OCCASION

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

DISCLAIMER

FAIR USE POLICY

CONTACT

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

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

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

21218

Distr.
LIMITED

ID/WG.541/2(SPEC.)
21 September 1995

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

First Global Consultation on Environmental Management/
Cleaner Technologies in the Metallurgical Industry
Vienna, Austria, 16-18 October 1995

COUNTRY PAPERS PRESENTED AT THE*

EXPERT GROUP MEETING ON COOPERATION ON ENVIRONMENTAL MANAGEMENT IN THE IRON AND STEEL INDUSTRY FOR THE AFRICAN REGION

Pretoria, South Africa
10-13 July 1995

*The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Secretariat of the United Nations Industrial Development Organization (UNIDO). Mention of firm names and commercial products does not imply the endorsement of UNIDO. This document has not been edited.

V.95-57427

TABLE OF CONTENTS

		Page
1.	***Ethiopia*** ..... Environmental Management in the Ethiopian Manufacturing Industries	3
2.	***Kenya***..... Kenya country paper prepared for the EGM on Cooperation in Environment Management in Iron and Steel Industry	9
3.	***Mauritania***..... Participation to the discussion on environmental issue presented by Moctar Salem, Mauritania Mining Company	17
4.	***Nigeria***..... The Nigerian contribution on the EGM on cooperation on Environmental Management in the iron and steel industry by Dr. E. Mudiare, Ajaoukuta Steel Company	35
	Management of Environmental Pollution in the iron and steel industry - The Nigerian Experience. H.N. Ofili, Delta Steel Company Ltd.	47
5.	***Senegal***.....	69
6.	***Zimbabwe***..... Environmental Management at the Zimbabwe iron and steel Company Limited (ZISCOSTEEL), compiled by J. Mukanhairi	83

ETHIOPIA

ENVIRONMENTAL MANAGEMENT IN THE ETHIOPIAN MANUFACTURING INDUSTRIES

June, 1995

The status of Environmental Management in the Ethiopian manufacturing Industries.

Although the degree of industrialization is steel relatively low in Ethiopia industrial plants are causing problems of waste management and pollution. The most offending industries in the country are the leather,textile and some food (particularly meat) processing plants. Currently there is no legislation regulating waste management or discharging of effluent or airborne pollution.

The Government of Ethiopia is trying to set up a policy to prevent pollution of land, air and water from domestic and industrial waste, and from emissions and discharges of hazardous materials and other pollutants including noise.

At present, the iron and steel industry which exist in the country are very few and the degree of damage caused by the sector are insignificant.

In Ethiopia, the steel making plants are with dated technology and equipment which are operated manually and thus increase their negative impact on the environment.

It was in 1950's that industrialization began in Ethiopia. Since then industrial technologies were transferred without giving consideration to industrial waste disposal techniques. Although the situation in Ethiopia is not as it is nowadays in developed countries it is to be noted that several types of industrial wastes (airborne effluent, liquid effluent, solid wastes,etc) are generated in the industries and discharged into the environment. The main sources of hazardous waste among the enterprises are the food, beverages, tobacco, textile, leather tanning and finishing,paper and paper products chemical products, non metallic mineral products (glass,cement,ceramics,etc.) and mechanical products, foundries and battery factories. The Composition of hazardous wastes is generally of mixed and varied nature, which could represent sources for a number of discrete hazardous substances.

Questionnaires have been sent to all manufacturing establishments intended to collect data and information regarding the state of industrial waste in the country. Quite a substantial number of plants have responded to the questionnaires although very little data and information were obtained.

The prevailing condition of industrial Waste

Almost all types of pollution (i.e.,air,solid waste,water, noise and heat) are prevalent in Ethiopian manufacturing industries. The intensity of these polluting vary from plant to plant. It is reported that in industries like textiles, tanneries, metal works, non-metallic minerals and tobacco all types of pollution indicated above do exist.

In beverage industries water and solid wastes are the causes of environmental pollution. Thermal effluent and noise pollution are generated in cement kilns and cement mills, respectively. Dust particles produced due to processing are the main cause of air pollution in cement plants and sugar industries. Edible oil and flour mills are also the cause of air pollution in Ethiopian food industries.

Industrial wastes from such industries as food,tobacco, textiles, and tanning and leather works emanate from processing, cleaning and washing pre-treatment and after treatment activities. Ethiopian sugar industries have pollution generated from processing and boiler operation activities. The liquid effluent produced in beverage industries in due to cleaning and washing operations Non-metallic mineral industries like cement and ceramics processing plants produce dust pollutants resulting from crushing operations and other production processes. Soap processing industries in the Ethiopian chemical sub-sector produce air pollution resulting in odorous working environment. Liquid effluent and solid wastes generated from Ethiopian tanneries have become serious causes of environmental (stream lines, land) contamination. The liquid effluent produced in Ethiopian breweries is led to near by streams which pollutes the stream water with hazardous chemicals such as caustic soda.

Quite a substantial number of technical measures have been taken and are at present under consideration by general Ethiopian industries. For instance, Akaki metal products factory has planned to install ammonium dust collector and Finfine house hold and office furniture factory has installed dust sucking apparatus. The Addis Ababa cement Factory is at present considering the installation of dust precipitator. Tabacchi ceramics factory has planned to change from dry process to wet process. The sugar industries are intending to release dust particles caused by bagasse burning. The Ethiopian pulp and paper Factory treats waste water by aeration and sedimentation in ponds. Purification of liquid effluent prior to environmental disposal (Kombolcha textile plant), letting discharged water through underground canal, installation of dust sucking apparatus and use of masks are some of the technical measures taken by Ethiopian textile industries to minimize pollution. Treating alkaline water with acid and reciamation of washing chemicals are also measures used in some plants of the beverage industries. Gullele soap factory employs neutralization of lye as means of combating environmental pollution. Installation of cyclones and dust collecting systems are used as measures of minimizing air pollution in some of the Ethiopian food industries. The technique of filtration, sedimentation and aeration (Ethiopian pickling) periodical removal of solid wastes, activated sludge drying beds (Awash tannery) are some of the technical measures considered by Ethiopian tanneries. A number of hazardous or toxic chemicals associated with industrial wastes are believed to have existed in many Ethiopian industries. Chemicals like hexane, acetone, sludges, oil cakes, and caustic soda are present in edible oil mills and spice extraction plant of Ethiopia. The Ethiopian chemical industry has reported the presence of hazardous chemicals such as sodium triply phosphate, dodecyclbinzyl, isocyanate, sodium hydroxide, acetone and paint preservating sodium sulphide, sodium sulfite, chrome, chlorides and mineral tanning chemicals are some of the hazardous chemicals reported to have existed in Ethiopian tanneries. The Ethiopian non-metallic minerals subsector contributes to environmental pollution with chemicals like asbestos fibre, silica sand, arsenic powder and barium carbonate.

Most of the wineries and soft drink factories located in Addis Ababa, including Addis Ababa Brewery, discharge their liquid effluent either directly into Akaki river or into small streams that end up into Akaki itself.

Almost all textile factories in Addis Ababa discharge liquid effluent also in to Akaki river which ends up into Aba Samuel water body. The degree of contamination of this river is even more aggravated since plants like Ethiopian pickling, addis Tannery, and Addis tyre dump their liquid waste into it.

Concerning detailed information on discharged liquid effluent, such values as PH of waste, temperature of discharged waste, volume, suspended solids (mg/l), BOD,COD, and information on possible toxic components are not yet known by the majority of Ethiopian industries. Very few number of textile plants like kombolcha and Ethiopian have some data although these values are not very reliable. Data of other plants such as Tabacchi ceramics, Fana oxygen and acetylene factory, Addis brewery, sugar industries at Wonji/Shoa, Ethiopian pickling and Awash tannery are very scanty.

Processing activities in most of the Ethiopian manufacturing industries generate solid wastes with hazardous chemicals components some industries like the metal works, and beverages are reported not to have contain any hazardous component disposed of into the environment.

The only iron and steel plant which is situated in Akaki Town pollutes near by stream. The gases emitted during the process, the cooling applied water, and the sludges from the cooling circuits and waste water from the rolling mill led to near by streams and pollutes the stream water with hazardous chemicals.

Industrial plants like printing presses employ incineration as a disposal method of solid wastes they produce. Sugar industries apply incineration and land spreading as a means of solid waste disposal. Industrial plants in beverages, tanning and textile industries use the methods of land spreading, sanitary land fill and incineration to dispose of solid wastes. Stinking smells and duty particles are types of air pollution prevailing in most of the Ethiopian manufacturing industries.

Conclusion

The Ethiopian pulp and paper factory is interested in recovery of waste components such as filters, fine fibers and waste water. Despite the fact that Ethiopian printing process are less contributors to environmental pollution, it is to be noted that there is much to do in recovering waste paper.

Plants like tobacci ceramics and muger cement are conscious of reusing waste heat.Tabacci employees waste heat for drying green tile and filter cakes, while muger cement plant uses waste heat for preheating combustion air. Broken glasses from breweries and soft drink factories considered as solid waste are supplied to glass factories to be used as raw material. No plant in the Ethiopian beverage industry has taken any measure for recovering waste heat. Kombolcha and Addis tanneries do recover waste by recycling residual chrome tanning liquor. These are no measures taken as far as recovery of waste heat is concerned. In most of the tanneries the extent of pollution is influenced by climatic changes since during rainy seasons the amount of pollution decreases due to dilution.

It has been investigated that most of the textile plants have not considered the recovery of any of the waste components. However some factories (Ethiopian textile, Akaki textile) have taken measures for recovering waste heat making use of condensate recovery system. Some soap factories are involved in the recovery of dissolved soap and caustic soda. Other plants like tobacco curing plant and Addis Ababa cigarette factories are also involved in waste

recovery. Such measures include reusing the green tobacco leaf waste as a source of biogas energy, reducing of waste dust by air conditioning and converting fine tobacco particles to chewing tobacco.

In general, there is no any legally constituted regulatory agency or authority that demands the treatment of industrial wastes in Ethiopia. The country does not have any approved policy on industrial waste management. However, factories like Gullele soap, Wonji/Shoa sugar and Akaki metal products plants reported that Addis Ababa municipality, Awash valley Development Authority and ministry of Health, respectively, have demanded the treatment of wastes from these plants. Due to the fact that there is very little or no awareness about the impact of industrial waste on the environment, no efforts have up to now been made to clearly identify the types of hazardous chemicals generated, any health impacts of those harmful effluent and occupational; diseases encountered. The majority of the manufacturing industries do not have any reliable data on the volume of liquid effluent discharged to nearby streams, nor do they are aware of the potential danger associated with hazardous wastes generated from industries.

I hope, experience gathered by working on environmental issues with iron and steel plants around the world forming such meeting will greatly help to solve and successfully identify develop mechanisms and methodologies which significantly reduce/prevent waste.

Hence, international body shall assist the developing countries financially and also sharing their experience to prevent the industrial pollution.

KENYA

COUNTRY PAPER PREPARED FOR THE EXPERT GROUP MEETING ON COOPERATION IN ENVIRONMENT MANAGEMENT IN IRON AND STEEL INDUSTRY

1.0 INTRODUCTION

1.1 Iron and Steel Industry within the metal industries forms 13% of the manufacturing sector. The manufacturing sector contributes about 13.5% of the GDP in the country's economy. There has however been a slow growth in the manufacturing sector, iron and steel included in the last five years, with the modest growth of physical output of 1.2% recorded in 1992.

1.2 Iron and Steel Industry being one of the core industries in the country contributes significantly to the development of other industries. The products from the iron and steel industry provide the raw materials for other industries e.g. construction, Agriculture, Building and Transport industries.

1.3 Kenya's Iron and Steel industry may be classified into five major categories depending on the type of products manufactured. These five major categories are;-

(i) Steel melting and Hot rolling

(ii) Wire rod and wire drawing

(iii) Cold rolling and Galvanizing

(iv) Castings (foundry products)

(vi) Pipes and tubular products.

1.4 Iron and Steel Industry in the country has been given high priority in the industrial development plan since independence due to its contribution to other industries. The iron and steel industry presently comprises of seven firms who are involved in the smelting and hot rolling of iron and steel scrap into ingots and billets, rolling the ingots and billets into the desired shapes and sizes. one firm is involved in the production of wire rods and wires from imported billets. The wire rods from this firm are used by about nine industries for further processing into other wire products.

1.5 There are two industries in Kenya involved in the production of cold rolled flat products which are then passed to several galvanizing firms. In addition there are about six major foundry firms involved in the production of casted products from iron and steel scrap. Last but not least there are about five pipe manufacturers in Kenya. They manufacture different types of pipes and hollow sections for different uses.

2.0 INVESTMENT

2.1 Iron and Steel Industry, being a priority industry has seen tremendous investment. An estimated total investment of about Ksh.5.0 billion has been committed in the establishment of iron and steel related firms for the production and processing of the various iron and steel products. Among the industries in the iron and steel sector, there are both foreign and locally owned firms.

3.0 PRODUCTS

3.1 The products range in this sector is varied according to the process employed. These include;- Pencil ingots, billets, wire rods, rounds, square, reinforcing bars, sections from the smelting and hot rolling firms. Other products include metal fasteners, barbed wire, fencing wire, pipes and different types of tubular sections.

3.2 The products from the galvanizing and cold rolling firms include cold rolled sheets and coils, galvanised corrugated iron sheets, steel drums, butt hinges, window louvres, wheel barrows, gutters, furniture tubes black and galvanised water pipes, square and rectangular hollow sections, Z-purling sections, angles and channels.

3.3 Products from the foundry firms include man-hole covers and frames, sanitary fittings, spares, pump castings, impellers, sugar cane crashing rollers, pulleys, flanges, couplings, Train brake shoes, lathe beds etc. It is estimated that over 159,134 tons of products are produced annually. The quality in this sector is encouraging considering that products from the firms do meet the international standards, and therefore find their way in the export market especially in the COMESA region.

4.0 PRODUCTION CAPACITIES

4.1 The overall installed capacity of the iron and steel industry is estimated to be about 600,000 tons/year. This can be distributed further to reflect the actual installed capacities of the various processes involved in this sector. The total installed scrap smelting capacity is 95,000 tons/year. Likewise the total installed cold rolling capacity of flat products is 286,000 tons/year. Most of the firms operate at between 40-60% capacity utilization.

5.0 TECHNOLOGY

5.1 The technology involved in the iron and steel industry varies in accordance with the type of products being produced. The most common production processes in our kenyan iron and steel industry include:

(i) Smelting

(ii) Profile rolling

(iii) Wire drawing

(iv) Flat Products Rolling

(v) Foundry

These are analyzed as follows:

(i) **SMELTING**

The local smelting facilities use two processes. The smelting based on electric furnaces of between 12-13 tonnes and 15 tonnes capacity. Most integrated steel mills (i.e. steel mills with both smelting and rolling capacities) apply this type of furnace. The other smelting process employs the induction furnace.

(ii) **PROFILE ROLLING**

The raw material used in this production process is either steel billet or steel pencil ingot. The production operation is hot rolling. Here, the billet or ingot is heated in a re-heat furnace to obtain the correct temperature. At this temperature the ingot/billets are squeezed through rollers to produce the elongated profiles. Majority of the technology employed in the iron and steel industry is labour intensive. The most common problems associated, with this technology include wear of bearing housing, omission of recuperator in the reheat furnaces. The products in these process include angles, section reinforcing bars, squares etc.

(iii) **WIRE DRAWING**

Products from the profile rolling process like wire rods are semi-finished items which undergo further process into final products. The wire rod as annealed or un annealed, forms the raw material for the manufacture of all wire products and some fasteners. The wire rod undergoes a process called drawing to produce wire. The process involves the reduction in diameter of the wire rod and an increase in length by passing through a small orifice in a die. The process is repeated to obtain the required final cross sectional diameter. The product from the drawing process, i.e. wire, could be used in this finished condition or it may be coated with zinc, through the galvanizing process, for use in the manufacture of various wire products including chain link, barbed wire, chicken wire mesh. The non-galvanized wire is used for the production of wire nails, rivets, welded wire mesh, fencing staples etc.

(iv) **FOUNDRY**

This process involves smelting the metal scrap or billet. The molten metal is then poured into moulds that solidifies into semi-finished parts or components. There are various methods for preparing the moulds depending on the composition of the metal and the desired properties.

6.1 RAW MATERIALS

6.1 The raw materials mainly used in the iron and steel industry sector are scrap metal, billets, hot rolled coils and wire rods. Other raw materials used in the iron and steel industry include limestones, coke, flushes such as dolomite, fluorspar, refractors and ferro - alloying elements.

6.2 The country does not however produce iron and steel from iron ore since no iron ore is mined locally. However, from studies carried out in the country, there are deposits of iron ore in several places. The quantities and qualities have not yet been established. Most of the raw material used in the iron and steel industry is imported mainly from Zimbabwe, Japan, Belgium and lately from South Africa. Only scrap metal is sourced locally.

6.3 The establishment of the exact quantities of iron ore deposits in the country is considered vital, as this will serve as a reliable source of the raw materials required in the iron and steel industry sector.

7.0 MARKETS

7.1 The market for the products in the iron and steel industry is mostly local with a small percentage of the products exported mainly in the COMESA market. The main export destinations for products in this sector include Uganda, Rwanda, Burundi, Zaire, Tanzania and other PTA countries.

8.0 PROBLEMS AND CONSTRAINTS

8.1 The problems that the Iron and Steel industrial sector faces include mainly;-

(i) ENVIRONMENTAL PROBLEMS Categorised as follows;-

(a) AIR POLLUTION

The furnaces used in smelters for scrap or heating furnaces mostly employ industrial oil and electricity. The amount of wasted gases generated and the dust content is quite substantial No gas cleaning facilities exist in most of the steel rolling mills in Kenya.

(b) SOLID WASTE

The solid waste generated in most mills are slag and debris. The slag and debris are usually dumped in adjoining land. No better use has yet been found of this slag.

(c) WORKING CONDITION

Most Iron and Steel Industries in Kenya are still lacking in proper control of the following, noise pollution, protective clothing, lighting system, exposure to fumes,thermal exposure in the blast furnaces.

(ii) HIGH ENERGY COSTS

The steel Industry is a very large consumer of energy, both fuel and electrical energy. The electrical tariffs in Kenya are quite high. This makes the production costs quite high.

(ii) UNDER UTILIZATION OF INSTALLED CAPACITY

This has been mainly due to shortage of raw material due to lack of foreign exchange, overproduction and monopolistic practices. However, with the recently introduced liberalization of the economy, it is expected that the firms in the sub-sector will enhance their production through improved quality control programmes so that products from the industry can compete with imports and also increase their capacities.

(iv) LIMITED SOURCE OF SCRAP METAL

Scrap metal which is the major locally sourced raw material is in limited supplies. This lowers the production capacity of most of the smelting mills.

8.0 POLICY FRAMEWORK

8.1 The Kenya Government Policy at present aims at the development of an iron and steel industry that will be efficient and able to depend on itself in raw material supply and be able to export. With this in mind the current development plan (1994-1996) advocates for the establishment of a direct reduction plant to produce more than 200,000 tonnes/year. This therefore calls for an in depth survey and study of the known locally deposits of iron ore with a view of establishing their exact quantity, quality and the viability of exploiting the Minerals.

8.2 In this era of liberalization the Government is moving away from protecting inefficient industries through tariffs and removal of subsidies. The industries are therefore required to be efficient and be able to compete. This competitiveness can only be brought about by high quality products. The Kenya Bureau of Standards in liaison with various quality control agencies is taking necessary measures to ensure that commodities entering the market conform to both the local and international standards, Emphasis is being laid on the right quality raw material. It is also in the Government policy to expand the operations of Kenya Bureau of Standards to include import inspection at all entry points in the country to prevent dumping of inferior goods and to create a level playing field for the locally produced steel products.

8.3 Since the level of technology in the iron and steel industry is still not very high, the Government during this plan period is strengthening its research institutions, Kenya Industrial Research and Development Institute (KIRDI) in particular to be able to carry out R&D in metallurgy to adapt, develop and improve the current technology employed in the iron and steel industry. KIRDI has also been identified by the Government to be the collaborating centre for the Metallurgical Technology Centre (MTC) created sometimes ago to conduct Metallurgical and technology research in the region.

DIRECTORATE OF INDUSTRIES

MINISTRY OF COMMERCE AND INDUSTRY

NAIROBI, KENYA.

JUNE, 1995

MAURITANIA

PARTICIPATION TO THE DISCUSSION ON ENVIRONMENTAL ISSUE

PRESENTED BY

MOCTAR SALEM
MAURITANIA MINING COMPANY

Mr chairman

Dear colleagues

It is an honor to me to present to you some thoughts about environment management as a participation to the ongoing discussion
The planet had preserved itself for millions of years But in the last few decades humanity had caused damages that might take centuries to repair And if such behavior run out of hand, damages would deepen and might turn to be hopelessly irreversible
If we continue, on the ongoing pace, to use up natural ressources, to pollute and waste, then we are mistaking ; ironically we will follow the declining route of ancient civilisation.
Humanity should know that the bountiful earth is fragile, and should strive to create wealth without endangering the delicate balance of earth's ressources, and recognize and respect the transcending sovereignety of our unique, livable earth. Positive attitude toward our environment must be awakened in each of us, and damaging production and consumption pattern should be dealt with thoughtfully and quickly. Such a goal can be achieved through a new order, where nations gear their means, within a global patnership, to overcome confrontation, to foster a climat of fruitful cooperation for all.

Mr Chairman,

The United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, on June 1992, offered a unique opportunity to establish the basis for the major shift required to put our planet on the path towards a more secure and sustainable future. The conference adopted the concept of sustainable development. This term, coined by Brundtland commission, is best discribed as economic progress which meets all our needs without leaving future generations with fewer resources than we enjoy. A way of living off of nature's income rather than its capital account. Participants came to understand that the issue do not just concern plants and animals but way of life. Indeed, sustainable development is not easy to achieve. It demands changes in way of life particulary for the more wealthy nations who continue to draw on nature's capital.

UNCED took a quantum leap forward, in recognizing that peace, development and environmental protection are interdependent and indivisible. It seemed uneasy to speak about environment while the poor are hanking after basic necessities ; while the majority of the world population is compelled to eke out a living, devoid of any social net, bereft of legal and human rights.

The third world backwardness is the geatest threat to environment. And UNCED recognized that there is a new global effort to make harmony between the elements of the international economic system and mankind's need for safe and stable natural environment.
Therefore, it was found, that the interactions among sectors, and the intertwined nature of economic social trends warranted a new approch to defining and organising tasks both at the national level and the international one. It was obvious, that it would be no progress, if the global economy lacks dynamism, stability and was beset withuncertainties, if the developing countries were weighted down by external indebtedness, if development finance was inadequate, barriers restricting access to markets, commodity prices and terms of trade remaining depressed.

Mr chairman,

Today, three years after the UNCED conference, we may say that worthy thoughts concerned with worthy deeds, for once did not fall on stony grounds. A comprehensive blue print - Agenda 21 - for global actions to affect the transition to sustainable development, is now widely accepted by all stakeholders. More precisely, the nature of the environment and development debate has changed forever. Issues such as poverty, trade and debt are put on the negociating table and, as never before, discussed by such a broad range of governemental and non governemental actors.

However, we should continue to push vigourously and relentlessly for steps yet to be taken. We should fight to ensure that tools created and agreed upon to achieve a new pattern of civilisation are used fully and effectively.

Mr chairman,

Seemingly, our meeting is going to put us on the testing bench as we will find ourselves in odd-line with all the above statements. Because we will have to deal with conflicts and dilemmas.
Infact, as stated in our background paper, first, our sector is one of the major source of air, water, land pollution and the effluents and waste of our plants are difficult to trap, isolate and process at acceptable cost. Second, the iron and steel industry is one of the most capital intensive sectors of the economy, and therefore many developping countries suffering shortage of capital are condemned to invest only in operational equipment.

Ten years ago, some of us would have said, echoing a famous leader pathetic call, "of all the polluants we face, the worst is poverty", meaning we want industry even with its inherent pollution problems. In other words, they were prepared to adopt classic ways with its drawbacks of environmental problems as part of the package.
Now, due to the growing public awareness this approch is little bit fading. Most leaders, today, recognize that polluting plants and processes are socially and environmentally unacceptable.

More over, business community, also agree that business excellence and environmental concern can be dealt with simultaneously. In fact, they accept that, in the new futur it will be impossible to separate the two.
According to these trends it will be mistaking to ignore the environmental friendly technologies and consider them as unvalued assets. The plants with dated technologies will be progressively dismantled.

So, if we want to harness effectively the ineluctable changes in near futur, industry must :

- Commit itself to the effective use of cleaner technologies ;

- Actively participate in the legislation process, so that the most efficient mix of - government regulations and self-regulations may be developed ;

- Monitor regular national and regional surveys on environment. And publisize reports whose documentation juxtapose programme objectives and targets againt results. This will gain us visibility.

- Develop hands on operational assistance programs and produce guidelines and operative manuels for problematic issues in the iron and steel sector

- Beget funding for environmental programs, and so, alleviate the problem of incurring "extra-costs"

Mr Chairman,

Whatever strong might be our commitment to tackle the pollution problems locally, and regionally, we would need assistance
New patterns of international cooperation are, usually, badly needed to adress global concerns among which pollution is the most important
Such cooperation shall emerge in the form of an internalisation of environmental cost

Consequently, aid partners have eventually to understand that cleaner technology must be transfered from those who develop it to those who need it
Government of both industrial and developing countries must work together to establish the required political, economic and legal frameworks to facilitate this process of technological transfert

Likewise, institutions organizing our present meeting could play the following significant roles

First, UNIDO, could manage channeling funds, expertise toward our industry, and through its national offices network, facilitate dissemination of relevant information about environment.

Second, AISA, that we consider an instututional umbrella for our industry, could serve as a shared structure where continental agreements can be forged, ressources pooled to achieve common goals and regulations set for existing and incoming plants.

Third, SASPCC, the coordinating council for the most advanced country in africa, could lead the movement and spread, continent wide, south african steel industry environmental achievements.

Thank you and I wish fruitful discussions for us.

FORMAT OF A STUDY ON THE ENVIRONMENTAL IMPACT OF A PROJECT

0. SUBJECT OF THE PROJECT

1. RECEIVING ENVIRONMENT

1.1 Geographical conditions
1.2. Geological and hydrogeological conditions
1.3 Climatic and hydrographical conditions
- temperatures
- precipitations
- evaporation
- moisture
- wind pattern
- currents
- streams

1.4 Biological conditions
1.5. Human conditions
1.6. Economy

2. ENVIRONMENTAL IMPACT OF THE PROJECT

2.1. Rejects
- chemical assaying
- volumes
- lifetime

2.2 Impact on the environment
- on water
- on earth
- on atmosphere
- on biological conditions
- on human conditions

  - public health
  - people's movements
  - national development
  - archeological sites
  - impact on history and religion
  - social clashes

3. SCIENTIFIC SUPERVISION

4. CONCLUSION

GRAVITATIONAL SPIRAL PROCESSING OF PRECONCENTRATE ORES

STUDY CASE

The advantage of this study, summoned to the maximum, is to draw a methodology approach related to the environmental effects of a given project. Therefore the chapter headings are more important than the following discussions.

0 SUBJECT OF THE PROJECT

To re-process in Nouadhibou, in order to upgrade them, the pre-concentrate oxydized ores produced in Zouerate through magnetic separation

The processing in Nouadhibou consists in a spiral gravitational separation, rejecting deads to be shot in the two natural depressions beside the upgrading facilities. The environmental impact of this project will be summarized hereunder

1 RECEIVING ENVIRONMENT : THE CAP BLANC PENINSULA

1 1 Geographical conditions : A sandy shelf

The Cap Blanc peninsula - spit of land bordered with low « white » cliffs, southwards over 50 kms long and 7 to 8 kms wide - is made of a low yellow White sandy shelf, with many small props (20 m maximum height) giving, this eroded relief, an undulating aspect

1 2 Geological and hydrogeological conditions : porous sandstones

The subhorizontal geological deposits of the Cap Blanc peninsula are comparatively recent and include up to down :

- a level of beaches mainly made of shells.

- some quaternary formations, many hundreds of meters thick, showing many facies changes , some continental sandstones and fossilized sandhills. The sandstones are well stratified and slightly dip westwards. The shelf soil is made of desert minerals and does not include vegetal land because of very few vegetation. The rock is everywhere bare and very poor - therefore the soil cannot be cultivated.

There are no fresh water oppotunities in the peninsula. The phreatic water in this area is made of sea water only, with rain water in some cases. Its level is almost that of the sea

1 3 Climatic and hydrographical conditions : a desert coast

The climate is characterized by its very high dryness, even next to the sea

Because of the influence of the sea, the temperatures are rather cool, between 12° C in January and 31° in September.

Average precipitation are low some tens of mm a year But evaporation is very high, it would be 200 times more than rainfall

Average comparative air moisture fluctuates from 52 to 65 %.

Wind pattern : winds are an important element in the dynamics of the region, because of the disturbance they generate on the one hand and for eolian transport on the other hand

The region is characterized by a great stability of the winds which blow almost all northwards. Their force is almost the same all year long as their speed is more than 6m/s about 90 % of the time. It may reach 22 m/s in the mid-year

Currents : the region is subject to two tides by day. The utmost sea levels are 0.34 m for low tides and 2.30 m for high ones. That is why the erosion of the ebb current (speed : 0.1 m/s) is higher than the flood one. Cliffs erosion is 0.5 m by decade

On the western coast of the peninsula, a North to South Atlantic current has generated an 8 m high undersea sand bar.

Hydrography here depends on the climate and in the whole region there is no permanent stream no any hints of a big wadi.

1.4. Biological conditions

In its natural condition, the Cap Blanc peninsula, with no fresh water and swept by frequent and strong winds, shows no vegetation.

The fauna of the small surface of the peninsula is also poor.

But, because of its very important fish reserves, some monk seals (Monachus monachus) shelter in some caves along the rocky coasts.

The special importance of the Cap Blanc peninsula is found in the proximity of the Banc d'Arguin National Park, located 50-170 kms Southwards. It is constituted of shores divided into hatches, islands, sand banks and low sea areas spreading over 12000 km² and marking « the union between the desert and the sea ».

Because of the rich alimentary chain here, this muddy coast complies with conditions, not only for a vivid sea fauna, but also for he wintering and the intermediate stay of millions of migratory birds : more than 108 species, some of which unique, have been registered there.

1.5. Human conditions

The population of the region, estimated 60.000 inhabitants, is exclusively urban. Nomadism with camels, although low in the past, has disappeared completely

1.6. Economy

The Cap Blan peninsula shelters two important Mauritanian ports through which the fishing products and iron ore, Mauritania's main ressources, are exported.

2 - RELEVANT ENVIRONMENTAL IMPACT OF THE PROJECT

As indicated hereinabove, the project consists in the upgrading of the pre-concentrate ores mined in Zouerate. The process applied is the wet washingspiral mechanical gravitational separation.

It is a well-known method already proven. The separation medium is water exclusively. In this case sea water is used at the rate of 1 m3 / ton of ore.

2.1 Processing rejects

The rejects from the processing are stockpiled in two natural depressions next to the separation workshop.

In fact, the deads, considering the configuration of this method, will take the shape of an a ueous solution with a 217 g/l pulp/solid concentration corresponding to a 736 m3/h pulp volume. The pulp current will be brought to the selected natural depressions through pipeline.

The residual ore content of the deads is 29 % Fe and, in dry state, granulometry is the following :

Oversize percentage (%)		Breaking (microns)
13		1 600
12.2		1 250
10.3	49 %	1 000
13.5		800
6.5		630
6.4		400
2.4		315
3.3		160
7.6		40
19.6		40
100 %		

About 20 % of the deads have a 40 microns size, but the clay content is low.

Dead materials are grey and do not smell.
Because of their density, they may deposit.

- Heavy metals samples have been taken to study the presence of metals like arsenic, mercury, cadmium and lead. The content of such metals in the sea water was analyzed first. Then the samples were eluted according to the DIN standard.
  The outcome is the following :

PARAMETERS	ORIGINAL SEA WATER mg/l	ELUTED PRODUCT mg/l	ADMISSIBLE LIMIT VALUES-mg/l
PH VALUE	7.9	7.9	6.5 9.5
ARSENIC (AS)	0.003	0.001	0.01
LEAD (Pb)	0.010	0.039	0.04
CADMIUM (cd)	0.007	0.008	0.005
MERCURY (Hg)	0.001	0.001	0.001

The differences in arsenic and cadmium contents in the original sea water and the eluted product are explained by the precision of the measuring instru nents

- Stockpiling capacity : The filling volumes of the depressions where the deads are to be poured, have been established according to the topographical maps. An embanking of the materi proportionately to 1 to 5 in the edges and a maximum 12 m shelf height has been assumed.
Assuming a loose density of 3.5 t/m3, the filling quantity would be 12.5 Mt.
Reducing the projected quantity of deads leads to a 20 years time to fill both depressions.

2.2. Impact on the environment

On sea water

The sea water in the pulp containing the deads will run back to the sea through the sandy massif of the peninsula without any impurity ; no chemical additive is provided for in the preconcentrates processing method. Such a water will not run to the bay, but westwards to the Atlantic Ocean, as the sandstone layers are sloped that way

Th water will be blended by the water stream from the North to that of the Atlantic Ocean. Therefore, there no chance that it direct towards the Banc d'Arguin National Park because the stream runs westwards from Cap Timirist.

Th a change in water quality in the long term is not foresee able, nor the pollution of fresh water reserves.

On earth

The deads have a low clay content, less than 1 %. Therefore it can be assumed that water draining from the porous substratum is ensured in the long term and that there is no chance that the substratum be made tight by the clayey materials

Moreover, the filling of the depressions because of the quantities cannot cause earthquakes, and stockpiling itself does not bring about earth tremors.

The geotechnical effects are insignificant , it is not planned to erect buildings, except the pipeline, and the region will not be provided for the erection of houses, no for farming. Finally, it does not include any protected natural site

On atmosphere

It is not expected that dust arise from the deads stockpiles because the salts in the evaporating sea water immobilize the fine grains so that even the high winds cannot recover them easily

The separation workshop too does not give of any dangerous gas or smell

On biological conditions

As described above, the restitution in the ocean of the sea water used in the processing method and included in the rejects, is made slowly through filtration in the existing ground, without generating therefore any violent current nor variation in temperatures. It must be reminded that the water thrown is not poliuted by any chemical additive

Moreover, it seems that the two natural depressions in which the rejects are to be collected, are not used either as a nesting-box nor as an incubator nor a burrow by the birds or animals.

There are many birds around the Cap Blanc peninsula, but they are sea birds accustomated to live in beaches, rocks or in the sea. The project will disturb in no way their way of life

On human conditions

The greatest difference with other projects using water is that in this cas it does not deal with fresh water but with salt water. Therefore there will be no effect related to stagnant fresh waters, such as parasitic disease or the risk of euthrophy related to abundant grasses

Therefore people's health will not be affected.

No archaelogical site has been proven in the area where the rejects are to be stockpiled and the more important excavation sites are located much to the North of the region. The area considered has no historical no religions importance and thus no social clash can be feared

3 SCIENTIFIC SUPERVISION

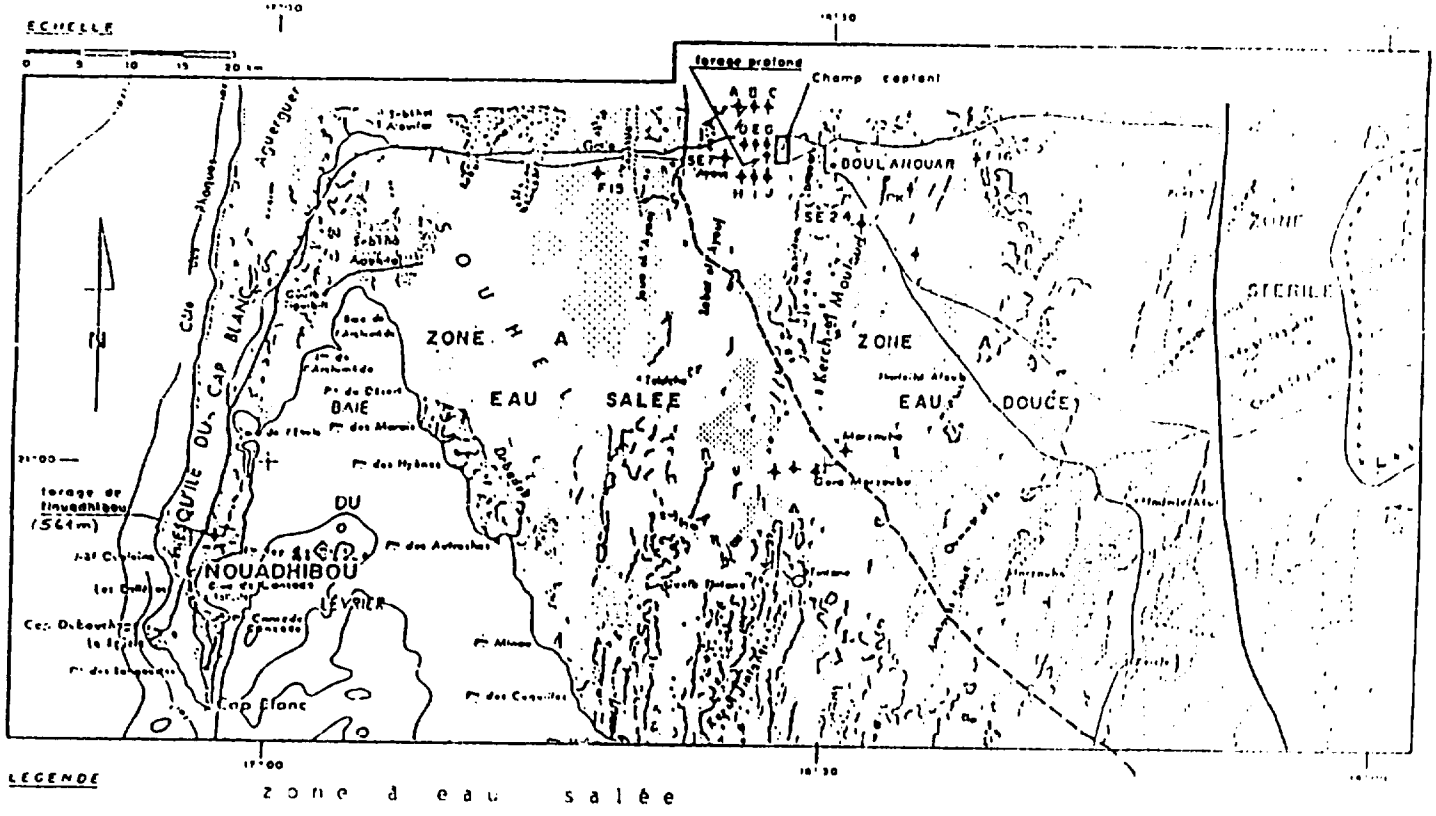
In order to follow-up the project and its effects, SNIM, the promotor of the project, expects to make the Mauritanian scientific centers interested

To such end, the « Institut Mauritanien des Recherches Scientifiques » and « Centre National de Recherches Océanographiques et des Pêches » have been requested to send some experts to draw up a draft agreement for the follow-up the environmental impact of the project

The plan to visit the site once a year during processing time.

4 CONCLUSIONS

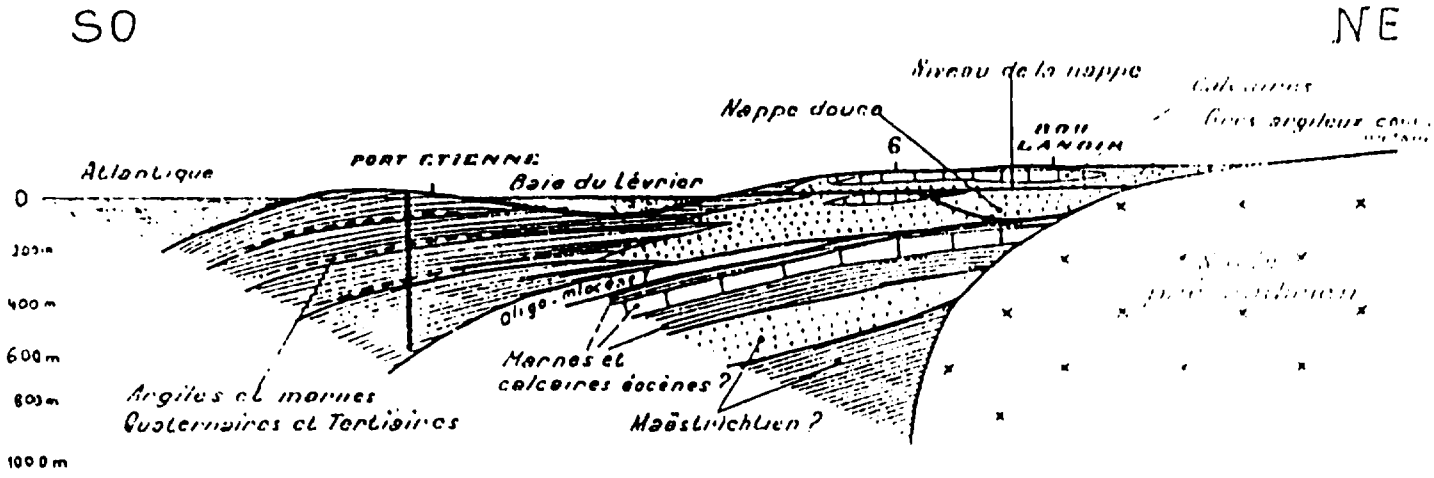
Environmental impacts of the project are insignificant and SNIM has the ability to deal with any alarming signs which may appear.



FORAGES REALISES POUR L'ALIMENTATION EN EAU DE NOUADHIBOU

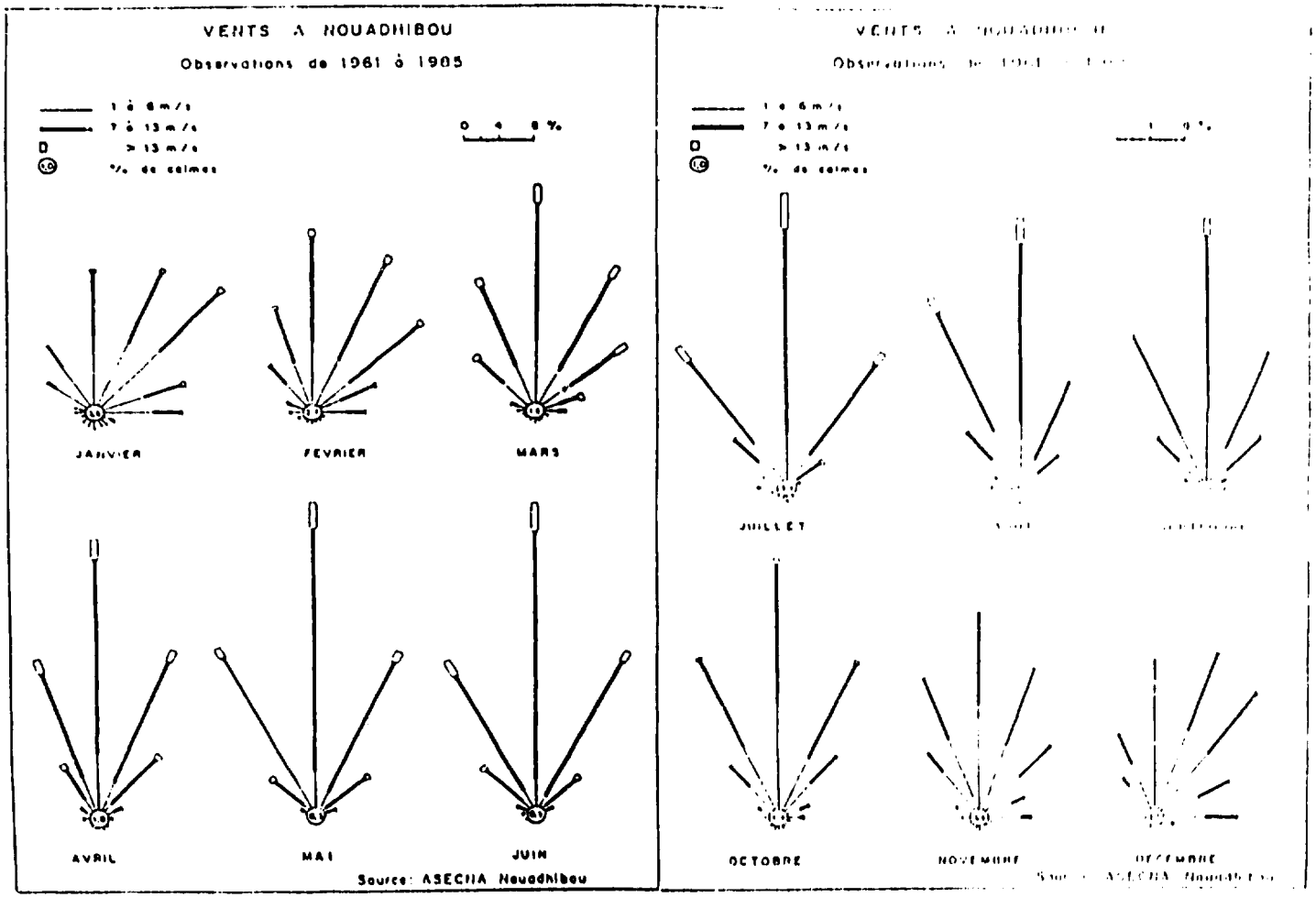
MC	Projet: Etude d´impact de l´environnement	Annexe 4

COUPE GÉOLOGIQUE SCHÉMATIQUE



DRESSÉ PAR : R. DEGALLIER ET H. PLOTE

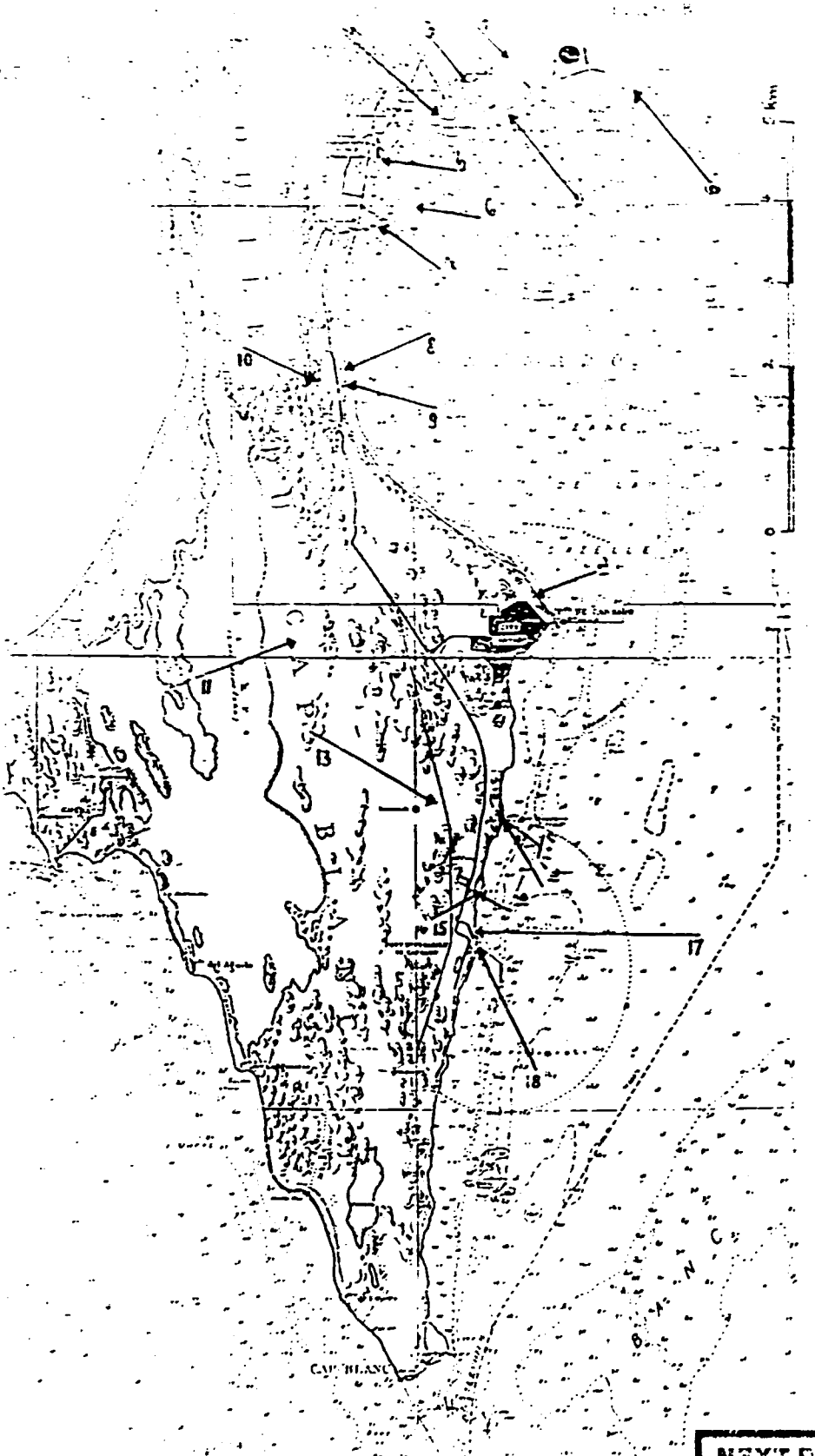
S.G.P.M. 1959. R. DEGALLIER n° 28



Source : SOGREAH 1988

- 32 -

MC	Projet: Etude d´impact de l´environnement	Annexe 7



Source : CNROP, MDB

NEXT PAGE(S) left blank

MC	Projet: Etude d´impact de l´environnement	Annexe 9

NIGERIA

THE NIGERIAN CONTRIBUTION ON THE EGM ON COOPERATION ON ENVIRONMENTAL MANAGEMENT IN THE IRON AND STEEL INDUSTRY FOR THE AFRICAN REGION

BY DR. E. MUDIARE
AJAOKUTA STEEL COMPANY
NIGERIA

THE NIGERIAN CONTRIBUTION ON THE EGM ON COOPERATION ON ENVIRONMENTAL MANAGEMENT IN THE IRON AND STEEL INDUSTRY FOR THE AFRICAN REGION.

1. INTRODUCTION

For developing countries, such as Nigeria, industrialisation is a mandatory vehicle for creating the economic growth and social development necessary to provide basic needs and augment the quality of life for the population as a whole. Industrial activities, by their very nature, are based on cycles which diverge from the natural ecological cycles: hence their propensity to impact the natural environment in an adverse manner. Programs for protecting and improving the human environment for the present and future generations must therefore be a necessary component of all industrialisation plans.

The past experience of developed countries has amply demonstrated that prevention is less costly than remedy where pollution is concerned. Ignoring environmental issues has caused several tragedies, with irremediable damage to human health in several industrialised countries. Fortunately, today, pollution control technology is now well developed and only needs to be learned and selected by, and transferred to, those who need it. There is therefore hope that developing countries may be spared the folly of leaping just first and looking after, which is the root course of the ecological disasters in developed countries.

Most countries of our continent are either newcomers to the iron and steel industry or are just planning/erecting/commissioning iron and steel plants. It is an established fact that the key to effective environmental management is "awareness" and "consciousness" of the potential risks and problems. If this EGM helps to promote this awareness, this consciousness, in top government officials who formulate policy and top management of our iron and steel plants, then a giant step would have been taken in our efforts to launch a virile iron and steel industry with a properly managed environment.

This paper will focus on describing the Nigerian iron and steel industry, so as to expose for critical review the areas where attention needs to be focused in environmental management.

2. THE NIGERIAN STEEL INDUSTRY

The Nigerian steel industry can be divided into privately owned plants and government or publicly owned steel/steel processing plants. There are about

thirty private mills, with the largest operating as mini mills equipped with electric arc furnaces which consume scrap as their primary source of iron. Since the contribution of private mills is relatively small, attention will be focused on the government plants.

Nigeria has two integrated steel plants:

The Delta Steel plant at Owvian-Aladja and the Ajaokuta Steel plant at Ajaokuta. the Delta Steel plant or Delta Steel Company (DSC) uses the Direct Reduction (DR) technology based on the Midrex process wherein the ore is reduced to sponge iron using natural gas available from Nigerian oil fields. The direct-reduced iron is smelted in an electric arc furnace to produce plain carbon steel which is turned into billets by continuous casting. The billets are rolled into long products both at DSC and three rolling mills located at other sites.

The plant has been operated using imported iron ore. In response to a recent foreign exchange squeeze, plant trials using indigenous ore from the local Itakpe ore deposit at Ajaokuta have been successfully concluded. The logistics of supplying iron ore to DSC from this source are being worked out. The DSC plant has an installed capacity of 1.0 million tones of steel per year and has been operating since it was commissioned in 1982, although at less than 20 per cent capacity.

The Ajaokuta Steel plant or Ajaokuta Steel Company limited (ASCL), on the other hand, is based on the conventional blast furnace and Basic Oxygen furnace route of steelmaking. Its source of ore when operational will be the Itakpe ore deposit, with the coking coal for the blast furnace imported. The blast furnace is to be fed with 100 per cent self-fluxing sinter. The raw materials for the fluxes and refractories are to be sourced from local deposits. The plant is 98,9% complete and is awaiting completion and final integrated commissioning.

ASCL has four rolling mills: The Billet Mill, the Medium Section and Structural Mill with a capacity for producing rails, the Light section mill and the Wire Rod Mill. Using a backward integration logic, the Light Section and Wire Rod Mills were commissioned in the early 1980's and operated for some time using imported billets. They had to be shut down because of various operational problems.

Both the Light Section and Wire Rod Mills have now been fully reactivated and will go into production very soon using imported billets. Simultaneously efforts are being made to complete and commission the primary units, i.e the blast furnace and the Steelmaking units. The ASCL plant has a capacity of 1.3

million tonnes of steel per year at its first design stage.

ASCL also has an array of auxiliary units - the lime plant, the alumino-silicate refractory shop, the tar-bonded dolomite shop, the oxygen plant and a captive gas thermalpower plant. Anticipating problems of spare parts supply to the plant, there is also provided a Repair Shops complex comprising of a foundry and Pattermaking shop, a Mechanical Repair Shop, a Forge and Fabrication Shop, a Rubberising Shop, and a Power and Equipment Repair Shop. This complex mill supply about 70 percent of the spares requirement of the plant, with some provision made for catering to outside customers.

Finally there are three publicly owned rolling mills located at Katsina and Jos in Northern Nigeria and Oshogbo in the South West. These have been run with billets from DSC and imports. In response to the need for flat rolled products a flat sheet production unit is to be built into the ASCL plant and it is based on the new CSP technology.

3 POLLUTION - GENERATING ACTIVITIES

From the brief description of the structure of the Nigerian steel industry depicted above, it is easy to list various pollution-generating activities that need to be monitored and controlled. These include:

3.1 Mining

Major Mining operations for iron ore, limestone, dolomite and refractory clays.

3.2 Raw Materials Preparation

The operations of transporting and stockpiling the above materials; blending; iron ore benification; screening; crushing and grinding; coke production; the manufacture of sinter for the blast furnace and pellets for the DR plant; the burning of limestone and lime processing; and the fabrication and firing of refractories.

3.3 Ironmaking

The production of DR sponge iron; the operation of the blast furnace to produce pig iron for sundry use and liquid hot metal for steelmaking.

3.4 Steelmaking and continuous casting

The manufacture of steel in the basic oxygen furnace; the operation of an electric arc furnace in the DR plant; continuous casting.

3.5 Hot and cold rolling

Inspection of ingots and billets before hot rolling; their preparation, reheating and hot rolling to produce hot rolled products; fabrication of hot rolled products to produce light angles and sections; cold drawing/cold rolling; cutting and machining for engineering use.

3.6 Manufacture of Steel-based products

The forming/machining, assembling, painting enamelling or coating of cold rolled, drawn or shaped products to make final engineering goods for sale.

It is to be noted that the above list is far from exhaustive and is meant only to be a guide for discussions.

4. ENVIRONMENTAL PROBLEMS AND POLLUTANTS AND THEIR SOURCES

From the above listing of pollution generating activities, the sources of environmental problems and pollutants can be easily identified and categorised as follows:

4.1 EMISSIONS TO THE ATMOSPHERE

These include:

4.1.1 Dust, fume and steam

- Granular particulate generated in mining, crushing/grinding and screening operations. These are spread during transportation, released at points of belt transfers, or blown from storage heaps and blending beds by winds.

- Fumes produced in basic oxygen steelmaking or in electric arc furnaces.

- Steam generated by wet quenching of coke.

- Heavy visible emissions due to the presence of oil in scrap or mill scale

returns to sintering plants.

4.1.2 Acid Emissions

- Acidic oxides of nitrogen and sulphur (NOx, SOx) and fluorides and chlorides (F^-,Cl^-) present in materials heated or formed during high temperature combustion.

4.1.3 Fugitive Emissions at Intermittent Operations

- Fumes of iron oxides, graphite (kish), soot and silica during pouring and alloying operations.

- Dusts during charging of coke ovens and pushing coke coarse grit.

- Emissions from coke ovens and by-product plants.

4.1.4 Toxic gases

- Toxic CO produced in blast furnaces, steelmaking furnaces and sinter plant gases.

- CO and H_2 present in coke oven gases.

- CO and H_2 from reformed natural gas used as reductant in the DR process.

4.2 WATER POLLUTION

- Water for cooling and purification of coke oven gas and wet quenching of coke with pollutants such as tar oils, ammonia, phenols, cyanides, thiocyanates and thiosulphates.

- Cooling and cleaning waters in contact with blast furnace gases which may be laden with cyanide, fluorides, lead and zinc compounds and dust particles.

- Waters from fume cooling and cleaning of steelmaking furnaces usually carrying particulates, fluorides and zinc compounds.

- Scale, lubrication oil and hydraulic fluids contamination of water in continuous casting units, rolling mills and scarfing operations.

- Fungal/bacterial growths in cooling water, and biological/inorganic corrosion in water circuits.

4.3 SOLID WASTES

- Materials rejected as waste in iron ore/coal washeries, slag, dust recovered from the cleaning of gaseous effluents, sludges from chemical treatment circuits, mill-scale, used refractories, oil and grease residues, waste by-products of cooling, discarded tools and equipment.

4.4 NOISE AND VIBRATION

- Noise from such sources as sinter plant fans, ultra high power electric arc furnaces and various burners.

- Noise of metal rubbing against metal in rolling mills and processing lines.

- Truck and rail movements.

5 ENVIRONMENTAL MANAGEMENT STRATEGIES

This EGM is requested to focus attention on the strategies listed below in the environmental management of the Iron and Steel industry in the African region.

5.1 Plant Siting

Plant siting is usually controlled by economic and political factors, raw materials availability, port or railway access, and market considerations. Management should from the inception of a new steel plant project, choose a site that will minimize adverse environmental impact.

This EGM should draft guidelines to be used by African nations embarking on new steel plant projects for choosing an appropriate site.

5.2 Environmental Impact Statement

Within the parameters of plant siting, a formal Environmental Impact Statement should be formulated. Such a formulation should include analyses of economic, aesthetic and social impacts on the region; considerations of present and future land use; the demands of the plant and its potential expansion on the infrastructure (social and physical) of the area; effects on the atmosphere and meteorology of the region; on water supply and use; on fauna and flora; and

on the problems of solid waste disposal. Such a statement must be certified as adequate by the relevant national environmental Protection Agency. This EGM should involve a mechanism for learning how to prepare such statements and disseminate this information to African countries.

5.3 Environmental control Organization

Each steel plant project must establish at its inception an Environmental Control Organization that will be charged, inter alia, with:

- Formulation of the Environmental Impact Statement.

- Setting a target of environmental control which includes emission standards; standards to regulate the quality of the ambient air and water. Such targets must conform to regulations of the national Environmental Protection Agency.

- Collection of initial data, before the plant's operation, on levels of noise and various pollutants. Such data facilitates making accurate comparisons and assessment of the actual environmental impact of the industry on the site area. This EGM should propose the structure and staff requirements for such an organization.

5.4 PLANT DESIGN

This involves the selection of production processes and technologies that are environmental-friendly. It has been noted, for example, that the DR process using natural gas causes less pollution problems than the conventional blast furnace process. In conventional ironmaking, the type and magnitude of emissions of pollutants from coke ovens has been a source of worry; the problem is compounded if sinter must be produced also for the blast furnaces. In this regard, the setting up of a DR plant at Aladja in Nigeria is a step in the right direction, while the integrated iron and steel project at Ajaokuta, using a blast furnace fed with 100 per cent sinter, is a step in the negative direction.

We should note, with appropriate approval, the establishment of a steel plant in South Africa based on the COREX process which bypasses the use of coke and coke making with its attendant pollution problems. One wishes to praise the wisdom of the organizers of this EGM in choosing South Africa, the very country that pioneered this environment-friendly process technology, as the venue for a meeting on environmental management.

This EGM is called upon to set up a mechanism for disseminating information on new processes/technologies procedures that have been proved to be environmental-friendly.

5.5 EDUCATION AND TRAINING

There is need to educate, both management and staff of our iron and steel plants about the desirability and necessity of minimizing the adverse environmental impact of this industry. The EGM is urged to:

- Set up mechanisms for disseminating information on pollution control science and technology.

- propose for adoption by African countries a mechanism of exchange visits by experts to each other's plants to encourage information exchange.

- advise on a mechanism for transferring technology/experience/expertise of developed countries to the African region.

- examine the feasibility of setting up a central organisation for training personnel in the techniques of environmental management monitoring.

- advice on how to administer/enforce the various environmental control laws/regulations in countries of the African region.

6 HOMEWORK

If this EGM wishes to go beyond pious posturing and vacuous eloquence, it must request African countries to submit for collation

- an Environmental Impact Statement.

- a review of the processes/technologies/procedures designed into their steel plants to aid in controlling pollution.

The data obtained can be disseminated for self education of African countries in the proposed programs on Education and Training.

7 CONCLUSION

A Nigerian proverb says that EVERYBODY'S goat ends up dying of hunger. Because:

EVERYBODY thinks that SOMEBODY will feed the goat. In the end NOBODY does. Hence the conclusion.

This is also the fate of our environment, if no concerted effort is made to break this vicious logic. Fortunately, various ecological disasters in the developed countries have forced them to tackle the problem head on. African countries cannot fail to join the race; neither can the African iron and steel industry opt out.

Our spaceship, the earth is still unique and indispensable. We have no other planet (even on our theoretical horizons) to which we could migrate in case our industrial activities vender this earth unhabitable.

The dinosaurs did not appreciate this simple fact in time.

CAN WE APPRECIATE IT? AND IN TIME?

MANAGEMENT OF ENVIRONMENTAL POLLUTION IN THE IRON AND STEEL INDUSTRY

THE NIGERIAN EXPERIENCE

H.N. OFILI
DELTA STEEL COMPANY LTD.
OVWIAN-ALADJA
P.B.M. 1220, WARRI
NIGERIA
MAURITANIA MINING COMPANY

ABSTRACT

This paper traces the timely appearance of the Federal Environmental Protection Agency (FEPA) on the Nigerian scene and its subsequent impact on industrialisation nationwide. It reviews the Nigerian Steel Industry and the sources of potential pollutants. Environmental Management is discussed in relation to the inbuilt control measures, the supportive environmental monitoring programmes as well as experience gathered over years of operating the systems. Constraints militating against better performance are out-lined and the paper concludes with an advice on Environmental Management in the Steel Industry.

1.0 INTRODUCTION

The full impact of Environmental Pollution and hence the need for measures to protect the environment can be said to have been dormant on the Nigerian scene uptil the late 1980s. Prior to this time, the Nigerian economy was mainly agrarian based, with a few industries dotted here and there. With the gradual shift in culture, more industries were soon established: mines, quarries, cement industries and later the petroleum and steel industries. These industries were sited in urban centres and more often than not, close to water sources to ensure abundant water supply and in some cases to facilitate easy transportation. They also found another use for the water; it was convenient for the discharge of effluents and by products from the industries.

Most communities in Nigeria, with the exception of a few urban communities, still rely on surface water resources and shallow wells for their subsistence. The threat to environmental purity became critical as these wastes had a direct effect on aesthetic, marine and human life. The need for environmental protection could no longer be delayed. The situation was further aggravated by the toxic waste incident of June 1988, in Nigeria, when three thousand, eight hundred and eighty-eight (3,888) tons of assorted toxic wastes from Italy were found dumped at the fishing port of Koko, Delta State of Nigeria (FEPA 1991). To forestall future reoccurrence the Federal Government of Nigeria promulgated Decree 42 of 1988. This was closely followed by the

establishment of the Federal Environmental Protection Agency (FEPA), by Decree 58 also in 1988. FEPA was given a mandate to protect, restore and preserve the ecosystems of the Federal Republic of Nigeria as its contribution to the overall goal of bequeathing a clean and safe environment to present and future generation of Nigerians.

In pursuance of its mandate, FEPA promulgated several regulations thus:

S.1.8 National Environmental Protection (Effluent Limitations) Regulations of 1991, which makes it mandatory for all industries to install anti-pollution equipment for the treatment of its effluents and chemical discharges.

S.1.9 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) regulation of 1991. This stipulates restrictions on the release of toxic substances into the environment. It also makes it mandatory for all industries to have pollution monitoring capabilities within their set-up.

S.1.15 Management of Solid and Hazardous Wastes regulations of 1991, which provides a comprehensive list of dangerous and hazardous chemicals and wastes and the prescription for their sound disposal.

Following the Rio Summit in June 1992, the Environmental Impact Assessment Decree was promulgated in December 1992. This requires all new and major industries to carry out an assessment of the potential environmental, socio-economic and health effects of any proposed project or business activity.

Either in conformance to these regulations or dread of impending penalties, there has been a rush to update pollution abatement facilities in industries nation-wide. Most of the large industries in Nigeria had imported technologies for their production processes from the more developed and industrialised nations. Along with these technologies they had also imported pollution abatement processes and practices where they were existent.

The Iron and Steel Industry, as stated in the World Bank monograph, Vol. 1 & 2, is the highest generator of both total and hazardous solid wastes in Nigeria and hence it is appropriate to intensify pollution management of this sector.

2.0 THE NIGERIAN STEEL INDUSTRY

The Nigerian Steel Industry comprises twenty-one (21) plants as listed in Table 1. Five of them are owned by the Federal Government of Nigeria. Two of these, the Ajaokuta Steel Company and the Delta Steel Company (DSC) have a capacity to produce above one (1) million tonnes of liquid steel per year. The other three are the inland rolling mills at Jos, Katsina and Oshogbo. In addition to the Government owned Delta Steel Company, there are six other mini-mills that produce crude steel through various routes - Fuel furnaces, Electric Arc furnaces and Blast furnaces.

The ore mining industry in Itakpe using surface mining techniques produces iron ores, and beneficiates it to acceptable concentrations for use in major steel plants like the Ajaokuta and Delta Steel Companies. It must be realised however, that the potential to pollute increases with the multiplicity of production processes used to generate the final products.

Of the two integrated steel mills owned by the Federal Government of Nigeria, the Ajaokuta Steel Mill utilises the Blast furnace technology, while the Delta Steel Company utilises the Electric Arc furnace (EAF) technology. The Ajaokuta Steel Company is yet to go into production, and of all the other steel companies using the EAF technology, the Delta Steel Company has evolved the most advanced environmental management practices which are being considered by the Federal Ministry of Mines, Power and Steel for adoption by the other steel companies. Discussing the management of Environmental Pollution in Delta Steel Company should therefore give an overall view of pollution control in the steel industries in Nigeria.

3.0 IRON AND STEEL PRODUCTION IN DSC

3.1 IRON MAKING ASPECT

IRON MAKING aspect proceeds in various stages namely:

. The transportation of iron ore from the harbour to the storage yard by means of conveyor belts, the reclamation of the iron ore by the stacker reclaimer and its conveyance to the Pellet Plant for pellet oxide production.

. Production of oxide pellets which involves drying and grinding of the iron ore to 0.045mm size, mixing with hydrated lime, pelletising, firing and hardening at a temperature of 850°C - 1300°C in an indurating machine.

. Production of Direct Reduced Iron (DRI) by the reduction of the oxide pellets with reformed Natural Gas with the liberation of carbon monoxide and water. Nitrogen from the air separation unit is used to maintain an inert atmosphere in the four giant silos where the DRI is stored until required for further processing.

3.1.1 STEEL MAKING ASPECT

Steel making takes place in the Electric Arc Furnace. Steel scraps and other steel-based wastes like tundish skull, down graded and returned products, billet scales and briquettes (compounded from DRI fines) are first melted down. DRI and scrap are added in a ratio of 80% DRI to 20% scrap. Burnt lime is added to remove impurities while oxygen is blown in to aid refinning. Additives like carburizing agents, ferro alloys (Ferro-Manganese, Ferro-Chrome, Ferro-Silica) are later added in the ladle for strengthening. The product, liquid steel is then conveyed to the Casting Station. And so ends steel making.

3.2 CONTINUOUS CASTING

The liquid steel now in the preheated ladles are then cast into billets. The billets are allowed to cool in a billet storage yard. Some of these billets are sold while the rest are processed via the rolling mills.

3.3 ROLLING

The rolling of billets into light sections (flats, channels, angles) as well as plain and ribbed reinforcement bars is achieved by

. Preheating of the billets.
. Roughing to remove scales and initial deformation.
. Intermediate rolling
. Finishing or final rolling and cooling.

Additional processes include cooling, cutting to market lengths, straightening if necessary then stacking and bundling in readiness for dispatch.

4.0 AUXILIARY UNITS

A variety of units exist which support the Steel Industry and contribute to the pollution problems. Such units include:

4.1 THE LIME PLANT: where limestone is received and calcined in a kiln at a high temperature to produce burnt lime. Some of the burnt lime is hydrated to produce hydrated lime for the pellets while some burnt lime is added to molten steel to remove impurities.

4.2 THE AIR SEPARATION PLANT: produces such gases as Oxygen, Nitrogen and Argon for consumption in various units of the steel plant viz: Preservation of DRI, refinning of molten steel. Argon is sold to external consumers.

4.3 FOUNDRY: originally designed to produce crusher balls and spares for the steel plant, but is now also involved in fabrication of other spare parts, steel jaws and hammers, rollers, gears and buoy sinkers. The imputs into the foundry are sand bentonite, starch, core oil and refractories.

4.4 WATER TREATMENT PLANT processes water for

. domestic consumption
. make-up water for cooling and other industrial purposes.
. fire-extinguishing

4.5 ENERGY: is supplied from the nearby Power Station of Ogorode and Ughelli some 35 kilometers away. The Steel Plant has a consumption capacity of 230 MW.

4.6 NATURAL GAS: Natural Gas is in abundant supply since it is a waste product (often flared away) of the Nigerian National Petroleum Company (NNPC) also in the nearby city of Warri. It is regulated from a nearby metering station of the NNPC.

5.0 ENVIRONMENTAL POLLUTANTS IN THE STEEL INDUSTRY

5.1 TYPES

Pollutants in the Steel Industry can be categorised as follows:-

(a) Air borne pollutants
particulates:- e.g. dust, Iron ore, lime dust, iron fines.
gaseous emissions:- odours, waste gases, volatile metallic oxides, toxic gases.

(b) Water borne pollutants
- dissolved wastes:- machine cooling waters, domestic effluents, Industrial effluents.
- suspended solids:- particles suspended in water, scales, sediments.

(c) oil and grease:- oil film, lubricants in machine cooling water, used oil.

(d) Solid wastes:- slag, sand, refractory bricks, flue dust, lime wastes, slurry, scales.

(e) Noise/vibrations

(f) Heat

5.2 SOURCES OF POLLUTANTS

(A) AIR BORNE POLLUTANTS

Small quantities of dust are discharged
- at material transfer points, during loading and unloading at the harbour.
- During transportation to the storage yard and retrieval by conveyor belts and the stacker reclaimer.
- By whirlwinds and air currents at the material storage yard.

A greater quantity of dust is discharged
- during the juggling, and crushing of limestone in the Lime Plant.

- During grinding, mixing and firing of ores.
- During scrap melt-down (as much as 8kg of dust per ton of liquid steel is produced.)
- During slag quenching and the cutting of skull.

The dust consists of iron oxide and metallic iron fines with substantial amounts of lead, zinc, cadmium, nickel, mercury, chromium, copper, tin derived from scrap. (Nriagu and Essien, 1983)

- Dust is also generated during the foundry processes involving grinding, wood finishing, shot blasting, mould shaking-out.
- Toxic gases are emitted during oxide pellet conversion to Direct reduced iron in the reforming process.

(B) WATER BORNE POLLUTANTS

The sources of water pollution include slag quenching, gas cleaning systems, and machine cooling systems. Contaminants in the effluents include suspended solids (up to 10,000 mg/l) low pH, high Biochemical Oxygen Demand (BOD), nitrate, phosphate, dissolved iron, sulfate, sulfide, silica, colour, arsenic, selenium, aluminium and toxic metals (Kermiche and Zerhouni, 1980).

- Other pollutants are scales, oils, lubricants and hydraulic fluids during continuous casting, rolling and scarfing.

(C) SOLID WASTES

Solid wastes may be categorised into two kinds, Industrial solid wastes and municipal/domestic solid wastes.

In the steel industry solid wastes are generated mainly as

. Slag from the Steel Melt Shop

. Particulate dust and slurry gathered from the dust cleaning systems.

. Broken and used refractory bricks

. Scales from the mould scale pit

. Waste mould sand from the foundry

. Sludges from sedimentation basins

. Sludge scooped from the drainage system and storm water lines.

Municipal wastes are generated from

. Kitchens and Canteens

. Horticultural wastes

. Waste paper

. Sweeping and cleaning of offices and workshops

. Toilet and washing facilities

(D) NOISE POLLUTION

. Produced during normal working procedures e.g. during scrap melt down, skull dumping.

. Vibration of machines as in the chain cross area in the rolling mills, and equipment vibration in gas facilities.

. Repair works in maintenance units: hammering, digging, welding.

. Alarms

. Human contributions to noise

(E) HEAT

Heat is generated

. In cooling water systems

. On the casting platforms

. At the cooling bed area of the billet and rolled products storage yard.

6.0 MANAGEMENT OF POLLUTANTS

From the foregoing account, it can be seen that the task of controlling these wastes to minimise deleterious impacts on the environment is by no means an easy one. Pollution abatement facilities installed during the plant construction is therefore a step in the right direction. This is backed-up by the services of a Safety Department which enforces the use of safety apparels and observation of safety regulations in the work place, while the Environmental Monitoring and Control Unit monitors the level of pollutant discharges.

The Envorinmental Monitoring and Control Unit was established in Delta Steel Company in 1983. The unit is responsible for monitoring pollutant levels to the air, land and water within DSC and the surrounding environment, to ensure that

emissions do not exceed the permissible limits set by FEPA. These limits are outlined in the FEPA publication "Guidelines and Standards for Environmental Pollution Control in Nigeria" (FEPA 1991). The Environmental Unit reports her findings to Top Management for necessary action.

6.1 IN-BUILT POLLUTION CONTROL FACILITIES

The Environmental Unit identified several pollution control facilities built into the system in various plants.

(1) Suction Pressure devices applied over areas where particulates and gases are emitted like conveyor belts, welding machines, furnaces, grinding and lathe machines, mould shake out machines. The pressure directs polluted air currents into gas cleaning equipments.

(2) Gas Cleaning equipments like

(a) Filter bags
(b) Mechanical collectors such as settling chambers and cyclones;
(c) Electrostatic precipitators
(d) Wet scrubbers

effect removal of particulates from the air current. When fully functional these devices are capable of achieving a 96 - 98% efficiency in dust removal.

The cleaned gases are finally vented out through tall stacks (over 150m high) for atmospheric dilution.

(3) Toxic gas alarms are sited in strategic areas of the D.R. Plant and programmed to warn workers of high carbon monoxide levels in the ambient air.

(4) In the area of water purification there are:

a) Sedimentation and settling basins to effect the separation of suspended matter from process water.
b) Clarifiers into which coagulants and floculants are added to effect removal of precipitable compounds.
c) The Scale pit effects separation of scales from polluted water.

(5) Belt scimmers remove floating oil and grease into an oil sump.

(6) a) For Noise reduction dampers are built into the design of the noisy units like the Steel Melt Shop.

b) Noise proof control rooms are also provided for operators.

(7) Heat is controlled by the use of

a) ventilators and Industrial fans. The Workshop sides are open for adequate aeration. High roofs are built into workshop designs.

b) Cooling towers equipped with auto-regulating fans aerate hot machine-cooling water to remove excess heat, and the water is returned to closed circuits for further use.

6.2 OTHER CONTROL MEASURES in place include:

(1) RECYCLING of ore fines and slurry in the Pellet and Direct Reduction Plants.

(2) RECIRCULATION of process water from the different cooling circuits.

(3) REMOVAL of scales in the concast and rolling mill water by a mechanically operated grap for land disposal. Similarly sludges and sediments are scooped and hauled away for land disposal.

(4) SEWAGE TREATMENT of domestic effluents channelled into the a biological sewage treatment plant for processing. The sludge from this system is mixed with soil and used as manure, while the final effluent is chlorinated to effect disinfection.

(5) CORROSION CONTROL

Corrosion inhibitors and biocides are dosed in to control corrosion and microbial growth in the systems. Blow down water and cooling circuit overflows are diluted and discharged via storm water lines.

7.0 ENVIRONMENTAL MONITORING

Environmental Monitoring activities provide final necessary checks for the performance of pollution control measures listed

above. Programmes drawn up for effective monitoring fall under five (5) headings:-

. Atmospheric pollution monitoring including noise and heat.
. Water pollution monitoring
. Solid waste disposal and monitoring of dump sites.
. Environmental hygiene and awareness programmes.
. Research.

7.1 ATMOSPHERIC POLLUTION MONITORING

(1) DUST MONITORING

(A) Dust levels in the ambient air and on the shop floors are monitored during production. This is done with the aid of a Strohlein STE 15, dust monitoring equipment.

(B) PETRIDISH METHOD

An innovation consisting of petri-dishes lined with weighed filter papers and exposed at graduated distances from identified high dust emission sources was introduced to boost monitoring.

(2) RAIN WATER ASSESSMENT

This is another method of estimating particulates in the ambient atmosphere. Rain water samples collected at different sites in the steel plant and several of the neighbouring villages around, are studied for pH changes, suspended solids, hardness. Results obtained are compared to give an insight into the effects of pollutant emissions.

(3) GASEOUS EMISSIONS

Gaseous emissions on the shop floors and D.R. Plant area are monitored using various portable equipments.

- Komyo Kitagawa precision hand pumps fitted with calibrated tubes for carbon monoxide, Hydrogen Sulphide, Sulphur dioxide and Carbon dioxide are available.
- In addition workers operating in the Reformer area are required to carry portable automatic alarm sets for toxic gas detection. Towards this end,
- A Como-warm set is available for carbon monoxide detection.

- 50 pieces of Sabre gas detector units with replaceable sensors are also available.

7.2 WATER POLLUTION CONTROL PROGRAMMES

(a) Drinking water quality examinations are carried out for portable water systems in the Steel Plant and residential area. These include physico-chemical as well as microbiological analysis.

(b) Industrial Effluents Monitoring

Here, samples are collected weekly from identified industrial effluent discharge points and analysed for their physical and chemical properties. The emphasis however is on the heavy metal load of the effluents.

(c) Sewage Effluents Monitoring

Both physico-chemical (settlable solids, Dissolved Oxygen (D.O.), pH, etc.) as well as microbiological properties (BOD_5) are monitored here for the two sewage treatment plants situated in the Steel Plant and the residential area.

(d) Stream Quality Survey

This usually is an annual assessment of ecological damage (if any) done to nearby receiving streams and water bodies. This entails a study of the rate of sediment build-up, dissolved oxygen levels, increase/decrease in aquatic life and activity, and other physical and chemical factors.

7.3 SOLID WASTE DISPOSAL

1 a) Municipal Wastes are disposed off by contractors and this is invariably dumped in a separate landfil site. Scavengers sort and remove paper, bottles, metal containers and tins, and plastic scraps. These are recycled for money.

b) INDUSTRIAL WASTES

Sludges and sediments, broken non re-usable refractory bricks, scales and foundry mould sand are hauled away from various points in the plant to a designated landfil site.

2) USED ELECTRODES

Used electrodes from the Steel Melt Shop are sold off for use in other smaller industries.

3) REFRACTORY WASTES

A method for the total utilisation of refractory wastes in preparation of various types of masses was developed in the Research and Development Department of the Company (Obikwelu, D.O.N. 1986).

4) SLAG

Slag is in high demand in the neighbouring communities. It is used for land reclamation, land stabilisation before erection of buildings, concrete flooring, and road construction.

Slag is sold out to the public for a token fee.

4) SOLID WASTE LEACHATE MONITORING

Leachates from the landfil site are analysed from time to time to determine their pollution potentials.

5) GROUND WATER POLLUTION MONITORING

In the absence of bore wells before and after the slag yard in the direction of water flow, a ground-water monitoring programme was designed such that, a sample of the slag quench water, and samples from water wells of the neighbouring communities are analysed weekly and the results compared for any evidence of ground water pollution.

7.4 DISPOSAL OF WASTE OILS AND LUBRICANTS

Oil in water is separated with the aid of surface skimmers and directed into an oil sump. Oil from such industrial water uses, waste oil from heavy duty vehicles, gear oils, lubricants used in the rolling mills and all other sources are collected into drums and tanks and transported to Ajaokuta Steel Mill which has a unit where the waste-oil is regenerated, and subsequently reused.

7.5 OTHER ASPECTS OF ENVIRONMENTAL MANAGEMENT

1) RESEARCH on the utilization of industrial wastes is in high gear in DSC.

2) ENVIRONMENTAL AWARENESS

(a) A regular seminar on "Environmental Hazards in the Steel Plant and their Control" is organised for workers in the Steel Plant.

(b) POSTERS: Carrying environmental slogans and Safety bill boards are used to raise the level of environmental awareness in the Steel Plant.

3) ENVIRONMENTAL HEALTH

Hospital facilities are provided within the Steel Plant to assess work related illnesses and recommend necessary remedies. This programme was discontinued since 1987 due to lack of trained personnel in this area.

8.0 FINDINGS

A general trend in results have been obtained in the course of our monitoring activities.

. Dust levels are found to be within the limits prescribed by FEPA except when the dust cleaning systems are faulty. Occasionally too, high dust levels have been recorded in the harmattan periods of December - February each year. Particulates remain in suspension in the ambient air causing a dust haze.

. In the area of noise pollution and heat, the effects of these factors are relatively subdued compared to the prevalent tropically hot climate which obtains outside in the open. However, rotation of shift workers and the use of heat retardant uniforms and ear plugs in high risk areas are enforced by Safety Department.

. In the area of water pollution, most of the results obtained for drinking water, industrial and domestic effluents fall within the permissible limits set by FEPA. It is only at one of the effluent discharge points which collects run-off waters into the receiving Oleri creek that excessively high levels of suspended solids up to 1287 ppm have been recorded. (Table II).

The spate of publications (Ahonkhai and Chukwuogo, 1991) purporting high concentrations of heavy metals in DSC effluents attracted the attention of a foreign firm who was interested in regenerating heavy metals from the Company's effluents in 1993. Samples were collected from effluent discharge points as well as leachates from the slag yard and the solid waste dumpsite and

sent abroad for analysis. The results obtained are shown on Table III. Effluents from these sources have been classified as Non Dangerous Waste (NDW)

. In another instance our bio-assay studies to determine the lethal dose of Residual Chlorine (used to disinfect sewage effluents) on Tilapia spp and Epiplatys spp (these are common local fishes) have shown that a 70% mortality is achieved at 0.5 mg/l Residual Chlorine.

8.1 FOCUS areas where assistance will be required are:-

i) Construction of a holding or settling tank at the effluent discharge point leading into the creek.
ii) Construction of a proper sanitary landfil site.
iii) Provision of monitoring equipment
iv)) Provision of adequate reading materials and references on Environmental issues

9.0 CONSTRAINTS

While the Delta Steel Company is making efforts to ensure environmental safety by adopting the measures outlined above, there are constraints militating against the Company. Most crucial among these are:-

(1) Equipment and Facility Constraints

A well equipped laboratory with essential facilities like, the Atomic Absorption Spectrophotometer (ASS), Infra Red Spectrophotometer, Gas analyser for exhaust fumes are a sine qua non for successful Environmental Pollution Control programme.

(2) TRANSPORTATION CONSTRAINTS

As monitoring stations are scattered within the plants and neighbouring communities, an effective pollution control unit must be mobile.

(3) TRAINING NEEDS

It was not until recently in the late 80's that two Universities in Nigeria, Ondo State University and University of Port Harcourt started offering courses leading to degrees in Environmental Science. Before then, no training was available in that field except for the occasional course on environmental

issues taught in the process of acquiring other degrees. Staff involved in Environmental Management should be exposed to intensive training programmes, to ensure better performance. Exposure to work and training in similar institutes abroad, noted for their good environmental practices is recommended.

(4) INFORMATION

. Information and reading materials on the environment are scanty. A well stocked library should be provided for reference purposes.

. Data storage is presently done on paper - resulting in bulky files which makes information retrieval laborious. Computer facilities for storing such data should be provided to ensure continuity of information on monitoring records.

(5) FUNDING

Funding is a major handicap to effective pollution monitoring and control. Special budgetary allocations should be made to further this course as greater priority is often attached to production.

10.0 CONCLUSION

Management of environmental pollution in the steel industry is essentially a component of the efficiency of the in-built pollution abatement facilities coupled with supportive monitoring programmes. Due to the enormity of its potential to pollute, the steel industry should never be operated in the absence of, or on the event of breakdown of the pollution control systems. The initial Environmental Impact Assessment studies carried out before plant construction should necessarily include details of the planned monitoring programmes to be implemented.

Finally, effective pollution management in the steel industry calls for regular reviews and improvement in the pollution control facilities, up-dating of the steel making technology and more committment to the course of making the world a cleaner and more habitable place.

REFERENCES

1. AHONKHAI, S. and E. CHUKWUOGO (1991) "Effects of Industrial Activities in Warri area on the Surface Water Quality," paper presented at the National Seminar on Water Quality Monitoring and Status in Nigeria, Kaduna 1991.
2. DSC Diary 1994 - a publication of the Delta Steel Company.
3. "Environmental Impact Assessment" Decree (1992) a publication of FEPA.
4. "Federal Environmental Protection Agency (FEPA) Decree 1988" a publication of FEPA.
5. "Guidelines and Standards for Environmental Pollution Control in Nigeria (1991), a publication of FEPA.
6. IGWE, B.U.N. (1990) "Environmental Management in the Nigerian Steel Industry", Proceedings of the Nigerian Society of Engineers (1990); pp.171 - 175.
7. Kermische, N.E. and M. Zerhouni, 1980 quoted by Igwe, B.U.N
8. National Environmental Protection (Effluent Limitations) Regulation (1991) published by Federal Environmental Protection Agency.
9. Nriagu, J.O. and E.M. Essien (1983) "Environmental Impact Assessment of the Iron and Steel Industries at Ajaokuta and Aladja" Preliminary Report. p.27 and 120.
10. OBIKWELU, D.O.N. DR. (1986) "Re-processing of Used Refractories", Report on the National Seminar on Ancillary Industries around the Nigerian Steel Industry; 5th - 6th June, 1986.
11. World Bank monograph (1995) "Nigeria Strategic Options for Redressing Industrial Pollution." Vol. 1 and 2

TABLE I

NIGERIAN STEEL INDUSTRY AT A GLANCE

COMPANY	MAJOR RAW MATERIALS	TYPE & NO. OF FURNACES	CRUDE STEEL CAPACITY (TONS)	ROLLING CAPACITY
DSC ALADJA	IRON ORE, SCRAP	EAF 4x100t	1,000,000	320,000
ASCL AJAOKUTA	BLOOMS, BILLETS			540,000
KSRC KATSINA	BILLETS			210,000
JSRC JOS	BILLETS			210,000
OSRC OSHOGBO	BILLETS			210,000
QUA STEEL EKET	BILLETS			100,000
UNIVERSAL IKEJA	SCRAP, INGOT	EAF 2x25t	80,000	80,000
AJIDE OLAIYA, IKEJA	BILLETS, CROP ENDS			20,000
CISCO IKEJA	SCRAP, INGOT, BILLETS	EAF 1x20t	60,000	150,000
SELS METAL IKEJA	BILLETS			100,000
FEDERATED OTTA	SCRAP, INGOT, BILLETS	EAF 1x12t	40,000	140,000
ALLIED ONITSHA	CROP ENDS			20,000
MAYOR IKORODU	BILLETS, CROP ENDS			228,000
NIGERIA/SPANNISH KANO	DRI, BILLETS	EAF 1x20t	72,000	188,000
CSM ASABA	SCRAP, BILLETS	EAF 1x8t	14,000	50,000
ASIATIC MANDARIN IKEJA	SCRAP, BILLETS			30,000
KEW METALS IKORODU	BILLETS, CROP ENDS	FUEL FURNACE 1x5t	9,000	20,000
KWARA COMM. ILORIN	BILLETS, CROP ENDS			40,000
UNION STEEL ORO	BILLETS, CROP ENDS			40,000
ORO STEEL ORO	COILS			-
BROLLO ONITSHA	SHEET COILS			65,000
TOTAL			1,275,000	2,631,000

SOURCE: DSC DIARY 1994

TABLE II

DSC DUMPSITES LEACHATE ANALYSIS

S/N	PARAMETER (PPM)	OLERI DUMP SITE	SLAG YARD DUMP SITE	FEPA STDS FOR RIVERS AND EFFLUENTS
1.	Chromium	N/D*	0.47	1.0
2.	Copper	N/D*	N/D*	1.0
3.	Iron	3.2	0.55	20.0
4.	Lead	N/D*	N/D*	1.0
5.	Manganese	N/D*	0.04	5.0
6.	Molybdenum	N/D*	N/D*	-
7.	Nickel	N/D*	N/D*	1.0
8.	Zinc	0.010	0.08	5.0
9.	Phosphate	6.8	11.4	5.0 - 10.0
10.	Temperature ^{o}C	28	32	10 - 50
11.	Mercury	N/D*	N/D*	0.05
12.	Tin	N/D*	N/D*	10.0
13.	Cadmium	-	0.11	1.0
14.	Arsenic	N/D*	N/D*	0.1
15.	Suspended Solids	331	1287	30.0
	Toxicity	NDW**	NDW**	-

N/D* = Not Detectable

NDW** = Non Dangerous Waste

TABLE III

EFFLUENTS MONITORING PROGRAMME

HEAVY METAL INVESTIGATION

Date: April 1993

PARAMETERS (MG/L)	SAMPLING POINT				INTERIM EFFLUENT LIMITATIONS (FEPA)
	A	B	C	D	
Arsenic	Nil*	Nil*	Nil*	Nil*	0.1 (<1)
Cadmium	0.20	0.16	0.20	0.11	less than 1 (<)
Copper	Nil*	Nil*	Nil*	Nil*	less than 1 (<)
Chromium	0.47	0.27	0.33	0.47	less than 1 (<)
Iron	0.14	0.28	0.47	0.55	20
Mercury	Nil*	Nil*	Nil*	Nil*	0.05
Manganese	0.05	0.05	0.07	0.04	5
Nickel	Nil*	Nil*	Nil*	Nil*	less than 1 (<)
Lead	Nil*	Nil*	Nil*	Nil*	less than 1 (<1)
Tin	Nil*	Nil*	Nil*	Nil*	10
Zinc	0.20	0.16	0.08	0.08	less than 1 (<1)
Toxicity	NDW**	NDW**	NDW**	NDW**	

* Not Detected

** Non-Dangerous Waste.

Sample A = 1st Effluent discharge point at DSC harbour.

B = 2nd Effluent discharge point.

C = Effluent discharge into creek.

D = Effluent from the Slag yard.

SENEGAL

I. INTRODUCTION:

My country, Senegal is very concerned by environmental preservation; as a proof:

- We have a Ministry called "Ministere de l'Environnement et de la Protection de la Nature", whose main responsibility is to make fast a global strategy of national management and planning of the environment in Senegal;

- Recently, during the 4th conference of African and American twinned towns, organized in Dakar, the environmental preservation took and important place during the meetings and several items was outline in order to protect the environment etc..

As we know, the iron and steel industry (Mines and Steel mills) is one of the major sources of air, water and land pollution. Thus the Senegalese authorities and the actual managerial staff of MIFERSO, the society which has the right to develop the iron ore deposits of the Faleme in South Eastern Senegal, are extremely conscious of the environmental problems and difficulties which will be link to the future exploitation of the iron ore deposits.

But until this time, in spite of completing the tender documents since 1988, any environmental study has been carried out. Meanwhile we plan to introduce request near the financial institutions and organizations which are supporting our project in order to determine the environmental impact of the different components (Mine, railroad, port) of the project. Nevertheless we would like to present below these components so the environmental impact of the MIFERSO iron ore development would be appreciated.

II. MINE AT FALEME

The mine is operated on a three shift basis, 6 days per week, 304 days per year. It is a classical open pit one, utilizing drilling, ANFO blasting, shovel loading and truck haulage to the primary crusher.

It will produce 12 million tones per year of marketable products. The products represent 83% by weight of the material fed to the treatment plant; the balance is rejected tailings.

The total proven and probable reserves are about 400 million tonnes of hematite and 250 millions tones of magnetite.

The deposits are located in a well wodded avanna near the Koila Kobé river where we will pick the 11 millions m³ per year needed for the treatment plant.

The dept of the quarry will be extremely important.

III. RAILROAD:

The railroad was designed to accept up to 22 tonnes per axle load trains. The total length is about 740 kms; passes out of the National Niokolokoba Zoological Park it includes:

- 311 km new railroad from the mine to Tambacounda with 25 bridges, 42 km/rail, concrete ties with 7 cm traverses spacing, 200 cm etc...

- 430 km of existing railroad from Tambacounda which will be rehabilitated based on conventional international railway standards to support 22 tonnes per axle load trains.

- Rollings stock (locomotives, world class are wagons, flat wagons and fuel wagons). The trains are about 1,5 km of length.

- Communication and signaling, mine and port terminal facilities etc...

IV. PORT AT BARGNY:

The harbour and dock were designed to accept up to 170,000 dwt bulk carriers. The berthing structures are to located 4.5 km offshore in a 21 m deep.

The port includes the following facilities:

- <u>ON-SHORE TERMINAL STOCKPILE FACILITIES</u>

The on-shore terminal stockpile facilities include:

- One Tamdem Rotary Railcar Dumper with indexer, dumper pit and shelter

- Twin receiving hopper and two loadout feeders

- One 1800 mm wide loadout conveyor

- Two 1800 mm wide yard conveyor

- Two 7000 TPH railmounted stacker/reclaimers and stockpiles

- One 1800 mm wide collector conveyor

- One 1800 mm wide transfer conveyor

- Transfer stations

- One sampling station

- Electrical substation (s)

- Mobile equipment

- Service facilities

- Control tower and administrative offices.

- MARINE FACILITIES FROM ON-SHORE SAMPLING STATION

  The marine facilities from the on-shore sampling station onward include:

  - One 1600 mm belt width trestre conveyor
  - One 1200 metric ton capacity surge bin with two load-out feeders
  - One 1800 mm wide elevated dock conveyor
  - One 7500 mtph travelling level luffing shiploader
  - One 7500 mtph supported trestle, 4400 m long supporting trestle conveyor and access roadway
  - One multi crib type loading dock for 170,000 dock max. carrier loading
  - One mooring dolphin with access foot bridge from lock.

V. CONCLUSION:

These above information prove that the development of the Faleme iron ore deposit will have certainly a positive impact on the economic development of Senegal, but it may also have a unfavorable impact on the environment (civil engineering works, deforestation, mine quarry, schlams etc..) if we neglect this aspect. That's why MIFERSO is presently privileging the environmental impact study of the project.

ANNEXES

MARKETABLE PRODUCTS

Following the sampling and testing program of 1985/86, conducted by Krupp/BRGM and Studiengesellschaft, respectively, the following range of product specifications were developed (Source: MIFERSO document of October 1986):

LUMP ORE

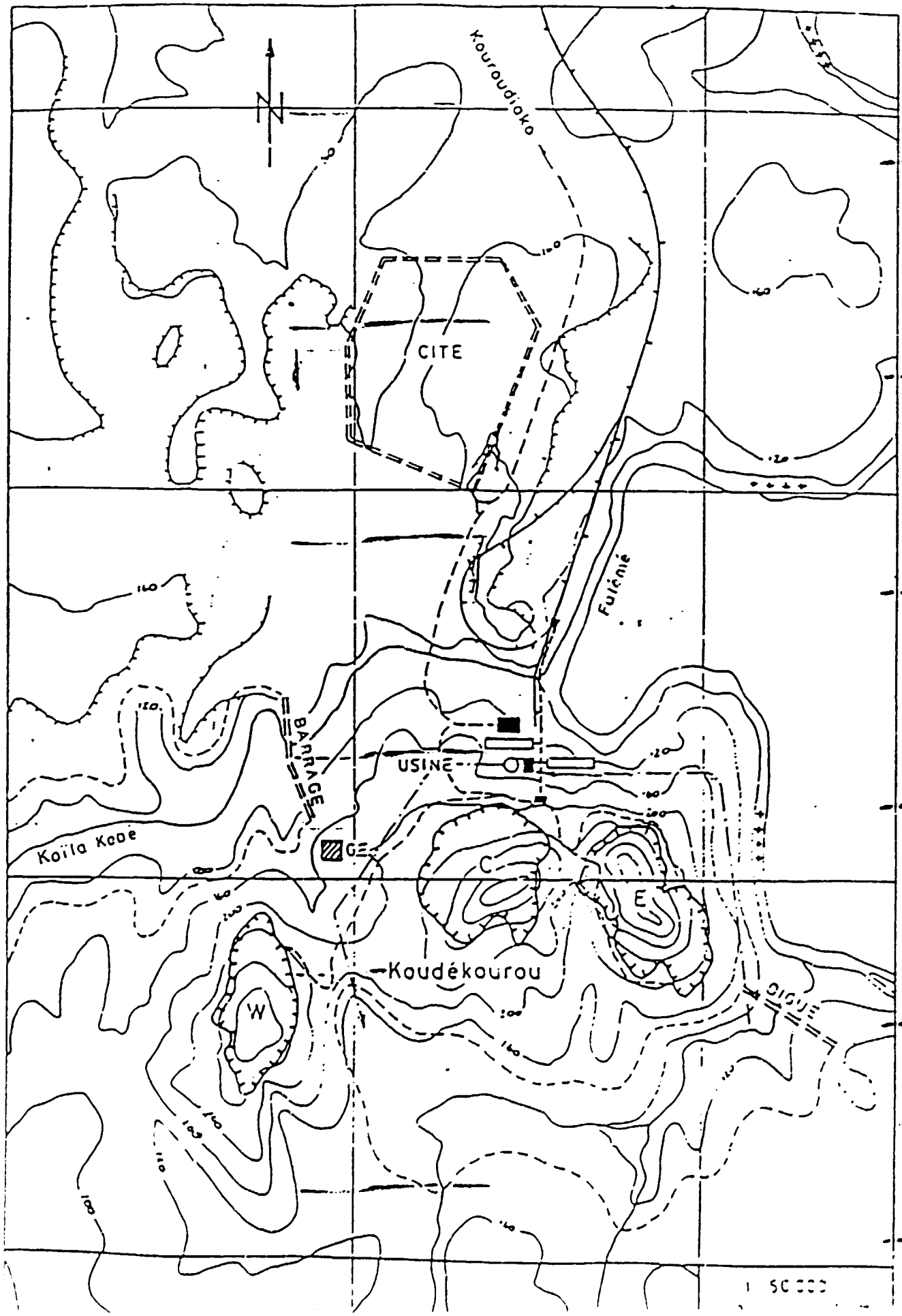
Granulometry (% by wt.)	
> 25 mm	8 - 12
25 - 10 mm	75 - 79
10 - 6.3 mm	10
< 6.3 mm	max. 5
ISO-Tumble Strength (% by wt.)	
> 6.3 mm	79 - 81
< 0.5 mm	12 - 14
Chemical Analysis (%)	
Fe	64.4 - 65.6
SiO_2	1.5 - 2.3
Al_2O_3	1.8 - 2.0
P	0.028 - 0.037
S	max. 0.03
Na_2O	< 0.01
K_2O	max. 0.015
Reducibility	
R 40 (%/min)	0.97 - 1.0
Differential Pressure	
at 80% Reduction (mm wt. gg.)	4 - 5
Dynamic Disintegration	
at 500 °C (% by wt.)	
> 6.3 mm	33 - 38
< 0.5 mm	22 - 25

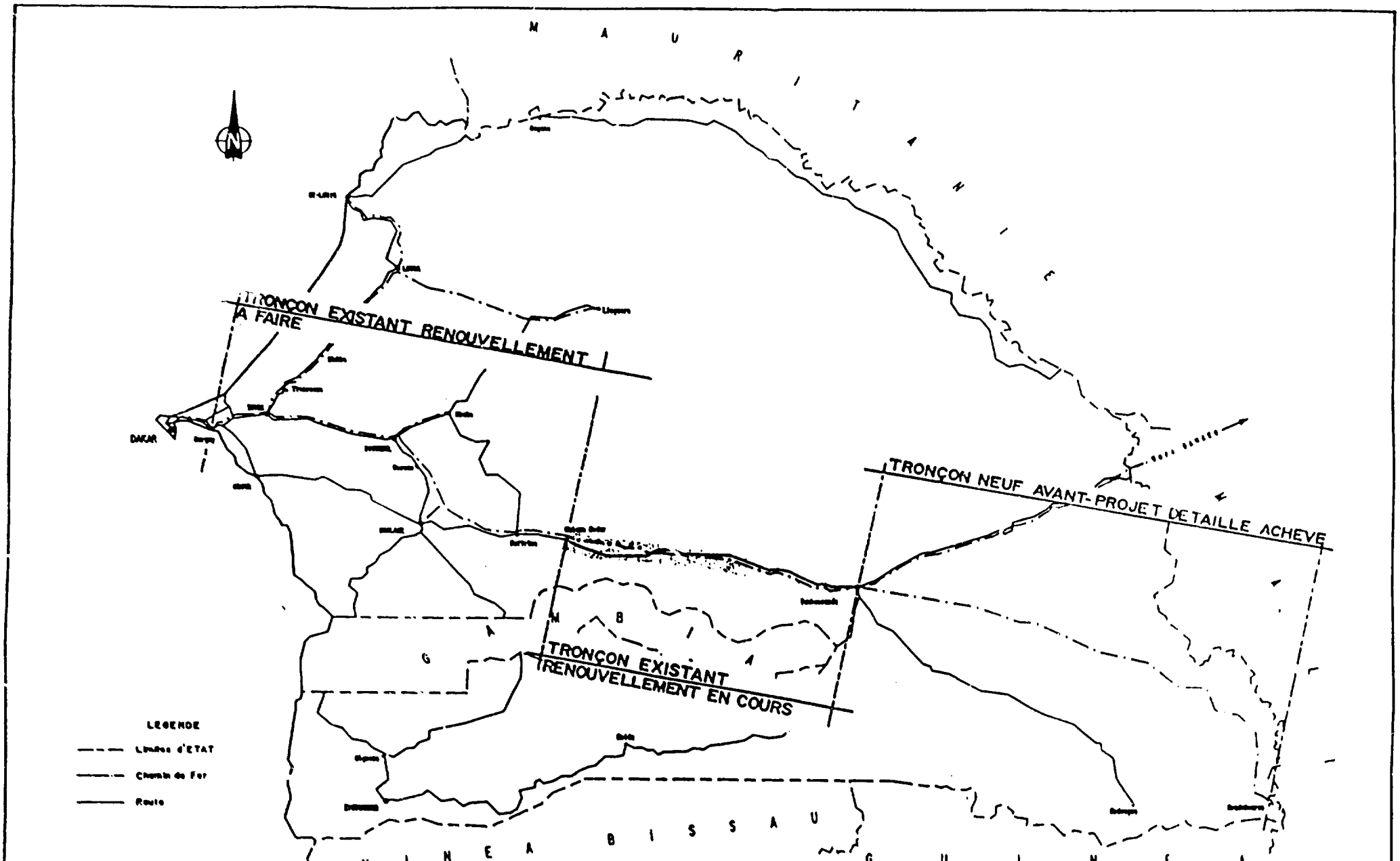
SINTER FEED

Granulometry (% by wt.)	
> 3.15 mm	28 - 34
3.15 - 0.315 mm	27 - 35
0.315 - 0.1 mm	17 - 18
0.1 - 0.04 mm	11 - 12
< 0.04 mm	max. 10
Chemical Analysis (%)	
Fe	62.7
SiO_2	3.4 - 3.8
Al_2O_3	2.9 - 3.4
P	0.030 - 0.038
S	max. 0.03

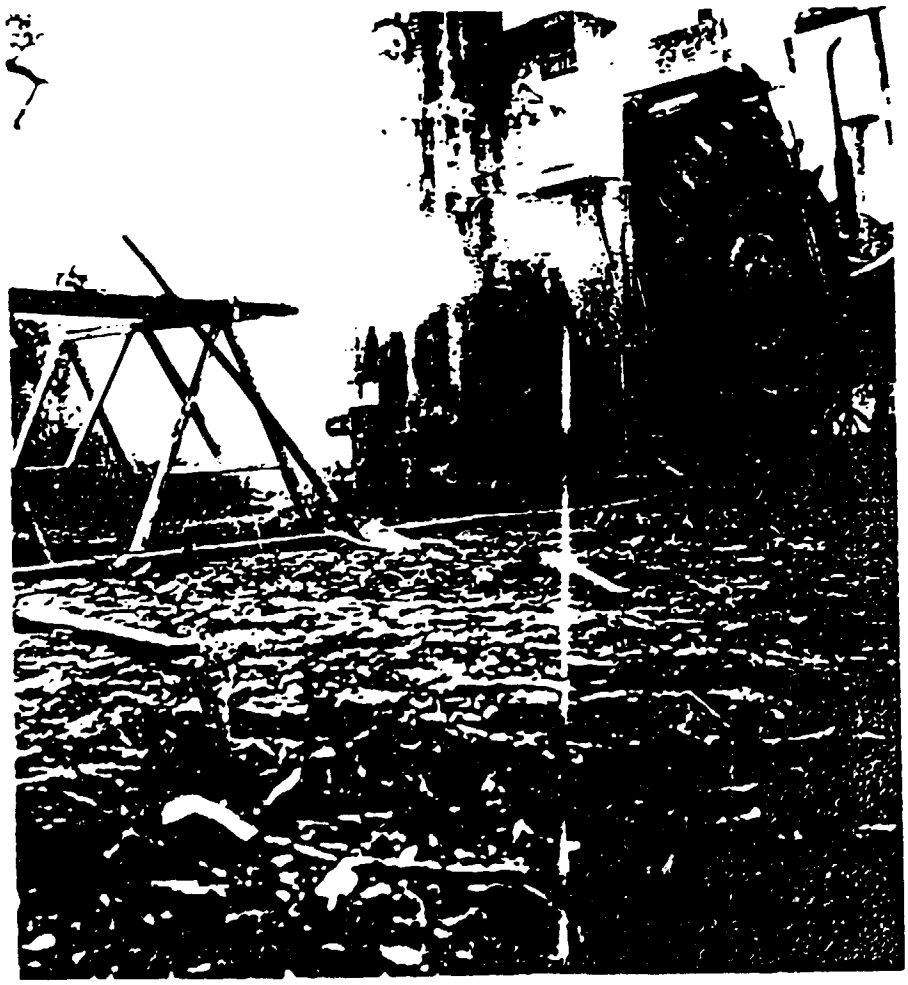
GISEMENTS DE KOUDEKOUROU

MIFERSO

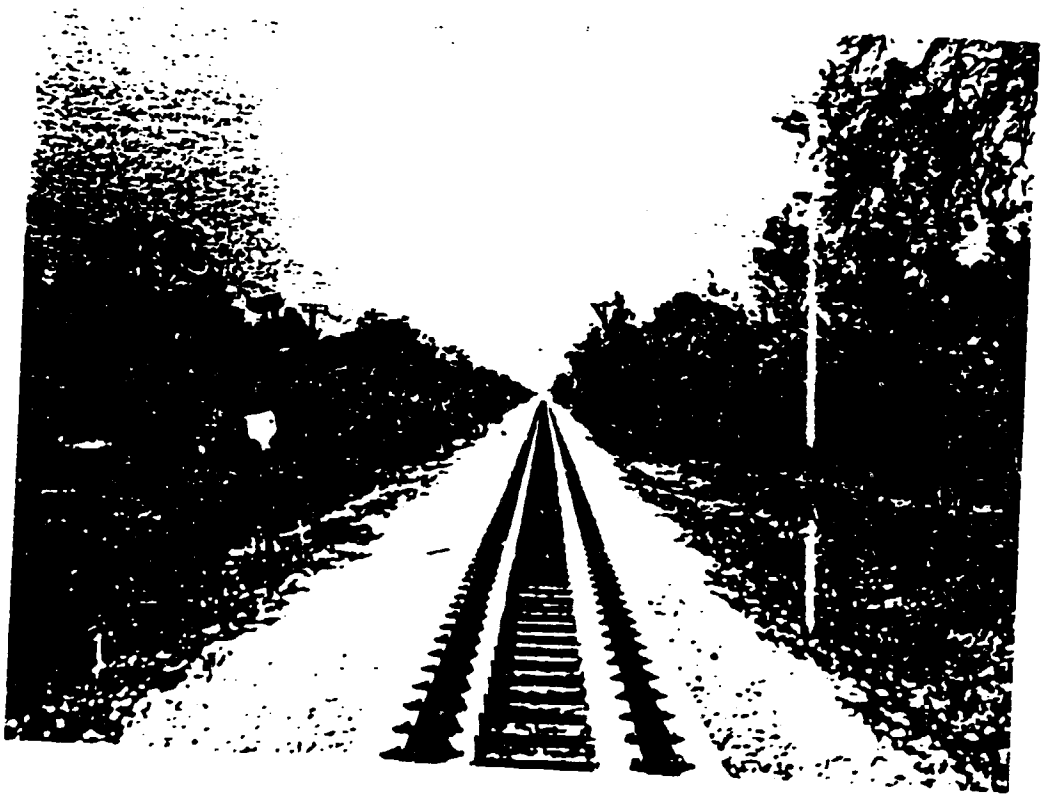



M A U R
TRONÇON EXISTANT RENOUVELLEMENT A FAIRE
TRONÇON NEUF AVANT-PROJET DETAILLE ACHEVE
TRONÇON EXISTANT RENOUVELLEMENT EN COURS
DAKAR
LEGENDE
Limites d'ETAT
Chemin de Fer
Route
B I S S A U
G U I N E A

4.- Implantation topographique de la culée Nord du pont sur la KOILA KOBE

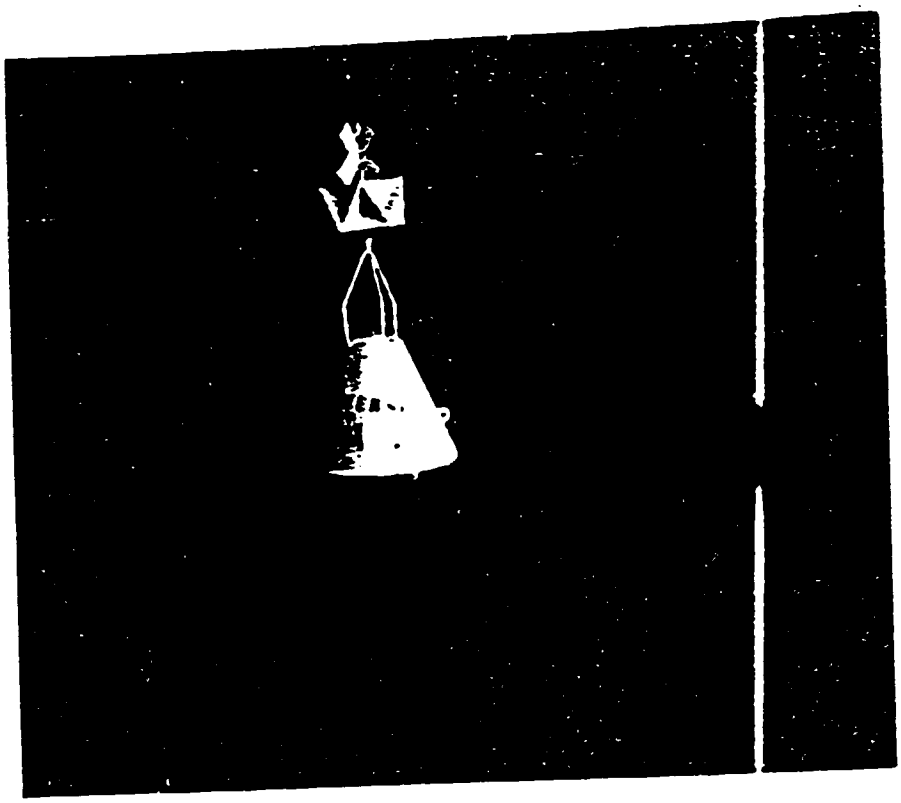


Implantation topographique sur l'emplacement de cette culée

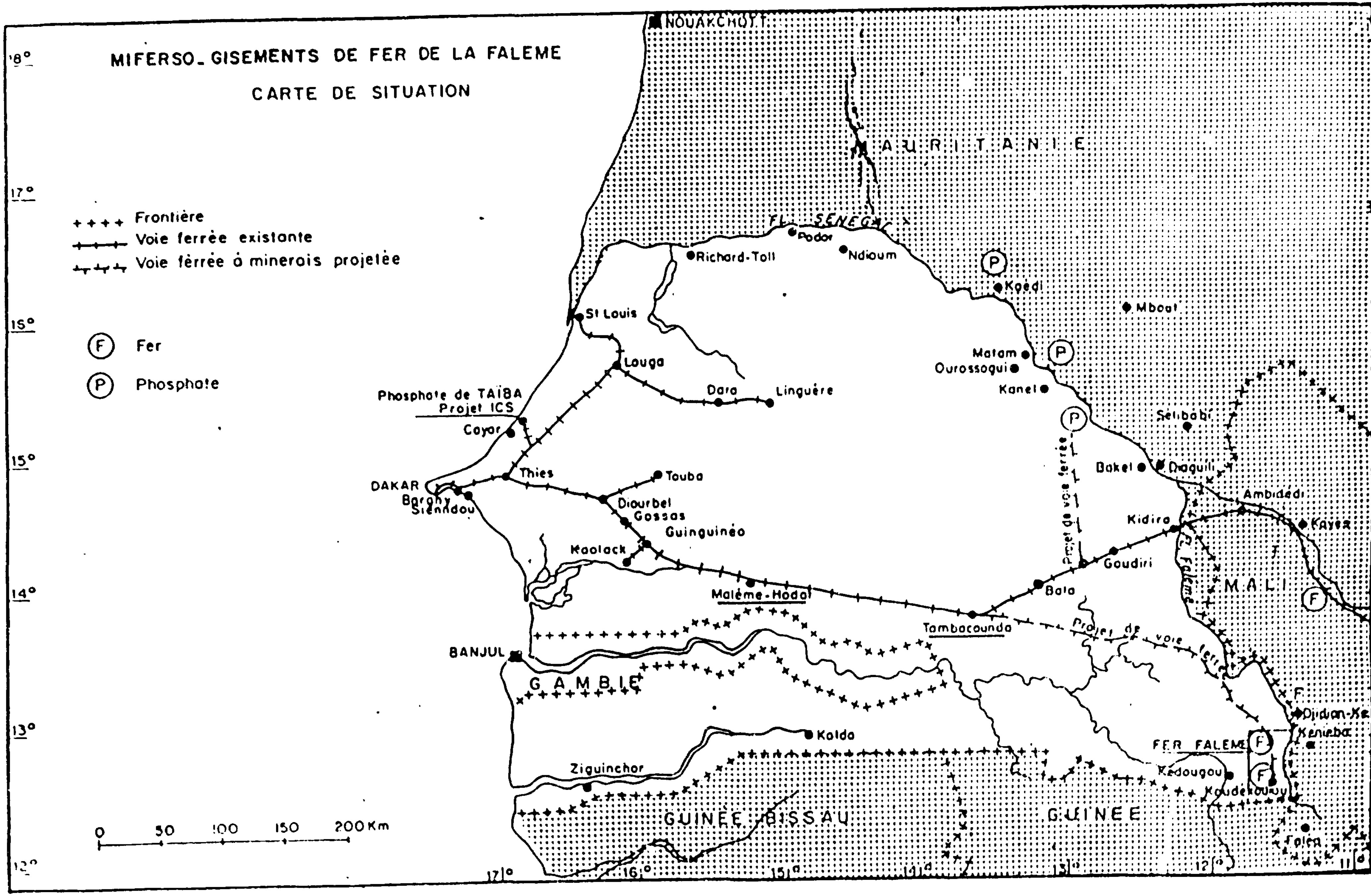


19.- La voie réhabilitée avant ballastage.

22.- Sondages en mer sur le site de Bargny avec le "BON ACCORD"
(Stés WIMPEY -Grand Bretagne et TECHNOGEN - talie.-



31.- Pour tous les navigants de la zone "MIFERSO" devient une présence très officielle, même si elle reste encore discrète.-


MIFERSO_ GISEMENTS DE FER DE LA FALEME
CARTE DE SITUATION
Frontière
Voie ferrée existante
Voie ferrée à minerais projetée
Fer
Phosphate
0 50 100 150 200 Km
NOUAKCHOTT
MAURITANIE
FL. SENEGAL
Podor
Ndioum
Richard-Toll
Kaédi
Mbout
St Louis
Louga
Dara
Linguère
Matam
Ourossogui
Kanel
Selibabi
Phosphate de TAÏBA
Projet ICS
Cayor
Thies
Touba
DAKAR
Bargny
Sienndou
Diourbel
Gossas
Guinguinéo
Kaolack
Bakel
Diaguili
Ambidedi
Kidira
Kayes
Goudiri
Projet de voie ferrée
Falémé
MALI
Bala
Maléme-Hodal
Tambacounda
Projet de voie ferrée
BANJUL
GAMBIE
Kolda
Ziguinchor
Djidian-Ke
Kenieba
FER FALEME
Kédougou
Koudekourou
GUINEE BISSAU
GUINEE
Falea
17°
15°
14°
13°
12°
16°
11°

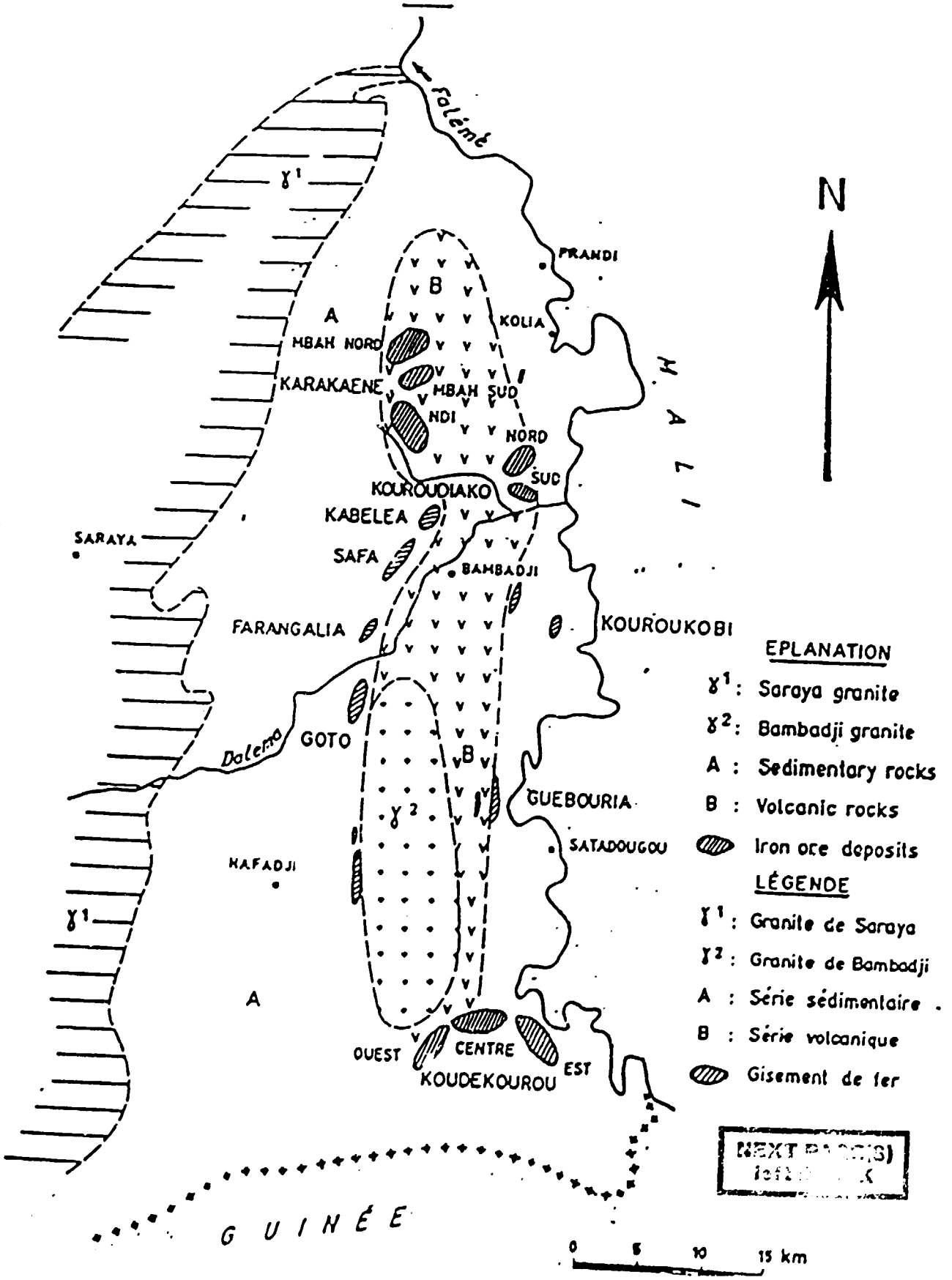
SÉNÉGAL

GISEMENTS DE FER DE LA FALÉMÉ

FALEME IRON ORE DEPOSITS

PLAN DE SITUATION DES PRINCIPAUX GISEMENTS

SITUATION MAP OF MAIN DEPOSITS



ZIMBABWE

ENVIRONMENTAL MANAGEMENT AT THE ZIMBABWE IRON AND STEEL COMPANY LIMITED (ZISCOSTEEL)

COMPILED BY
J. MUKANHAIRI
SENIOR PROJECTS ENGINEER

ENVIRONMENTAL MANAGEMENT AT THE ZIMBABWE IRON AND STEEL COMPANY LIMITED (ZISCOSTEEL)

1. INTRODUCTION

The technological advancement of the modern society has been achieved with little due regard on the adverse effect of the gaseous and dust emissions and process waste waters on the environment. Pollution of the air, water and land is taking place almost in all countries of the world.

Credit must however, be given to the recognition by the international community that for any sustainable development to be meaningful, it must fully address environmental issues and attempt to fully reverse the damage already incurred through past practices.

Zimbabwe is fully committed to the global aspirations to coexist with the main source of our own survival - the environment.

The long term goal of virtually eliminating undesirable emissions to the air and the waste water discharges can be accomplished by technological changes, best management practices and through a dedicated commitment to the environmental protection.

Environmental protection costs money, the blue skies and the clear waters have a price tag, a cost which both the manufacturer and the consumer must be prepared to share. There is a limit as to how far one can vigorously pursue the policy of environmental protection and simultaneously operate economically and achieve pr: luct price competitiveness.

With stiffer price competition in regional and international steel markets, a level playing field has to be established so that those who freely and vigorously pursue environmental protection policies are not disadvantaged through increased prices of their products.

It must be also recognised that the environment is global, what happens in one part of the globe can be equally disastrous to any other part of the globe A global approach is likely to achieve more meaningful results than a national approach. Hence the regional approach as a forestep to the global approach is most welcome.

2. ENVIRONMENTAL MANAGEMENT AT ZISCOSTEEL

Environmental issues in Zimbabwe are governed by various acts of Parliament such as:

a) The Atmospheric Pollution Prevention Act.
b) Hazardous and Allied Substance Act
c) The Water Act.
d) Factories and Works Act.
e) The Mining (management and Safety) Regulations

The legislation aims at limiting atmospheric pollution to levels indicated in Table 1. The levels covering the discharge of treated wastewater to a water course are given in Table 2. Ziscosteel, just like any other organisation in Zimbabwe, is obliged to comply with the national pollution standards.

3. SOURCES OF POLLUTION AND WASTE MANAGEMENT AT ZISCOSTEEL

3.1. Source of Pollution

Ziscosteel is an integrated Iron and Steelworks comprising of raw materials preparation, Sinter Plant, Coke Ovens, Blast Furnaces, Steel making Converters and Rolling Mills.

The raw materials section involves receipt of and storage of iron ore and coal. Coal is transformed to coke in the Coke Ovens whilst iron ore fines are converted into sinter at the Sinter Plant. In the blast furnaces iron ore, sinter and coke are melted to produce iron which is subsequently converted into steel in the Steel making converters.

The steel is either continuously cast into blooms or cast into ingots. In the rolling mills both the blooms and ingots are reduced into semifinished products such as billets and wire rod and to finished sections for various applications.

The related environmental wastes are summarised in Table 3.

3.2. Waste Management

Table 3 contains a brief outline of production processes, pollutants generated and pollution abatement measures in place.

In order to fully comply with national standards on environmental pollution, Ziscosteel has in the recent past embarked on an extensive program of waste management.

The program involves:

a) The mechanical treatment of heavy slurries
b) Biological treatment of effluent emanating mainly from the coke making process.
c) Technological improvements: elimination of emissions through adoption of environmentally friendly technologies.

3.2.1. The Effluent Treatment Plant

For many years effluents from the Steelworks were discharged untreated or inadequately treated into a nearby river. This practice was possible because environmental legislation, though very strict in its standards, was very deficient on a coordinated enforcement from the several governmental organs responsible for policing adherence to the various Acts.

Recent developments are showing a greater concern on environmental issues, and environmental auditing is being emphasized by state machinery as well as pressure groups and individuals.

The situation at Ziscosteel is expected to improve significantly when the effluent treatment plant under construction comes into operation in September 1995.

The plant was split in two parts:
The first stage, which has since been completed, involves the mechanical separation of suspended solids by clarification from effluents which do not contain harmful dissolved solids and chemical elements.

The second stage involves the biological nutrient removal from effluent arising mainly from the Coke Ovens, which contains substantial amounts of organic matter. Laboratory test work indicated that in order to make the steelworks effluent more amenable to biological treatment, it will be necessary to blend it with raw domestic sewage stream. The biological nutrient removal activated sludge plant (Effluent Treatment Plant) is to treat 3500m3/day of industrial effluent with 1400m3/day of domestic sewage to a standard suitable for reuse as industrial water within the Steelworks.

The characteristic of the Steelworks and domestic sewage effluent are given in Table 4.

Fig 1 shows the layout of the Effluent Treatment Plant.
The effluent from the different parts of the Steelworks is conveyed to a pre-treatment plant. At this stage grit, tar, oil and other similar pollutants which will cause difficulties in pumping and treatment are removed. The pretreated effluent is pumped to the biological treatment unit (Bioreactor).

The raw domestic sewage is pretreated by screening and grit removal before being discharged to the Bioreactor.

The Bioreactor is a rectangular tank, 40m long and 25m wide, with an average depth of 4m and an operating volume of 4000m3. It has been designed as a 3 stage "Bardenpho" process. As shown in Fig 2, the inlet channels to the Bioreactor allow maximum flexibility in either separation or blending of the domestic and industrial effluent streams.

The anaerobic zone has an operating volume of 400m3 and has been separated into two equal halves by a precast baffle wall to ensure plug flow conditions. The mixed liquor will be kept completely mixed by bridge mounted mechanical stirrers.

The anoxic zone has an operating volume of 1000m3. Mechanical stirrers are provided to maintain completely mixed conditions.

The aerobic zone has an operating volume of 2600m3. This zone is mixed and aerated by four platform mounted slow speed mechanical aerators.

The biological processes within the three zones ensure successful removal of organic matter (COD), Nitrogen and Phosphorus prior to the subsequent separation of the activated sludge and clear effluent in the next stage of the process.

Secondary Clarification

A single 26m diameter circular scraped clarifier with bottom sludge withdrawal has been provided for clarification of the Bioreactor mixed liquor stream. The maximum suspended solids concentration in the clarified effluent is expected to be about 50mg SS/l.

Tertiary Treatment

Clarified effluent may either be discharged via aeration cascade to the river, recycled to a holding pond for subsequent disposal by irrigation or passed through a sand filter to remove residual suspended solids. The filtered effluent, which is expected to have a suspended solids concentration of less than 5mg SS/l, will be chlorinated before being pumped to nearby storage reservoir for reuse within the Steelworks industrial water system.

Disposal of Waste Sludges

Oil and other flotables from the pretreatment unit will be disposed of by inceration, together with the screenings from the domestic stream.
Grit and tar will be disposed of by controlled burial.

The waste activated sludge (WAS) will be sufficiently stable for direct disposal. The WAS will be disposed of by irrigation on the existing woodlot.

The Effluent Treatment Plant is scheduled for commissioning in September this year. Stuart Scott Zimbabwe has been contracted by Ziscosteel for the design and for the overall consultancy during implementation of the project.

3.2.2. Technological Improvements

It is now mandatory that before any new plants are built an environmental impact assessment has to be carried out and submitted to the authorities before any approval can be granted.

All new plants being build at Ziscosteel incorporate emissions suppression systems. The new Sinter Plant incorporates an electrostatic precipitator for dust removal before exhaustion of the waste gases to the atmosphere. Statutory maximum dust content is set at 115mg/m3.

The iron ore supply projects incorporates dry fog dust suppression systems and bag filters for dust suppression. Significant reductions in coke consumption (and hence reduction in coke making emissions) expected when the new projects come into operation.

The new coke ovens incorporates features which minimise emissions from oven doors, charge hold lids and assertion pipe lids.

For integrated works it is the coke making process which is the greatest polluter in terms of its aqueous discharges as well as its air emissions. Pulverised coal injection can reduce the amount of coke used at the blast furnaces by up to 40% thereby reducing coke plant effluent. This is being considered for the long term. Ziscosteel is also watching closely the developments in alternative methods of ironmaking . Processes such as the Corex eliminates the need for coke and hence the production of waste water effluent during coke making.

4. CONCLUDING REMARKS

1) Environmental awareness is increasingly growing in importance as a national issue in Zimbabwe. This is evidenced by

i) the efforts being made to create a single enforcement body which can better coordinate the pieces of legislation currently the responsibility of various government ministries.

ii) the requirement for an environmental impact assessment before approval can be granted for new major projects.

iii) the requirement for environmental facilities to be part of the new projects.

iv) educational campaign in schools.

v) increased activities from pressure groups and individuals.

2. Environmental protection increases significantly the costs of new projects, operational and maintenance costs. Zimbabwe facing capitalisation problems and the need to develop, is finding it difficult to obtain financial resources to fully implement environmental issues.

3. The need to create/maintain jobs, poverty circles worsened by frequent droughts and unproportional increases in the population, tend to pressure the government and companies to put environmental issues on second place.

4. Despite financial constraints, Ziscosteel has embarked on a program geared at reducing environmental pollution. The success of the program will be tested in the near future when its effluent treatment plant is commissioned in September 1995.

5. No country can successfully handle environmental issues in isolation. A regional cooperation is likely to produce meaningful results.

5. REFERENCES

a) N.M. Mashanyare : Environmental Management in the Iron and Steel Industry in Zimbabwe. (presented at the Energy and Enivironment Management meeting in Algeria 24-27 October 1993).

b) Stewart Scott NCL: Report on effluent collection, treatment and reuse , March 1989.

c) Stewart Scott NCL: Effluent treatment Plant : Stage 2 Design Report. February 1993.

Table 1 **Permissible Levels for Ambient Air**

Pollutant	Level
Sulphur dioxide	< 1310 mg/m3 per hour
Carbon dioxide	< 5000 ppm
Carbon monoxide	< 100ppm
Oxides of Nitrogen	< 5ppm
Hydrogen Sulphide	< 20ppm
Ammonia	< 50ppm
Inflammable Gas	< 1.2ppm
Dust	< 115mg/m3
Noxious Dust	Standards set by Chief Government Mining Engineer

Table 2

The maximum permissible concentrations of chemical constituents in water which is discharged or disposed of in catchment.

Constituent	Maximum Concentration in mg/l
PH	6-9
Dissolved Oxygen (% saturation)	60%
Chemical Oxygen Demand (mg COD/l)	60
Oxygen Absorbed (4hr PV mg/l)	10
Total undissolved solids (mg/l)	25
Ammonia: free (mg/l as N)	0,2
Total Nitrogen (mg/l as N)	10
Phosphate (mg/l as P)	1,0
Phenolic Compounds (mg/l as phenol)	0,1
Cyanides and related compounds (as CN) mg/l	0,2
Iron (as Fe) mg/l	0,3
Manganese (as Mn) mg/l	0,1
Total heavy metals	1,0

Table 3: Production process, pollutants and abatement measures.

Plant	Production Process	Pollutants Generated	Abatement Measures
Orco Plant	Raw Materials Handling. 1. Coal from Hwange 2. Iron Ore from Buchwa & Ripple Creek	Coal Dust Iron Ore Fines	None but study underway on Water Spraying and Wind breaks
Coke Ovens	Coking Conversion of coal into coke	Coke Ovens emissions, Ammonia liquor, Aromatic Hydro-carbons, tar waste oil, coal and coke dust	1. Oil separator in main outlet drain sumps to recover tar. 2. Incinerator to break ammonia into hydrogen and nitrogen which are released into the Atmosphere. 3. New batteries are equipped with self sealing doors which reduce emission into the atmosphere. Improved emissions suppression by steam injection. 4. Ammonia liquor to be treated in Biological plant yet to be constructed.

Table 3 cont/.....

Blast Furnace	Processing Iron Ore into pig iron	Dust, slag, fumes, sludge cooling water overflows.	1. Slag is granulated and conveyed to slag dumps and part is sold for cement manufacturing. 2. Sludge is clarified in clarifiers resultant sent to sludge dumps and clarified water is recycled in process.
Steel Plant	Converting molten pig iron into steel	Sludge, dust Boiler feed regeneration waster water	Venturi scrubbers convert dust into sludge. Sludge in clarifier is clarified and resultant is sent to sludge dumps. Clarified water is recycled.
Foundry	Mould Casting	Cement dust and siliceous dust	Project underway for dust extraction
Rolling Mills	Production of steel sections	Mill scale waste oil.	Sumps to recover mill scale
Power Station	Production of Steam Compressed Air, Cold blast air	Noise	Walls padded with acoustic absorbent material screening cubicles
Limestone Crushing	Breaking up limestone to suitable sizes for furnace charging	Lime dust and sludge	Water spray to convert dust into sludge which is sent to sludge dumps.
Lime Kilns	Generation of reactive lime	Lime dust.	Water spraying and dust is sold as lime.
Sinter Plant	Converting iron ore fines into lumps suitable for charging into the furnace.	Dust, gases eg. Sulphur dioxide, nitrogen oxide.	Electrostatic precipitator to remove dust. Gases being released into the atmosphere.

Table 4 Characteristics of Steelworks and Domestic Sewage Effluent

Parameter	Domestic Sewage	Steelworks Effluent	Composite Wastewater
Chemical Oxygen Demand (mg COD/l)	830	200	380
Suspended Solids (mg SS/l)	490	330	376
Total Kjedahl//Nitrogen (mg/l as N)	150	34	61
Ammonia (mg/l as N)	85	28	44
Phosphorus (mg/l as P)	10.0	1.0	3.6
Phenol (mg/l)	0.0	0.15	0,11
Alkalinity (mg/l as CaCO3)	360	178	230
Average Dry weather flow (m3/d)	1400	3500	4900

Fig 1:
ZISCOSTEEL Stage 2 Effluent Treatment Plant:

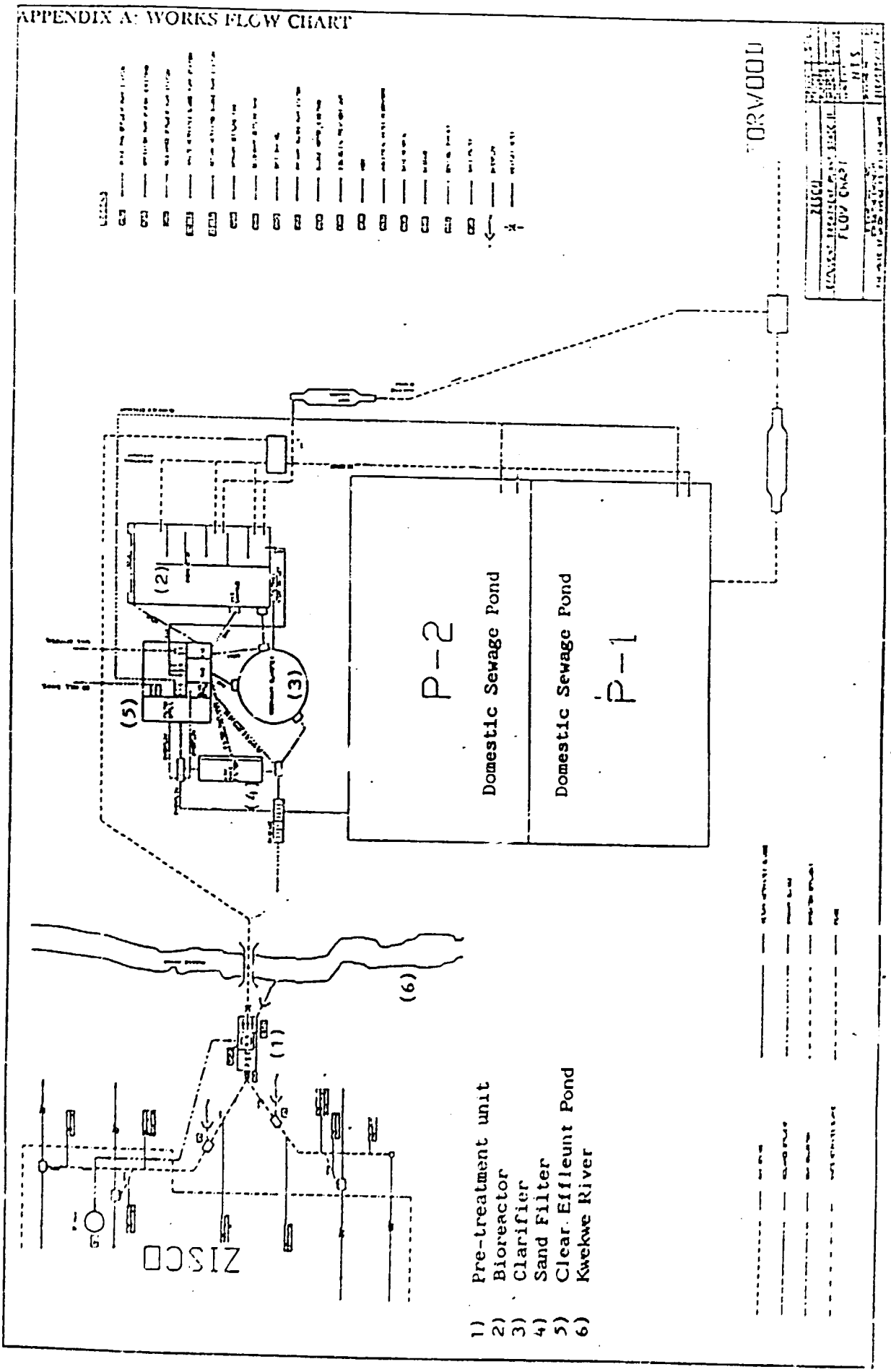


Fig 2 . BIOLOGICAL NUTRIENT REMOVAL PROCESS OPTIONS