercerizing effluent is mixed with the flue gas coming out of the boiler plant with the aim of obtaining a pre-neutralization effect.

The solid waste is separated from the effluent using an arc screen which is in continuous movement.

The effluent from each basin is pumped to the neutralization basin where the PH is kept between 6-8.

The PH regulation is accomplished automatically by the addition of acidic or basic additives activated by remote sensing switch.

The neutralized water is sent to the aeration lagoons, which is composed of four two block lagoons and is located about 2kms from the plant.

The water over flows from the first block to the second block and then overflows to the surrounding marshy area.

The retention time in the aeration lagoon is dependent on the incoming flow rate and capacity of the lagoon.

In addition to the treatment plant, the chemical laboratory of the factory has an adequate facility for the effluent analysis. However, due to lack of know now, they were not able to use the laboratory set up, hence no characteristic data for the evaluation was available.

As to the operating condition, the plant has already stared facing shortage of neutralizing chemicals. Thus, the neutralization plant is operating inter mitently.

Harar Beer Factory

This Factory has a waste water treatment plant aimed at obtaining a quality of purified water of BOD value of 300 mg/l. The plant is mainly composed of gravity setter, basins followed by a biological filter and filtration basins for the sludge removal. The working principle is as follows.

Waste water flows into the space of the purification plant through a pipe line. The waste water passes through a rotational sieve machine and the over sized solid particle are removed.

In cases of mal operation of the machine sieve, there is an alternate channel with hand screens fiting and an additional by pass channel of the plant in case of total failure.

Removing sand parts, glass chips and other granulated materials is carried out in the following sand catcher, which is cleaned by an air lift pump.

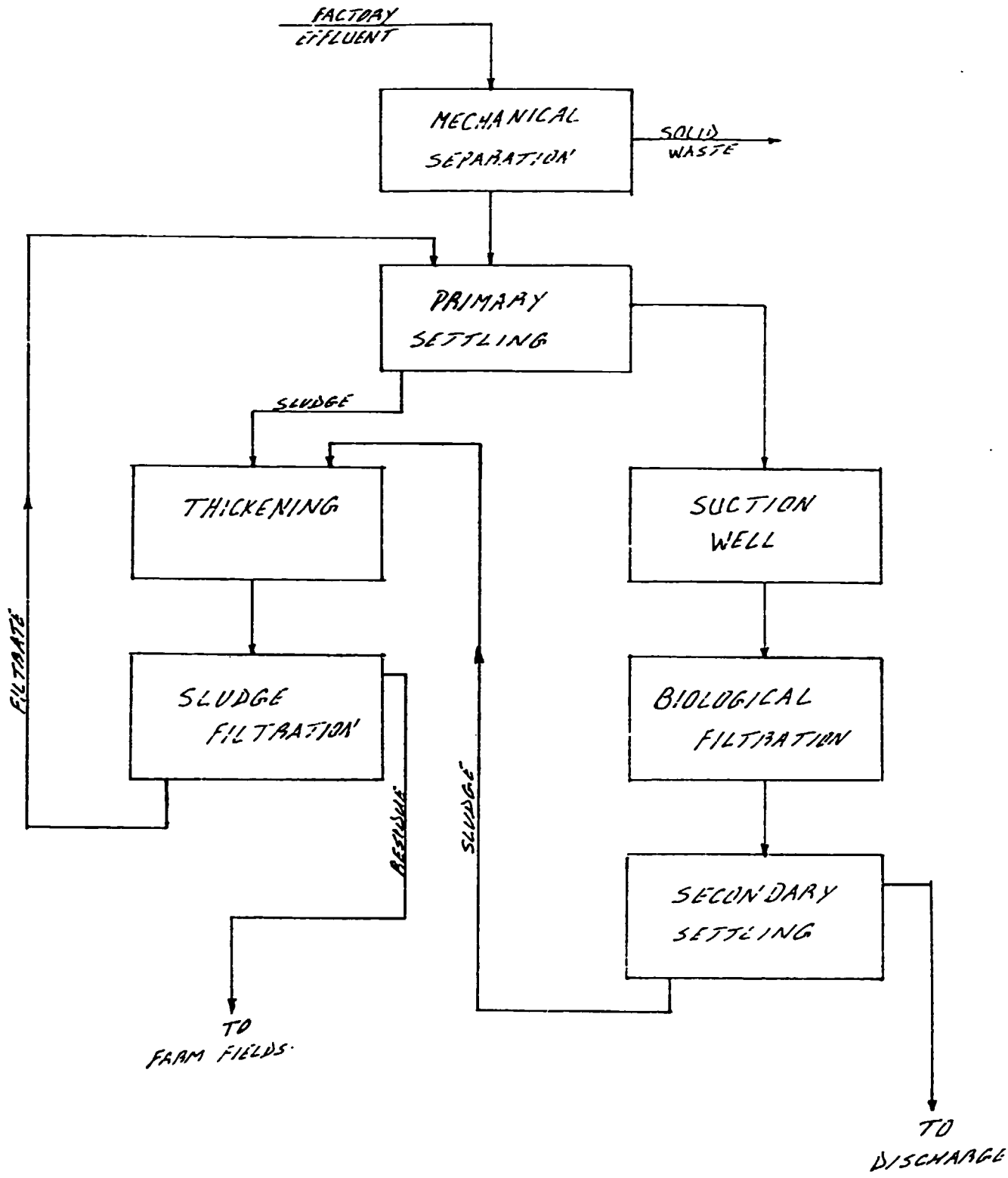
The retained material from the machine sieve, the hand screen, and from the air lift pump is conveyed away from the factory.

Waste water stripped off rough impurities is led evenly over the overflow edge of the distribution little channel and under submersion wall into the primary settling tank with capacity of 240 m^3.

The fixed scrappers collect sludge on the whole area of the tank bottom into the little channel in the center of the tank, from where it is pumped by sludge pump into the little channel along the tank.

Floating impurities from the water level are picked up by the top side of travelling bridge and get mixed with the sludge from the tank bottom in a free pipe.

FLOW CHART OF HARAR BEER TREATMENT PLANT



The travelling bridge is controlled autom atically from the terminal switches and from the switch board which is situated on the bridge.

Settled water from the settling tank overflows the edge into a suction well and from there it is pumped by sub-mersible pumps to the biological filter.

The float equipment for the remote level transmitter secures automatic starting of the pumps. One of the three pumps is in permanent operation while the others are stand by pumps.

The biological filter is a cylindrical basin of five meter diameter, filled with a different layers of sand along its height (4 meter) leaving a free collection space at the bottom.

The biological filter is fitted with a rotary sprinkler at the top which sprinkles the waste water on the top layer.

The partially biologically treated water flows through a pipe line from the bottom of the filter to the secondary settling tanks.

The settled water from the secondary settling tanks is led from the collecting channel through a pipe line out of the purification plant.

Mixture of sludge flow into the thickening tank, and settled water from the thickening tank returns by a pipeline into the primary sedimentation tank.

Thickened sludge is pumped onto the sludge field from which the filtered water returns back into the purification plant.

The residue of the sludge is scraped from the top to the field and used as fertilizer by the surrounding farmers.

The over all treatment set up of Harar Bear Factory is a bit sophisticated with a lot of mechanical parts involved, as compared to the other ones. And it is clearly seen that there is lack of skill in handling the set up and using the treatment plant effectively.

Ethiopian Tannery:-

This factory has its own treatment plant which is built together with the construction of the factory. The industrial waste water coming out of the factory is of two types.

- Concentrated toxic waste
- Light Effluent

The concentrated toxic waste mainly comes out of the beam house and tanning house operations. Hence they are of two distinct nature.

- Alkaline effluent with heavy load of sulphides and organic load.
- Acidic waste with relatively high load of chromium.

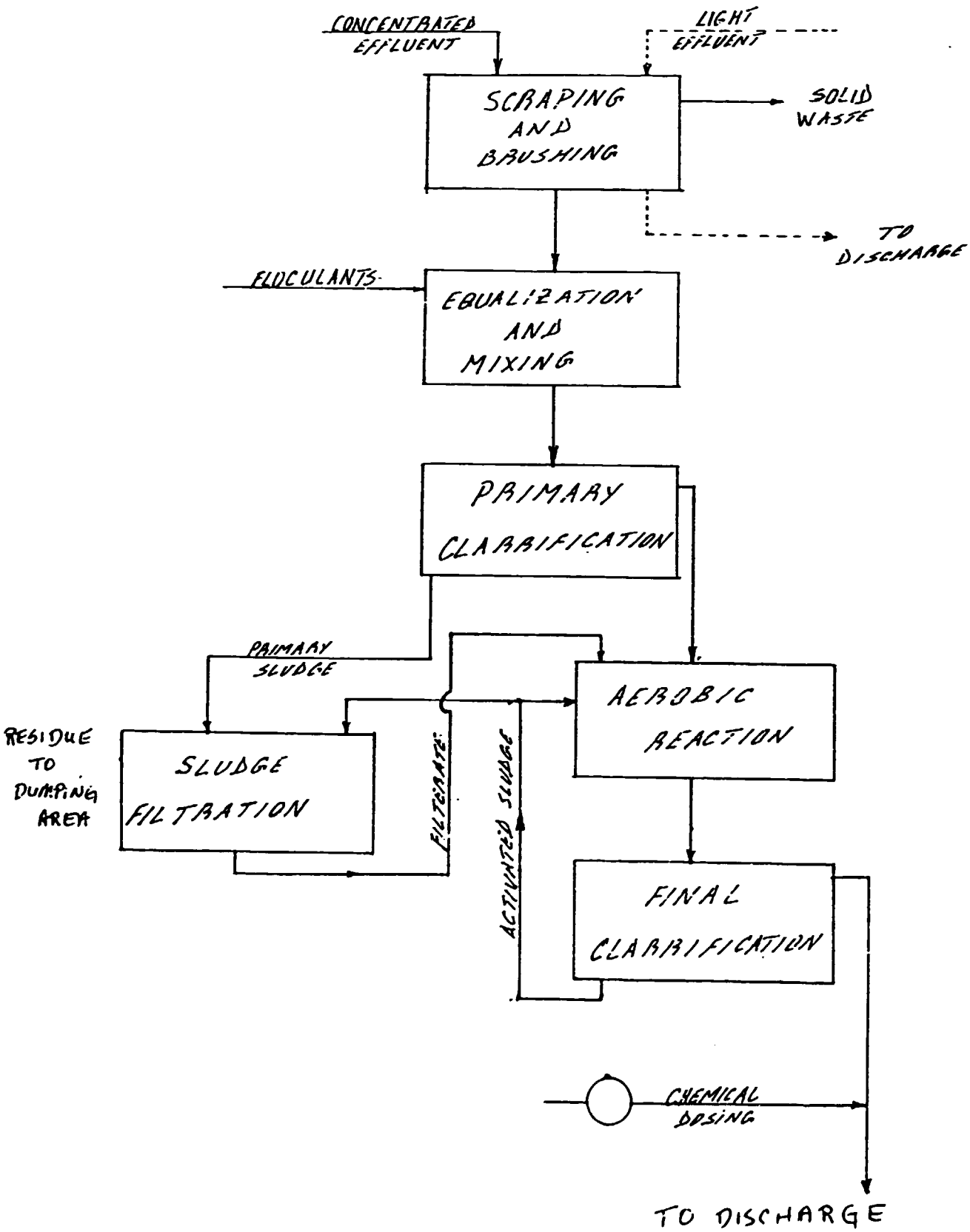
The light effluent comes out of all stages of the plant. The effluent is mainly waste water resulting from washing of drums and all sorts of cleaning. Hence it is assumed to have a very low toxic chemical contents.

Due to this fact, it is exposed only to mechanical treatments with the aim of separating the solid particles from the liquid part and the water is directly discharged into the near by water body.

The concentrated toxic waste is sent to the waste water treatment plant. The treatment plant mainly consists of machanical separator, mixing tank, settlement basin and aeration basin (aerobic reactor) and the effluent passes through the following stages.

- In the mechanical separator the solid particles are removed with the help of scrappers and the waste water which is free from solid grits is poured to the mixing tank.

FLOW CHART OF ETHIOPIAN TANNERY TREATMENT PLANT



-The soultion mixture (manily floculants) is poured into the mixing tank and gets mixed with the waste water. The mixed solution is pumped to the settlement tank.

-In the settlment tank the coagulated particles settle down and is drained to evaporation pond as a sludge. The water overflows from this tank to the aeration basin (aerobic reactor).

-In the aeration basin, three fixed aerators are working to develop a sufficent air distribution througout the water body.

-After getting the neceessary aeration, the water overflows from this basin to the final settlement tank.

-In the final settlement thank, the final particles settle and is drained to the evoporation pond as a sludge and also taken to the aeration tank as an activated sludge.

-Finally the waste water treated in this manner is released to the lake after dosing chemicals for killing microorganism.

-The sludges which are drained from the first and second settlement tanks are dried in the evaporation pond. The dried residue which is expected to contain chrome, and susphide residues are disposed in pits.

-During the on site investigation the plant was operating fully. However, it was found that due to a number of reasons from the managemnt side, the plant is either out of operation or partially operating most of the time.

Sugar Industries:-

Even though, there is no distnict type of waste water treatment plant in this sector for the evaluation, the specific way of the industrial waste water management is worth to be discussed.

All of the Sugar Factories use a prodigous amount of water for different industiral purposes. the major components of the indiustrial effluent are :

Washing water used for cleaning the different components of the factory which is loaded with organic components and a limited amount of washing chemicals.

- Cooling water used for the different mills and roller bearings.

- Rotary vacum and press filter muds in the form of dludge.
- Blowdown of Boiler
- Waste water from the Ionic exchangers during regeneration.

- Condenser water with a load of organic vapours.

- Overflow of molasses (sometimes when there is a mechanical or technical problem).

In all of the three factories, washing water with chemical additives are recycled to be used for another washing with the addition of make up water and chemicals.

The over all effluent is managed in two ways. With the exception of the filter mud sludge, all of the other effluents are collected through an under ground drainage system and taken to a retention ponds which are located in the middle of the plantation area. On the way to the ponds, fresh water from Awash River is added. After a certain retention time - not specified-in the pond, the water is used for irrigation.

According to the outcome of the follow up made on the plantation fields taking this water for irrigation, no negative effect on the yield and quality of harvest is observed.

The sludge from the filter mud is transported by a container to an area where it is exposed to natural evaporation. After a limited period of evaporation the residue is scraped of and used as a fertilizer in the plantation. Since the residue is proofed to be rich in nitrogen and phosphorus, its fertilizing effect is very much beyond doubt.

Considering the agricultural waste water, out of the total water coming into the industrial area about 10 - 15% of the water is drained back to Awash. Owing to the difference in the irrigation mechanism, the nature of the backdrained water of Metahara is somehow different from that of Wonji shoa.

The back tail water which comes out of the Metahara plantation has no possibility of coming into contact with the agricultural chemicals utilized for different purposes. Hence the back drained water from Metahara can be assumed to be free of any agrochemical content.

On the other hand, the layout of the irrigation mechanism of Wonji/Shoa plantation is in such a way that the excess water from the furrows, which is already in contact with the agro chemicals drains back to the secondary drainage system which collects the back tail water from every plot. Thus, there is the possibility of having some agro -chemical components in the final drainage water which goes directly to Awash.

None the less, the status of the industrial waste water management in the sugar subsector is found to be a very commendable one when it is compared with the condition in the other sub-sectors. The only problem which needs consideration is the stinking smells which rises from the exposure area of the sludge and comes in the direction of the residential areas of the workers. This can be corrected by making an appropriate location of the exposure area based on the actual metreological data of the surrounding.

In general although the practical evaluation of the existing treatment facilities is found to be difficult due to the absence of characteristic analytical data on the effluent at differnet stages, these treatment plants can be taken as the first steps towards the achievement of sustainable development in the country.

Furthermore, it is believed that, by developing the skill in the field of waste water management at the factories level and making some additional inputs and process modifications, these treatment plants can be used as practical demonstration sites for waste treatment activity in the respective subsectors.

3. An Over view of Supplementary Factors

3.1 Conditons of Supporting Facilities

As the word purification implies meeting a certain quality, it's beyond doubt that analytical facilities would be the backbone for any activity in the field of industrial waste water purification.

From the number of analytical insitiution in the country, here are some which can be strictly related to the field of activity under consideration.

1. **Water resource Development Authority Central Laboratory**

It is established with the purpose of providing facilities for the implementation of various water resource projects including drainage, the safe disposal of sewage, and industrial effluents as well as for the control and prevention of pollution and diseases.

To fullfill the above objective three sections were formed under the laboratory service, which are:

- water laboratory
- soil laboratory
- soil mechanics laboratory.

One of the responsiblity of the water laboratory is pollution monitoring on river water and their surrowdings caused by sewage and industrial effluents.

Toachievethis, the laboratory has a setup for the following types of analysis.

Physical: including PH,EC, Colour, Turbidity, Total suspended solids.

- Chemical:- Including Nitrates, Sulphates, Carbonates, Chemical Oxygen Demand, Biochemical Oxygen Demand.

Bacteriological :- Which includes Total collonies, Fecal coliform, Total coliform.

Many of the tests carried out in the water laboratory are done by using portable field kits, which are more usefull for surveillance and field tests.

There are a total of five personel in this laboratory. Among these two are chemists, one biologist, one senior lab technician and one lab technician.

2. National Quality control and Testing Center

This is a well organized center under the administration of Ethiopian Authority for Standardization. The center is established and is still under the support of UNDP. The center is mainly geared towards the achievement of national quality controll. Besides, it has the objectives of conducting research with the aim of generating concrete data for the various activity of standardization.

In order to achieve this, the testing and research laboratory has mainly two divisions, namely Biochemical and Engineering division. The Biochemical division, which is of interest to this paper has the following section.

- Biological products testing and research
- Chemical products testing and research
- Petroleum products testing and research
- Analytical and instrumental laboratoty.

Out of the various instruments in the laboratory here are the representative ones.

1. Atomic Absorption Spectrophotometer-SP2900
2. Gas Chromatograph-Series 304
3. Melting point Apparatus
4. Infrared Spectrophotometer-Sp3-300
5. UV/VIS Spectro photometer -Sp8-400
6. High performance liquid chromatograph

The center being a service giving body, its testing activity depends on the client's request. Thus it has not yet done any effluent analysis upto now. However, it is believed that, the existing laboratory set up could be used for various type of effluent analyses.

3. National Research Institute of Health

This is one of the oldest research laboratories which is orginally built by the Frenchs and now adminstered by the Ministry of Health. As the name implies, the institute's activity is mainly focused on health and health related aspects.

Accordingly the Institute has,

- Toxicology section which deals with the toxic aspect of chemicals on human health,
- Bacteriology section which focuses on the bacteriological character of the sample under study,
- Industrial chemistry section which mainly focuses at present, on the quality controliing of industrial products, especially cousumer goods.

In the industrial chemistry lab, a comprehensive physical and chemical analysis of water is usually done upon the request of different clients. The following are the major groups of testing which are being done in this section.

Physical Analysis:- PH, EC, settlable, floating and suspended solids, colour, Turbidity

Chemical Analysis:- Different types of cations and anions analysis
- BOD and COD
- Carbonate and bicorbonate alkalinity
- Phenolic compounds & heavy metals.

Even though most of the equipments implemented are of relatively oldage, the laboratory set up is quite important, especially when it comes to the determination of the health impact of pollutants.

4. Enviromental Hygene Department laboratory

The Enviromental Hygene Department is the sanitary section of Ministry of Heath, which is recently raised to a department level. At present, the enviromental health management at national level is left to this department, though there are other bodies which are involved in sanitation activities.

The department, being a newly organised, is trying to develop a monitoring mechanism in connection with enviromental health. To this end, it has started to organize its own laboratory which can exclusively deal with the hygenic aspect of the enviroment.

5. Laboratory of Geological Research Institute.

The Geological Research Institute is an establishment which carries out all geological studies and surveys with the aim of determining the country's potential of mineral resources and furnishing an adequate informations for the further exploitation of the sector.

To this end, the institute has a central laboratory which is mainly geared towards analysing geolegical materials. To achieve the objectives of the institute, the laboratory is organized under three main sections; namely chemical, physical, and hydrocarbon.

The chemical section deals with various types of chemical analysis as required by the institute activities and country's demand. This section is again suborganized under three main subsectors: Hydrogeology,Geothermal, and water quality.

All of these subsections are equipped with relatively latest type of analytical instruments and well skilled laboratory personnels, with practical experience of upto 20 years.

Although, the laboratory hasn't had any acctivity in dealing with waste water analysis, it is found that the analytical capability both in terms of facilities and expertise is beyond doubt for such purpose.

6. Institute for development and Disaster Studies (IDDS)

This is an institute within the Ethiopian Red cross Society Trainning center, which has the following objective.

> "To serve the trainning, research and disaster prevention and development needs of organizations committed to the principles of the alleviation of human suffering, the promotin of human welfare and the conservation of the enviroment." (Dr. Dawit Zawde ERCS chairman).

IDDS is situated on the Debre Zeit road in Addis Ababa. Constructed to a very high specifications of quality in all respects, its premises provide full residential, research, teaching and recreation facilities.

The Institute has full board accomodation for 62 persons, three spacious class rooms (with an accomodation capaccity of at least 25 persons each) and a conference hall with modern audio visual and sound systems, which can acomodate up to 120 persons. The facilities of IDDS also include a library, materials reproduction, secretarial and telecommincation services, and a clinic for the medical care of guests.

All these supporting facilities are believed to be of some assistance for the future activities of the programm in the country.

3.2 The Government and Enviromental Concern

As it is well known, Developing countries remained only peripherially interesed, considering enviromental concerns. Ethiopia had no different history concering this aspect.

In retrospect, starting from 1942 there are number of rules and regulations issued especially by the Ministry of Health. Since these regulations with regard to waste disposal were initiated when towns, factories and other establishments were under developed as compared to todays magnitude, they were pretty vague in terms of various standards.

Hence, neither enviromental health standards nor their detailed regulation were made by the repective authorities. For this reason, International Standards were employed for routine controlling activities.

To overcome this in 1974, the Envirmomental section of the Mininstry of Health had prepared an enviromental health draft regulation, which includes an effluent standard for the industrial sector. But it never came through the state approval for implementation.

This effort of the Ministry of Health, which had been developing from year to year is somehow stifled by the 1974 revolution, which has brought about a completely new socio economic condition in the country.

Today, enviromental problems are generally seen to stem both from economic growth and from activities induced by an actual lack of development. Enviroment and development are thus linked together so intricately that, separate approaches to either of the two is piece meal at best.

In this connection, there are a number of indicative steps which show that the people's Democratic Republic of Ethiopia is considering enviromental issues as one of the country's priority, as far as the country's development is conerned.

Concerning the legal aspect, albeit in a decentralized way, the government is trying to creat responsible bodies for enviromental regulation. For instance, here are some of the institutions which are made responsible for the different aspects of enviromental activities.

Proclamation No. 217/81, Article 8 sub article6.

" The National water Resource Commission shall prepare and upon approval implenet directives in order to ensure that water resources are not polluted and sewage do not become a hazard to health."

Proclamation No. 218 of 1981 Article 8 sub article 6. "The water Resource Development Authority shall supervise the implementation of the quality standards for waters to be used for various purposes and treatment standards for sewages prescribed by the appropriate government office."

Proclamation No. 328/87, Article 7, sub article 1:

"The Ethiopia Authority for standadization shall prepare, improve or change compulsory Ethiopian standards relating to goods, practices and processes in the economic sector and follow up the implementation of the same."

Proclamation No. 8/87, Article 35 sub article 2:

"The Ministry of Health shall supervise the enforcement of public health laws, order appropriate measures to be taken in the event of situations that threaten public health, and ensure the enforcement of the same."

Proclamation No. 318/87, article 9.

" The Ethiopian Valley Development Studies Authority shall conduct environmental research and studies with aview to controlling depletion or pollution of natural resources in valleys, initiate policy and devise ways and means for the protection of the enviroment and, upon approval, supervise the implementation of the same."

All these articles show that, how keen the government is to alleviate adverse enviromental impacts. However, since there is no National Enviromental Policy and a central evirommental body which could serve as a plat form for the facilitation of the activity of these governmental bodies, the achievement of these bodies in connection with their responsibility is not significant.

Recently, the country has had a symposium which is aimed at generating ideas for the formulation of a national conservation strategy for the country. Although, the attention given to the industrial sector and its contribution to this strategy is minnimal , the outcome of this symposiun is believed to serve as the cornerstone for the further formulation of National Enviromental Policy of the country.

SUMMARY

Ethiopia is a country located near the equator in the eastern part of Africa, and has the most diversified climatic and topographic condition. The Country has a yet untouched natural resource of various kinds which includes a very fertile irregable land, abundant animal resource, untapped water bodies and unveiled mineral reserve.

The Country's industrial sector, although it is still in the making, has a considerable share in the country's GDP and is expected to be the major component of the country's economic development when viewed from the point of the country's potential for the sector.

There are sixty seven factories in the selected four industrial subsectors, which are: Tannery, Textile, Beverage and sugar. From the sixty seven factories, twenty six of them are found to be of interest to this program and effort is made to cover up these factories in this paper. More over, fifteen of the twenty six factories are investigated on sight with the aim of further evaluation of the existing situation in the factories.

In terms of technology, it is observed that there are two distinct groups. To the first group belongs the majority of the factories which are of age greater than sixteen years and they predommantly practice a relatively obsolete technology, while in the second group are the few factories which are established or gets renovated after 1975. The factories in the second group have a relatively better technological practice than the other ones.

Most of the factories covered under this study discharges a considerable amount of effluent, which could have an adverse impact on the environment. Especially, the effluents coming out of the tanneries and textiles are found to be highly loaded with serious pollutants.

The potential bodies which receives the effluent are in most cases an all purpose water bodies which are used for different purposes. The main potential body which receives the lion share of the effluent is the Akaki river, which is a tributary to Awash - the most utilized and developed river in the country.

When we come to the waste treatment facilities, we have three distinct categories of factories.

- Factories which do not have any form of treatment facilities.
- Factories which did have treatment plant in the past, but which are now out of use.

- Factories which do have treatment facility at this moment and are partially operating.

All of the factories which are categorized in the third group are all of age between 1 - 15 years.

Although there isn't an exclusive analytical laboratory meant for water quality analysis, there are found to be a number of institutions with sufficient anlytical set up and skill for this purpose, provided that they get some additional inputs such as reagents required for the different analytical activities.

The final point of deliberation in this paper is the legal aspect of environmental protection. In this connection, we see that there are a number of fragment of laws concerned with environment. But these laws neither springed from a solid environmental policy nor extended into the formulation of practical regulations and standards.

CONCLUSION & RECOMMENDATION

In this paper, although it cannot be claimed that the issues discussed are treated exhaustively and rigorously, a modest attempt is made to explain the existing nature and characteristics of the problem of industrial waste water in the country.

From what is discussed upto now, one can conclude that the problem of environmental pollution caused by the industrial waste water discharged from the different factories is of considerable extent. What is more, the problem is going to be intensified in the following years, as the country indulges more in further developing its industrial sector.

Furthermore, when we consider the impact of industrial waste water in the developing countries, the community feels not indirectly through the imbalance created within the Biosphere, as it is the case in the developed country, but directly through the nutrient chain in which the already polluted water is the major component.

For instance, considering the case in our country, the Akaki river, which is a tributary of Awash, receives effluents of thirty eight factories located in and around Addis Ababa. On the other hand, the same receiving body serves as a supply of water for an all purpose activity at down stream, for thousands of people. This holds true for other receiving body as well.

In general, the water bodies in the country are serving two major functions, which are expected to have a qualitative characteristics of extreme polarity, namely: as natural sewage system and as a source of utility water, including potable water.

This fact reaffirms the common conjecture of environmentalist that, due to the problem of environmental pollution the developed countries face a deterioration of the quality of life while life itself might be at stake in developing nations when their natural resource base is destroyed.

These and all other basic reasons call for an immediate and appropriate action to preserve the environment and minimize the impact of industrial waste on the surrounding. However, the steps to be taken should be as realistic as possible, with due consideration of the specific feature of the industrial sector and the country's need.

A prudent environmental programme stems from the right combination of generation and implementation of a suitable environmental policy from the government with an appropriate industrial waste management practice in the industrial sector.

In this regard UNEP and UNIDO, respectively are expected to be the leading bodies in helping the developing countries to strike the right balance between the two components of an environmental activity.

As to the way out from the existing situation, here are some recommendation as follow up activities to be taken by the government, industrial sector and international organization.

The Government

A lot has been said about the " lip service" paid by the developing countries government to the "integrated approach to environment and development" in most of their development plan, and it is in most cases assumed to be from lack of good will. However, the major hindrance is the fact that it is found to be extremely difficult to give an operational content to the concept or to identify policy guide lines for its realization.

If the twin goals of development and environmental conservation are to be achieved, then they must both form part of the national policy. The national policy, as a guiding environmental document, should be: practicaly achievable, specific with respect to national concern, flexible with changing conditions, and responsive to the social and cultural tradition of the people of the country.

Such a policy clearly documented will be of benefit to both the industrialist and the government. It indicates to the former the constraints within which he must operate and it enables the latter to proceed with consistency from project to project.

The other problem, which is also the problem of the majority of the developing countries is the setting up of an appropriate environmental body.

As it is mentioned in the previous chapter, in Ethiopia there are a number of laws which gives environmental rights to different government bodies at different degree. However, the intersectoral co-ordinaation is quite undeveloped because of data gaps, institutional barriers and some times jealousies, which prevent interdepartmental cooperation and the application of multi-sector modelling.

Although, it is out of the scope of this study to suggest the from of machinery required, it has to be noted that it is important to establish an environmental body which can deal with the complex data processing involved and manage to satisfy the need for cross - sectorial co-ordination between the different governmental bodies.

The other component is the generation of legislations. Although there is no universal model for legislation, it is expected to provide a legally binding set of procedures which set to safeguard the environment while permitting development. In other words, the legislation should go beyond a package of do and don'ts.

Otherwise, the ancient peoples were also aware of the importance of water. And in retrospect, the Hippocrates, Hamurabi and even the Caesars did set down laws governing what could and could not be discharged into the stream waters.

If the country is desired to make any headways in the field of industrial waste management it has to generate legislations with detailed standards as to the waste characteristics, so that it could be used for monitoring, control, and enforcing the policy.

The Industry

As long and medium term remedial measures are possible through improved environmental education, training and anticipatory policies based on the prediction of environmental impacts,the continuing damage in the short term needs to be addressed.

This could be done by practicing an adequate industrial waste management in the industrial lector. In general there are five basic objectives which should be achieved in the field of industrial waste management.

Which are:-

- removal of all pollutants
- recovery of any valuable by products
- recycling of recovered material, including water
- providing for a simple operation
- low capital

Concerning the practical aspect, there are two major technical approaches in waste management.

Waste minimization:- which deals with the reduction of waste generation by going back to the source and aggravating factors, and using different technical approaches to minimize the load of treatment required.

Waste Treatment:- which deals with the purification of the waste water with the aim of meeting a certain standard, and is considered as an end of pipe management.

Coming to the specific condition of Ethiopia,out of the number of steps which could be taken in connection with the first line of activity, here are the major ones.

- upgrading of the technology of production in most of the factories.

- Taking an appropriate measures in achieving a good house keeping and efficient material handling in the factories.

- Encouraging in - plant modifications aimed at better energy and resource utilizations.

- Upholding the principles of Low and Non Waste Technology (LNWT) as much as possible, in future implementation of the number of projects aimed at renovation, extension and new establishments.

- Since most of the potential bodies in Ethiopia are not of stagnant nature, the fear with regard to the cumulative effect of pollutants is minimal and the instant impact of certain effluents on a continuously flowing body could be reduced by developing an appropriate discharge mechanism based on the stream behavior of the receiving body.

These and other related steps in the field of waste minimization could considerably eliminate a number of side factors which contributes to the agrvation of the pollution problem and reduce the treatment activity required while at the same time contributes to an increase in productivity.

In parallel to these should be taken an appropriate action in the field of waste water coming out of the factories. To this effect, the possible follow up activities are

- Further strengthening the existing treatment plants with the aim of achieving an efficient utilization.

- Reconstructing or Rehabilitating the treatment plants which are down the way to absolute demolition.

- Developing a treatment system for the other factories which needs to have a treatment plant.

The International Bodies

In the past few decades, a number of conferences were held on environmental issues and a lot of effort have been made to persuade the developing countries that long term and sustainable development could only be achieved through sound environmental management.

This is, however, no longer necessary. Because, the developing countries have drawn their own lessons from a number of major ecological disasters, emerging trends from the accelerated rate of urbanization, and visible results of ill-considered and short term development activities.

What the developing countries are now lacking is the methodlogies, analytical tools, conceptual frame works and above all the skill for the appropriate formulation and utilization of the afore mentioned. Apparently, the root cause for the lack of these components is their economic backwardness, and hence meagre financial resource.

It this context, Developed countries and International Bodies are expected to do more in assisting the developing countries to overcome their hindrances and be able to make an objective contribution for the international effort of environmental protection, as the problem is of transbourdary nature.

The major lines of assistance could be:-

- Consultancy support, especially in policy formulation, institutional setup, and standard generation.

- Training assistance with the aim of creating the necessary skill on the field of industrial waste water management at all levels of the industrial sector.

- Technical assistance aimed at further strengthening the already started treatment activities by:

  - Establishing treatment plants which could serve as a model, and used as a training demonstration site,

  - Further strengthening the existing treatment plants and related facilites by making supportive inputs in connection with their physical shortcomings.

To finalize, as the secret of life is a question of keeping the right balance, it has to be underlined that the key to a successful environmental program is the achievement of balance between development need and environmental concern, which is important and crucial to the developing countries rather than for the developed countries.

REFERENCES

1. Ahmed j.Y., and sammry K.G, Environmental Impact assessment, Hodder and stoughton, London, 1985.
2. Bartelmus P., Environment and Development, Allen and unwin, London, 1986
3. Besselevre B.E. and Schwartz M., The treatment of Industrial wastes, MCGraw Hill, Tokyo, 1976.
4. Charmichael B.I. and strzepek M.K., Industrial water use and treatment practices, cassed Tycooly, London, 1987.
5. Cavssanon V., Industrial waste water and sold wastes Engineering, Pergamon press, New York, 1980.
6. Chan M.W.H., Pollution in the Urban Environment, Elsevier applied science, London, 1985.
7. Goranson B., Industrial waste water and wastes, pergamon press, stockholm, 1975.
8. Land F.H., Industrial pollution control Handbook, Mcgraw Hill, New York, 1971
9. Overcash B.M., Techniques for industrial pollution prevention, lewis publishing house.
10. UNIDO, Industry and Development series, Viena
11. World Bank, Environmental consideration for the Industrial Development sector, World Bank , London, 1978.

Formal Questionair for the Country paper On the Programm for Purification of Waste Water

1. Name of the Factory : _____

2. Location of the Factory : _____

3. Year of Commencement of operation _____

4. Starting Fixed Capital _____

5. Starting Capacity _____

6. Year of Renovations _____

7. Present Fixed Capital _____

8. Present Capacity _____

9. Chemicals Utilized during Production _____

10. Chemicals generated during processing _____

11. Volume of discharged effluent _____

12. Temprature of the effluent _____

13. Frequency of Discharge _____

14. Treatment of Waste Water before discharge _____

15. Mode of discharge _____

_____

16. Effluent is discharged into _____

17. The present utility of the potential body which recieves the discharged effluent: _____

_____

18. Additional Remarks _____

_____

_____

_____

_____

Filled by: _____

Job Title : _____

Address: _____

Date : _____