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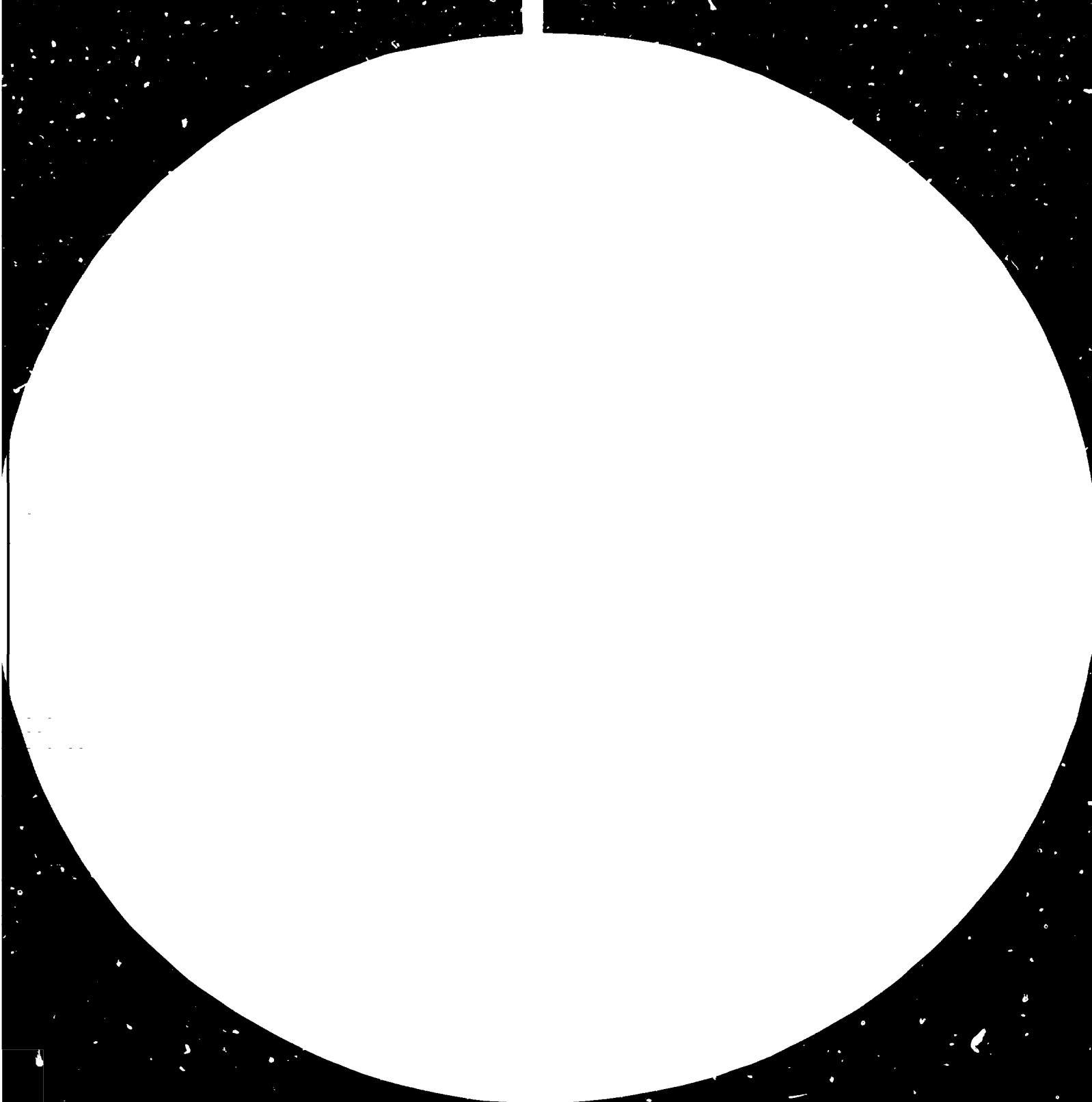

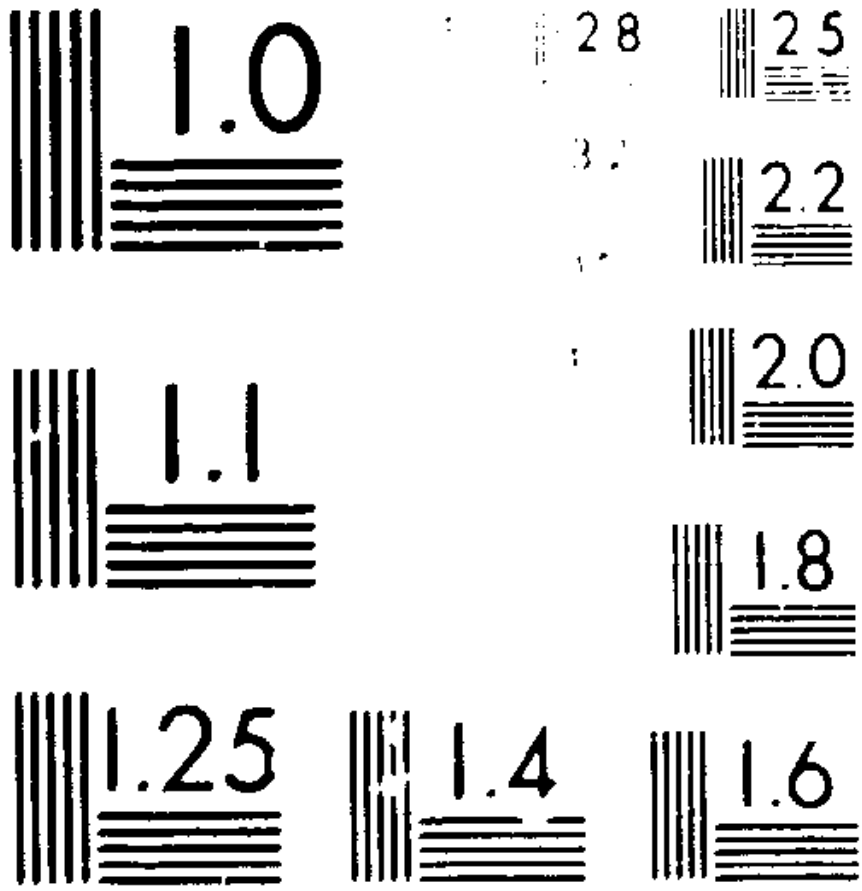
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EP

United Nations Environment Programme

Distr.
RESTRICTED

UNEP/IG.12/INF.3
19 December 1980

ENGLISH

Conference of Plenipotentiaries on
Co-operation in the Protection and
Development of the Marine and Coastal
Environment of the West African Region

16 - 23 March 1981

SURVEY OF MARINE POLLUTANTS FROM INDUSTRIAL SOURCES IN THE WEST AFRICAN REGION

Prepared with the co-operation of the
United Nations Industrial Development Organization

80-43353

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SURVEY OF MARINE POLLUTANTS FROM INDUSTRIAL SOURCES IN THE WEST AFRICAN REGION*

Prepared by the

United Nations Industrial Development Organization

Division of Industrial Studies

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TABLE OF CONTENTS

INTRODUCTION

BACKGROUND DATA

The West African Region has been recognized by the Governing Council of the United Nations Environment Programme (UNEP) (Decision 88.C(V) of 25 May 1977) as a "concentration area" in which UNEP, in close collaboration with the relevant components of the United Nations system, will attempt to fulfill a catalytic role in assisting the developing States of the West African Region to formulate and implement, in a consistent manner, a commonly agreed upon Action Plan.

Recognizing the complexity of the problem and being aware of ongoing activities, numerous preparatory activities have been undertaken to provide a sound basis for the adoption of the Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the West African Region.

At the IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas (Abidjan, 2-9 May 1978), industrial waste was identified as a major source of marine pollution in the region. The report of the meeting noted (Report of the Workshop, pages 8 and 9) that:

> "Rapidly increasing industrial development of the region, particularly in the coastal zone and along the major rivers, is likely to lead to an increase in the volume and diversity of industrial wastes discharged without adequate treatment into the marine environment. Detrimental effects of these discharges have been observed in many places, and yet practically no records exist on the amount discharged, on the concentration of these pollutants in the marine environment or on their effects on marine life and human health .... . Considering that the living marine resources, which are easily damaged by these types of pollutants, constitute an important source of revenue and

food for the population of the region, a pilot project to assess the magnitude of the problem caused by discharges of industrial and agricultural waste into the marine environment is recommended".

The meeting recommended that a detailed survey of land-based sources of industrial and agricultural pollutants be carried out as a first step towards the objective of establishing regionally applicable standards for the management and control of industrial and agricultural pollutants.

Based on the recommendations of the Abidjan workshop, the draft action plan for the West African Region adopted by the Meeting of Experts to review the draft action plan for the West African Region calls for "a detailed survey of industrial and agricultural pollutants discharged directly or indirectly into the sea (UNEP/WG.27/3, page 5, para. 13.5)."

The present survey is concerned with pollution from industrial sources. The ultimate objective of the project is to provide the West African Region with appropriate information on the type and quantity of pollutants from major land-based sources entering the marine environment through direct coastal discharges or indirectly through rivers, as well as on the present status of industrial waste management (treatment and disposal) practices. In particular, the results of the survey should assist Governments in identifying priority activities which could be incorporated in the regional action plan and should provide the basis on which related concrete waste management activities may be initiated (see Appendix D).

The survey is based on information obtained through field missions to the States of the West African Region.

The objectives of the field missions were to survey the industrial pollution in the region and to produce:

(i) An inventory of industrial sources of pollution discharging into the marine environment of the West African Region;

(ii) An assessment of the nature and quantity of pollutants entering the sea area from industrial sources, including pollutants from indirect discharge;[1/]

(iii) A review of present industrial waste treatment and disposal practices.

1/ An indirect discharge is understood to mean a discharge into a river or stream located not more than 20 km from the coast.

SUMMARY

SURVEY OF MARINE POLLUTANTS FROM INDUSTRIAL SOURCES IN THE WEST AFRICAN REGION

The objective of the project was to provide the West African region with appropriate information on the type and quantity of industrial pollutants from major land-based sources entering the marine environment through direct coastal discharges or indirectly through rivers, as well as on the present status of industrial waste management (treatment and disposal) practices.

Most of the data utilized in this report were collected by six UNIDO experts who visited the eighteen countries of the West Arican region during the period of January through August 1980. Industrial operations were visited and information was collected from the various ministries involved with industrial development and environmental protection. Estimates of the mass of pollutants discharged to the ocean were based upon production rates used in conjunction with actual measurements made by the industries located in the countries visited; studies reported in the literature; and an extrapolation of the U.S. Environmental Protection Agency Effluent Standards for various industrial sectors.

The West African region was divided into five zones closely approximating the major currents of the Atlantic Ocean. The estimated pollution discharged by industrial sector was calculated for each of the zones by adding the contribution from each country assigned to a zone.

In Zone I (From Cape Blanc to Cape Verga), 41 and 44 per cent of the estimated mass of biochemical oxygen demand (BOD_5) discharged to the ocean were attributable to the edible oils and leather industries, respectively. The vast majority of suspended solids (SS), oil and grease and chemical oxygen demand (COD) discharged to tne ocean were also produced by the edible oils and leather industries.

Over 50 per cent of the mass of BOD_5 being discharged to the ocean was coming from breweries in Zone II (from Cape Verga to Cape Palmas). The estimated mass of SS emanating from breweries comprises only 30.5 per cent of the total SS discharged, but this contribution was over one and one-half times as large as the second largest contribution to the SS which was the fish and shrimps industry (19%). Oil and grease discharges to the ocean from Zone II resulted principally from the edible oils (47%), petroleum refining (33%), and fish and shrimps (18%) industries.

The majority of the mass of BOD_5 discharged to the ocean from Zone III (from Cape Palmas to Cotonou) was evenly distributed between the edible oils (19%), breweries (21%), cement (14%), and coffee (20%) industries. Textile industries contribute an additional seven per cent of the mass of BOD_5 discharged. Phosphate mining contributed over 74 per cent of the SS discharged to the ocean. The second largest contribution to the SS discharged was the textile industry (5.5%), but comparatively the mass was insignificant. Oil and grease discharges principally resulted from the edible oils industries (72.4%). Large quantities of flouride and total phosphorus were discharged by the phosphate mining industry.

Petroleum refining and handling operations accounted for 6.8 per cent of the BOD_5 and for 99.0 per cent of the oil and grease discharged to the ocean from Zone IV (from Cotonou to Cape Lopez). The majority of the crude oil production and petroleum refining along the West African coast occurred in Zone IV. The distribution of pollution discharges from other industrial sectors was similar to that observed in the other four zones except that activity in Zone IV was generally on a much larger scale.

The estimated discharges to the ocean from Zone V (from Cape Lopez to Cape Frio) were the lowest of any of the five regions. Beer production accounts for 45 per cent of the BOD_5 discharged in the zone. Petroleum refining and handling contributed over 17 per cent of the BOD_5 discharged. Approximately 98 per cent of the oil and grease discharged in the Zone results from petroleum refining and handling. Suspended solids discharges came principally from petroleum (18%), beer (31%), and textiles (27%).

A comparison of the pollution loads for the five zones shows that Zone IV was discharging by far more pollution than any of the other four zones. Of the total pollution discharged to the ocean from the eighteen

countries of the region, it was estimated that 43 per cent of the BOD_5, 36 per cent of the SS, 83 per cent of the oil and grease, and 60 per cent of the COD were discharged from Zone IV. Nigeria alone was estimated to contribute 37 per cent of the BOD_5 and 30 per cent of the SS discharged to the Atlantic Ocean in the West African region. Zones I and III contributed almost equally the majority of the remaining pollution load except in the case of suspended solids where Zone III discharged 38 per cent of the total discharged in the region. This large percentage of the SS was principally attributable to phosphate mining operations. Zones II and V discharged only a minor proportion of the pollution to the ocean in the region. Senegal discharges over 92 per cent of the estimated industrial pollution (BOD_5) in Zone I, and approximately 85 per cent of the industrial pollution (BOD_5) in Zone IV was discharged by Nigeria.

During the visits to the West African region (1980), industrial development was relatively limited and pollution discharges from the industries were creating little impact on the environment except in isolated cases. Waste treatment in the countries of the West African region was essentially non-existent. Only an occasional sedimentation basin, grease trap or intermittent sand filter was observed by the consultants as they visited industries in the eighteen countries of the region. A significant change in the impact on the environment will likely occur in the future because of the concerted efforts being made toward expanding industry in the region. See projected development table, Table 10, page . Many large industries are planned in the coastal area of the West African region. Because of the extensive natural resources in the region, it is very likely that rapid development will occur in most countries of the region. The lack of a significant pollution problem in most countries of the region at this time allows government and industry to begin a planning process that will allow them to avoid creating an environmental problem. The immediate needs in most areas were solutions to the human pollution problems. It is strongly recommended that planning begin and a long-range plan be implemented to avoid the creation of industrial pollution problems. Where localized pollution problems currently exist, the problems will be compounded as new development occurs unless development is co-ordinated with an environmental protection plan.

Local universities and technical programmes should be encouraged to begin a long-range plan to produce the professionals and technicians required to protect the environment of the West African region. It is imperative that individuals become knowledgeable and begin to consider protection of the entire environment when expansion is considered. Adequate planning at this stage will ensure that the environment is not degraded beyond repair.

CONCLUSIONS

Information describing the contribution of industrial pollution to the marine environment from eighteen West African countries (all of the coastal countries from Senegal to Angola) was collected by six UNIDO experts who visited each country. Reports from earlier studies and information from the literature were used to integrate the data collected. An assessment of the information collected resulted in the following conclusions.

1. Data describing the industrial pollution discharges to the ocean in the West African region are limited.

2. Estimates of the pollution discharges from each of the countries, the zones and the region are conservative, and actual discharges are probably higher. However, it is difficult to estimate how low the estimated discharges may be.

3. Projected industrial growth in the region is great, but data on the expected capacity, completion data and types of industries are limited.

4. Pollution discharges to the Atlantic Ocean will likely increase significantly in the next ten years, and industrial pollution discharges are likely to become a significant problem in the Gulf of Guinea and many localized areas where industry is concentrated.

5. Discharge of industrial pollution to estuaries, rivers and the ocean in many of the countries is not currently creating a significant problem. If the planned increase in industrialization occurs, significant water pollution problems could develop in a relatively short time span.

6. The major sources of pollution in most of the countries of the West African region result from human waste and not from industrial sources. Estimates indicate that approximately 80 per cent of the pollution currently discharged to the ocean is attributable to people.

7. Development of the tourist industry on the coast of the West African region is directly dependent upon the protection of the environment. Continuation and expansion of the uncontrolled discharges from the municipalities and industrial sites will eventually destroy the beautiful beaches and the tourist industry.

RECOMMENDATIONS

UNIDO recommends that the governments of the region undertake the following activities in order to help achieve the objectives of understanding and managing present and future environmental problems in the region.

1. Each government may usefully undertake, on the national level:

   (a) The development of a joint municipal industrial and governmental planning commission to evaluate the trends and needs for pollution control. One of the functions of the commission should be to carry out a systematic review of national industrial development plans and an assessment of their impact on the environment. Appropriate measures either to eliminate or to reduce damaging environmental effects should be adopted.

   (b) The development and implementation of a long-range plan of action to provide municipal and industrial waste water, air pollution, and solid waste control programmes, and

   (c) The development of regulations to control pollution discharges in order to provide guidance for industry so that future needs may be anticipated and incorporated in pollution control plans.

2. In order to assist governments to implement effectively the above, the following regional, co-operative activities are recommended for inclusion in the action plan for the Protection and Development of the Marine Environment and Coastal Areas of the West African Region:

   (a) As part of the regional marine pollution research and monitoring programme to be organized under the environmental assessment component of the action plan, the establishment of a project to identify and assess the magnitude of wastes from industrial sources and their effects on the marine and coastal environment. (Such a project is foreseen at present in paragraph 13.5 of the draft action plan, document UNEP/WG.27/4.)

(b) The development of principles and guidelines for industrial waste management on the basis of a series of workshops. An initial workshop may be convened to review the overall problems of industrial waste in the region and to suggest appropriate environmental management practices. Subsequent workshops may usefully deal with specific subsectors, such as: industrial air pollution monitoring and control, industrial water pollution assessment and control, and industrial solid waste management. (Such a project is foreseen at present in paragraph 19.4 of the draft action plan.)

(c) The convening of a workshop to review various methodologies to be used for the assessment of the impact of industrial development activities on the environment and to propose management policies to eliminate or reduce damaging environmental effects (such a project is foreseen at present in paragraph 18.4 of the draft action plan).

(d) Maintenance of an up-to-date compilation of national legislation of the West African states concerning the control of industrial pollution, and the provision, upon request, of technical assistance and advice on drafting of appropriate national legislation (such a project is covered by the activity foreseen at present in paragraph 21 of the draft action plan).

PROJECT DESCRIPTION

BACKGROUND DATA

The West African Region has been recognized by the Governing Council of the Untied Nations Environment Programme (UNEP) (Decision 88.C(V) of 25 May 1977) as a "concentration area" in which UNEP, in close collaboration with the relevant components of the United Nations System, will attempt to fulfill a catalytic role in assisting the developing states of the West African Region to formulate and implement, in a consistent manner, a commonly agreed upon Action Plan.

Recognizing the complexity of the problem and being aware of numerous ongoing activities, the following preparatory work was undertaken or is underway to provide a basis for the Action Plan:

UNEP Exploratory Mission on Marine Pollution Problems of the West African Coastal States of the Gulf of Guinea, 25 April - 2 July 1976;

IMCO/UNEP Workshop on Prevention, Abatement and Combating of Pollution from Ships in the Gulf of Guinea and Adjacent Coastal Areas, Douala, 12 - 17 December 1977;

IOD/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas, Abidjan, 2 - 9 May 1978;

UNDP Resident Representives/Interagency Meeting, Abidjan, 10 - 11 May 1978;

FAO/UNEP Studies on: (i) Legal Aspects of Marine Environment Protection in the Gulf of Guinea and Adjacent Coastal Areas, and (ii) on the Marine Pollution of the Region, and Need and Possible Mechanisms for Control thereof;

UNEP Mission to the West African coastal States to discuss the first draft Action Plan, December 1978 - April 1979;

United Nations/Governments of Benin and Togo Workshop on Causes of and Possible Solutions to Coastal Erosion in Benin and Togo, Lomé, 29 January - 9 February 1979;

Informal consultation with representatives of the West African States attending GC.7, Nairobi, 26 April 1979.

The IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas (Abidjan, 2 - 9 May 1978), identified industrial waste as a major source of marine pollution in the region. The report of the meeting noted (Report of the Workshop, pages 8 and 9) that;

> "Rapidly increasing industrial development of the region, particularly in the coastal zone and along the major rivers, is likely to lead to an increase in the volume and diversity of industrial wastes discharged without adequate treatment into the marine environment. Detrimental effects of these discharges have been observed in many places, and yet practically no records exist on the amounts discharged, on the concentration of these pollutants in the marine environment or on their effects on marine life and human health.... Considering that the living marine resources, which are easily damaged by these types of pollutants, constitute an important source of revenue and food for the population of the region, a pilot project to assess the magnitude of the problem caused by discharges of industrial and agricultural waste into the marine environment is recommended."

The meeting recommeded that a detailed survey of land-based sources of industrial and agricultural pollutants be carried out as a first step towards the objective of establishing regionally applicable standards for the management and control of industrial and agricultural pollutants.

Based on the recommendations of the Abidjan workshop, the draft action plan for the West African region called for "a detailed survey of industrial and agricultural pollutants discharged directly or indirectly into the sea (UNEP/WG.27/3, page 5, para. 13.5)."

The objectives of the field missions to the West African region were to survey the industrial pollution in the region and to produce:

(i) an inventory of industrial sources of pollution discharging into the marine environment of the West African region;

(ii) an assessment of the nature and quantity of pollutant entering the sea area from industrial sources, including pollutants from indirect discharge;[1/]

(iii) a review of present industrial waste treatment and disposal practices.

1/ An indirect discharge is understood to mean an discharge into a river or stream located not more than 20 km from the coast.

SURVEY METHODS

DATA COLLECTION

Most of the data utilized in this report were collected by six UNIDO experts who visited the eighteen countries of the West African region during the period of January through August 1980. Prior to fielding the mission in a particular country, the Senior Industrial Development Field Adviser (SIDFA) of that country was contacted. Copies of the correspondence were sent to the UNDP Resident Representative. The SIDFA contacted the appropriate ministry of the country to be visited to ascertain the optimum period of time for the visit of the consultant and to arrange for a government counterpart. In a subsequent letter the project document describing the study was sent to the SIDFA or the Resident Representative of UNDP for distribution to the appropriate government officials. After clearance of the timing of the mission with the government officials, the visit to the country by the UNIDO expert was arranged by either the SIDFA or the Resident Representative of UNDP. The consultant visited the principal industries of the participating country and gathered the pertinent data and prepared a report presenting information on industrial activities and estimates of the pollution discharged to the ocean.

> "Country reports were prepared by the mission. Each Government received a copy of the report prepared on its country with a request for comments and suggestions. Certain Governments indicated changes that should be made to their country report, and these have been taken into account in the preparation of the present survey. When no reaction was received from a Government, it was assumed that the report was acceptable".

A summary of the activities of the consultants is presented in Appendix F.

Data were collected from as many sources as possible before and during the visits. Reports from earlier studies were consulted, industrial operations were visited and information was collected from the various ministries involved with industrial development and environmental protection. Each of the industries visited was requested to complete one of the questionnaires shown in Appendix A. The smaller questionnaire was developed near the end of the project for use with small industries that were just beginning to develop pollution control data. The majority of the industries visited by the consultants were asked to complete the larger questionnaire.

Data describing the quantity of pollutants discharged from industrial sources were collected as well as data on production rates, number of employees, type of operation, water usage, and the projected industrial growth.

Data on industrial activity in Nigeria were compiled differently than for the other countries of the region. Industrial activity on the coast of Nigeria was estimated by using data presented by ASOTS (1978), MDBFS (1980) and Mounier (1980). Production data for the sectors of crude petroleum, petroleum refining and pulp and paper shown in Table B-11 were collected by Mounier (1980) during a visit to Nigeria in July 1980. Production data for the other segments of industry (Table B-11) were taken from ASOTS (1978) and updated by using indices presented by MDBFS (1980). The proportion of the industrial activity situated on the coast of Nigeria was estimated to be 75 per cent of the total. Mounier (1980) estimated that approximately 50 per cent of the industrial activity in Nigeria was concentrated in the Lagos area, and approximately one-half of the remaining industry was located along the coast.

Production indices were based upon an index of 100 in 1972 and a value for 1979 was available (MDBFS, 1980). Production data for industry in Nigeria were available for 1972 (ASOTS, 1978) and the index was used to update the production data to 1979. Since the degree of concentration of industry on the coast was unknown and it was necessary to use judgement to estimate the activity on the coast, an attempt was not made to correct the 1979 projection to 1980. It was assumed that these projections were adequate to estimate 1980 conditions.

Certain sectors of industry were not included in the indices (MDBFS, 1980), and it was necessary to assume an index. In these cases an overall industrial index of 163.8 was used to correct the 1972 production rates. When the projected production for 1979 was less than the production that actually occurred in 1977, the projected value was discarded and judgement was used to estimate a 1979 production rate.

ZONES

The countries of the West African region were divided into zones approximating the major currents in the Atlantic Ocean off the coast of West Africa (Table 1). The zones closely parallel the five zones established by

Williams (1968); however, Williams' zones were modified by moving the zone boundaries to the nearest border. This modification resulted in relatively small changes in the original configuration proposed by Williams (1968). Williams divided the West African Region into five basic hydrographic zones and the zones were as follows:

(1) North Transitional Zone (NTZ) extending from Cape Blanc in Mauritania to Cape Verga in Guinea;

(2) Western Tropical Zone (WTZ) extending from Cape Verga to Cape Palmas in Liberia;

(3) Central Upwelling Zone (CUZ) extending from Cape Palmas to Cotonou in Benin;

(4) Eastern Tropical Zone (ETZ) extending from Cotonou to Cape Lopez in Gabon;

(5) Southern Transitional Zone (STZ) extending from Cape Lopez to Cape Frio in Angola.

The Tropical Surface Water of the West African Region is warm (more than $24^{o}C$) and has a salinity of less than $35^{o}/oo$. Seasonal replacements of the Tropical Surface Water occur with cold, high-salinity water replacing the warm waters in the NTZ, CUZ and STZ zones. This replacement is caused in the NTZ zone by the southward-moving oceanographic front. The replacements in the NTZ and STZ occur about six months apart. Cold, high-salinity water upwells in the CUZ between late June and October. Off the Ivory Coast, a weaker, secondary upwelling also occurs in January-March, but the other part of the CUZ is more stable. The temperature and salinity of the WTZ and ETZ fluctuate with rainfall and run off from the land. Productivity tends to be much higher where upwelling occurs; whereas, the Tropical Surface Water has a relatively poor productivity.

Although the basic structure of the currents of the West African Region and the adjacent regions are reasonably well established, Portmann (1977) indicates that it is unlikely that enough detail exists to predict the movement and fate of waste waters discharged to most areas of the West African coast. Eddy currents and seasonal changes are not understood well

enough to predict the impact of discharges to specific areas of the ocean. Studies to determine the movement of discharges will be necessary at most sites selected for discharge.

Pollutional discharges were estimated for each of the zones by adding the estimated discharges from each of the countries assigned to a zone.

Table 1. Zones and countries included in the survey of pollution discharged to the atlantic Ocean from the West African region.

ZONE	COUNTRIES
I	Senegal
	Gambia
	Guinea-Bissau
II	Guinea
	Sierra Leone
	Liberia
III	Ivory Coast
	Ghana
	Togo
	Benin
IV	Nigeria
	Cameroon
	Equatorial Guinea
	Sao Tome & Principe
	Gabon
V	Congo
	Zaire
	Angola

DATA ANALYSIS

The various types of data were compiled for each country and an individual country report was prepared for each of the eighteen countries visited and sent to the Government concerned for comments (Margola, 1980a, 1980b, 1980c, 1980d, 1980e, 1980f, 1980g, 1980h, 1980i; Middlebrooks, 1980a, 1980b; Mounier, 1980a, 1980b; Rozanov, 1980a, 1980b; Schifini, 1980a, 1980b, 1980c). Each of the country reports should be considered as an annex to this report. Details about the country, its pollution control laws and projected growth of the population and industry are frequently presented. The level of detail varies in each report, but all of the information collected by the consultants was summarized. The individual questionnaires completed for the industries visited in each country are maintained on file at the International Centre for Industrial Studies, UNIDO.

The pollution discharge projected for each of the countries reported herein may differ from the values given in the country reports. These differences were caused by the individual preferences of the various authors in selecting pollutional mass loading factors for each type of industry. To ensure continuity a common set of pollutional mass loading factors for each type of industry was selected and used for all of the countries. The values used herein are not considered superior to those employed by the authors of the individual country reports. Wide variations in the mass of pollutants discharged per unit of production are reported in the literature, and depending upon the one selected, the estimated discharge for a country can vary considerably.

Estimates of the mass of industrial pollution discharged to the Atlantic Ocean were included in each country report. Estimates of the mass of pollutants discharged to the ocean were based upon production rates and the number of employees used in conjunction with three sources of information. The first source of information consisted of actual measurements made by the industries located in the countries visited; the second source was based upon studies reported in the literature; and the third source was based upon an extrapolation of the U.S. Environmental Protection Agency Effluent Standards for various industrial sectors. It was necessary to use all three sources of information with the production data collected in each of the countries to estimate pollution discharges because of the lack of detailed data in the country or in the literature for certain types of industries. A detailed description of the methods used to project pollutional loads is presented in the following section.

POLLUTION LOADINGS

Because of the variability between industries and countries, it was necessary to develop some technique for uniform projection of the pollution discharges from the West African countries. The most desirable method of projecting pollutional discharges would be to have information on the quantities of waste water discharged and the characteristics of the waste water measured by a competent laboratory. Frequently this type of information is unavailable in countries just beginning to undergo industrial development. The second method of making projections can be based upon the daily or yearly production of goods, or the consumption of water and the number of employees actually working in a given plant. Because of the paucity of data in the West African region, it was necessary to utilize either the production, employees, or water consumption data to project waste water discharges. It was very difficult to relate the number of employees to pollution discharges because of the effort to convert the industries to a labour intensive operation to take advantage of the large labour force in many of the countries of the region. Although all industries did not attempt to take advantage of the large labour force, the majority did, and for this reason there was a great deal of disparity between the numbers of employees used at similar manufacturing plants.

A great deal of variability in the results would be obtained using any of the above sources of information, but the variation in reliability of results from country to country and from industry to industry were sufficiently large that the use of the above mentioned type of information will result in as accurate an estimate as any other technique that might be employed. Although numerous waste loading parameters are available for various industries, it was felt that it would be advantageous to use the same procedure employed by UNIDO in the Mediterranean Sea study (Carmichael and Nemerow, 1977). Carmichael and Nemerow (1977) used the USA Environmental Protection Agency Guidelines (1977a) where information was available to convert production data to contaminant loads. In all cases where EPA guidelines were used, 30-day average values were selected in hopes that this would more accurately describe world-wide conditions. The EPA guidelines described pollutional parameters for effluents from a treatment facility only. The EPA guidelines used to project waste discharges in West Africa are summarized in Table 2 (see Appendix E for definitions).

Table 2

Raw waste loads based on production rates used to estimate pollution discharges from West African countries

Type of Industry	Raw Waste Loads, kg/ton									Reference
	BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus	
Canned and preserved fruits and vegetables	5.13	6.33		12.8							EPA, 1977a
Southern (nonbreaded) shrimp		253.3	80.0								EPA, 1977a
Alaskan bottom fish processing		11.3	0.60								EPA, 1977a
Corn wet milling	9.02	8.93		22.6							EPA, 1977a
Corn dry milling	0.71	0.63		1.78							EPA, 1977a
Bulgur wheat flour mills	0.10	0.10		0.25							EPA, 1977a
Parboiled rice	0.93	0.53		2.33							EPA, 1977a
Ready-to-eat cereal	2.67	2.67		6.68							EPA, 1977a
Wheat starch gluten	13.3	13.3		33.3							EPA, 1977a
Simple slaughterhouse (kg/ton LKW)	0.80	1.33	0.4	2.0							EPA, 1977a
Dairy products	0.90	1.35		2.3							EPA, 1977a
Crystalline cane sugar	5.73	1.20		14.3							EPA, 1977a
Edible oils	22.3	19.5	14.0	55.8							Middlebrooks, 1979
Brewery	10.2	4.73		11.2							Middlebrooks, 1979
Soft drinks	3.15	4.33		7.9							Middlebrooks, 1979
Flavouring extracts (chocolate, etc.)	Insignificant discharges										Middlebrooks, 1979
Coffee	625	50		1,562							Nemerow, 1978
Bottling wine	3.15	4.33		7.9							Middlebrooks, 1979
Alcohol production (kg/m^3)	4.85			12.12							Middlebrooks, 1979
Petroleum refining (topping)	0.094	0.080	0.029	0.47	0.010	0.0006	0.0016				EPA, 1977a
Petroleum refining (cracking)	0.126	0.080	0.048	0.35	0.026	0.0006	0.0016				EPA, 1977b
Petroleum storage and washing			0.5								Carmichael + Nemerow, 1977
Petrochemicals	0.144	0.116	0.047	0.85	0.084	0.0009	0.0024				EPA, 1977a
Manufacturing soap flakes and powders	0.067	0.067	0.067	0.33							EPA, 1977a
Manufacturing bar soap	2.27	3.87	0.27	5.67							EPA, 1977a

Table 2 (cont'd.)

Raw waste loads based on production rates used to estimate pollution discharges from West African countries

Type of Industry	Raw Waste Loads, kg/ton										Reference
	BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus	
Tires and inner tubes		0.43	0.11								EPA, 1977a
Emulsion crumb rubber	2.67	4.33		53.3							EPA, 1977a
Solution crumb rubber	2.67	4.33	1.07	24.3							EPA. 1977a
Latex rubber	2.27	3.67	0.93	45.7							EPA, 1977a
Leather tanning + finishing (hair pulp with chrome tanning)	26.67	33.3	5.0	66.7			0.67				EPA. 1977a
Pulp, paper and paperboard (unbleached kraft)	18.67	40.0		46.7							EPA, 1977a
Cement manufacturing (leaching)	2.67			6.7							EPA, 1977a
Explosives	1.46	29.3		3.87							EPA, 1975
Textiles printing and dyeing (assume cloth weighs 0.15 kg/m^2)	22.7	58.0		282.0		0.40	0.40				EPA, 1977a
Paint and laquer	0.13	0.20		0.3							Margola, 1980
Plywood (kg/m^3 of plywood)	0.62			1.56		0.70					Nemerow, 1978 and BSWCWD, 1978
Veneer (hardwood, kg/m^3)	3.64			0.1							EPA, 1977a
Iron and steel		0.24	0.073		0.61	0.01			0.15		EPA, 1977a
Primary aluminium smelting by Hall-Heroult process		10.0						6.67			EPA, 1977a
Phosphate manufacturing		3.33						0.33		1.00	EPA, 1977a
Sulfuric acid		0.30	0.045								BSWCWD, 1978
Ammonium sulfate					2.5						EPA, 1977a
Plating and galvanizing		1.26					0.018	0.031		0.063	EPA, 1977a
Fertilizers		3.33						0.33		1.00	Nemerow, 1978
Pharmaceuticals	21.3	47.3		53.3							BSWCD, 1978
Batteries 1/	6.24	1,560		15.6							BSWCWD, 1978

1/ 62.4 kg/ton of lead and cadmium are also discharged.

Where effluent guidelines were not available for a particular industry, the characteristics of raw waste waters for a given industry were taken from books by Nemerow (1978), Middlebrooks (1979), EPA reports (1977b; 1976), Carmichael and Nemerow (1977) and a book prepared by the Eastern European countries and the USSR (BSWCWD, 1978). These data are also summarized in Table 2.

It was necessary to extrapolate effluent loading data to raw waste water information by considering what constitutes best practical treatment utilized to produce these effluent guideline levels. It was realized that there were inherent weaknesses in estimating raw waste discharges from an industrial installation by using effluent standards; however, the standards were based upon 85 per cent removal of biochemical oxygen demand (BOD_5) and suspended solids (SS). The estimates for BOD_5 and SS are more reliable than the estimates for other parameters such as oil and grease, chemical oxygen demand (COD), and the heavy metals. Recognizing this weakness, it was decided that a rough approximation and an indication as to the types of materals being discharged to the ocean would be more valuable than ignoring these constituents and misleading the countries involved. Production data were reported most often by the industries surveyed; therefore, an example illustrating the method used to make projections utilizing the EPA guidelines is presented in the following paragraph.

For a petroleum refining operation the EPA guidelines (1977a) state that an effluent from a waste water treatment facility at a petroleum refining operation (cracking subcategory) should contain on a 30-day average, 5.5 lbs of BOD_5/1,000 barrels of feed stock. To convert this quantity of discharge from a treatment facility to the pounds of BOD_5 contained in the raw waste water effluent, it was assumed that 85 per cent removal of the BOD_5 was obtained with the treatment facility. The untreated waste water would, therefore, contain 5.5 : 0.15 or 36.7 lbs of BOD_5/1,000 barrels of crude oil refined (16.68 kg/1,000 barrels). It was assumed that 7.3 barrels of crude oil weighed one ton (specific gravity = 0.86), and the discharges in terms of pounds per 1,000 barrels were converted to kilogrammes per ton of crude oil processed (0.126 kg/ton). Assuming that an oil refinery was processing 4.5 million barrels of crude oil per year, or 616,440 tons per

year, the quantity of BOD_5 expected in the raw waste water would be (4,500,000 : 7.3 barrels/ton) x 0.126 kg of BOD_5 per ton, or 77,670 kg BOD_5/year. The same procedure was followed to calculate the other types of pollution discharged from the oil refinery.

An API (American Petroleum Institute) separator was operating at all of the oil refineries visited, and the separator is considered an integral part of a refinery operation. The guidelines present in Table 2 are based upon the production of a treated effluent starting with the effluent from an API separator. Comparing the median BOD_5 effluent concentration measured at 135 refineries of 17.25 kg/barrels of crude oil with the calculated discharge based on 85 per cent removal of 16.68 kg/1,000 barrels of crude oil shows excellent agreement between the two values.

When an industries' pollution production is expressed in terms of thousand pounds of product, it is possible to make the following calculations that are more convenient than the one presented above. Since one pound of BOD_5 per 1,000 pounds of product is equal to one kilogramme per ton of product, the English units can conveniently be converted to the metric system. If units are expressed in other units such as barrels, as used above, it is first necessary to convert the quantity of material to a mass of product before these conversions can be made.

In cases where values for the COD are not available, an approximation can be calculated by converting the value of the BOD_5 with a selected conversion factor. There is much controversy as to what constitutes an acceptable factor, but for convenience the ratio of COD to BOD_5 will be assumed to be 2.5 in all of the calculations in this report where actual data are unavailable.

ESTIMATED POLLUTION DISCHARGES

PRODUCTION RATE METHOD

Compilations of the production data and estimated mass of pollutants being discharged to the ocean for each of the countries on the West African coast are presented in Tables B-1 through B-18 in Appendix B (see Appendix E for definitions). In some countries a complete listing of industry along the coast was unavailable, and in some cases when a complete listing was available, production rates were unavailable. Production rates were frequently reported for periods other than the immediate past year (1979) and it was infrequent that estimates for 1980 were available. Through consultations with the local ministries associated with industrialization, estimates of the 1980 production were made and used to estimate the pollution discharged to the Atlantic ocean.

When production rates were not available for an existing industry, it was listed in the table containing the data for the country, but pollution discharge projections were omitted for the particular industry. Only installations with reported production rates were used to estimate the pollution being discharged to the ocean. This approach resulted in a low estimate of the discharges, but with the exception of three countries (Liberia, Sierra Leone and Nigeria), the numbers of industries in the coastal areas without production data were insignificant when considering the uncertainty involved in the projection techniques.

Industries known to be discharging very little or essentially no pollution to the ocean were also excluded from the estimates even though production data were available. Therefore, there are two classes of industries without pollution discharge projections in Tables B-1 through B-18: those with production rates but contributing little pollution, and those without production data.

Production rate data for most of the industries in Liberia and Sierra Leone were unavailable, and it was necessary to project the pollution discharged to the ocean by multiplying the estimated pollution discharges from the visited industries by a ratio of the local number of employees in the coastal areas to the number of employees working at the visited industries.

INDUSTRIAL DATA METHOD

Some of the visited industries in seven of the eighteen countries visited reported data describing the characteristics of the waste water discharged, number of employees, and production rates. These data differ from the data presented in Tables B-1 through B-18 in that the data represent laboratory measurements or an estimate of the pollution discharged by the industry based on the judgement of the consultant and the industry representative.

With such a methodology, the estimated total pollution discharges were calculated by multiplying the total pollution discharged by the visited industries by a ratio of the total number of employees in industry in the coastal area to the number of employees working at the visited industries. When an unusually large and specialized industry was encountered (for example, BLOHORN in Ivory Coast), the pollution discharges were not included in the visited industry totals to calculate the projected total coastal discharge. These unusually large quantities were added to the projected total.

A comparison of the above estimates with the estimates based upon the guidelines (Table 2) is presented in Table 3. There was very little agreement between the results of the two methods. This is not unexpected when the differences in the two methods are considered. In general, the visited industry projection method would be expected to yield the higher values, because the visited industries were known to be the largest users of water, and consequently the most likely dischargers of pollutants. When the total pollutant discharges were multiplied by an employee ratio that included employees from all categories of industry, a high estimate would likely result. This was particularly true where only a few industries discharging large quantities of waste water were included in the number of industries visited.

The most logical method of making projections of pollution discharges would be based upon actual data collected by a competent independent laboratory. This option was unavailable to this study and is unlikely to become available in the near future because of the expense involved, lack of equipment and trained personnel.

Table 3

Comparison of methods to estimate mass of pollutants discharged to the ocean in seven countries of the West African region

Country and Projection Method	Mass Discharged, tons/year										Reference
	BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus	
IVORY COAST											
Guidelines	5,216	3,507	815	14,173.7	75.3	5.9	8.8	21.9		65.2	
Visited Industry	14,880	4,650	536	39,450							
[illegible]											
Guidelines	1,708	23,898	250	3,885	62.6	1.2	1.6	2,310	9.0	7,000	
[illegible] Industry	710	2,450,425	36	2,040							
[illegible] + PRINCIPE											
Guidelines	38	18	27	43							
Visited Industry	47	390									
CAMEROON											
Guidelines	2,187	4,800	259	5,139		2.2	2.1	334			
Visited Industry	10,400	9,000	196	32,000							
GABON											
Guidelines	897	381	5,601	1,840	54.8	54.0	3.8				
Visited Industry	1,400	5,200	42	37,200		5.6					
[illegible]											
Guidelines	1,085	606	1,265	2,656	10.0	3.5	2.4				
Visited Industry	402	330	48	800		0.2					
NIGERIA											
Guidelines	449	497	3,766	2,076	41.8	2.7	4.2		0.5		
Visited Industry	720	402	115	2,584			1.5				

The difference of two orders of magnitude between the values obtained from Guidelines and from the industry visited for suspended solids in Togo is because the USA phosphate mining operations are carried out utilizing a holding pond or some other preliminary treatment for waste waters before discharge of what is termed raw waste. Since nearly all the suspended solids in industrial waste comes from phosphate mining operations in Togo, this reflected in the substantial difference observed in the two figures in the Table.

The data reported in Tables C-1 through C-7 were not necessarily based upon laboratory studies. Much of the data were approximations based upon the judgement of the industrial personnel and the consultant visiting the industry. The production data were thought to be the most accurate of all data collected, and estimates of pollution discharge rates based upon production rates and the guidelines (Table 2) were probably the most accurate results.

POLLUTION DISCHARGE BY ZONE

As mentioned above, the West African region was divided into five zones closely approximating the major currents of the Atlantic Ocean. The estimated pollution discharged by industrial sector was calculated for each of the zones by adding the contribution from each country assigned to a zone. Estimated pollution discharges for the five zones are presented in Tables 4 through 8 (see Appendix E for definitions). Although the results are reported to the first decimal point, the intent is not to imply that the results are significant to that level. The values in Tables 4 through 8 are probably accurate to only two or three significant figures. Figure 1 shows the boundries of the five zones, the types of industries located near the coast, and the magnitude of industrial pollutants discharged to the ocean in each zone.

When the expression "NO DATA" appears in Tables 4 through 8, it indicates that the category of industry was known to exist in the coastal area of the zone, but production data were not available. As explained above, when production data were not available, estimates of the pollution discharged were not attempted.

In Zone I, 41 and 44 per cent of the estimated mass of BOD_5 discharged to the ocean were attributable to the edible oils and leather industries, respectively (Table 4). The vast majority of the SS, oil and grease and COD discharged to the ocean were also produced by the edible oils and leather industries. Processing of fish and shrimps made a significant contribution to the SS and oil and grease discharged, but the contribution was less than 15 per cent of the total discharged.

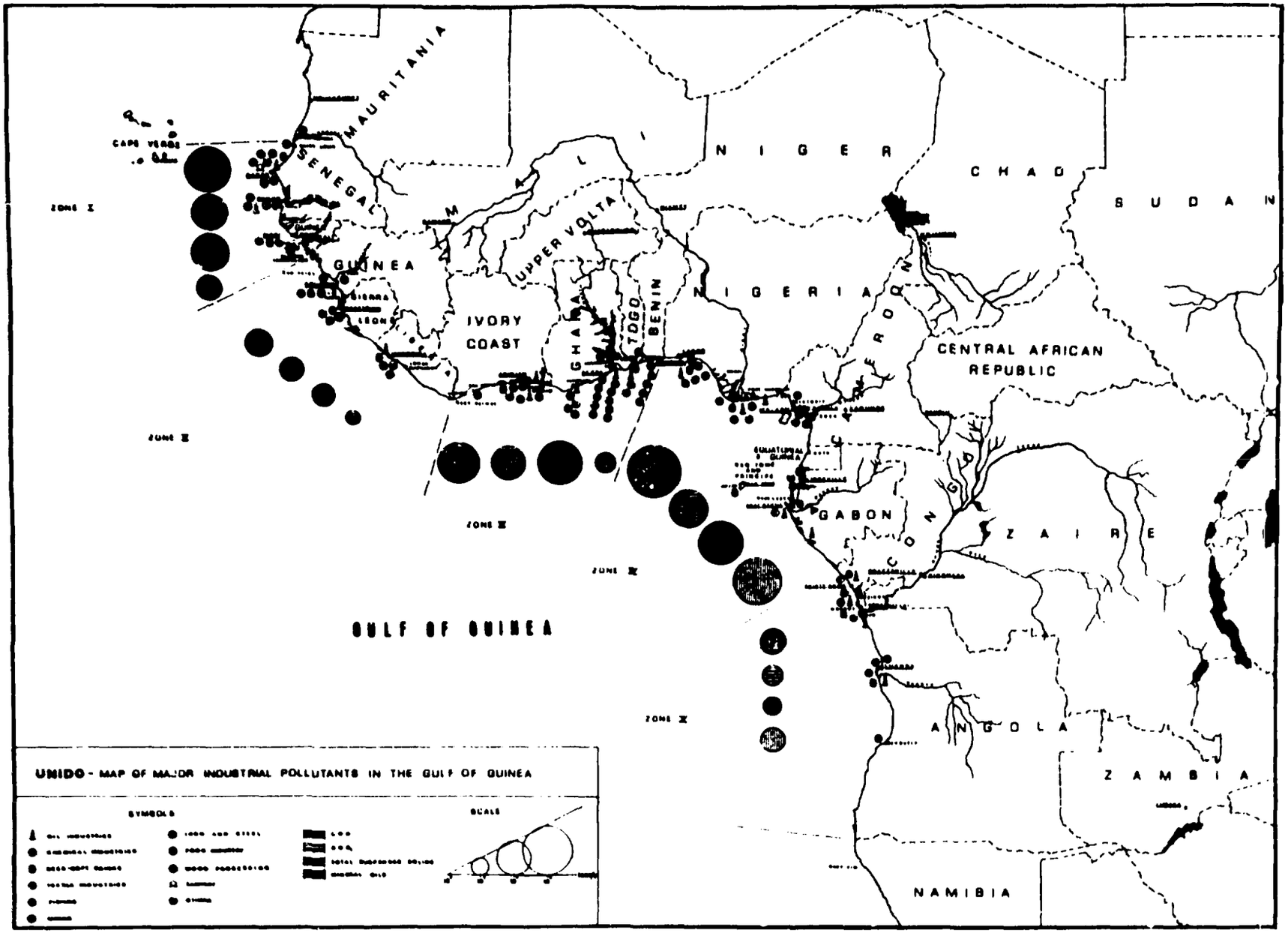
MAURITANIA
SENEGAL
GUINEA
MALI
NIGER
CHAD
SUDAN
UPPER VOLTA
GHANA
TOGO
BENIN
NIGERIA
IVORY COAST
CAMEROON
CENTRAL AFRICAN REPUBLIC
GABON
CONGO
ZAIRE
ANGOLA
ZAMBIA
NAMIBIA
GULF OF GUINEA
ZONE I
ZONE II
ZONE III
ZONE IV
ZONE V
UNIDO - MAP OF MAJOR INDUSTRIAL POLLUTANTS IN THE GULF OF GUINEA
SYMBOLS
SCALE

Table 4

Estimated mass of pollutants discharged to the ocean by Industrial Sectors in Zone I of the West African region

Country and Projection Method	Mass Discharged, tons/year										Reference
	BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus	
Petroleum refining and handling	116.1	74.2	44.1	331.1	25.0	0.6	1.5				
Edible oils	4,984.1	4,356.3	3,129.0	12,471.5							
Beer	418.2	193.9		459.2							
Soft drinks	154.4	212.2		387.1							
Soap and detergent	63.7	108.5	7.7	159.3							
Fish and shrimp		2,338.4	557.0								
Sugar	779.8	962.2		1,945.6							
Textiles	230.0	587.8		2,857.8		4.1	4.1				
Paint	0.5	0.8		1.3							
Rice	2.8	1.6		7.0							
Dairy products	20.0	30.0		51.2							
Fruits and vegetables	27.5	33.9		68.6							
Meat	0.6	1.0	0.3	1.5							
Leather	5,334.0	6,660.0	1,000.0	13,000.0			134.0				
Fertilizer		381.6						38.2		114.6	
Asphalt	0.7	0.6	0.2	4.1	0.4	0.1	0.1				
Metal working + coating	0.3	1.7	0.1	0.8	0.1	0.1		0.7			
Total	12,132.7	15,944.7	4,738.3	31.746.1	25.5	4.7	139.6	38.9		114.6	

Table 5

Estimated mass of pollutants discharged to the ocean by Industrial Sectors in Zone II of the West African region

Country and Projection Method	Mass Discharged, tons/year										
	BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus	Reference
Petroleum refining	598.3	379.9	227.9	1,662.0	123.5	2.8	7.6				
Edible oils	515.9	451.1	323.9	1,290.4							
Beer	1,704.5	792.3		1,876.0							
Soft drinks	192.2	264.3		480.6							
Alcohol and blending of spirits	0.4			1.0							
Soap and detergent	84.1	143.5	10.1	211.1							
Fish and shrimp		490.8	125.3								
Sugar	68.8	14.4		171.6							
Textiles	10.2	26.1		126.9							
Explosives	1.0	20.5		2.7		0.2	0.2				
Paint	0.3	0.5		0.8							
Flour	3.7	3.3		9.3							
Fruits and vegetables	7.4	9.1		18.4							
Total	3,186.8	2,595.8	687.2	5,850.8	123.5	3.0	7.8				

Table 5 shows the estimated mass of pollutants discharged to the ocean in Zone II. Over 50 per cent of the mass of BOD_5 being discharged to the ocean was coming from breweries. The estimated mass of SS eminating from breweries comprises only 30.5 per cent of the total SS discharged, but this contribution was over one and one-half times as large as the second largest contribution to the SS which was the fish and shrimps industry (19%). Oil and grease discharges to the ocean from Zone II resulted principally from the edible oil (47%), petroleum refining (33%), and fish and shrimps (18%) industries.

Pollution discharges to the ocean in Zone III by industrial sector are presented in Table 6. The majority of the mass of BOD_5 discharged to the ocean was evenly distributed between the edible oils (19%), breweries (21%), cement (14%), and coffee (20%) industries. Textile industries contribute an additional 7 per cent of the mass of BOD_5 discharged. Phosphate mining contributes over 74 per cent of the SS discharged to the ocean. The second largest contribution to the SS discharged was the textile industry (5.5%), but comparatively the mass was insignificant. Oil and grease discharges principally resulted from the edible oils industries (72.4%). Large quantities of flouride and total phosphorus were discharged by the phosphate mining industry.

Table 7 summarizes the estimated pollution discharged to the ocean in Zone IV. Petroleum refining and handling operations accounted for 6.8 per cent of the BOD_5 and for 99.0 per cent of the oil and grease discharged to the ocean. The majority of the curde oil production and petroleum refining along the West African coast occurs in Zone IV. The distribution of pollution discharges from other industrial sectors was similar to that observed in the other four zones except that activity in Zone IV was generally on a much larger scale. For example, pulp and paper manufacturing occurs in other zones, but on such a relatively small scale that pollution discharges were an insignificant part of the total; whereas, in Zone IV the estimated mass of pollution contributed (SS) by the pulp and paper industry was larger than the total mass of SS discharged from Zone V.

Estimated mass discharges of pollutants from industries located on the coast of Zone V are summarized in Table 8. The estimated discharges to the ocean from Zone V were the lowest of any of the five regions. Beer

production accounts for 45 per cent of the BOD_5 discharged in the Zone. Petroleum refining and handling contributed over 17 per cent of the BOD_5 discharged. Wood products (10%), edible oils (8%), and textiles (7%) were the other large contributors to the total mass of BOD_5 discharged. Approximately 98 per cent of the oil and grease discharged in the Zone results from petroleum refining and handling. Suspended solids discharges came principally from petroleum (18%), beer (31%), and textiles (27%).

A comparison of the pollution loads for the five zones shows that Zone IV was discharging by far more pollution than any of the other four zones. Of the total pollution discharged to the ocean from the eighteen countries of the region, it was estimated that 43 per cent of the BOD_5, 36 per cent of the SS, 83 per cent of the oil and grease, and 60 per cent of the COD were discharged from Zone IV. Zones I and III contributed almost equally the majority of the remaining pollution load except in the case of suspended solids where Zone III discharged 38 per cent of the total discharged in the region. This large percentage of the SS was principally attributable to phosphate mining operations. Zones II and V discharged only a minor proportion of the pollution to the ocean in the region.

Table 6

Estimated mass of pollutants discharged to the ocean by Industrial Sectors in Zone III of the West African region

Country and Projection Method	Mass Discharged, tons/year										Reference
	BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus	
Petroleum refining and handling	537.0	341.2	204.5	1,496.3	111.4	2.6	6.8				
Edible oils	1,828.6	1,599.0	1,143.0	4,575.6							
Beer	2,007.4	930.9		2,204.2							
Soft drinks	241.6	332.1		605.9							
Alcohol and wine bottling	187.2	257.4		469.6							
Soap and detergent	93.6	159.5	11.2	234.0							
Textiles	684.5	1,752.2		8,519.2		12.1	12.1				
Paint	0.5	0.9		1.5							
Flour	57.7	51.3		144.7							
Dairy products	189.0	283.5		483.0							
Fruits and vegetables	82.1	101.3		204.8							
Meat	1.4	2.2	0.7	3.4							
Fertilizer		23,525.9	0.9		6.3			2,330.8		7,063.0	
Asphalt	27.8	22.4	9.1	164.1	16.2	0.2	0.5				
Steel		14.4	4.4		36.6	0.6			9.0		
Aluminum		1,874.4						1,250.2			
Metal plating and coating		44.6					0.6	1.1		2.2	
Cement	1,355.0			3,400.3							
Coffee	1,875.0	150.0		4,686.0							
Cocoa products	329.7	288.3	207.0	824.9							
Wood products (plywood, veneers, lumber)	13.2			33.2		2.6					
Total	9,511.3	31,731.5	1,585.8	28,050.7	170.5	18.1	20.0	3,582.1	9.0	7,065.2	

Table 7

Estimated mass of pollutants discharged to the ocean by Industrial Sectors in Zone IV of the West African region

Country and Projection Method	Mass Discharged, tons/year										Reference
	BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus	
Petroleum refining and handling	1,386.0	712.0	59,528.4	3,850.0	286.2	6.6	17.6				
Edible oils	698.0	610.4	438.2	1,745.6							
Beer	5,371.3	2,490.8		5,897.9							
Soft drinks	726.8	998.9		1,822.0							
Soap and detergent	276.8	471.9	33.0	691.9							
Textiles	6,428.6	16,426.1		79,864.7	0.1	113.2	113.2				
Paint	236.4	355.6		592.0							
Dairy products	0.2	0.3		0.6							
Wood products (plywood, veneers, lumber)	96.5	20.4		242.0		108.3					
Pulp and paper	1,179.0	2,526.0		2,949.0							
Alcohol and blending of spirits	0.1	0.1		0.2							
Tubes and tires		1.7	0.4								
Steel and fabrication		2.3					0.1	0.1		0.1	
Matches	No data										
Glass	No data										
Fruits and vegetables	25.7	31.7		64.1							
Aluminum		500.0						333.5			
Blankets and linen	No data										
Rubber	4.5	7.3	1.9	91.3							
Shoes	No data										
Batteries	9.4	2,340.0		23.4		93.6 (Pb)	93.6 (Cd)				
Fishing		1,921.0	102.0								

Table 7 (cont'd.)

Estimated mass of pollutants discharged to the ocean by Industrial Sectors in Zone IV of the West African region

Country and Projection Method	Mass Discharged, tons/year										Reference
	BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus	
Flour	60.0	60.0		150.0							
Sugar	158.1	33.1		394.7							
Canned meat	0.8	1.3	0.4	2.0							
Cement	3,791.4			9,514.0							
Total	20,449.6	29,510.9	60,104.3	107,895.4	286.3	228.1 93.6(Pb)	130.8 93.6(Cd)	333.6		0.1	

Table 8

Estimated mass of pollutants discharged to the ocean by Industrial Sectors in Zone V of the West African region

Country and Projection Method	Mass Discharged, tons/year										Reference
	BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorus	
Petroleum refining and handling	342.1	238.0	4,948.6	1,165.3	61.1	1.8	4.8				
Edible oils	164.1	143.5	103.0	410.6							
Beer	900.7	417.7		989.0							
Soft drinks	56.7	77.9		141.8							
Soap and detergent	5.9	10.1	0.7	14.7							
Fish and shrimp	No data										
Sugar	77.4	16.2		193.4							
Textiles	144.7	369.8		1,797.8		2.6	2.6				
Explosives	No data										
Paint	0.1	0.1		0.1							
Flour	96.6	85.7		242.1							
Dairy products	No data										
Wood products (plywood, veneers, lumber)	198.4			496.1		2.1					
Pulp and paper	No data										
Cement	No data										
Tubes and tires		0.1	0.1								
Steel		1.0	0.3		2.4	0.1			0.5		
Total	1,986.6	1,359.9	5,052.6	5,450.8	63.5	6.5	7.4		0.5		

COMPARISON OF MUNICIPAL AND INDUSTRIAL WASTE DISCHARGES

Table 9 shows a comparison of the potential mass of BOD_5 and SS discharged to the ocean by the population of the major coastal cities and industries. The BOD_5 estimate was based upon a per capita discharge of 64 grammes per day, and 91 grammes per capita per day was used to estimate the SS discharged by the population of the coastal cities. The estimated industrial pollution discharged to the ocean for each country was taken from Tables B-1 through B-18.

Only in Zone I and IV did the percentage of the BOD_5 discharged by industry exceed 12 per cent of the municipal discharge. Both Zones I and IV are much more industrialized than the other zones. The precentage of SS discharged by industry was approximately the same as that observed for the BOD_5 with the exception being Zone III where large phosphate washing operations were located. The phosphate washing operations resulted in an exceptionally large discharge of SS.

In industrialized nations the discharge of BOD_5 and SS usually exceeds 50 per cent of the municipal waste water discharges and in many locations can exceed the municipal discharges. Only Zones I and IV were approaching full industrialization, and in these two zones most of the industrial activity was concentrated in Senegal and Niger . Of the five zones, number IV is in need of immediate planning and implementation of pollution control programmes. Other areas of concentrated activity on the coast also need immediate attention, but the greatest potential for a serious problem to develop on a large scale exists in Zone IV.

Table 9

Comparison of estimated pollution discharged to the ocean by the population of the major coastal cities and industries in the West African region

Zone	Country and Major Coastal Cities	1980 Estimated Population1/ (1,000's)	Estimated Pollution Discharged by Population		Estimated Industrial Pollution Discharged	
			BOD_5 tons/yr	SS tons/yr	BOD_5 tons/yr	SS tons/yr
I	SENEGAL	5,585			11,201	14,950
	Saint Louis	97	2,266	3,222		
	Dakar	879	20,533	29,200		
	Ziguinchor	80	1,869	2,658		
	Thiés	129	3,013	4,285		
	GAMBIA	591			310	438
	Banjul	45	1,051	1,495		
	GUINEA BISSAU	1,006			622	557
	Bissau	100	2,336	3,322		
	ZONE TOTAL		31,068	44,182	12,133	15,945
	PERCENT INDUSTRIAL				39	36
II	GUINEA	4,983			427	370
	Boffa	134	3,130	4,451		
	Conakry	530	12,381	17,607		
	Forécariah	146	3,411	4,850		
	SIERRA LEONE	3,421			1,677	1,179
	Freetown	316	7,382	10,498		
	LIBERIA	1,766			1,083	1,048
	Monrovia	221	5,163	7,342		
	ZONE TOTAL		31,467	44,748	3,187	2,597
	PERCENT INDUSTRIAL				10	6
III	IVORY COAST	7,548			5,216	3,507
	Abidjan	1,573	36,745	52,255		
	GHANA	11,473			1,414	3,669
	Accra-Tema Area	965	22,542	32,057		
	Takoradi-Sekondi	210	4,906	6,976		
	Cape Coast	68	1,588	2,259		
	TOGO	2,548			1,708	23,899
	Lomé	249	5,817	8,272		
	BENIN	3,558			1,174	657
	Porto-Novo	119	2,780	3,953		
	Cotonou	203	4,742	6,744		
	ZONE TOTAL		70,120	112,516	9,512	31,732
	PERCENT INDUSTRIAL				12	28

Table 9 (cont'd.)

Zone	Country and Major Coastal Cities	1980 Estimated Population[1] (1,000's)	Estimated Pollution Discharged by Population		Estimated Industrial Pollution Discharged	
			BOD_5 tons/yr	SS tons/yr	BOD_5 tons/yr	SS tons/yr
IV	NIGERIA	82,800			17,328	24,311
	Lagos	4,100	95,776	136,202		
	Port Harcourt	276	6,447	9,169		
	CAMEROON	8,355			2,187	4,800
	Douala	532	12,427	17,673		
	Victoria	34	794	1,129		
	EQUATORIAL GUINEA	298				
	Malabo	37	864	1,229		
	Bata	27	630	897		
	SAO TOME AND PRINCIPE	80	1,869	2,657	38	18
	GABON	1,300			897	381
	Libreville	251	5,863	8,338		
	Port-Gentil	78	1,822	2,591		
	ZONE TOTAL		126,492	179,885	20,450	29,511
	PERCENT INDUSTRIAL				16	16
V	CONGO	1,548			1,085	606
	Pointe-Noire	164	3,831	5,448		
	ZAIRE	28,188			452	257
	None					
	ANGOLA	7,067			449	497
	Luanda	602	14,063	19,998		
	Lobito	74	1,729	2,458		
	Benguela	51	1,191	1,694		
	ZONE TOTAL		20,814	29,598	1,986	1,360
	PERCENT INDUSTRIAL				10	5
	REGION TOTAL		288,961	410,929	47,269	81,145
	PERCENT TOTAL				16	20

1/ Africa South of the Sahara, 1979-80. Europa Publications Limited, 18 Bedford Square London.

STATE OF THE ENVIRONMENT

During the visits to the West African region (1980), industrial development was relatively limited and pollution discharges from the industries were creating little impact on the environment except in isolated cases. A significant change in the impact on the enviornment will likely occur in the future because of the concerted efforts being made toward expanding industry in the region. The lack of a significant pollution problem in most countries of the region at this time allows government and industry to begin a planning process that will allow them to avoid creating an environmental problem. Avoiding environmental problems is far less expensive than trying to correct problems after they develop.

Oil discharges which accumulate on the beaches was the major problem mentioned by the local citizens and observed by the consultants. Boat owners also mentioned the coating of the sides of boats with oil. Two sources of oil were identified by the individuals interviewed and through observations. The first source of oil discharges was credited to petroleum loading terminals, oil exploration activities and oil tankers cleaning bilges near shore after unloading at oil refineries. Tankers transporting petroleum from the Middle East were also thought to contribute. The second source of oil likely resulted from the discharge of used automobile crankcase oil into the drainage canals and sewers of the cities located along the coast. Many service stations apparently do not have oil traps to capture the crankcase oil prior to discharging water to the ocean. This discharge would have a significant impact on the streams, estuaries, and ocean near the cities of the region. This oil problem could be solved relatively inexpensively by requiring that the garages construct oil traps.

Floating logs from lumbering operations were a navigation hazard and accumulated on certain beaches. In certain areas of the region, large quantities of oil, brewery, tannery, non-carbonated beverage, textile and food processing wastes were being discharged, but the concentration had not reached a level that caused a nuisance. What impact these contaminants may be having on the health of the people remains unassessed, but in many areas of the region drinking water was obtained from streams receiving industrial and human wastes. Clothes were also washed in these streams.

In most of the countries of the region, visual observation of the rivers, estuaries, and streams indicated that the major types of materials discharged were the result of human activity and not industrial. However, there were exceptions and efforts should also be directed toward solving localized industrial problems.

The immediate needs in most areas were solutions to the human pollution problems. It is strongly recommended that planning begin and a long-range plan be implemented to avoid the creation of industrial pollution problems. It is essential that planning be implemented immediately for the entire region to avoid costly rehabilitation efforts.

INDUSTRIAL WASTE TREATMENT AND DISPOSAL PRACTICES

Waste treatment in the countries of the West African region was essentially non-existent. Only an occasional sedimentation basin, grease trap or intermittent sand filter was observed by the consultants as they visited industries in the eighteen countries of the region. The role of waste water treatment in pollution control is discussed in Appendix D.

API separators were observed at most of the petroleum handling and refining facilities, but this device is considered an integral part of most petroleum operations and is generally not considered to be waste water treatment as such. The installation of an API separator makes a significant difference in the quantity of oil that would be discharged to the environment and results in considerable financial savings as well because the recovered oil is recycled through the operation.

The majority of the industries in the West African region were producing waste products that are amenable to biological treatment. Planning of waste water treatment facilities for the industries should be co-ordinated with the efforts made for the various municipal waste water treatment systems. It is likely that a combined treatment facility would be far more economical for all people involved. If new industries that produce wastes not amenable to biological treatment are attracted to the area, then some form of pretreatment could be required before the industry could discharge into the municipal system.

EDUCATION NEEDS

It was not obvious from the visits to the countries that the appropriate public officials were sensitive to potential environmental problems due to pollution. In addition only an extremely limited number of people receive an education in the area of pollution control and environmental protection. In order to protect the paradise that currently exists in most areas of the region, it is essential that people be trained in the areas of environmental engineering and sciences to develop programmes that will allow expansion of industry while protecting the environment.

The development of the tourist industry has a high priority in the governments of many of the countries of the region, and if this industry is to develop to its maximum potential, it is essential that the industrialization of the countries be co-ordinated with environmental protection activities. The survival of the tourist industry is integrally linked with the protection of the environment.

Local universities and technical programmes should be encouraged to begin a long-range plan to produce the professionals and technicians required to protect the environment of the West African region. Adequate planning at this stage will ensure that the environment is not degraded beyond repair. Ministry personnel knowledgeable in the control of pollutional discharges and the protection of the environment were not encountered in most of the countries visited. It is imperative that individuals become knowledgeable and begin to consider the protection of the entire environment when expansion is considered.

PROJECTED INDUSTRIAL DEVELOPMENT

A summary of the projected industrial development for thirteen of the eighteen countries visited is presented in Table 10. The production rates were frequently unknown or unavailable, and five of the countries did not report information about future development. All eighteen countries were anticipating extensive industrial development within the next ten years even though information about specific plans was not available.

As shown in Table 10, many large industries are planned in the coastal area of the West African region. Because of the extensive natural resources in the region, it is very likely that rapid development will occur in most countries of the region. Unfortunately, inadequate data were available to make estimates of the likely increase in the discharge of industrial pollution to the ocean, but the information provided shows that a significant increase in the discharge of industrial pollution is likely to occur within the next five to ten years. Where localized pollution problems currently exist, the problems will be compounded as new development occurs unless development is co-ordinated with an environmental protection plan. Industrial developments will also catalyze increase in human settlements, thereby exacerbating the pollution problems caused by domestic sources which according to the survey are already the major sources of pollution loads discharged into the marine environment.

Table 10

Projected industrial establishments in the west African region

Country	Location	Company	Products	Estimated Production Rate	Estimated No. of Employees	Estimated Year of Completion
Senegal	Dakar	SIES	Phosphoric acid Fertilizer	300 tons/day 300 tons/day		
Senegal	Casamance		Oil extraction			
Senegal		SAR	Petroleum refinery			
Senegal	Kadac	SOTEXKA	Cotton textiles	2,000 tons/year		
Senegal			Starch and glucose from manioca			
Senegal			Sugar and alcohol			
Senegal	Cap Vert	ICOTAF	Textiles		127	before 1983
Senegal	Cap Vert	SIPL	Dairy products		55	before 1983
Senegal	Cap Vert	SONACOS	Edible oil		30	before 1983
Senegal	Casamance		Fruit juice		34	before 1983
Senegal	Casamance	AMERGER	Fish		126	before 1983
Senegal	Cap Vert	AGROCAP	Food		76	before 1983
Senegal	Casamance		Dairy products			before 1983
Senegal	Cap Vert	SOSACHIM	Chemicals		21	before 1983
Senegal	Cap Vert	PINSER	Paints		10	before 1983
Gambia		FMC	Fish			
Gambia			Sugar*			
Gambia			Oil refinery*			
Guinea-Bissau	Bissau	SEMEPESCA	Fish	twice the present production		
Guinea-Bissau			Fish meal			
Guinea-Bissau	Northern zone		Sugar refinery	10,000 tons/year		
Guinea-Bissau			Textiles*			
Guinea-Bissau			Leather*			

Table 10 (cont'd.)

Country	Location	Company	Products	Estimated Production Rate	Estimated No. of Employees	Estimated Year of Completion
Guinea-Bissau	South-eastern zone		Bauxite* and aluminum oxide extraction			
Guinea-Bissau			Pulp paper*			
Guinea-Bissau			Petroleum* extraction and refinery			
Guinea-Bissau			Phosphates* and fertilizers			
Guinea	Conakry	SAPROCIMENT	Cement	250,000 tons/year		
Guinea	Conakry	Pilot centre	Electromechanical workshop			
Guinea	Conakry		Footwear*	440,000 pieces/year		
Guinea	Conakry		Fertilizers*	100,000 tons/year		
Guinea			Batteries*			
Guinea			Paper pulp*			
Guinea			Fish canning*			
Guinea			Steel*	18,000 tons/year		
			Shapes*	3,000 tons/year		
Guinea			Milk*	140,000 tons/year		
Guinea			Caustic soda*	55,000 tons/year		
			Table salt*	40,000 tons/year		
			Coarse salt*	25,000 tons/year		
Guinea			Wheat flour*	57,300 tons/year		
Guinea			Soap*	15 tons/day		
Guinea			Petroleum refinery*	20,000 bbl/day		within 1985-1990

Table 10 (cont'd.)

Country	Location	Company	Products	Estimated Production Rate	Estimated No. of Employees	Estimated Year of Completion
Guinea			Lubricants*	12,000 tons/ year		
Sierra Leone	Freetown		Slaughterhouse			
Sierra Leone	Makeni		Slaughterhouse			
Sierra Leone		Integrated Fish Meal Ind. Ltd.	Fish meal			
Sierra Leone		SLPMB	Edible oil refinery			
Ivory Coast		SIR	Petroleum refinery	4 million tons/year		
Togo	Kpémé		Phosphoric acid	1 mill tons/yr. of phosphate mineral		
Togo	Lama-Kara	TOGOTEX	Textiles			
Togo	Lama-Kara	Brasserie du Benin	Beer			
Benin	Seme		Petroleum refinery	600,000 tons/ year		
Benin			Mixing and packaging of fertilizers			
Cameroon	Cap Limboh	SONARA	Petroleum refinery	2 million tons/year		1981
Cameroon	Edea	CELLUCAM	Paper pulp	130,000 tons/ year		end of 1980
Gabon	Kango	SOGACEL	Paper pulp	700 tons/day		1982
Congo	Pointe-Noire		Paper pulp			1985
Zaire			Phosphate*			
Zaire			Aluminum*			
Zaire			Fertilizers*			
Zaire			Calcium carbide*			

Table 10 (cont'd.)

Country	Location	Company	Products	Estimated Production Rate	Estimated No. of Employees	Estimated Year of Completion
Zaire			Specialized steel*			
Angola	Zaire region		Fertilizers*			
Angola	Luanda + Soyo		Ammonia* Urea Methanol			

* Feasibility study.

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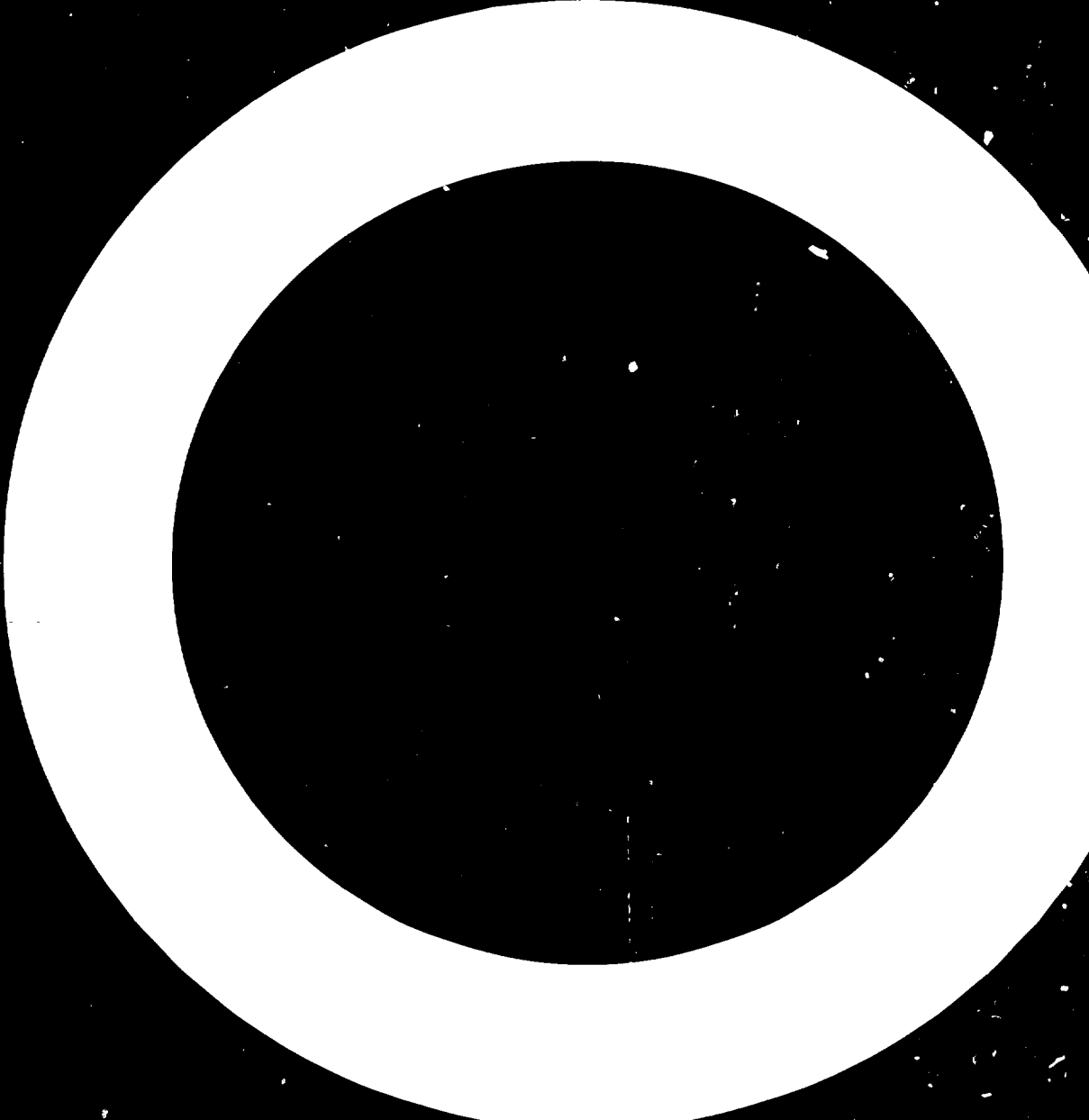

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SURVEY QUESTIONNAIRE ON INDUSTRIAL WASTES DISCHARGED DIRECTLY OR INDIRECTLY* INTO COASTAL WATERS

UNIDO project carried out in co-operation
with the
UNEP Regional Seas Programme

SURVEY OF MARINE POLLUTANTS FROM INDUSTRIAL SOURCES IN THE WEST AFRICAN REGION

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* An indirect discharge is understood to mean a discharge into a river or stream located not more than 20 km from the coast.

1. Industry identification

1.1 Country: .....

1.2 Province, district: .....

1.3 Place where industrial wastes are disposed of: .....

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1.4 Description of general setting where industry is located: .

.....

.....

1.5 Name of industry and address: .....

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2. Classification of industry (check appropriate classification or identify otherwise here): .....

.....

1110	Agriculture and livestock	( )
1110	Feedlot	( )
2110	Coal mining and preparation	( )
2200	Oil mining	( )
2302	Mineral mining	( )
2901	Store quarrying, clay and sand pits	( )
3111	Meat packing	( )
3112	Cannery	( )
3114	Fish	( )
3117	Bakery	( )
3118	Beet sugar	( )
3119	Cane sugar	( )
3121	Coffee	( )
3121	Pickle	( )
3121	Rice	( )

3131-3133	Brewery, distillery, pharmaceutical and winery	( )
3134	Soft drink	( )
3211	Textile	( )
3231	Tannery	( )
3311	Plywood glue plant	( )
3320	Wood furniture	( )
3411	Pulp and paper	( )
3412	Building paper	( )
3420	Printing	( )
3511	Acid	( )
3511	Explosives	( )
3511	Formaldehyde	( )
3511	Naval stores	( )
3511	Other inorganic chemicals	( )
3511	Phosphates	( )
3511	Radioactive waste from fission and fusion products and laboratories	( )
3511	Wood preservation	( )
3512	Fertilizer	( )
3512	Pesticide	( )
3513	Plastic and resins	( )
3521	Paints	( )
3523	Animal glue	( )
3523	Soap and detergent	( )
3529	Candle making	( )
3529	Cornstarch	( )
3529	Photographic wastes	( )
3530	Oil refinery	( )
3540	Coke mill	( )

3540	Fuel oil	( )
3540	Petrochemicals	( )
3551	Rubber	( )
3620	Glass	( )
3692	Cement	( )
3699	Asbestos	( )
3710	Steel mill	( )
3720	Iron foundry	( )
3720	Other metal working	( )
3819	Metal plating	( )
3821	Motor industry	( )
4103	Steam power	( )
4200	Water treatment	( )
9520	Laundry	( )

3. Production of goods

3.1 Type of product

For each type of product, indicate production units/year[1/]

Type of product	Max.	Min.	Average	Year
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....

1/ i.e.: tons/year, cases/year, square meters/year etc.

3.2 Raw materials

For each raw material, indicate the quantities/year

Name of raw material	Max.	Min.	Average	Year
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....

3.3 Type of employees in plant

Description	Max.	Min.	Average	Year
Workers	.....	.....	.....	.....
Staff	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....

3.4 Indicate the number of daily shifts of 8 hours duration

1 ( ) 2 ( ) 3 ( )

3.5 Percentage of local community employed at plant(s): .....

.....

4. Industrial uses of water

4.1 The water used in the plant is taken from:

Well(s) of the industry ..... ( )

Municipal supply ..... ( )

Surface waters ..... ( )

Other (specify) ..... ( )

4.2 The inlet water is used for:

Process	..... m^3/d	average
Cooling	..... m^3/d	"
Boiler	..... m^3/d	"
Sanitary sewage	..... m^3/d	"
Other (specify)	..... m^3/d	"
TOTAL daily consumption of water	..... m^3/d	average

4.3 Give a summary description of the main processes involving the use of water

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5. Industrial wastewater collection

5.1 Type of industrial wastewater collection

- Combined for all effluents ..... ( )

- Separate for process water, domestic water and rain run-off ..... ( )

- Other (specify) ..... ( )

5.2 Waste water outfalls

- One general outfall ..... ( )

- More than one outfall ..... ( )

In case of many outfalls specify, if possible, the nature of the process waters and the total daily quantity for each outfall.

- Outfall No. 1 .....

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.....;..... m^3/day

- Outfall No. 2 .....

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.....;..... m^3/day

- Outfall No. 3 .....

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.....;..... m^3/day

- Outfall No. 4 .....

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.....;.....m^3/day

- Outfall No. 5 .....

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.....;..... m^3/day

6. Industrial wastewater treatment

	Treated		Untreated		Year
	m^3/year	%	m^3/year	%	
6.1 Total industrial wastewater m^3/year					
6.1.1 Estimated part discharged in a municipal system					
6.1.2 Estimated part discharged by industry directly into receiving waters					
6.1.3 Estimated part re-used or recirculated					

6.2 Industrial wastewater treatment

Type of wastewater	Total discharged quantity m^3/year	Quantity discharged in a community system				Quantity discharged directly into receiving waters				Type of treatment 2/	
		Treated		Untreated		Treated		Untreated		Treated wastewaters into municipal sewers	Treated wastew directly into receiving wate
		m^3/y	%	m^3/y	%	m^3/y	%	m^3/y	%		
Process											
Cooling											
Boiler											
Domestic sewage											
..... (other)											
TOTAL											

2/ Type of treatment abbreviations:

P : Process technical measure (re-use, recycling, separation of waters, evaporation, etc.)
G : Preliminary (screening, grit removal, flotation)
H : Primary sedimentation
C : Chemical treatment (chemical oxidation or reduction, acid-alkaline neutralization, precipitation, coagulation and sedimentation, etc.)
S : Secondary (sand filters, trickling filters, activated sludge, oxidation ponds, etc.)
T : Tertiary (absorption, electrodialysis, ionic exchange, etc.)
A : Any other (specify)

Use a combination of letters where more than one type of treatment is being applied.

6.3 Summary description of type of final treatment before discharge

Process technical measures (re-use, recycling, separation, etc.) ...

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Preliminary: .....

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..... Removal efficiency .....

Primary: .....

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.....Removal efficiency .....

Secondary: .....

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..... Removal efficiency .....

Tertiary: .....

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..... Removal efficiency .....

Chemical treatment: .....

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..... Removal efficiency .....

Any other: .....

.....

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..... Removal efficiency .....

6.4 Estimated operating and maintenance costs (inclusive of chemicals, electricity, spare parts and labour) .....$/m^3

TOTAL operating costs .....$/year

6.5 Capital cost of treatment plant

7. Wastewater

7.1 Are data on the characteristics of the wastewater available or possible to be estimated?

Data available ( )

Data possible to be estimated with, presumably, reasonable accuracy ( )

Data impossible or unlikely to be estimated with reasonable accuracy ( )

7.2 If data are available or possible to be estimated, report the characteristics of the final effluent for each process or mixed water outfall. (Year of survey .....)

	OUTFALL No.	1				2				3				4				5			
		max	min	avg	analysis or estimation	max	min	avg	analysis or estimation	max	min	avg	analysis or estimation	max	min	avg	analyis or estimation	max	min	avg	analysis or est.
7.2.1	Volume (m^3/day)	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
7.2.2	POLLUTANTS																				
7.2.2.1	General																				
	- Temperature ^oC	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
	- Colour	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
	- Odour	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
	- pH	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
7.2.2.2	Solids																				
	- Settleable solids(ml/l)	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
	- Total suspended solids (TSS, mg/l)	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
	- Volatile suspended solids (VSS, mg/l)	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
7.2.2.3	Organic matter																				
	- BOD_5 mg/l	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
	- COD mg/l	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
	- TOC mg/l	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
	- others (specify)	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
		...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....
		...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....	...	...	...	.....

OUTFALL No.	1				2				3				4				5			
	max	min	avg	analysis or estimation	max	min	avg	analysis or estimation	max	min	avg	analysis or estimation	max	min	avg	analyis or estimation	max	min	avg	analysi or est.
7.2.2.4 Heavy metals																				
- Iron (Fe, mg/l)																				
- Manganese (Mn, mg/l)																				
- Arsenic (As, mg/l)																				
- Mercury (Hg, mg/l)																				
- Lead (Pb, mg/l)																				
- Cadmium (Cd, mg/l)																				
- Copper (Cu, mg/l)																				
- Chromium^{6+} (Cr, mg/l)																				
- Chromium^{3+} (Cr, mg/l)																				
- Nickel (Ni, mg/l)																				
- Zinc (Zn, mg/l)																				
- others (specify)																				

OUTFALL No.	1				2				3				4				5			
	max	min	avg	analysis or estimation	max	min	avg	analysis or estimation	max	min	avg	analysis or estimation	max	min	avg	analyis or estimation	max	min	avg	analysi or est.
7.2.2.5 Specific organic pollutants																				
- Mineral oils (hexane soluble) mg/l																				
- Methylene blue active substances (MBAS) mg/l																				
- Phenols (mg/l)																				
- Chlorinated organic compounds (specify) mg/l																				
- Polychlorinated biphenyls (PCB) mg/l																				
- others (specify)																				

OUTFALL No.	1				2				3				4				5			
	max	min	avg	analysis or estimation	max	min	avg	analysis or estimation	max	min	avg	analysis or estimation	max	min	avg	analyis or estimation	max	min	avg	analysi or est.
7.2.2.6 Nutrients																				
- Total phosphorous (mg/l)																				
- Total Kjeldahl nitrogen (mg/l)																				
- Nitrates (NO_3, mg/l)																				
- Nitrites (NO_2, mg/l)																				
- Ammonia (NH_4, mg/l)																				
- others (specify)																				
7.2.2.7 Bacteria																				
- Total coliform bacteria (MPN/100 ml)																				
- 6thers (specify)																				

7.2.3 Sampling frequency

7.2.4 Method of analysis

- Standard methods ..... ( )
- Other methods (specify) ..... ( )

7.3 With the above data, evaluate the total pollution load for each main pollutant (year of survey .....)

Pollutant	Average Concentration	Volume m^3/day	Pollution load kg/day	TOTAL POLLUTION LOAD 3/ Tons/year
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....

3/ The evaluation should be considered

accurate ( )

fairly good ( )

only general and indicative ( )

8. Location of discharges

in municipal system ..... ( )
in sea ..... ( )
in river ..... ( )
in lake ..... ( )
on land ..... ( )
other (specify)..... ( )

Year of survey.....

9. Use(s) of receiving waters

Drinking ..... ( )
Irrigation ..... ( )
Fishing ..... ( )
Swimming ..... ( )
Other (specify) ..... ( )

9.1 General observations on quality of receiving waters:

.....
.....
.....
.....

10. Water Pollution Control Agency (if any) having jurisdiction at point of discharge (other than municipal system): .....
.....

11. Nearest municipal system (if discharge is not already made into the municipal sewer system)

Distance in metres: .....

11.1 Type of sewage treatment (if any) at nearest sewage treatment plant (if discharge is not already made into the municipal sewer system): .....
.....

12. Solid wastes

		tons/year
12.1	Total annual industrial solid wastes (year.....)	.....
12.1.1	Estimated annual disposal of industrial solid wastes to a municipal or centralized system (year.....)	.....
12.1.2	Estimated annual disposal by industry's own means (year.....)	.....

12.2 Description of disposal method:		% of total waste
to municipal or centralized system	( )	.....
in sea	( )	.....
in lake	( )	.....
in river	( )	.....
on land	( )	.....
other (specify)	( )	.....

12.3 General character of solid wastes

Organic ..... ( )

Inorganic ..... ( )

12.4 Treatment of solid wastes by industry:

Storage ..... ( )

Compression ..... ( )

Recovery ..... ( )

Incineration ..... ( )

Other (specify) ..... ( )

13. Gaseous wastes

13.1 List major air contaminants produced: .....

.....

.....

.....

13.2 Treatments used (if any)

Filter ..... ( )

Electrostatic precipitation ....( )

Scrubbers ..... ( )

Others (specify) ..... ( )

13.3

Contaminants discharged	Unit/unit of time	year
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

13.4 Stack height above ground level: .....

UNIDO
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre
P.O. Box 300
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Industrial Wastes Questionnaire

1. Industry identification

   1.1 Name and address

   1.2 Geographical location where industrial wastes are disposed

2. Identify type of industry

3. Production of goods (list various types) | Amounts and Units of Production | Year

4. Number of employees (average)

5. Source of water:

6. Industrial uses of water (average values, m^3/d)

   Process ————————
   Cooling ————————
   Boiler ————————
   Sanitary Sewage ————————
   Total ————————————

7. Industrial wastewater collection

   Combined ( )
   Separate for process water, sewage, rain run off ( )
   Number of wastewater outfalls ————————

8. Total industrial wastewater, m^3/year ————————
   Amount receiving treatment ————————

9. Describe treatment processes before effluent discharge

10. Are data available on characteristics of the wastewater ?
    Summarize available data below

Pollutant	Ave. Conc.	Vol, m^3/day	Total Pollution Load, tons/year
BOD_5			
COD			
Temperature			
pH			
Suspended solids			
Metals (specify!)			
Specific organic pollutants			

11. To what body of water or sewer system are wastes discharged?

12. Uses of body of water receiving wastes

13. Distance in metres to sewer system

14. Amounts of solid waste, tons/ year

15. Disposal practice for solid wastes

	% total
Municipal system	_____
body of water	_____
land fill	_____
incineration	_____

Table B-1

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Senegal

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Dakar	CDS	Tunafish canning	8,534 tons/year		96,434	5,120							
Dakar	ADRIPECHE	Fish and shrimps	11,993 tons/year		425,769	102,424							
Dakar	SAPAL	Tunafish canning	6,994 tons/year		79,030	4,196							
Dakar	SURGEL	Fish and shrimps	3,162 tons/year		112,251	27,003							
Ziguinchor	AMERGER	Shrimps	1,190 tons/year		301,427	95,200							
Dakar	PROCOS	Fish and shrimps	2,618 tons/year		92,939	22,357							
Dakar	SPAC	Fish and shrimps	2,125 tons/year		75,437	18,147							
Ziguinchor	CRUSTAVIF	Shrimps	408 tons/year		103,366	32,640							
Dakar	SOSECHAL	Shrimps	1,020 tons/year		258,366	81,600							
Dakar	SOPESEA	Fish and shrimps	8,330 tons/year		293,715	71,138							
Dakar	SENEPESCA	Fish and shrimps	2,040 tons/year		72,420	17,421							
Dakar	SAFCOP	Fish	2,040 tons/year		23,052	1,224							
Dakar	SAPOA	Fish and shrimps	1,181 tons/year		41,943	10,090							
Dakar	SARDINAFRIC	Fish	1,836 tons/year		20,747	1,102							
Ziguinchor	PROPECSEN	Shrimps	170 tons/year		43,061	13,600							
Dakar	AFRICAZOTE	Fish meal	3,400 tons/year		38,420	2,040							
Dakar	COMAPECHE	Fish + fish meal											
Dakar	CDS	Fish meal	5,100 tons/year		57,630	3,060							
Dakar	LESIEUR	Raw edible oil Cake Refined edible oil	100,000 tons/year 125,000 tons/year 20,000 tons/year	2,230,000	1,950,000	1,400,000	5,580,000						

Table B-1 (cont'd.)

Principal industrial establishments and es.imated mass of pollutants discharged in the coastal area of Senegal

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Dakar	PETERSEN	Raw edible oil	50,000 tons/year	1,115,000	973,000	700,000	2,790,000						
		Cake	65,000 tons/year										
Ziguinchor	SEIC	Raw edible oil	36,000 tons/year	802,800	702,000	504,000	2,008,800						
		Palm kernels	1,920 tons/year										
Dakar	SAPROLAIT	Yogourt, milk, cheese, creme											
Dakar	SIPL	Condensed milk (with and without sugar)	16,000 tons/year	14,400	21,600		36,800						
Dakar	CODIPRAL	Condensed milk											
Dakar	SOBOA	Beer	30,000 tons/year	306,000	141,900		336,000						
		Carbonated beverages	30,000 tons/year	94,500	129,900		237,000						
Dakar	SIBRAS	Beer	3,500 tons/year	35,700	16,555		39,200						
		Carbonated beverages	16,500 tons/year	51,975	71,445		130,350						
Dakar	SEVEN UP	Soft drinks											
Dakar	SOCAS	Tomato paste	5,040 tons/year	25,855	31,903		64,512						
		Canned dry vegetables	320 tons/year	1,642	2,026		4,096						
Dakar	SIDCA	Green beans											
Dakar	BATA	Leather	200,000 m^2/year	5,334,000	6,660,000	1,000,000	13,000,000			134,000			
Dakar	BERAS	Leather + furs											
Richartou	CSS	Sugar cane	40,000 tons/year	205,200	253,200		512,000						
		Refined sugar	112,000 tons/year	574,560	708,960		1,433,600						
Dakar	CCV	Cotton thread	1,072 tons/year	24,334	62,176		302,304		428	428			

Table B-1 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Senegal

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Dakar	SOSEFIL	Sewing thread	352 tons/year	7,990	20,416		99,264		140	140			
Dakar	ICOTAF	Textiles	14.2 mill. m/year[1/] (14.2 mill. m^2/year)	48,351	123,540		600,660		852	852			
		Bedspreads	100,000 pieces/year	2,270	5,800		28,200		40	40			
Dakar	SOTIBA-SIMPAFRIC	Textiles	40 mill. m/year[1/] (40 mill. m^2/year)	136,200	348,000		1,692,000		2,400	2,400			
		Thread	480 tons/year	10,896	27,840		135,360		192	192			
Dakar	SAR	Petroleum refinery	900,000 tons/year	113,400	72,000	43,200	315,000	23,400	540	1,440			
Dakar	CSL	Lubricants	18,900 tons/year	2,722	2,192	888	16,065	1,587	17	45			
Dakar	SIES	Fertilizers	114,600 tons/year		381,618						38,162		114,600
		Aluminum sulfate	2,000 tons/year										
Dakar	SSEPC	Animal feed	5,000 tons/year										
		Pesticides	1,690 tons/year										
		Propellants	84,650 tons/year										
Dakar	NSOA	Toilet soap	27,000 tons/year	61,290	104,490	7,290	153,090						
Dakar	SAF	Soap Candles											
Dakar	SAD	Soap powder	1,373 tons/year	92	92	92	453						
		Liquid detergents	343 tons/year	23	23	23	113						
Dakar	SPS	Soap											
Dakar	VALDAFRIQUE	Tablets	5,541,000 boxes/year										
		Liniments, salves	477,000 tubes/year										
		Alcohol	268,000 flasks/year										
		Pesticides	800,000 spray cans/year										

1/ Production reported in linear meters of material. Width of cloth varies but is approximately 1 m.

Table B-1 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Senegal

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Dakar	SIPOA	Tablets Bottles	130 mill./year										
Dakar	SABC	Laquers	56 tons/year	7	11		18						
		Solvents	164 tons/year	21	33		54						
		Putty	61 tons/year	8	12		20						
		Coating materials	103 tons/year	13	21		34						
		Water based paints	1,048 tons/year	136	210		345						
		Other paints	959 tons/year	125	191		316						
Dakar	La Seigneurie Afrique	Laquers, paints and solvents	1,593 tons/year	207	319		526						
Dakar	COLAS	Asphalt emulsion	4,800 tons/year	691	557	226	4,080	403	4	8			
Dakar	NEMAS	Enamelled items	2,484 tons/year	323	497		820						
Dakar	SENEPLAST	Plastic items											
Dakar	SIAP	Plastic shoes											
Dakar	PES	Polyurethane foam	553 tons/year										
Dakar	SIMPA	Plastic shoes	1.6 mill. pairs/year										
		Plastic bags	1,760 tons/year										
		Plastic pipes	128 tons/year										
		Estruded items	288 tons/year										
Dakar	CCIS	Granuled PVC Pipes	800 tons/year										
Dakar	ENSEME	Plastic foam items	136 tons/year										

Table B-1 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Senegal

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Dakar	VILBOIS	Cast iron	190 tons/year		46	14		116	2			30	
		Bronze	6 tons/year		2			4				1	
		Aluminum											
		Zinc											
Dakar	AFD	Cast iron, bronze alloys											
Dakar	SAFAL	Aluminum foundry	112 tons/year		1,120						747		
Dakar	TREFILERIE DE DAKAR	Wire	1,600 tons/year										
		Iron rods	80 tons/year										
		Trellis work	720 tons/year										
		Nails + nail products	800 tons/year										
		Springs	80 tons/year										
		Rods	160,000 tons/year										
Dakar	FUMCA	Metallic rods	96,000 pieces/year										
		Kegs	152,000 pieces/year										
		Cans	1,360,000 pieces/year										
Dakar	ELMAF	Cans, metal packages											
Dakar	SACOME	Metal shapes	1,056 tons/year										
Dakar	SODACOM	Metallic constructions											
Dakar	VIRMAUD	Metallic constructions											
Dakar	SAPONIGRO	Polishing and galvanizing of metals											

Table B-1 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Senegal

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Dakar	LEGAVRE	Metal windows	283 tons/year										
Dakar	Other industries												
TOTAL				11,200,731	14,949,722	4,164,095	29,520,480	25,510	4,615	139,545	38,909	31	114,600

Table B-2

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Gambia

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Banjul	Gambia Produce Marketing Board	Ground-nut oil Cake	13,000 tons/year 15,000 tons/year	289,900	253,500	182,000	725,400						
Banjul	Seagull Coldstores	Frozen fish	4,800 tons/year		170,400	40,992							
Banjul	Gambia Port Authority Dockyard	Boat building Ship repairing											
Banjul	Gambia Port Authority Sea Port	Ship loading and unloading operations											
Banjul	Jul Brew	Beer Soft drinks	1,500,000 l/year 1,500,000 l/year	15,300 4,725	7,095 6,495		16,800 11,850						
TOTAL				309,925	437,490	222,992	754,050						

Table B-3

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Guinea-Bissau

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Bissau	CICER, Companhia Industrial de Cervejas e Refrigerantes	Beer	6 mill. l/year	61,200	28,380		67,200						
		Soft drinks	1 mill. l/year	3,150	4,330		7,900						
Port de Bissau	SEMAPESCA	Fish	810 tons/year		9,153	486							
		Shrimps	90 tons/year		22,797	7,200							
	BLUFO	Dairy products	24,000 l/day	5,616	8,424		14,352						
Cumeré	Complexo Agro-Industrial de Cumeré	Peanut oil	24,500 tons/day	546,350	477,750	343,000	1,367,100						
		Peanuts roasted	45,500 tons/day										
		Rice	3,000 tons/year	2,790	1,590		6,990						
		Soap	1,000 tons/year	2,270	3,870	270	5,670						
	Slaughterhouse	Meat	2 tons/day	582	968	291	1,456						
TOTAL				621,958	557,262	351,247	1,470,668						

Table B-4

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Guinea

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Conakry	ENTA, Enterprise Nationale de Tabacs et Allumettes	Cigarettes	72,000 cartons/year										
		Matches	120,000 cartons/year										
Boffa	SUCRERIE KOBA	Sugar	12,000 tons/year	68,760	14,400		171,600						
		Alcohol	82,500 l/year	400			1,000						
Conakry	SOBRAGUI Société de Brasserie de Guinée	Beer	60,000 l/year	612	2,129		5,040						
		Soft drinks	20,000 l/year	63	87		158						
	FRUITAGUINEE	Fruit juices	396 m^3/year	2,031	2,507		5,069						
		Syrup	500 l/hour	5,335	6,583		13,312						
	SIPA, Société Industrielle de Pâtes Alimentaires	Flour	20 tons/day	3,692	3,276		9,256						
Ile de Kassa	Huilerie de Kassa	Edible oil	15,000 tons/day	334,500	292,500	210,000	837,000						
Conakry	IGAT, Industrie Guinéenne d'Articles de Toilette	Toilet items	16,000 l/year										
	SIPECO, Société Industrielle de Peintures de Conakry	Paint	100 tons/month	312	480		792						
	SOFAB, Société de Fabrication de Bougies	Candles	200 cartons/day										
		Shoe wax	2,000 units/day										
		Wax	30 tons/year										
	SOGUIPLAST Fabrication de Plastiques	Plastic products	30,000 units/year										

Table B-4 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Guinea

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Conakry	SOGUIREP, Rechapage de Pneus	Recaping tires	20,000 units/year (200 tons/year)		86	22							
Conakry	Complexe Textile de Sanoyah	Bleaching and Printing Textiles	3 mill. meters/year (450 tons/year)	10,215	26,100		126,900						
Conakry	Briqueterie de Kebaya	Bricks	50,000 bricks/day										
Conakry	Ceramique de Matoto												
Conakry	Meubles Sonfonia	Furniture	45,000 units/year										
Conakry	C Metallique	Metal products	4,800 tons/year		1,150	350			50				
Conakry	SOGUIFAB, Société Guineénne de Fabrications	Aluminum shts.	10,000 tons/year										
Conakry	SOMOVA	Assembling vehicles											
Conakry	SOGEX	Explosives	700 tons/year	1,022	20,510		2,709		180	180			
TOTAL				426,942	369,808	210,372	1,172,836		230	180			

Table B-5

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Sierra Leone

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Freetown	Sierra Leone Petroleum Refining Co.Ltd.	Petroleum refining	237,270 tons/year	29,900	18,980	11,390	83,050	6,170	140	380			
Freetown	Palm Kernel Oil Mill	Palm oil	880 ton /year	19,620	17,160	12,320	49,050						
Freetown	Sierra Leone Brewery Ltd.	Beer	10 mill. l/year	102,000	47,300		112,000						
Freetown	Sierra Leone Enterprises	Soft drinks	3.6 mill. l/year	11,340	15,590		28,350						
Freetown	Freetown Cold Storage	Soft drinks	3.0 mill. l/year	9,450	12,990		23,625						
Freetown	Wellington Distilleries Ltd,	Blending of spirits	137,000 l/year										
Freetown	Soap Factory	Soap	4,000 tons/year	9,070	15,500	1,070	22,700						
Freetown	Sierra Fishing Co., Ltd.	Fish + shrimp											
Freetown	Red Lion Bakery	Bread											
Freetown	National Confectionery Ltd.	Cookies + candy											
Freetown	Seabread Flour Mill	Flour											
Freetown	Foam Manufng. Co.	Pillows and mattresses											
TOTAL				181,380	127,520	24,780	318,775	6,170	140	380			
Projected Discharge to Ocean 1/				1,676,655	1,178,780	229,063	2,946,719	57,035	1,294	3,513			

1/ Based on ratio of number of employees working in industry to the number of employees working at the visited industry on the coast in Sierra Leone. 11,333/1,226 (BOD_5) = 9.244 (181,380) = 1,676,655.

Table B-6

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Liberia

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Monrovia	Liberia Petroleum Refining Co.	Petroleum refining	616,438 tons/year	77,671	49,315	29,589	215,753	16,027	370	986			
Monrovia	Monrovia Breweries Inc.	Beer	18 mill. l./year	183,600	85,140		201,600						
Monrovia	Mesurado Fish Company	Fish	2,400 tons/year		27,200	1,440							
		Shrimp	360 tons/year		91,200	28,800							
Monrovia	Mesurado Detergent Ind. Inc.	Detergent	900 tons/year	60	60	60	300						
Monrovia	Liberia Bleach and Chemicals	Sodium hypochlorite	117,000 l/year										
		Candles	35,000 kg/year										
		Insectide	800 kg/year										
Monrovia	Liberia Distilling Corporation	Blending of spirits	301,000 l/year										
TOTAL				261,331	252,915	59,889	417,653	16,027	370	986			
Projected Discharge to the Ocean 1/				1,083,110	1,048,230	248,215	1,731,000	66,425	1,533	4,086			

1/ Based on ratio of number of employees working in industry to the number of employees working at the visited industry on the coast in Liberia. 4,099/989 x (BOD_5) = 4.145 x (77,671) = 1,083,110.

Table B-7

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Ivory Coast

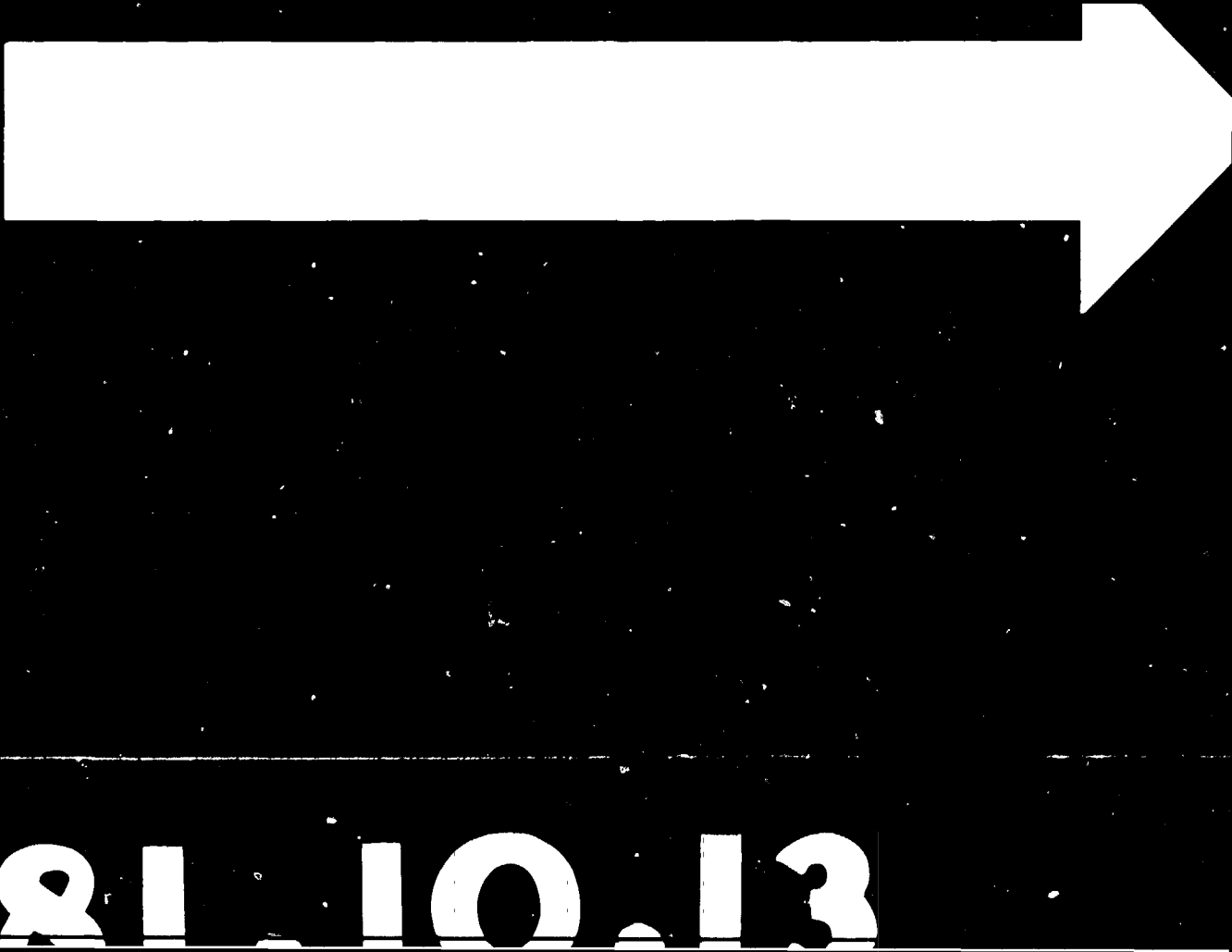
Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Abidjan	Société Ivorienne de Raffinage (SIR)	Petroleum refinery	2 mill. tons/year	252,000	160,000	96,000	700,000	52,000	1,200	3,200			
Abidjan	Lubtex	Lubricants	12,000 m^3/year	1,486	1,197	485	8,772	867	9	25			
Abidjan	Société Multinationale de Bitumes (SMB)	Asphalt	93,000 tons/year	27,790	22,390	9,070	164,050	16,212	174	463			
Abidjan	SOTEXI	Printed textiles	24 mill. meters/year[1/] (24 mill. m^2/year)	81,720	208,800		1,015,200		1,440	1,440			
Abidjan	ICODI	Printed textiles	27 mill. meters/year[1/] (27 mill. m^2/year)	91,935	234,900		1,142,100		1,620	1,620			
Abidjan	UNIWAX	Printed textiles	20 mill. meters/year[1/] (20 mill. m^2/year)	68,100	174,000		846,000		1,200	1,200			
Abidjan	SOFITEX	Printed textiles	4 mill. meters/year[1/] (4 mill. m^2/year)	13,620	34,800		169,200		240	240			
Abidjan	BLOHORN	Palm oil refinery	50,000 tons/year	1,115,000	975,000	700,000	2,790,000						
		Soap	33,000 tons/year	74,910	127,710	8,910	187,110						
Abidjan	Palmindustrie	Palm oil											
Abidjan	BATA	Plastic shoes	1.2 mill. pairs/year										
		Leather shoes	1.4 mill. pairs/year										
Abidjan	SOLIBRA	Beer	60 mill. l/year	612,000	283,800		672,000						
		Non-alcoholic carbonated beer	12 mill. l/year	37,800	51,960		94,800						
Abidjan	BRACODI	Beer	50 mill. l/year	510,000	236,500		560,000						
		Soft drinks	27 mill. l/year	85,050	116,910		213,300						
		Ice	380,000 tons/year										

1/ Production reported in linear meters of material. Width of cloth varies but is approximately 1 m.

Table B-7 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Ivory Coast

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/y.									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Abidjan	SOBOCI	Soft drinks	6.8 mill. l/year	21,420	29,444		53,720						
Abidjan	IRAN	Soft drinks Ice	6.8 mill.l/year 10,000 tons/year	21,420	29,444		53,720						
Abidjan	SICODIS	Bottling wine	33 mill. l/year	103,950	142,890		260,700						
Abidjan	SOVINCI	Bottling wine	25 mill. l/year	78,750	108,250		197,500						
Abidjan	AGR	Bottling wine	1 mill. l/year	3,150	4,330		7,900						
		Bottling alcohol	220,000 l/year	693	953		1,738						
Abidjan	GANAMET	Bottling wine	220,000 l/year	693	953		1,738						
Abidjan	SACO	Cocoa seed	35,000 tons/year										
Abidjan	API	Cocoa seed	18,000 tons/year										
Abidjan	PROCAI	Cocoa seed	18,000 tons/year										
Abidjan	CHOCODI	Cocoa seed	7,000 tons/year										
Abidjan	Grand moulins d'Abdijan (GMA)	Grain mills	80,000 tons/year	56,800	50,400		142,400						
Abidjan	CAPRAL	Coffee and instant coffee	3,000 tons/year	1,875,000	150,000		4,686,000						
Abidjan	PFCI	Canned vegetables	8,000 tons/year	41,040	50,640		102,400						
Abidjan	SCODI	Canned vegetables	8,000 tons/year	41,040	50,640		102,400						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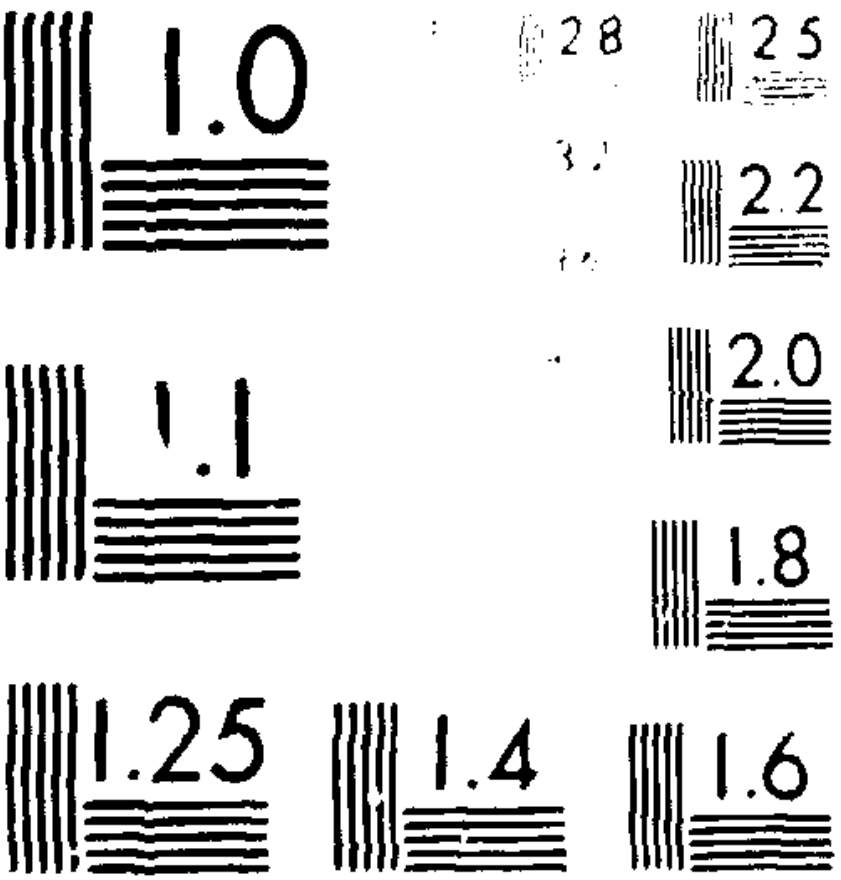
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Table B-7 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Ivory Coast

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Abidjan	SIVENG	Sulfuric Acid	20,000 tons/year		6,000	900							
		Fertilizer: superphosphate	8,000 tons/year		26,640						2,640		8,000
		Fertilizer: superphosphate gran.	55,000 tons/year		183,150						18,150		55,000
		Fertilizer: ammonium sulfate	2,500 tons/year					6,250					
Abidjan	Shell-Chimie	Chloro-organic + organophosphates - packaging	1,500 m^3/year										
		Pyrethine-packaging	700 m^3/year										
		Herbicides-packaging	100 m^3/year										
Abidjan	IPL	Paint + laquer	3,000 tons/year	390	600		990						
Abidjan	Toles Ivoire	Galvanizing metals	33,000 tons/year		41,580					594	1,023		2,079
Abidjan	Zintec Ivoire	Zinc plating	2,400 tons/year		3,024					43	74		151
Abidjan	IMCI	Concrete reinforcing bars	25,000 tons/year										
TOTAL				5,215,757	3,506,905	815,365	14,173,738	75,329	5,883	8,825	21,887		65,230

Table B-8

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Ghana

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Tema	Food Specialities	Condensed milk	14 mill. cases/year	189,000	283,500		483,000						
		Milo (cocoa bev.)	300,000 cases/year										
		Cerelac (baby food)	100,000 cases/year										
		Nescafe	180,000 cases/year										
		Ketchup	17,000 cases/year										
Accra	Accra Brewery	Beer Soft drinks	19,300 tons/year	196,860	91,289		216,610						
Accra	Tata Brewery	Beer	15,000 tons/year	153,000	70,950		168,000						
Tokoradi	Pioneer Tobacco	Cigarettes + tobacco	200 tons/year										
Tokoradi	Cocoa Products	Cocoa butter	5,208 tons/year	116,138	101,556	72,912	290,606						
		Cocoa liquor	4,200 tons/year	93,660	81,900	58,800	234,360						
		Cocoa cake Cocoa powder	5,376 tons/year	119,885	104,832	75,264	299,980						
Accra	Ghana Pharmaceutical	Antibiotics + pharmaceuticals											
Accra	Freedom Textiles	Grey cotton yarn	1,600 tons/year[1/]	36,320	92,800		451,200		640	640			
		Printed textiles	5.76 mill.m/year (5.76 million m^2/year)	23,608	60,320		293,280		416	416			
Tema	Tema Textiles	Printed textiles	2.2 mill.m/year[1/] (22 million m^2/year)	89,892	229,680		1,116,720		1,584	1,584			
Tema	Ghana Textiles Manufacturing	Textiles	36 mill.m/year[1/] (36 million m^2/year)	147,096	375,840		1,827,360		2,592	2,592			
Tema	Ghana Textiles Printing	Printed textiles	18 mill.m/year[1/] (18 million m^2/year)	72,252	187,920		913,680		1,296	1,296			

1/ Production reported in linear meters of material. Width of cloth varies but is approximately 1 m.

Table B-8 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Ghana

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Tema	West Coast Dyeing	Dyed cotton + rayon yarns	240 tons/year	5,448	13,920		67,680		96	96			
Tema	Volta Aluminum	Aluminum	187,440 tons/year		1,874,400						1,250,225		
Tema	GHAIP	Petroleum refinery	1,250,000 tons/year	157,500	100,000	60,000	437,500	32,500	750	2,000			
Tema	Lever Brothers	Soap and detergents											
Takoradi	The Takoradi Veneer and Lumber	Plywood	3,750 m^3/year	2,325			5,850		2,625				
		Lumber	3,000 m^3/year	10,920			27,300						
		Doors	50,000 pieces/year										
Takoradi	L'Air Liquide	Oxygene	70,000 m^3/year										
		Acetylene	26,000 m^3/year										
Tema	Tema Development Co.	House construction											
TOTAL				1,413,904	3,668,907	266,976	6,832,676	32,500	9,999	8,624	1,250,225		

Table B-9

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Togo

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Kpémé	Office Togolaise des Phosphates (O.P.T.)	Washing of phosphate mineral	7 mill. tons/year		23,310,000						2,310,000		7,000,000
Lomé	Société Togolaise d'Hydrocarbures (S.T.H.)	Petroleum refinery	1 mill. tons/year	126,000	80,000	48,000	350,000	26,000	600	1,600			
Lomé	Brasserie du Benin (B.B.)	Beer	30 mill. l/year	306,000	141,900		336,000						
		Carbonated beverages	7 mill. l/year	22,050	30,310		55,300						
Lomé	Société Togolaise de Boisson (S.T.B.)	Soft drinks	8 mill. l/year	25,200	34,640		63,200						
Lomé	Société de Detergentes du Togo (SODETO)	Detergents	1,200 tons/year	80	80	80	396						
Lomé	Société Nationale de Siderurgie (S.N.S.)	Steel	20,000 tons/year		4,800	1,460		12,200	200			3,000	
		Steel rolling	40,000 tons/year		9,600	2,920		24,400	400			6,000	
Lomé	CIMTOGO	Cement	340,000 tons/year	907,300			2,278,000						
Lomé	SOTOMA	Marble working											
Lomé	Office National des Abbattoirs et Frigorifie (O.N.A.F.)	Bovine slaughtering	1,200 tons/year	960	1,595	480	2,400						
		Swine slaughtering	140 tons/year	112	186	56	280						
		Ruminants slaughtering	350 tons/year	280	465	140	750						
Lomé	Luxolin	Paints	1,500 tons/year	195	300		495						
Lomé	Huilerie du Benin	Peanut oil	14,000 tons/year	312,200	273,000	196,000	781,200						

Table B-9 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Togo

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Lomé	SAVONNERIE	Soap	3,000.tons/year	6,810	11,610	810	17,010						
Lomé	Société Generale des Moulins du Togo (S.G.M.T.)	Flour mill											
TOTAL				1,707,687	23,898,486	249,946	3,885,031	62,600	1,200	1,600	2,310,000	9,000	7,000,000

Table B-10

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Benin

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Cotonou	SONICOG	Palm oil	15,000 tons/year	334,500	292,500	210,000	837,000						
		Peanut oil	1,000 tons/year	22,300	19,500	14,000	55,800						
		Vegetable butter	2,000 tons/year	44,600	39,000	28,000	111,600						
Porto Novo	SONICOG	Bar soap	5,200 tons/year	11,804	20,104	1,404	29,484						
Cotonou	SOBETEX	Printed textiles	16 mill. m/year[1/] (16 mill. m^2/year)	54,480	139,200		676,800		960	960			
Cotonou	LA BENINOISE	Beer	22,500,000 l/year	229,500	106,425		252,000						
		Carbonated beverages	9,100,000 l/year	28,665	39,403		71,890						
		Ice	10,950 tons/year										
Cotonou	SCB	Cement	167,500 tons/year	447,225			1,122,250						
Cotonou	GMB	Wheat flour	9,380 tons/year	938	938		2,345						
Cotonou	MABECY	Bicycles	13,400 pcs./year										
		Motorbikes	9,500 pcs./year										
		Bicycles inner tubes											
Cotonou	BATA BENINOISE	Shoes	321,600 pairs/year										
TOTAL				1,174,012	657,070	253,404	3,159,169		960	960			

1/ Production reported in linear meters of material. Width of cloth varies but is approximately 1 m.

Table B-11

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Nigeria

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Eastern Part of Atlantic Coast	NNOC	Crude petroleum	107 mill.tons/year			53,500,000							
		Fishing	170,000 tons live weight		1,921,000	102,000							
		Tinned meat	986 tons/year	790	1,310	394	1,972						
		Margarine	6,000 tons/year	133,800	117,000	84,000	334,800						
		Groundnut oil	7,300 tons/year	162,790	142,350	102,200	407,340						
		Wheat flour	600,000 tons/year	60,000	60,000		150,000						
		Raw sugar	27,600 tons/year	158,148	33,120		394,680						
		Beer	357 mill. liters	3,641,400	1,688,610		3,998,400						
		Soft drinks	181 mill. liters	570,150	783,730		1,429,900						
		Textiles	276,608 tons/year	6,279,000	16,043,264		78,003,456		110,643	110,643			
		Plywood	80,000 m^3/year	49,600			124,800		56,000				
		Paints	26,500 tons/year	3,445	5,300		8,745						
		Soap and detergents	103,800 tons/year	235,626	401,706	28,026	588,546						
		Petroleum refining	8.9 mill. tons/year	1,121,400	712,000	427,200	3,115,000	231,400	5,340	14,240			
		Bicycle + motor cycle tires	1,914 tons/year		823	210							
		Other tires	2,050 tons/year		881	226							
		Cement	1.42 mill. tons/year	3,791,400			9,514,000						
		Pulp + paper	60,000 tons/year	1,120,200	2,400,000		2,802,000						
TOTAL				17,327,749	24,311,094	54,244,256	100,873,639	231,400	171,983	124,883			

Table B-12

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Cameroon

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Douala	Complexe chimique camerounais (CCC)	Soap Detergent	18,000 tons/year 2,000 tons/year	40,860 134	69,660 134	4,860 134	102,060 660						
Douala	Cotonnière industrielle du Cameroun (CICAM)	Bleaching and printing Textiles	35 mill. m/year[1/] (35 mill. m^2/year)	119,018	304,500		1,480,500		2,100	2,100			
Douala	Societé Guiness-Cameroun	Beer	50 mill. l/year	510,000	236,500		560,000						
Douala	Emaillerie Nouvelle Afrique	Fabrication of steel containers + enamel plating	1,800 tons/year		2,268					32	56		113
Douala	Brasseries du Cameroun (SA)	Beer Non-alcoholic carbonated beverages	65 mill. l/year 25 mill. l/year	663,000 78,750	307,450 108,250		728,000 197,500						
Douala	ALUBASSA	Aluminum products											
Douala	CTMC	Concrete re-inforcing bars											
Douala	CEP	Paint											
Douala	UNALOR	Matches											
Douala	CHOCOCAM	Chocolate refining Candy	7,000 tons/year 4,500 tons/year										
Douala	SOPARCA	Perfumes + creams	2,000 tons/year										
Douala	SAPCAM	Paint, varnish + bleach	1.75 mill. tons/year	232,750	350,000		582,750						

Table B-12 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Cameroon

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Douala	UCB	Non-alcoholic carbonated beverages	12 mill. l/year	37,800	51,960		94,500						
Douala	PILCAM	Batteries	1.5 mill. batteries	9,360	2,340,000		23,400		93,600 (Pb)	93,600 (Cd)			
Douala	SOCADEM	Fabrication of metal containers											
Douala	PLASTICAM	Assorted plastic articles											
Douala	Milliat Frères	Food pastes											
Douala	BATA	Shoes											
Douala	Societé camerounaise de produits laitiers	Dairy products	250,000 l/year	225	338		563						
Douala	SOLADO	Concrete re-inforcing bars											
Douala	SYNTHECAM	Synthetic fabrics	1.5 mill.m/year[1/] (1.5 mill. m^2/year)	5,100	13,050		63,450	90	90				
Doula	SOCAVER	Glass											
Douala	CIAC	Tires											
Douala	SYNCATEX	Blankets + bed spreads											
Douala	CICAF	Blankets											
Douala	MCD	Blankets											

Table B-12 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Cameroon

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Douala	REGIC	Toilet paper	300,000 rolls/year (assume 1 roll weighs 0.5 kg)	2,790	6,000		6,975						
Douala	SOCAFRUITS	Canning vegetables + fruits	5,000 tons/year	25,650	31,650		64,125						
Bonaberi	SOCAME (not presently operating)	Fertilizer											
Bonaberi	CAMOA	Oxygen + acetylene											
Bonaberi	DRATEX	Linen											
Bonaberi	ALPICAM	Small metal articles											
Victoria	Victoria Paper Mills	Paper pulp	3,000 tons/year	56,010	120,000		140,025						
Victoria	Plantation Pomoi	Palm oil	13,000 tons/year	289,900	253,500	182,000	724,750						
		Palm kernal oil	5,000 tons/year	111,500	97,500	70,000	278,750						
		Raw rubber	2,000 tons/year	4,540	7,340	1,866	91,340						
Edea	ALUCAM	Aluminum	50,000 tons/year		500,000						333,500		
TOTAL				2,187,387	4,800,100	258,860	5,139,348	90	2,190 (93,600 Pb)	2,132 (93,600 Cd)	333,556		113

1/ Production reported in linear meters of material. Width of cloth varies but is approximately 1 m.

Table B-13

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Equatorial Guinea

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Rio Muni		Cacao											
Rio Muni		Coffee											
Rio Muni		Forest products											
Rio Muni		Palm oil											
Rio Muni		Soap											
Rio Muni		Beer											

Table B-14

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Sao Tome and Principe

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Neves	CETO	Beer	3.6 mill. l/year	36,720	17,028		40,320						
Neves	FLEBE	Carbonated soft drinks	0.2 mill. l/year	630	866		1,580						
Neves	Stockage Shell	Storage of petroleum products											
Neves		Boats											
Neves	SIPLANE	Alcoholic beverages	30,000 l/year	95	130		237						
Sao Tome		Soap	100 tons/year	227	387	27	567						
TOTAL				37,672	18,411	27	42,704						

Table B-15

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Gabon

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Libreville	Societé des brasseries du Gabon (SOBRAGA)	Beer Non-alcoholic carbonated beverages	36 mill. l/year 10 mill. l/year	376,200 31,500	170,280 43,300		403,200 78,750						
Libreville	Societé industrielle des textiles du Gabon (SOTEGA)	Printed textiles	7.5 mill. m/year[1/] (7.5 mill. m^2/year)	65,500	65,250		317,250		450	450			
Libreville	Gabonaise de peintures et laques (GPL)	Paint + laquer	1,500 tons/year	200	300		500						
Libreville	SOGAPIL	Batteries											
Libreville	GABOA	Oxygen, acetylene + nitrogen											
Libreville	ABA	Paint and glue											
Port Gentil	Terminal petrolier d'Elf-Gabon	Washing + storage of crude oil	8 mill tons/year			4,000,000							
Port Gentil	Societé gabonaise de raffinage (SOGARA)	Petroleum refining	900,000 tons/year	113,400		43,380	315,000	23,490	540	1,440			
Port Gentil	COGER	Petroleum refining	1.2 mill. tons/year	151,200		57,840	420,000	31,320	720	1,920			
Port Gentil	Societé des brasseries de l'Ogoue maritime (SBOM)	Beer Non-alcoholic carbonated beverages	15 mill. l./year 2.5 mill. l/year	153,000 7,875	70,950 10,825		168,000 19,750						
Port Gentil	Compagnie forestiére du Gabon (CFG)	Plywood Lumber Lumber	75,000 m^3/year 9,000 m^3/year 4,000 m^3/year	46,892	20,440		117,230		52,280				

1/ Production reported in linear meters of material. Width of cloth varies but is approximately 1 meter in width.

Table B-15 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Gabon

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Port Gentil	SAGA	Soaps and plastic products											
Port Gentil	GABOA	Oxygen, acetylene + nitrogen											
Port Gentil	Placages gabonais	Wood veneers											
Port Gentil	SADER	Wood veneers											
Port Gentil	Terminal Shell-Gabon	Washing (salt removal) and storage of crude oil	3 mill. tons/year			1,500,000							
TOTAL				896,767	381,345	5,601,220	1,839,680	54,810	53,990	3,810			

Table B-16

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Congo

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Brazzaville	Brasseries africaines de Brazzaville (BAB)	Non-alcoholic carbonated beverages	6 mill. l/year	18,900	25,980		47,250						
Brazzaville	Brasseries de Brazzaville (PRIMUS)	Beer	25 mill. l/year	255,000	118,250		280,000						
Brazzaville	SCBK-Brazzaville	Beer	6 mill. l/year	61,200	28,330		67,200						
		Non-alcoholic carbonated beverages	6 mill. l/year	18,900	25,980		47,250						
Brazzaville	Yaourt Biso	Yogurt											
Brazzaville	Yaourt Yogo Santé	Yogurt											
Brazzaville	SIAT	Cigarettes											
Brazzaville	SIAP-CONGO	Paper											
Brazzaville	SOTEXCO	Printed textiles	14 mill. m/year[1/] (14 mill. m^2/year)	47,670	121,800		592,200		840	840			
Brazzaville	IMPRECO	Printed textiles											
Pointe-Noire	Société congolaise de brasseries Kronenbourg (SCBK)	Beer	22.5 mill. l/year	229,500	106,425		252,000						
		Non-alcoholic carbonated beverages	6 mill. l/year	18,900	25,980		47,250						
Pointe-Noire	SIDETRA Société industrielle de deroulage et tranchage	Lumber	10,800 m^3/year										
		Wood veneer	24,000 m^3/year	97,360			218,400						
		Plywood	3,000 m^3/year	1,872			4,680		2,100				

1/ Production reported in linear meters of material. Width of cloth varies but is approximately 1 m.

Table B-16 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Congo

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Pointe-Noire	PLACONGO	Wood veneer	30,000 m^3/year	109,200			273,000						
Pointe-Noire	Terminal Elf de Djeno (ELF)	Washing and storage of crude oil	2.4 mill. tons/year			1,200,000							
Pointe-Noire	Raffinerie nationale de petrole (not operating)	Petroleum refining	1.0 mill. tons/year	94,000	80,000	29,000	471,000	10,000	600	1,600			
Pointe-Noire	BATA	Shoes	790,000 pairs/year										
Pointe-Noire	SOVERGO	Glass											
Pointe-Noire	PLASCO	Plastic bottles											
Pointe-Noire	MACC	Munitions											
Pointe-Noire	CFA	Transporting and Selling Wood											
N-Kayi	SUCO	Sugar	13,500 tons/year	77,355	16,200		193,388						
N-Kayi	HUILKA	Palm oil	2,600 tons/year	57,980	50,700	36,400	144,950						
N-Kayi	MAG	Flour	10,000 tons/year	7,100	6,300		17,800						
TOTAL				1,084,937	605,995	1,265,400	2,656,368	10,000	3,540	2,440			

Table B-17

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Zaire

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Moanda/ Banana	Société zairo-italienne de raffinage (SOZIR)	Petroleum refinery	450,000 tons/year (capacity = 750,000 tons/year)	56,700	36,000	21,600	157,500	11,700	270	720			
Moanda/ Banana	Zaire-Gulf	Off-shore crude oil	begin production in 1980										
Moanda/ Banana	Zairep (FINA)	Off-shore crude oil											
Matadi	Minoterie de Matadi (MIDEMA)	Flour mill	126,000 tons/year	89,460	79,380		224,280						
Matadi	Service entreprises pétroliéres (SEP ZAIRE) Matadi, Ango-Ango	Storage of petroleum products											
Matadi	PEMARZA	Fish											
Boma	BRALIMA	Beer	30 mill.l/year	306,000	141,900		336,000						
Boma	ONATRA	Dry dock											
TOTAL				452,160	257,280	21,600	717,780	11,700	270	720			

Table B-18

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Angola

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Luanda (Area of Cacuaco, Viana, Cazenga)	PETRANGOL	Petroleum refinery	1,500,000 tons/year	189,000	120,000	72,300	525,000	39,150	900	2,400			
Luanda	SONANGOL	Storage + loading of crude oil	250,000 tons/year			125,000							
Luanda	Companhia Uniao de Cerreja Angola (CUCA)	Beer	1.8 mill. l/year (maximum capacity 2 mill. l/year)	18,360	8,514		20,160						
Luanda	NOCAL	Beer	3 mill. l/year (maximum capacity 31.5 mill. l/year)	30,600	14,190		33,600						
Luanda	TEXTANG	Printed textiles	5.5 mill. m/year[1/] (5.5 mill. m^2/year)	18,727	47,850		232,650		330	330			
Luanda	Ex Fabrica Imperial de Borracha (FIB)	Printed textiles	2 mill. m/year[1/] 2 mill. m^2/year)	6,810	17,400		84,600		120	120			
Luanda	CURBOL	Bicycle inner tubes	10,000 pcs./year		3	1							
		Tyres	20,000 pcs./year		43	11							
Luanda	Tintas Dyrup	Paint	100 tons/year	13	20		33						
Luanda	Siderurgia Nacional	Steel	4,000 tons/year (maximum capacity 30,000 tons/year)		960	292		2,440	40			500	

1/ Production reported in linear meters of material. Width of cloth varies but is approximately 1 meter in width.

Table B-18 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Angola

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr								
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Luanda (Area of Cacuaco, Viana, Cazenga)	Cementeria National	Cement											
Luanda	Industria Angolana de Oleas Vegetales (INDUVE)	Vegetable oil	2,200 m^3/year	39,248	34,320	24,640	98,208						
		Soap	2,600 tons/year	5,902	10,062	702	14,742						
		Plastic btls.	6 mill. pieces										
Luanda	FABIMOR	Bicycles	24,000 pieces										
		Motorcycles	2,500 pieces										
Cabinda	Gulf-Oil Terminal Cabinda	Washing + storage of crude oil	5 mill. tons/year			2,500,000							
Cabinda	Gulf-Oil Refinery Cabinda	Oil refinery (topping only)	25,000 tons/year	2,350	2,000	725	11,775	250	15	40			
Soyo	Oil Terminal Soyo (PETRANGOL/ TEXACO)	Washing and storage of crude oil	2 mill. tons/year			1,000,000							
Benguela	Africa Textil	Printed textiles	11 mill. m/year1/ (11 mill m^2/year)	37,455	95,700		465,300			660	660		
Huambo	Unidade Textil do Huambo	Printed textiles											
Huambo	UNTEX (not operating)	Printed textiles											

Table B-18 (cont'd.)

Principal industrial establishments and estimated mass of pollutants discharged in the coastal area of Angola

Location of Industry	Company	Products	Production Rate	Pollutants Discharged, kg/yr									
				BOD_5	SS	Oil + Grease	COD	Ammonia Nitrogen	Phenols	Total Chrome	Fluoride	Cyanide	Total Phosphorous
Puambo	Fabrica Ulisses	Motocycle assembling	5,000 pieces										
Lubango	NGOLA	Beer											
Alto Catumbela	Companhia de cellulose et Papel de Angola	Paper pulp											
Alto Catumbela	Algodoura Agricola do Alto Catumbela (AAA)	Vegetable oils	3,000 tons/year	66,900	58,500	42,000	167,400						
Dongo	EKA	Beer											
Dongo	SATEC	Printed textiles	10 mill. m/year 1/ (10 mill. m^2/year)	34,050	87,000		423,000		600	600			
TOTAL				449,415	496,562	3,765,671	2,076,468	41,840	2,665	4,150		500	

Table C-1

Characteristics of the Wastewaters and number of employees as reported by the visited industires in Ivory Coast

Name of Industry and Product	Number of Employees	Settleable Solids m^3/yr	Phenol tons/yr	Urea and Formalin tons/yr	Suspended solid tons/yr	BOD_5 tons/yr	COD tons/yr	Oil Mineral tons/yr	Solvents tons/yr	Caustic Soda tons/yr	Grease tons/yr	Wastewater Discharged m^3/yr
ICODI	450	90			45	180	450					900,000
SOTEXI	460	77			38.5	154	385					770,000
SIR	800	27.5			8.2	27.5	66	15.5				275,000
SOLIBRA	800	2,400			180	300	900			150		600,000
BRACODI	800	2,000			150	250	750			125		500,000
SOBOCI	250	75			15	24	60			80		150,000
PFCI	250	11.2			3.4	112	280				2.2	112,000
API	173	6			6	12	30					60,000
IBL	75				24							10,000
TOLES IVORIE	150	0.15			0.9							30,000
TOTAL	4,209	4,686.85			471.0	1,059.5	2,921	15.5		355	2.2	3,407,000
BLOHORN[a/]	831					4,380	10,950			1,500	365	730,000
Projected discharge to ocean[b/]	41,169	46,000			4,650	14,880	39,450	150				

a/ Not included in totals used to make projections because of the unusual character of the wastewater. Contributions of pollutants by BLOHORN were added after the projections were made.

b/ Based on ratio of number of employees working in industry to number of employees working at the visited plants on the coast in the Ivory Coast. 41,169/4,209 x (Setteable Solids) = 9.8 x (4,686.85) = 46,000 m^3/year.

Table C-2

Characteristics of the Wastewaters and number of employees as reported by the visited industires in Togo

Name of Industry and Product	Number of Employees	Settleable Solids m^3/yr	Phenol tons/yr	Urea and Formalin tons/yr	Suspended solid tons/yr	BOD_5 tons/yr	COD tons/yr	Oil Mineral tons/yr	Solvents tons/yr	Caustic Soda tons/yr	Grease tons/yr	Wastewater Discharged m^3/yr
S.T.H. Petroleum refinery	230				6	20	48	10		-		
S.T.B. Soft drinks	130				7	11.2	28			55		
B.B. Beer and carobnated beverages	420				105	175	525			100		
TOTAL	780				118	206.2	601			155		
O.T.P.[a/] Washing of phosphats mineral	1,150				2,450,000		-			-		
Projected discharge to ocean[b/]	4,000				2,450,425	710	2,040	36		560		

a/ Becasue of its atypical pollutant charges, this industry has not been considered in the further projection for the nation.

b/ Based on ratio of number of employees at all industry on the coast in Togo (except O.T.P.) to number of employees at visited plants (except O.T.P.), plus the figure for O.T.P. E.G.: (4,000 - 1,150)/780 x (suspended solid) = 3.6 x 118 + 2,450,000 = 2,450,425 ton/year.

Table C-3

Characteristics of the Wastewaters and number of employees as reported by the visited industires in Sao Tome and Principe

Name of Industry and Product	Number of Employees	Settleable Solids m^3/yr	Phenol tons/yr	Urea and Formalin tons/yr	Suspended solid tons/yr	BOD_5 tons/yr	COD tons/yr	Oil Mineral tons/yr	Solvents tons/yr	Caustic Soda tons/yr	Grease tons/yr	Wastewater Discharged m^3/yr
CETO												
Beer	80				150	18	54			18		36,000
FLEBE												
Soft drinks	15				0.2	0.3	0.8			1		2,000
TOTAL	95				150.2	18.3	54.8			19		38,000
Projected discharge to ocean[a/]	250				390	47	140			50		100,000

a/ Based on ratio of number of employees working in industry to number of employees working at the visited plants on the coast in Sao Tome and Principe.

Table C-4

Characteristics of the Wastewaters and number of employees as reported by the visited industires in Cameroon

Name of Industry and Product	Number of Employees	Settleable Solids m^3/yr	Phenol tons/yr	Urea and Formalin tons/yr	Suspended solid tons/yr	BOD_5 tons/yr	COD tons/yr	Oil Mineral tons/yr	Solvents tons/yr	Caustic Soda tons/yr	Sodium Carbonate
CICAM	550					282	1,128	1.2		500	120
CCC	520				12.5	12.5	50			3`5	
Nouvelle émaillerie Afrique	375				1.5		0.6	0.1			
Guiness	1,200	2,000			500	250	500				
ALUCAM	1,100							10			
CELLUCAM	1,100	4,896			571	652	1,958				
SONARA	230					75	302	12.6			
TOTAL	5,075	6,896			1,085	1,271.5	3,138.6	23.9		875	120
Projected discharge to ocean[a/]	41,252	51,200			9,000	10,400	32,000	196		7,200	980

a/ Based on ratio of number of employees working in industry to number of employees working at visited industry on the coast in Cameroun. 41,252/5,075 x (Settleable Solids) = 8.2 x (6,896 m^3/yr) = 51,200 m^3/year.

Table C-5

Characteristics of the Wastewaters and number of employees as reported by the visited industires in Gabon

Name of Industry and Product	Number of Employees	Settleable Solids m^3/yr	Phenol tons/yr	Urea and Formalin tons/yr	Suspended solid tons/yr	BOD_5 tons/yr	COD tons/yr	Oil Mineral tons/yr	Solvents tons/yr	Caustic Soda tons/yr	Grease tons/yr	Wastewater Discharged m^3/yr
SOBRAGA Beer and carbonated beverages	280	43			9	36	90					
SOTEGA Printed Textiles	120	350			35	87.5	350		1.75			
GPL Paint and laquer	43	3.5			0.3	0.2	0.5		0.1			
SBOM Beer and carbonated beverages	146	70			17.5	21	56			3.6		
CFG Plywood and lumber	1,764		2.5	2.5	2,260	420	1,050					
Terminal Elf-Gabon Crude oil storage	100					50	100	12.5				
SOGARA and COGER Petroleum refining	330					10.5	20	6				
TOTAL	2,783	466.5	2.5	2.5	2,315.8	625.2	1,656.5	18.5	1.85	3.6		
Projected Discharge to ocean[a/]	6,320	1,050	5.6	5.6	5,200	1,400	37,200	42	4.2	8		

a/ Based on ratio of number of employees at visited plants to number of employees at all industry in Gabon.
$6,320/2,783 \times$ (Setteable Solids) $= 2.25 \times (466.5) = 1,050$ m^3/year.

Table C-6

Characteristics of the Wastewaters and number of employees as reported by the visited industires in Congo

Name of Industry and Product	Number of Employees	Settleable Solids m^3/yr	Phenol tons/yr	Urea and Formalin tons/yr	Suspended solic tons/yr	BOD_5 tons/yr	COD tons/yr	Oil Mineral tons/yr	Solvents tons/yr	Caustic Soda tons/yr	Grease tons/yr	Wastewater Discharged m^3/yr
SCBK Beer and carbonated beverages	343	700			165	83	165			60		
Terminal Elf-Djeno Washing and storage of crude oil	33					110	220	21.9				
SIDETRA Lumber, veneer and plywood	772		0.1	0.4								
Raffinerie nationale Petroleum refining	350					8	15	2				
TOTAL	1,498	700	0.1	0.4	165	201	400	23.9		60		
Projected discharge to ocean[a/]	3,000	1,400	0.2	0.8	330	402	800	48		120		

a/ Based on ratio of number of employees working in industry to number of employees working at visited industry on the coast in the Congo. 3,000/1,498 x (Settleable Solids) = 2.0 x (700m^3/yr) = 1,400 m^3/year.

Table C-7

Characteristics of the Wastewaters and number of employees as reported by tne visited industires in Angola

Name of Industry and Product	Number of Employees	Settleable Solids m^3/yr	Phenol tons/yr	Urea and Formalin tons/yr	Suspended solid tons/yr	BOD_5 tons/yr	COD tons/yr	Oil Mineral tons/yr	Solvents tons/yr	Caustic Soda tons/yr	Chrome 3+	Iron
PETRANGOL												
Petroleum Refinery	550					30.20	54.75	22.3				
SONANGOL												
Hydrocarbons storage	32					0.25	0.50	0.1				
TEXTANG												
Printed textiles	1,290	500			50	125	500	0.5		60	0.25	
CURBOL												
Copper and Tyres	347	50			4	5					0.25	
INDUVE Vegetable oils, soap, Plastic bottles	620				80	40	160			50		
SIDERURGICA NACIONAL												
Steel	400	25						1				0.25
CABINDA GULF-INST												
Washing and Storage	20					73	146	14.6				
TOTAL	3,259	575			134	273.45	861.25	38.5		110	0.50	0.25
Projected Discharge to ocean[a/]	10,000	1,725			402	720	2,584	115		330	1.5	0.75

a/ Based on ratio of number of employees at all industry on the coast in Angola to number of employees at visited plants. 10,000/3,259 x (Settleable solids) = 3 x (575) = 1,725 m^3/year.

APPENDIX D

The role of waste water treatment in pollution control (Extracted from Middlebrooks, E.J., Industrial Pollution Control - Vol. I Agro-Industries, Wiley-Interscience Publication, John Wiley and Sons, New York, N.Y.)

Stream Degradation

When many types of substances are discharged into a receiving body of water, the water quality is degraded to such an extent that beneficial uses are no longer possible. No one industry discharges all types of pollutants, but the discharge of only one substance in sufficient quantity can cause irreparable harm.

Components with Pollution Potential

Industrial waste discharges contain solids (floating, suspended, settleable, and dissolved), organic matter, nutrients, toxic substances, acids, and alkalies; frequently the discharged water is hot enough to cause temperature changes in the receiving stream.

Floating solids (grease and scum) are unsightly and can affect natural aquatic characteristics such as oxygen transfer and light penetration.

Settleable solids can form sludge blankets which decompose and produce odorous gases and floating mats on the surface of the water body. Blankets of solids also interfere with natural organisms which live attached to the stream bed. Fish hatching is also impeded by settleable solids. Suspended solids detract from the appearance of water and impede light penetration, probably retarding the growth of aquatic vegetation necessary for the survival of other life in the stream or lake. Water treatment for human consumption or other industrial processes is necessary when large concentrations of suspended solids are present.

Organic matter discharged to a water course depletes the dissolved oxygen supply in water. The depletion of the dissolved oxygen supply results in a change in the composition of organisms that inhabit a stream. When the dissolved oxygen level drops below approximately 5 mg/l, the more

desirable species of fish such as trout and bass leave the area and coarser types predominate. Below an oxygen level of approximately 2 mg/l fish disappear and the environment shifts toward anaerobic species. Only the elimination of the discharge of organic matter or mechanical mixing which increases gas transfer can help the stream to recover from the oxygen-depleted state.

The addition of nutrients such as phosphorus, nitrogen, and trace elements can result in excessive algal growth, and when this growth dies it can exert an oxygen demand which may cause fish kills, as well as unpleasant odors and tastes. Excessive algal growth also interferes with the recreational and domestic uses of a body of water.

Temperature changes in water can produce adverse effects on all aquatic organisms, and the reaeration rate slows with increases in temperature. Fish and other organisms function best within certain temperature limits, and when this optimum range is violated, the organisms move to another location or die. Rapid changes in temperature are extremely dangerous to aquatic life.

Toxic compounds are common constituents of some industrial processes and frequently find their way into streams. Where toxic substances are discharged, however, plant and animal life may be affected and the water becomes unsuitable for recreation or human consumption.

Acidity and alkalinity concentrations in wastewater can be critical factors in the quality of a receiving stream. Although not an exact measure of acidity and alkalinity, the pH value is frequently used to measure the effect that a discharge may produce. Effluents from wastewater treatment plants are usually controlled near neutrality, or a pH value of 7. Wide fluctuations or prolonged changes in the pH value of a receiving stream can be devastating to an aquatic environment.

Management Philosophy

It is advantageous to consider excess materials as an additional resource to be utilized either in the form discarded or after further processing. This approach to waste processing is economically and environmentally important. If a government or ministry considers protection of the environment and maximum utilization of the base resource important, then the production management and the employees probably have an entirely different attitude toward performing this function and are more likely to take pride in producing high quality effluents and in recovering and utilizing as much of the material as possible. The importance of protecting the quality of the environment and the impact that improper handling of waste materials has on the employees' life styles and the nation as a whole must be emphasized.

Environmental protection must be stressed when management is expected to meet productin quotas. Under such production systems management tends to concentrate its talent on product output, if not reminded continually of the value placed on environmental protection by the ministry and the nation. Environmental protection must be considered as a valuable natural resource in the same manner as the labor, materials, and the capital investment required to produce the basic product.

The costs for environmental protection must be paid either now or in the future. The most effective method of handling excess products is to incorporate the facilities for protecting the environment and for further processing of the excess into useful products. It is much less expensive to install such equipment initially than to convert a production process and add pollution control equipment later; moreover, it has proved cheaper to spend today's money than an inflated one of a later date. However, it is still less expensive to add to existing systems the facilities for processing materials than to allow excess to be wasted as environmental pollutants; to clean these up at a future time is costly and difficult. Indeed, the damage to the environment before installing equipment to correct a situation may be impossible to rectify. It is burdensome to assess the economic losses incurred by people and industry because of delayed pollution control; however, these are real economic factors which must be considered and emphasized. The losses of health, happiness, and productivity of people owing to environmental pollution are the greatest costs of all.

Long-term economic effects of industrial pollution must not be neglected. If an industry is allowed to develop in an area without pollution control facilities, eventually the area may deteriorate to a level unacceptable to many of the residents, and they move away. Relocation of the population depletes the tax base for public services and results in a further deterioration of the local living conditions. With an added tax burden the community is forced to extract more support from the industry, resulting in higher product costs. Environmental pollution also influences maintenance costs for homes, public buildings, and thoroughfares, as well as the industrial buildings and equipment themselves.

Pollution control is a good business practice which a nation cannot afford to neglect. Maintenance of the environment is much the same as maintenance of machinery, automobiles, and other devices: if a nation does not routinely care for the environment, eventually it deteriorates. In this case, deterioration may occur to a level that is intolerable to flora and fauna and cost the people and the government more than the industry produces. A nation must not sacrifice its customs and desirable environment to short-term economic advantage.

APPENDIX E: Definitions

BOD_5

The 5-day, 20°C, biochemical oxygen demand (BOD_5) test is widely used to determine the pollutional strength of wastewater in terms of the oxygen required to oxidize or convert the organic matter to a nonputrescible end product. The BOD_5 is a bioassay procedure that measures the oxygen consumed by living organisms while utilizing the organic matter present in the wastewater under conditions as similar as possible to those that occur in nature. To make results comparable, the test has been standardized. The BOD_5 test is one of the most important in stream pollution control.

Suspended solids (SS)

Suspended solids are the suspended material that can be removed from wastewaters by laboratory filtration excluding coarse or floating solids that can be screened or settled out readily. Suspended solids are a vital and easily determined measure of pollution and also a measure of the material that may settle out in slow moving streams. Both organic and inorganic materials are measured by the suspended solids test.

Oils and greases

Oils and greases are determined by multiple solvent extractions of the filterable portion of a sample of wastewater; therefore, floating oils and greases are not included in the analysis. Several solvents are commonly used and each gives a different result with the same sample. Standarized tests are recommended, but there is much disagreement as to what constitutes the best method. Solvents such as hexane, ether, freon, and carbon tetrachloride are used, and it is important that the solvent be specified. Grease and oil exert an oxygen demand, cause unsightly conditions, and can interfere with anaerobic biological treatment systems.

PH

Acidity, alkalinity, and pH are terms used to express the corrosive or caustic properties of a wastewater. None of the tests related to these properties measures a specific component in a wastewater, but they serve a useful purpose by indicating a relative toxicity to aquatic life (see Appendix D).

COD

The chemical oxygen demand (COD) is an alternative to the biochemical oxygen demand (BOD_5). It is widely used and measures the quantity of oxygen required to oxidize the materials in wastewater under severe chemical and physical conditions. The major advantage of the COD test is that only a short period (3 hours) is required to conduct the test. The major disadvantage is that the test does not indicate how rapidly the biologically active material would be stabilized in a natural condition.

APPENDIX F

Table F-1: Consultant activity in West African region

Country	Consultant	Number of Visits	Dates of Visits
Senegal	Juan Pablo Schifini	1	25 May - 14 June 27 June - 1 July 1980
Gambia	Alexander G. Rozanov	1	24 June - 8 July 1980
Guinea Bissau	Juan Pablo Schifini	1	14 - 27 June 1980
Guinea	Juan Pablo Schifini	1	19 - 25 May 1980 1 - 5 July 1980
Sierra Leone	E. Joe Middlebrooks	1	25 Jan. - 6 Feb. 1980
Liberia	E. Joe Middlebrooks	1	7 - 14 February 1980
Ivory Coast	Alfredo Margola	1	23 May - 8 June 1980
Ghana	Alexander G. Rozanov	1	30 May - 23 June 1980
Togo	Alfredo Margola	1	8 - 22 June 1980
Benin	Michel R. Mounier	1	30 June - 10 July 1980
Nigeria	C.A. Sanders Michel R. Mounier G. Bekele 1/	3	23 - 28 March 1980 10 - 15 July 1980 10 - 17 July 1980
Cameroon	Alfredo Margola	1	23 Jan - 8 Feb 1980
Equatorial Guinea	Alfredo Margola	C	
Sao Tome and Principe	Alfredo Margola	1	23 - 30 June 1980
Gabon	Alfredo Margola	1	9 - 20 February 1980
Congo	Alfredo Margola	1	20 - 29 February 1980
Zaire	Alfredo Margola	1	17 - 23 March 1980
Angola	Alfredo Margola	1	1 - 16 March 1980

1/ Senior Industrial Development Field Adviser (SIDFA) from Kenya.