FISH INDUSTRIAL PROCESSING COMPLEX - AIYETORO

A Contribution towards Agro-Allied Industry In
ONDO State

by

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D E D I C A T I O N

This thesis is dedicated to my Mother Madam BOLA AJULO and to my brother SUNDAY BABALOLA AJULO who, through the Grace of God were able to shoulder the burden of my educational up-bringing from my Primary School up to now.

And also dedicated to MRS. TAIYE AJULO who devotedly see to my welfare throughout the duration of my course in Architecture.

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F O R E W O R D

Since Nigeria has joined the Club of the "most Oil producing Nations" of the world, the talk of the town is "Oil Boom". Not until the new military government launched "the operation feed the Nation programme" in 1976, it appears that the Nation no longer reckons very much with the age long part which agriculture has played in our economic and Cultural Development.

Thank Goodness for the Military Governments launching of operation feed the Nation Programme. Agriculture is once again accorded the recognition it deserves.

"Fish Boom" may soon become the talk of the masses now that the Federal Military Government has voted N101.5 million for fishing Industry Development as an important part of agriculture and Natrual resources in the third National Development plan.

Architecture can not be left out of the successful execution of the operation.

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I N T R O D U C T I O N

Agriculture is the largest single Industry in the world. It is also one of the earliest human occupations.

Fishing is a very important Department of the Ministry of Agriculture and Natural Resources. Fish as a Natural Resources helps to sustain human life as other types of food do since as far back as the time of the early man. Books written thousands of years ago for an example the Holy Bible, refer to fishing as a form of occupation.

Fish as food is one of the greatest source of protein which man needs very much for growth and body building. The Federal executive Council took a decision on 1st January 1970 establishing four Ministries from the former Ministry of Agriculture and Natural Resources. Federal department of Fishery is one of the four new Ministries created then.

Since the establishment of the Ministry, little has so far been done in improving Nigerian Fishing Industry to the standard required of a Nation as big as Nigeria despite our many inland waters and the Atlantic ocean which forms one of Nigeria's boader lines. The ocean runs for hundreds of kilometres along the southern most part of the Country: The North Coast of the Gulf of Guinea.

Apart from Agriculture, Building is about the largest single Industry in the world. The role of Architecture in the Building Industry is a very important one. Architecture does not only provide shelter for human abode it also provides suitable shelter where indoor industrial production would be best carried out with better efficiency.

Provision of shelter where the fish catch landings could be better and more speedily processed would certainly make fish more readily available and cheaper for the Nigerian masses.

It will also help to encourage the Fisher-men to increase their fish catch to meet the industrial processing Unit's high demand.

It is quite nice that Nigerian Military Government has discovered that the Nation has not been tapping the Natural food resources which our rivers and sea could offer us to assist the farm products in feeding the masses. The Federal Military Government's realization of the above fact has led to the allocation of more than ₦36 million to small scale Fisheries and a total of ₦101.5 million to Fishing Industry development.

Architecture has got to play a key role in the development of Nigerian Fishing Industry.

PURPOSES OF INVESTIGATION

The purposes of carrying out investigation are:-

- To exploit ways of further fulfilling the "Operation Feed the Nation Programme" launched by the Federal Military Government in 1976 (the greatest attention of the operation is focused on land cultivation)
- To find ways of contributing to the Nigerian Rural industrialization scheme; other than concentrating industries in the already over populated cities.
- To see the feasibility of establishing an industry near the source of raw material even though the site is considerably far removed from where land vehicles could have access to circulate the manufactured products (But there is effective water transportation).
- To investigate any architectural problems that such an establishment would bring and then make proposals for solutions to such problems.

SCOPE OF THESIS

My Research and investigations shall be limited to

(a) A general study of ocean fisheries and modern commercial ways of fish processing.

(b) A study of the traditional methods of fish curing in Nigeria

(c) An assessment of the staff development requirement that will be able to meet the demand of the industry without stopping production for shortage of technical staff; and for expected expansion in the Industry in the near future.

The scope of the architectural aspect of the thesis shall be limited to the

(a) design of a model fish processing industry complex which will be located in Aiyetoro Village, Okitipupa Division of Ondo State.

(b) The Industry will be expected to have a processing capacity of about 500 tons of raw fish daily in different forms of fish product.

(c) The Industry will be expected to expand to a maximum of twice the above capacity within two decades.

PART ONE

PRELIMINARY INVESTIGATION INTO THE NIGERIAN FOOD SITUATION AND A BRIEF LOOK INTO FISHING INDUSTRY

1.01 NUTRITIONAL PATTERN IN NIGERIA

In Nigeria, the greatest percentage of the population lives in the rural areas. And in the rural areas, the greatest percentage of the population lives on the land (i.e. farming) The farming which the greater population of the farmers practise is at a subsistence level. It is the collection of the extra bits in excess of what they could consume that is sent to urban areas for sale.

The crops which the farmers grow is a function of ecological differences (e.g. variations in climate, vegetation and occurence of particular insects species in certain areas) The crops which the ecological conditions permit the farmers to grow in their localities form the staple food of the population in the locality or region. Taking rice for an example, in some rural areas where rice is not cultivated, the people in such areas treat rice as a special food to be taken occasionally. Transportation system has considerably improved over the years and this makes it possible for different types of food to be circulated; But people still stick to the ones that are readily and cheaply available in their locality. The food brought from other parts are not always available and are generally more costly.

In the Northern part of the Country, cereals like millet, rice, guninea corn etc form larger part of their diet. They have Natural facilities for rearing cattle in large numbers. The availability of large number of cattle makes meat readily available and cheaper for consumption by the masses in the northern part.

In the south, the main diet are the root crops and tubers like yams, cassava etc. Meat is scarce. They depend mainly on the cattle brought from the Northern part for their sources of animal protein. The cattle brought down south is far from being able to meet the demand of the population. Infact the ones brought down are usually taken to the Urban areas and the greater population living in the rural areas depend on scanty meat from game.

In the southern most part of the Country, the coastal towns and villages do get fish to eat in absence of meat; but the method of fish catch and processing is not so advance to the extent of being able to get enough to feed themselves and still have sufficient quantity to circulate among other non-coastal towns where there is scarcity of animal protein as part of their diet.

In order to meet peoples food needs some food item has to be imported to supplement the Nations own.

The table in the next page shows the list of some of the food items and the quantities imported from other Countries between 1970 - 1973.

IMPORTS OF SOME FOOD ITEMS BETWEEN 1970-1973

ALL WEIGHTS ARE IN kg. TABLE 1

	FOOD ITEMS	1970	197	1972	1973
1.	Fish, Fresh & Chilled	739,496	2055,317	335744	1,152,065
2.	Sardine	969,670	2542,540	3934562	4,615,588
3.	Corned Beef	63,755	34,290	5690	28
4.	Bacon and Ham	762	610	1930	612
5.	Macaroni, Spaghetti etc	563,916	740,359	366140	481,241
6.	Pastry Cakes & Biscuits	139,751	782,777	768909	1,231,343
7.	Chocolates & Confectionery	755,268	1128118	597,819	7,11089
8.	Dried Fruits Including artifically hydrated fruits	69,037	29,464	72,441	71,192
9.	Bread, Biscuits and Baker's ware	2,794	34,087	22,708	51,715

Source: Federal Ministry of Trade Lagos.

Note: From the list above it could be seen that items I and 2 which are fish products are the largest single food imported. If the government could fully develop the fishing industry in our inland waters and the ocean, if Nigeria could not export fish and fish products the amount of fish imported would be reduced to barest minimum.

1.02 A LOOK INTO WORLD OCEAN FISHERY

It is quite important to have some understanding of the raw materials for this important industry and also know the method of getting the raw materials from their habitat. To really have some understanding we have to look briefly into world fisheries and the leading fishing nations of the world.

The capture of fish as food for man seems to have been carried on from the early times. Cave remains in western europe gives evidence of the use of many different kinds of implements for fishing Shell fish formed a staple part of primitive man's diet. Heap of rubbish formed by empty shells clearly showed it.

In the modern time the term 'fishery is not just the capture of fish as food for man but - the capture or harvest and the processing of sea, coastal and inland aquatic animals and plants for human food, animal food and industrial products for profit. In contrast, sports fishing is the capture of fish and shell fish for recreation and enjoyment.

Many of the famous cities both in the ancient and this our modern time had their origin in fishing villages. In a world in which the arable land areas have been almost fully explored, the food potential of the seas is attracting attention. The time has come when mere mulitiplication of mouth to feed caused by increasing population growth has focused attention on this last of the unexplored food possibilities.

A square mile of sea produces an average of 13000 tons of vegetation annally this is about five times the vegetation on land. the principal commercially valuable fauna of the sea and inland waters are fish, shell-fish and mammals. Fish have always been the most important of all the living resources of the sea.

1.03 FISH

There are teleostean or bony fish such as herring tuna, salmon, flounder and cod. There are hard scale fish such as sturgeon garfish and paddle fish. Also there are fish with lamellate gills as sharks, skates and rays. Fish are more abundant for example than marine mamals (whales, walrusses, sea offer, sea lions and seals). Also fish are more widely distributed. In parts of world where fishing is practised with modern equipments, an average fisherman with an average vessels and gear catches a few tons of fish with a day's effort. Fish are easier to preserve, prepare and market than mammals.

1.04 SHELL FISH

Although fish are so plentiful and easily caught, yet more than 90% of the mass of animals life in the sea is composed of invertebrates or what is more commonly known as shell fish. The shellfish are divided into two major groups:-

(1) Crustaceans usually distinguished by chitinous covering as shrimp, crabs and lobters.

(2) Mollusks - are commonly with a calcareous shell as oysters, scallops, squid and octopus. There is a great variety of general and species of shell-fish. Some species occur in enormous numbers but few are known or usuable by man with our present knowledge. The food shell-fish consist principally of oysters, clams, scallops, lobsters shrimp and squid: they are well known at present. Vast amounts of fish and shell fish species not now commercially desirable are discarded at sea when north Atlantic fishermen hunt for cod and haddocks.

Many kinds of marine invertebrates all rich in nutrient are not being harvested even though they are close to areas where people are in need of protein food.

1.05 MAMMALS

Aquatic of marine mammals such as whales dolphims, seals, sea lions, walruses and sea other include a larger share of spaeies that are commercially useful than is found among any other group of animals in the sea. Although some of the marine mammals are very valuable, their use is severely limited despite their being very valuable. They are limited because of their small population number and by a low rate of reproduction. Of lesser importance are other awuatic fauna including reptiles as turtles, amphians as frogs etc.

Also included among the products of the sea are aquatic animal residual as sponges and corals.

1.06 CONSERVATION

The ecologists and some other sympathisers with the Natural resources have since the middle of 19th century started to preach the gospel of conservation and preservation of Natural Resources. The preachers of the above gospel meant well for humanity but sometimes in attempt to preserve and conserve we succeeded in making no profitable use of what we preserve and conserve. They would only later create problems of how best to get rid of them in their rotten state.

Preservation and conservation is possible only non renewable resources like Coal, Oil, and Minerals. If they are not exploited they will remain as they are. But for resources renewable like crops, fish, shell fish, wild life timber, aquatic fauna and lfora must be harvested each season because the surplus will die in one way or another. To use is to conserve them.

1.07 WORLD HARVEST

The keeping of records of catch statistics are the best measure available of what the seas and inland waters yield to man for food and industrial products. Since people of the coastal areas and close to bodies of waters take large quantities in most instances which are not relfected in existing catch statistics. Therefore knowledge of consumption of aquatic products is only fragmentary. The estimated world commercial catch of fish crustaneean, mollusks and other aquatic fauna and flora has increased from 19 million metric ton in 1948 to about 30 million metric tons in 1957. Almost 50% more was landed in 1957 in 1938.

1938 was the last full fishing year before world War II when 20.5 million metric tons was landed according to the fisheries Division of Food and Agriculture Organisation of United Nations. Although the seas and inland waters occupy most of the earths surface the total harvest including fish, shell-fish and even edible sea weeds is only about half of the worlds consumption of beef or 1/30th of the total food production of the land.

Since 1947 when the world harvest of aquatic products amounts to 17.9 million tons and still showed the effect of world war II, there has been a steady increase in each years harvest The steady post war expansion of the fishery catch was checked only 1957 due to certain economic factors.

1.08 SPECIES

Of the worlds total fishery landings almost 25% are cod and their relatives (menhaden, sardine and anchovy). About 15% are cod and their relatives. Also known as ground fish (cod, haddock, hake, pollock, cusk, ocean perch or rose fish). About 10% are miscellaneous marine teleosteans of which about 6% are tuna, bonitos, mackerels and their relations. The remainder are almon, flounder, shark, ray, crustencean, mollusks and a variety of other groups including those raised in pond.

An analysis of the catch of the Nations which are largest producers show that their large scale fishery landings are based to an appreciable degree on the herring and cod groups which predominate in the world fisheries.

In amny of fishing Nations, activities are based almost entired on these two groups. Norway's large catch consists chiefly of the herring and cod occuring in abundance close to its shores. In U.K. Herring and cod predominate. In United States where there is varied fisheries some species predominate such as menhaden, tuna herring, haddock ocean perch or red fish, salmon and shrimp. In Union of South Africa and South West Africa the fisheries are largely based on pilchard, meashbanker or jack macherel and cape Hake. Similar species figure prominently in catches of Angola.

The marine fisheries of Morocco are dependent virtually on sardine alone. In Denmark, France, Germany, Iceland, the Netherlands Portugal and Spain the catch is on a few predominant species such as cod, herring, sardine, ocean perch or rose fish. Marina production in great areas of south and east Asia tropical Africa and Latin America is scattered and based on large number of different species. Fishing grounds played an important role in the exploration, settlements and development of adjacent land areas. For example Boston and New York were early fishing ports in United States of America. These area has a settlement of about 50 million people in 1958. Lagos also originated from Fishermen settlement .

1.09 COMMERCIAL FISHERIES

During the latter part of the 19th Century, the Fishing Industry throughout the so called civilized world received an impetus from the introduction of new source of power which is the steam engine. The introduction of steam driven trawlers and of difters enabled ships to go on longer trips into distant fishing grounds hundreds of miles from their home shores. They were able to fish more efficiently and intensively. They could catch more fish than was needed for their nations and so they were able to engage in interantional trades in fish and fish products. They were able to fish and return to their home fishing harbours with more certainty and on schedule than their former sailing fishing boats which were at the mercy of ocean tide. After the second world war, steam engine gave way to diesel power. The new source of energy give the trawlers more power and efficiency .

The world catch of fishery products has totalled over one billion pounds (0.45 billion kg) each year since 1962 and there was a record of 115.5 billion pounds in 1965. Asia accounts for 38.1% of 1965, Europe 20.6%, South America 17.1% the Soviets Union 9.5%, North America 8.5%, Africa 5.9% and oceania 0.3%. In 1962 Peru replaced Japan as the leading fishing nation.

In 1964 peruvian fishermen landed a record catch of 21 billion pounds (9.5 billion kg) of fish and shell fish. Anchovies which yield meal and oil accounted for over 97% of Peru catch. Most of the meal is exported to Europe and the U.S for poultry and animal food. Most of the Oil went to Europe for manufacture into margarine and industrial products.

Japan with an annual catch of over 14 billion pounds (6.4 billion kg) ranks second among fishing nations. The large population and small area available for farming force the Japanese to look to the sea for much of their protein food. China ranks third with amal catch of 13 billion (lbs) pounds. U.S.S.R. also has a large fleet of vessels most of it fish in West Atlantic, Eastern Pacific. Her annual catch is 12 billion (lbs) pounds. U.S lands 6 billion (lbs) pounds of fish. The table in the next page shows the statistics of the fishery catch for 1965.

COUNTRY	MILLION (lbs)	% PERCENTAGE PER COUNTRY
Peru	16,450	14.2
Japan	15,165	13.1
China (Mainland)	12,787	11
U.S.S.R.	10,978	9.5
Norway	5,027	4.4
U.S.	6,015	5.2
Spain	2,951	2.6
India	2,935	2.5
Canada	2,775	2.3
Ice-Land	2,643	2.0
Indonesia	2,064	1.8
Other Countries	33,423	29
TOTAL	115,521	100%

The above table is the world catch of fish, crustanceans and Mollusks by principal Countries in 1965. The above Countries are still the leading fishing nations of the 1970s. The above table is given to show how much fish the other Countries (especially Nigeria) can respectively produce before they can be reckoned as one of the leading nations in fishery.

1.10 COMMERCIAL FISHING TECHNIQUES

There is a difference between commercial fishing and sports or recreational fishing. The development of commercial fishery is linked to the development of fishing techniques that grew in response to various pressures especially the growth of the market.

(ix) Seining

(x) Fishing with surrounding heb

(xi) Driving fish into net

(xii) Fishing with lift nets

(xiii) Fishing with falling gear

(xiv) Gillnetting

VALUE OF FISH

1.2 FOOD VALUE

Fish has a great taste appeal and in addition to this, it is a good source of animal protein which human body greatly needs. Apart from protein it has fat, minerals and vitamins as food elements. Animal protein is the substance that replaces the worn out body tissue and promote growth. An average serving of fish or shell fish will supply the animal protein necessary for properly balancing the less efficient cereals and vegetable proteins in the daily diet. Fish are also valuable because of their mineral content, iron, copper, iodine, calcium and phosphorons - all essential to human well being.

1.3 FISH BY-PRODUCTS

In addition to use as humand food, large quantities of fish and shell fish are used to make industrial product. An important portion of the world catch is utilized directly in the production of fish meal, oil and other products. Greater quantities of waste from canning, filleting and other wise preparing fishery products for human food are also used in production of by-products.

Formerly large quantities of fish meal were used as fertilizers but now, they are used as animal food. The meal provides protein of high biological value and other elements which makes it valuable in rations for poultry, pigs and young cattle. Fish, wale and other marine animal oil have a large number of industrial uses. They are used in treating of leather and in the manufacture of soap, paint printing ink, linoleum oil cloth, lubricants and greases etc. For example, shoes may be made of shark skin leather buttons from abalone shells. Men-haden, sardine, herrings and shark produce oil for use in the manufacture of vanishes, the tanning of leather, paints and synthetic materials. Fish oil is also used in making candles. Fish body oils have sufficiently high vitamin A & D potency to make them valuable as feeding oils for pooultry. Fish liver oils are also important sources of vitamin A & D for human and animal nutrition.

PART TWO

NIGERIA FISHERIES

2.01 NIGERIA FISHERIES

In the past years, Nigeria government failed to pay much attention to the development of her fishing industry to a level whereby fish could be readily available for the consumers throughout the Country. Despite the available inland waters, lake and sea, little or nothing was done by the government to encourage the fishermen to increase their productivity by giving them both the financial and technical aid. Instead of improving the fishing industry to such a level that fish can be readily available for the masses to meet the high animal prtein demand of the body, attention is focused on importation of fish and fish products from foreign Countries. The amount of fish imported is also not sufficient for circulation in the Country. Large amount of foreign exchange goes into the fish importation. Fish and fish products is the largest single food item that is imported into the Country.

The evidence of little or no attention paid to fishing industry could be seen in the tables of established industries between 1952 and 1963 and 1963-1967 respectively in the next page.

YEARS IN WHICH SELECTED AGRO-INDUSTRIES BEGAN OPERATION. (IN NIGERIA) TABLE 3

1.

INDUSTRY	NUMBER OF ESTABLISHMENTS		
	Before 1952	1952-1957	1958-63
Meat	2	1	3
Grain Milling	-	2	4
Fruit	2	1	-
Dairy	1	-	2
Bakery	14	15	31
Sugar Confectionary	1	-	3
Textiles	11	7	17
Miscelaneous food	4	2	5
Saw Milling	13	11	31
Tanning	1	-	4
Rubber	12	12	10
Vegetable Oil	6	6	5
TOTAL	67	57	115
%	28	24	48

*Source: Federal Office of Statistics.

TABLE 4

II

INDUSTRY	NUMBER OF ESTABLISHMENTS 1963	1964	1965	1967
Meat & Meat Products	9	11	11	18
Dairy Products	5	6	9	8
Fruit & Vegetable) Canned & Processed)	8	8	10	10
Grain Mill Product	9	7	8	11
Sugar Factories &) refineries	-	-	2	2
Bakery Products	41	51	54	138
Cocoa, Chocolate) Sugar Confectioneries)	3	5	10	10
Miscellaneous Food	14	12	12	15
Wine Industries	-	-	1	1
Tobacco Products	3	3	6	7
Spinning, Weaving) Finishing of Textiles)	31	33	35	51
Cordage, Rope, Twine	1	1	2	2
Saw Mill, Planing) & other mills)	64	68	85	116
Pulp & Paper	-	-	-	1
Tanneries & Leather) Finishing Plants)	9	7	8	12
Leather Products) except foot wear)	2	3	3	6
Rubber & Rubber) Products except) Foot wear)	41	53	55	60

Source: Federal Office of Statistics.

Going through the tables one can see that in a span of 15 years in which attention was focused on the establishments of Agro business firms and industries, fishing industry was neglected. Lack of encouragement of local fishermen in term of technical and financial aid makes their fishing to be at a subsistent level. The fishing communities along the coast and inland waters lack infrastructure especially fishing terminals and shortage of trained man power. They also lack the funds to transform their fishing from subsistent level to industrial level. Although there are some fishing Companies who use the modern techniques of fishing with a fleet of sea going vessels, yet there production is still far from meeting the needs of the masses. Before going into the projected plans of the third National Development Plan, it is nice to look at the existing condition of fish industry. Lagos has the largest sea port in the Country. Most of Nigerian's bound foreign fishing vessels land their catch in Lagos. Lagos is the operating base for most of the fishing Companies in the Country. Lagos then will be good for a case study of fishing industry in Nigeria.

On the next page is the table of Total Annual catch and effort statistics of Lagos in-shore trawling fleet between 1960-73.

TABLE 5

Year	Total Catch in Tonnes	Effort in Horse Power Hour/1000	Catch per Unit Effort in kgx 100/Hour	No. of Boats
1960	3481	6390	54.5	17
1961	3561	5815	61.2	14
1962	3263	5283	61.8	20
1963	4146	6693	61.9	15
1964	2172	4908	44.3	15
1965	889	2599	34.2	8
1966	865	3486	24.8	12
1967	1185	2827	42.0	14
1968	698	1619	43.1	8
1969	756	1704	44.5	10
1970	842	2339	41.0	12
1971	1093	3935	27.8	13
1972	1403	47019	29.8kg/hr	26
1973	2012	59900	34 " "	27

Source: Federal Department of Fisheries.

TABLE 6(a)

LAGOS LANDING OF DISTANT VESSELS - 1972 BY FISH SPECIES

FISH SPECIES	TONNES
Breams	5,160,810
Horse Mackerel	30,257.944
Spanish Mackerel	2,545.365
Mackerel	6,129.343
Hake	5,625.522
Sole	286.461
Mixed	15,058.467
Prawns (Head-on)	10.440
TOTAL	65,074.352
No of Vessels	45

TABLE 6(b)

GENERAL LAGOS FISH LANDING STATISTICS 1972 IN TONNES

CATEGORY	COMPARNIES	BOATS	FISH	SHRIMPS (HEAD-ON)
Inshore) general)	6	26	1363.56	39.61
Prawns	2	27	1555.23	1245.00
Deep Sea	6	45	65063.91	10.44
TOTAL	14	98	67982.70	1295.05

* Source: Federal Department of Fisheries.

The table below shows the analysis of fish landed in 1973.

TABLE 7

DISTANT WATER LANDINGS BY CATEGORIES OF FISH IN 1973

(IN METRIC TONS)

TYPES	METRIC TONS
Beams	2887.5
Horse Mackerel	41757.3
Spanish Mackerel	1786.8
Mackerel	77430.4
Hake	644.1
Sole	17.01
Croaler	21.6
Shark	0.5
Green Jack	0.8
Yellow Jack	166.4
Black Jack	1357.5
Thread-Tin	4.0
Catfish	0.7
Red Snapper	17.1
Grey Snapper	160.5
Sardinella	1224.5
Cutlass fish	374.4
Blue fish	78.5
Baracuda	0.2
Lichia	1.4
Spade fish	1.5
Mixed	6324.0
Total	71411.3
No. of Boats	68

TABLE 8

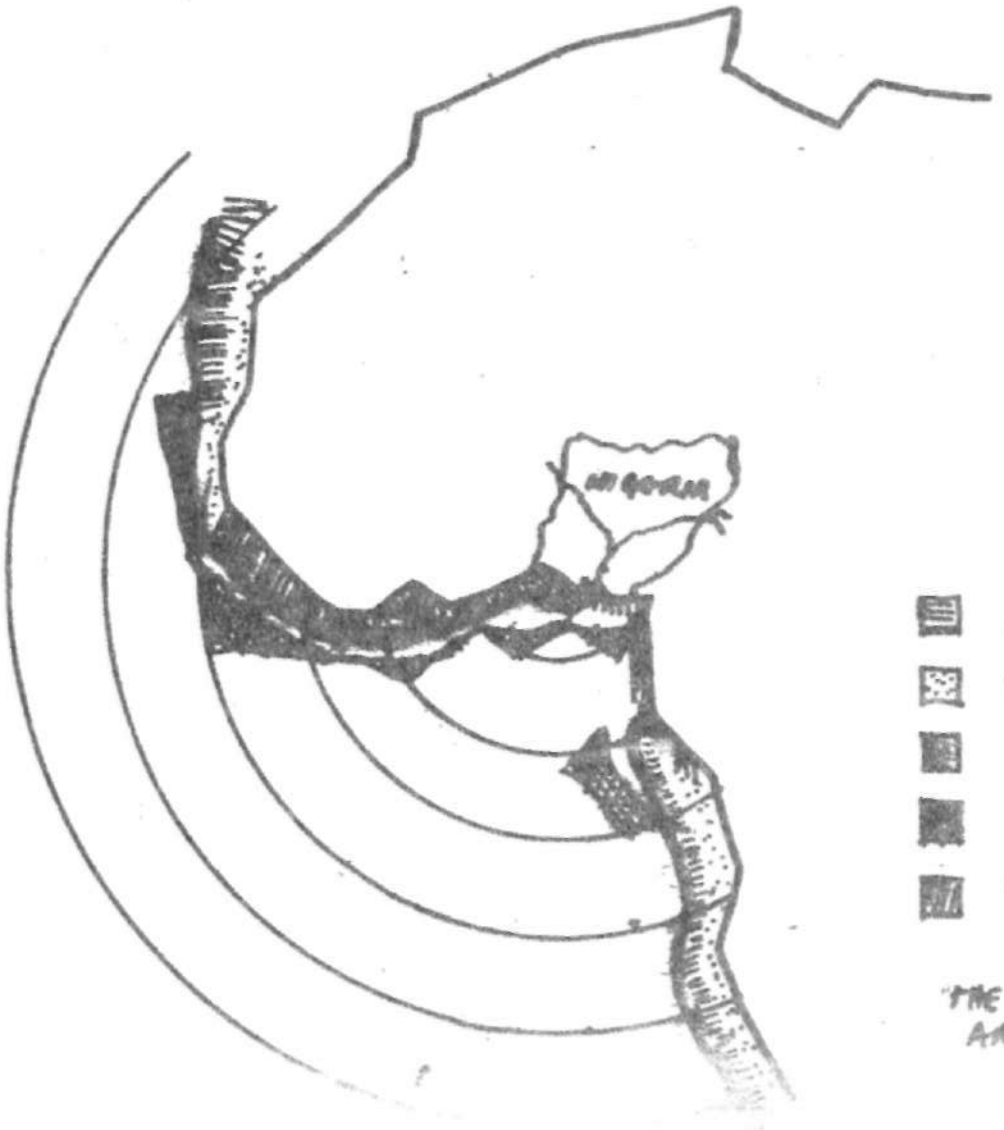
GENERAL LAGOS LANDING STATISTICS (IN METRIC TONS)

FOR 1973

TYPES OF VESSEL	PERIOD	FISH	PRAWNS (HEAD-ON)
INSURE TRAWLERS	Jan-Dec. 12 Months	1945.3	66.8
PRAWN TRAWLERS	" " " "	2093.1	1358.8
DEEP SEA TRAWLER	" " " "	71411.3	-
TOTAL	" " " "	75,449.7	1,425.6

SCHEMATIC MAP OF THE

FISHERIES RESOURCES OF THE HIGH SEAS AVAILABLE TO NIGERIA



- DEEP TRAWLING SHORE FOR HAKE
- TRAWLING DOWN TO 180m FOR BREAM, SNAPPER, CROAKER
- SARDINELLA FISHERIES
- OFFSHORE TUNA FISHERIES
- INSHORE TRAWLING GROUNDS FOR CROAKER, SOLS, SPADEFISH ETC.

THE CONCENTRIC ARC CENTRED AROUND LAGOS ARE 400m.

PART THREE

THE SITE -- AIYETORO

3.01 THE SITE(AIYETORO)

Aiyetoro is a small coastal town in Ondo State of Nigeria It has a population of about 4,000 people. It is about 160 kilometres east of Lagos and about 80 kilometres south of Okitipupa the headequarters of the division in which the town is in Onde State.

It is a nunique town among all Nigerian towns and villages It is unique because it is the only town where communism is practised in the real sense of the word. Their own type of communism is not based on any of the 19th century philosophy on which some of now-a-days socialist and communist States are based. Theirs is purely based on mystical grounds. (It is frankly based on Bible)

The town is referred to by its - inhabitants as

(i) the happy city

(ii) the Holy Apostles Community)

The town is a new town. It was founded by a group of Christians who broke away from the earlier form of Cherubin and Seraphin sect. Aiyetoro is built on a swampy beach between the atlantic ocean and the creeks. Igbokoda village near Okitipupa town is the nearest dry land area where vehicles can reach. The only means of getting to Aiyetoro from Igbokoda is by boat which takes about three hours non-stop. Between Igbokoda and Aiyetoro there is nothing but water, swamp and vegetation in varying proportions. Before 1976, only very small boats can get to Aiyetoro from the hinterland areas during the dry season because the water ways have some narrow and very shallow parts along the ways. Now that the dredging of the entire water way has been

virtually completed, fairly large launches and barges can ply Aiyetoro at any time of the year.

The town is compactly built up on an area of about 1.2 kilometre by 0.8 kilometre along the swampy beach. The houses are built on stilts. The streets are built of planks on timber piles. The major street which runs through the middle of the town is about 3.6 metres wide and the monor ones are between (1.5-2.5)m wide. For structural reasons, the main circulation pattern is pedestrian. About 97% of the population move about on foot while about 3% use bicycle and motor cycles. There is a ring road which partially surrounds the town. The road was built by filling it up with earth to reclaim it from water and a portion of the road has been paved with concrete. During the rainy season, a substantial portion of the ring road is submerged in water. The replacement of the streets made of planks with concrete slaps and piles is already in the community's development plan.

The main occupation of the community is fishing. The men go to sea for fishing and the women do the smoking and selling The community has a number of inshore small trawlers and a fleet of small outboard engine boats for inshore ocean fishery. From the compiled data of fish catch of the community, in 1970 the six small inshore trawlers owned by the community made a catch of 583 tonnes of fish. At the end of August in 1976 the same trawlers made an improved catch of 30% above that of 1970; which means that in 8 months in 1976 they caught about 758 tonnes of fish. There are more than 100 smoking houses where the fish brought from the sea by men are cured by the women.

The main occupation of these villages and Aiyetoro is fishing. Aiyetoro in particular is good in ocean fishery. If there is a new method of fishing to be introduced, it would take the potential fishermen less time and effort to master such techniques than people with no former knowledge of fishing.

Aiyetoro has the highest level of infrastructural development among all the villages in the Igbohoda district in which it is located. Aiyetoro is the first town to have electricity supply among all towns in Okitipupa Division and it is the first town in Nigeria to have electricity supply without government aid. There are other infrastructures like, primary school, Technical school, Restaurants, Rest house for visitors, health centre, postal agency soon to be converted to a sub post office internal telephone system soon to be linked with other parts of the Country etc.

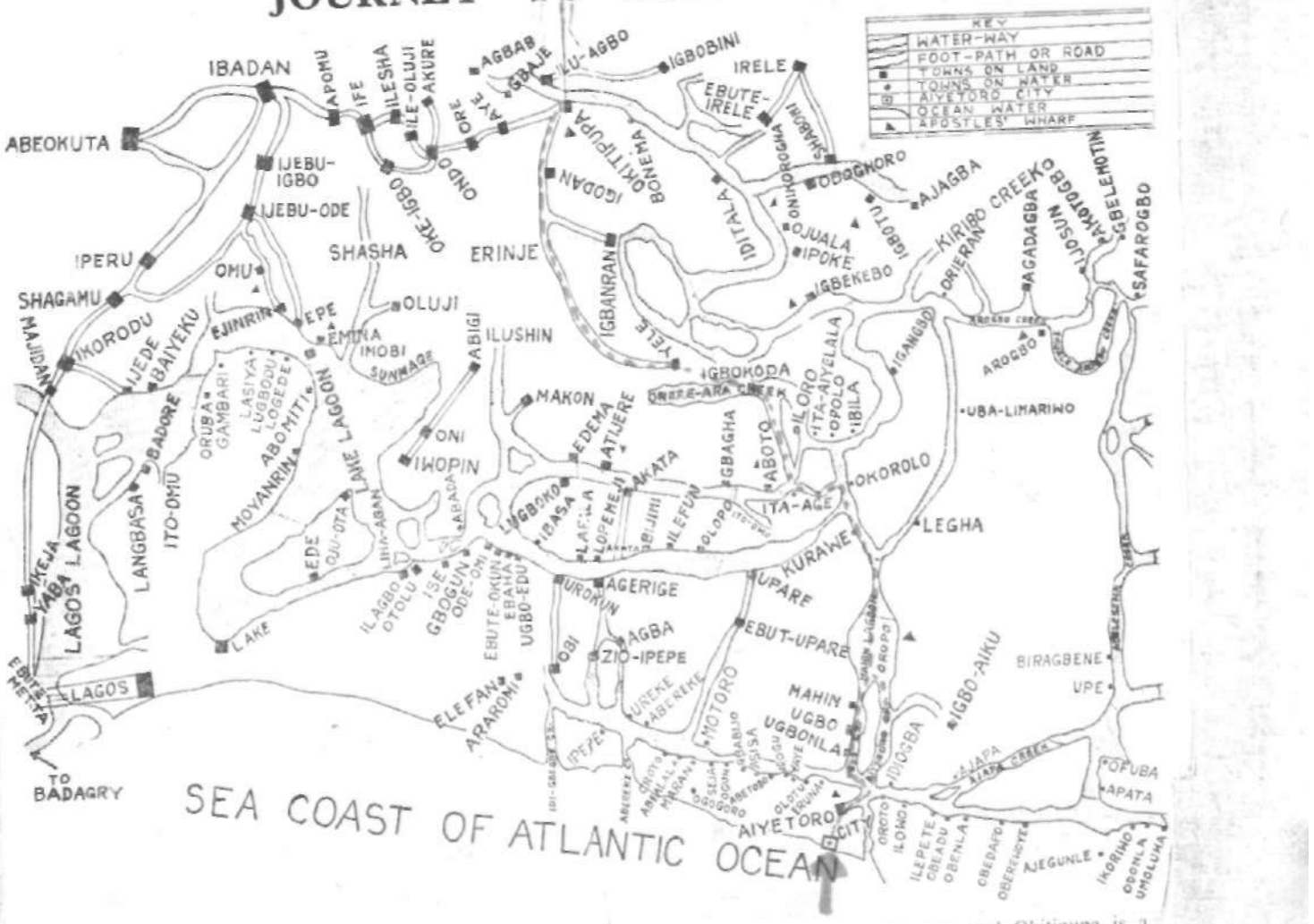
As already described, Aiyetoro is built on swampy beach of Atlantic ocean. The town is almost at the sea level. Because of the nature of the soil, much work has to be done in the construction of the industry complex. The complex will be located by the side of a cannal which links the inland waters with the Atlantic. The canal has to undergo the widening and dredging processes. The dredged material will be pumped to reclaim the site where the industry complex would be built. The sea and the inland waters which sandwiched Aiyetoro are the main physical features of the site. These physical features are of great advantage when one considers the much amount of water that is needed in fish processing. Sea water which has a relatively



A MAP OF NIGERIA SHOWING ~~SHOWING~~
THE LOCATION OF AIYETORO IN ONDO STATE.

32(b)

JOURNEY TO AIYETORO

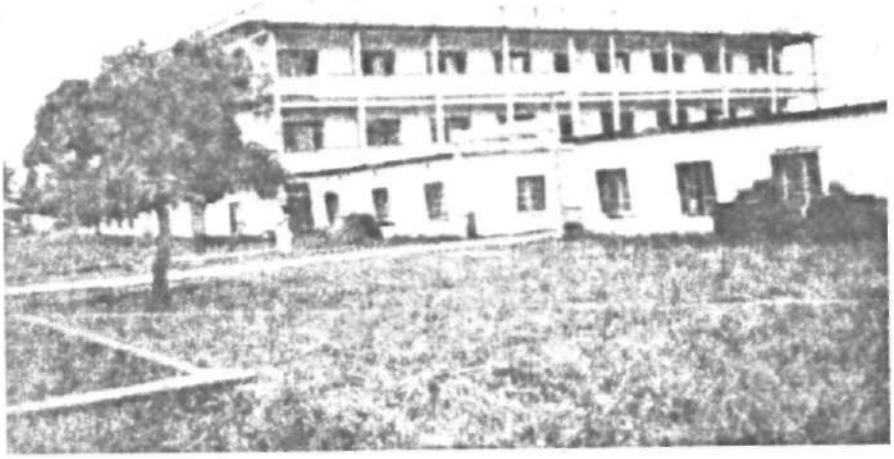


This is a sketch Map showing the position of Aiyetoro on the Coast of the Atlantic Ocean about 104 Miles by sea east of Lagos, Federal Capital of Nigeria. This Map, which is not shown to scale, is to give a clear idea of how to journey to the City.

The area between Aiyetoro and Okitipupa is a region of creeks and dense swamp forest without roads or foot paths. In a few places, there are small areas of land rising a few feet above the sea level. The whole division is nearly covered by water.

AIYETORO CITY [illegible] THE BOTTOM PART OF THE MAI

DRAWN BY S. O. A. AUTHORIT



THE PALACE OF AIYETORO OBA.
(BUILT ON RECLAIMED LAND)

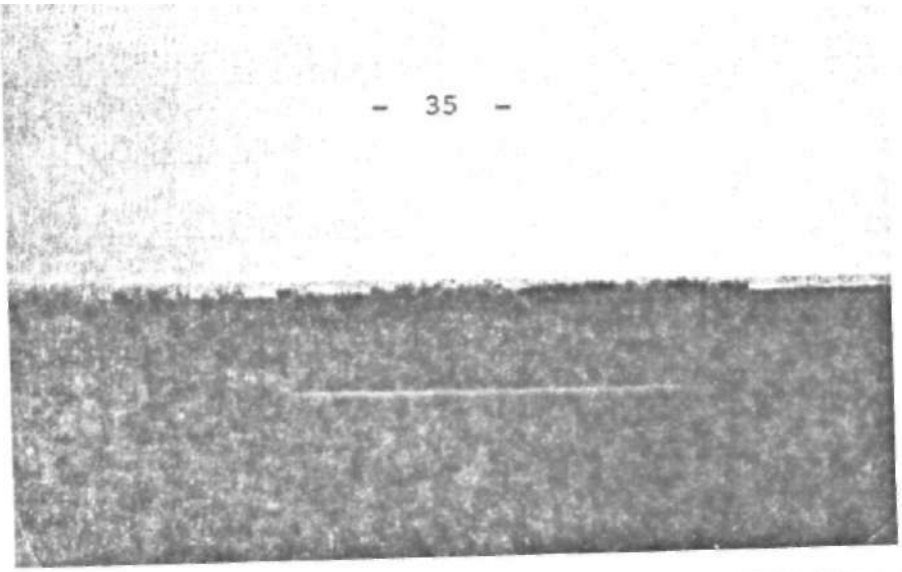


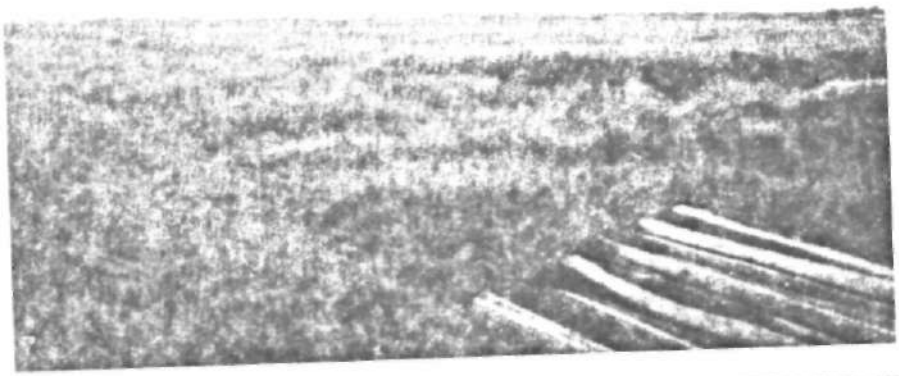
A VIEW OF ROAD FROM
PORT OF ARRIVAL AT AIYETORO.

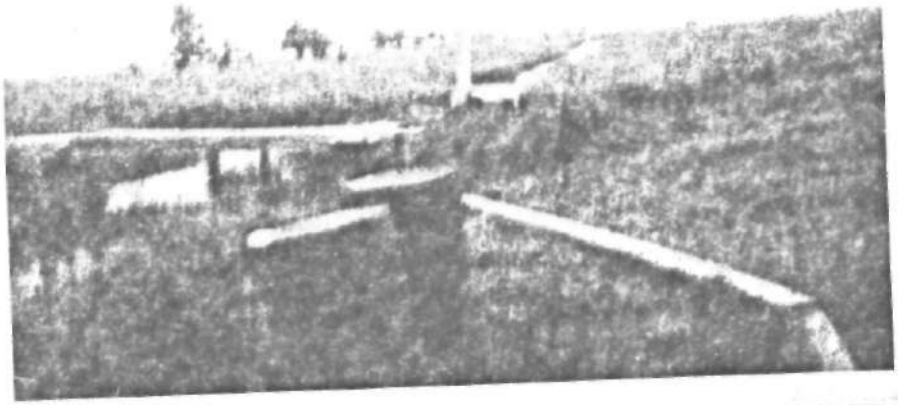




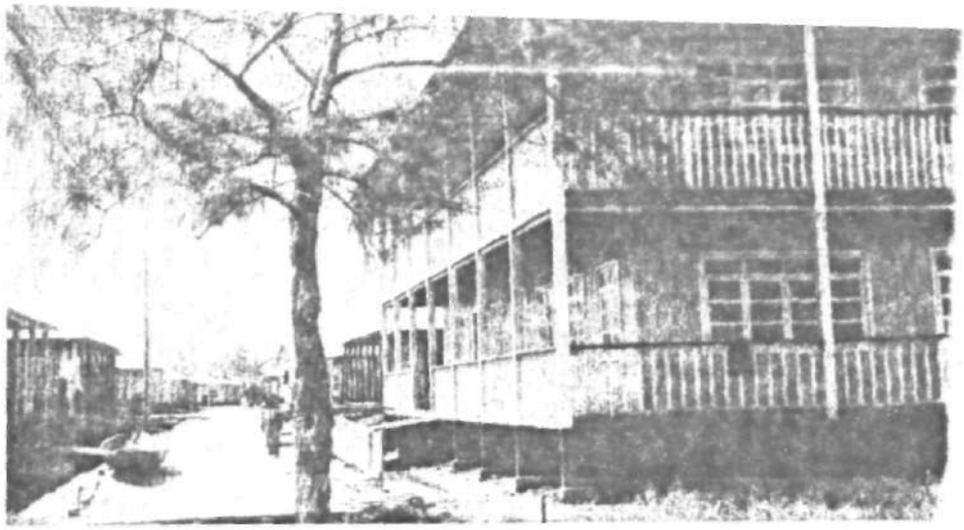
VIEWS OF THE MAJOR STREET OF AIYETORO







VIEWS TOWARDS THE SITE FROM AIYETORO.







SOME OF AIYETORO STREETS.

Apart from the fishing department, there are other departments like Boat building, shoe making, textile etc.

3.02 FACTORS CONSIDERED BEFORE CHOOSING THE SITE.

Some factors are considered in the location of the industrial complex in a site.

The factors are:

(1) Location in relation to the source of raw material and its reception.

(2) Availability of labour force to man both the raw material supply and production units.

(3) The level of development of the town's infra structures

(4) The physical features of the site.

(5) Method of distribution of finished products.

In siting an industrial complex in a place, due consideration has to be given to how the raw material to be used in the factory would be received in order to keep the factory running.

Aiyetoro is right on the coast of Atlantic ocean from where the raw material will be supplied to keep producation going. It is also a right place to receive other ships that would bring fish supply from distant waters and essential material supply like cans from can making factory in Lagos through the Atlantic ocean.

Both the skilled and unskilled labour force required to run the factory and to supply the raw material which is essential to the industry can be got in Aiyetoro and its Environ. Aiyetoro has about eight neighbouring villages which are within 30 minutes from it by boat. The total population of the villages is not less 17000 people (figure from 1963 population census).

high degree of salinity is of high importance in preservation of small fish like sardine and herring in brine tanks while awaiting processing.

The sea and the inland waters act as good and cheap means of communication especially for an industry which its existence lies in the transferring of goods to and fro.

3.03 CLIMATIC DATA OF AIYETORO

Location -	Longitude	4°, 46'E
	Latitude	6°, 6'N
Mean Temperature		79.25°F
Mean Relative Humidity		85%
Average Annual Rainfall		84 ins or 210cm
Prevailing wind		South West Wind

3.04 TYPES OF FISH PROCESSING TO BE DONE IN THE FACTORY

(a) Canning of fish (e.g. Sardine, herring)

(b) Freezing of fish

(c) Mechanical drying or dehydration of fish

(d) Rendering of condemned fish, small fish and fish offal.

Relevant of the types of fish processing to be done in the Factory to the needs of the Nigerian Masses:-

3.05 (a) CANNING OF SARDINE & HERRING

Apart from the nutritional value of fish, the taste appeal which fish and fish products give the masses who consume them make them a very important compliment of other types of diet. e.g. fish is eaten with other food types like yam, gari, beans rice and bread etc.

Taking bread for an example, the popularity of bread among the Nigerian City dwellers as an acceptable ready-made food for the masses' consumption can not be over - emphasized.

Most of the industrial workers and traders during break eat bread and sardine without any ceremony of having to cook ot before eating.

Peter Kilby in his research published in his book the African enterprise - the Nigeria Bread industry noted that bread consumption is determined by:

(1) Economic factors and

(2) Sociological factors.

He noted that bread eating habit assumed a remarkable scale in 1946 and within this period of 30 years, the per capita consumption per annum has increased by well over 30 times because of:

(i) higher per capita income over the years.

a. bread was convenient and it tasted good.
it was also taken as a sign of social prestige.

b. the size of Nigeria market for bread.

(ii) Of the sociological factors which change the wants are:

a. increasing urbanization

b. change in occupation levels for better.

All the above factors given for bread do not apply to bread only but to some other ready made food which have taste appeal like sardine, corned beef, biscuit etc.

As level of bread consumption increased, people are no more content with eating it ordinarily without having some thing to eat it with in order to give it better taste. Sardine is readily accepted as one of the things to eat bread.

The creation of 19 States out of the former 12 States has turned more rural areas to Urban areas, more towns have turned from their former provincial headquarters to State Capitals. More industries will also spring up. The greater the level of urbanization and industrialization the greater the demand for ready made or canned food products because the industrial or commercial workers will most of the time go for such products to safe them the time of having to do the coooking themselves especially at the rush-hours.

Although fish canning is generally regarded as a rather expensive industry but if care is taken to compile the statistics of the quantity of canned fish imported into the Country and the cost, it would be difficult to justify the continued delay of starting the canning of our sardine and herring fish catch.

The table on the next page gives the quantity of canned fish (Sardine, herring etc) imported into Nigeria between 1965-1972.

TABLE 9

Year	Quantity of Canned Fish in Metric Tons
1965	3311
1966	1557
1967	1988
1968	1488
1969	1568
1970	1264
1971	3776
1972	7885

Nigeria spent millions of Naira to import the above quantities of canned fish. If fish canning industry is established million of Naira would be saved in future.

3.06 FREEZING OF FISH

Frozen fish is becoming the more popular in the major cities of the Country. They are available for people to buy only in Lagos and some other big cities of the Country. In the cities where they are available, they are not always abundantly available. The result is that not all those who want to buy it could get to buy. Even though there is lack of sufficient animal protein in most Nigerians diet, the development of fishing industry has until now been sadly neglected by the government.

Apart from the fact that the quantity of available frozen fish is not large enough for the people in the rural areas to be supplied, they hardly could get fresh fish to buy from the local fishermen because the fishermen lack the freezing facilities to preserve their catch in the fresh State. The local fishermen catch are cured by the traditional method of smoking and drying.

It will be very unfair to cater for the urban dwellers only as regards fresh fish supply because the greater population of Nigerians live in the rural areas. The table below shows this fact.

ESTIMATED PROPORTION OF EACH STATE'S POPULATION NOW LIVING IN URBAN CENTRES OF 20,000 AND ABOVE BEFORE THE CREATION OF MORE STATES IN 1976 TABLE 10

State	(%) Percentage living in Urban Centres.
Lagos	82.5%
West	64.2%
Mid West	30.0%
East Central	30.0%
Rivers	29.9%
Kwara	29.7%
North Central	15.3%
North East	13.8%
Benue Plateau	12.4%
North West	10.4%
Kano	9 %
South East	8.9%

The table shows that an estimated figure of about 28% of Nigerian population live in the urban centres while about 72% live in rural areas. Nigeria imports hundreds of metric tons of frozen fish annually. The table on the next page shows the quantities imported between 1965-1972.

Year	Frozen Fish Imported In Metric Tons
1965	3881
1966	5288
1967	749
1968	351
1969	144
1970	1110
1971	3086
1972	11014

Source: Federal Department of Fisheries

There is need for establishment of large cold stores for freezing of fish so as to make frozen fish available to the masses.

3.07 MECHANICAL DRYING OF FISH

The large quantities of dry fish imported into the Country in form of stock fish and dried fish smoked fish shows that dry fish is really in demand.

Establishment of an idustry where dry fish can be produced is highly justified.

THE TABLE ON THE NEXT PAGE SHOWS THE AMOUNT OF DRIED FISH & SMOKED FISH AND STOCK FISH IMPORTED INTO THE COUNTRY BETWEEN 1965-1972

° Weights are in metric tons:

TABLE 12

Year	Dried & Smoked Fish by Weight	Stock Fish by Weight
1965	1143	188184
1966	1980	181425
1967	2074	122599
1968	477	32864
1969	2687	4022
1970	1538	28589
1971	2348	11641
1972	947	13010

3.08 FISH RENDERING (All weights are in metric tons)

The rendering of fish and fish offal into fish meal and fish oils are very important to this Nation. They are very useful both for agricultural and industrial use. Nigeria launched operation feed the Nation programme in 1976 and gave a greater attention to agriculture than before. Nigeria is also becoming more and more industrialized. The rendering of fish which will contribute to the development of both the agricultural and industrial programme of the Nation is necessary.

Fish meal is used both as animal feed and as fertilizer for better crop yield. Fish oil is used in the manufacturing of vanishes, paints, tanning of leather, candles and soap.

3.09 THE DEPARTMENTS OF THE INDUSTRIAL COMPLEX

(1) Production and storage department

(2) Administration department

(3) Welfare department

(4) Maintenance department

(5) Staff development department.

3.10 DETERMINATION OF THE PRODUCTION CAPACITY OF THE FACTORY

There is high demand for fish in the Country. A bold step in the right direction is to produce as much fish as to meet a reasonable level of demand at a reasonable cost. The population of Ondo State and part of Oyo State to be primarily served by the industry is large. To be able to serve these areas effectively, the factory should be able to process an average distant water trawler load in a day.

An average distant water trawler has a fish capacity of 400-500 metric tons per month after spending about 21 days in the fishing grounds.

The factory will process 500 tons of raw fish daily.

3.2 METHODS OF RAW MATERIAL SUPPLY

The factory will be supplied by 25 distant water trawlers. 20 inshore trawlers for inshore fishing. Each distant water trawlers will land its catch once a month. Each of the inshore trawler will land its catch once daily or once in 2-3 days.

3.3 PERCENTAGE OF EACH TYPE OF PROCESSING

Total weights to be processed Daily = 500 tonnes.

(a) Weight of fish to be canned = 30 tonnes

% of the total processing = 6%

(b) Weight of fish to be frozen = 270 tonnes

% of the total processing = 54%

(c) Weight of fish to be dried = 100 tonnes

% of the total processing = 20%

(d) Weight of fish to be rendered 100 tonnes

% of total processing = 20

In fish processing, some substantial protion of the fish is not fit for human consumption. This part is termed the offal. The offal in fish varies from 15-40% of the total fish weight. The variation in the offal portion depends on the type of fish. For an example sardine and anchovies have about 15% waste while mackerel and herring have about 30% waste.

Apart from the offal of processed fish. Some fish are too bony while some are too small for consumption. These types are normally condemned. These condemned whole fish are added to the offal of the consumable types for rendering into fish meals and fish oil. Therefore from a total weight of 500 tons of fish to be processed about an average of 20% would go for rendering i.e. $\frac{20}{100} \times 500 = 100$ tonnes.

3.4 PROPOSAL ON HOW THE INDUSTRY WOULD BE RUN

The project is a large scale type which would involve the investment of a heavy sum of money at the initial stage.

(1) It involves the development of the fish landing habour which also involves simutaneous dredging and reclamation of land.

(2) Building of the industry complex

(3) Running and maintenance of the fishing fleet.

Because of the magnitude of the project the proposal is for the project to be run by both the Aiyetoro community (who operate all economic scheme in common) and the government of Ondo State.

Ondo State government could benefit immensely from the project since the source of raw material needed to keep the

Production going is virtually inexhaustible, although the tend to be scarce in the National territorial waters if it is heavily fished. There is no cause for alarm since:

(i) Nigeria is a member of the international body, she can fish in the international waters with permission from the right quarters.

(ii) The territorial fishing limits have been extended to 320 km or 200 miles.

Initially the raw material supply can be done partly by contract with the fishin g companies and later the industry can gradually build up its own fleet until it can completely supply its own raw material.

PART FOUR

DESCRIPTION OF FISH PROCESSING METHODS

4.01 DESCRIPTION OF THE FISH PROCESSING METHOD FROM THE TIME THE FISH ARE LANDED TO THE TIME THE FINISHED PRODUCTS ARE SHIPPED AWAY.

When fish are landed from the fishing vessels at the harbour, they are loaded either into wood, aluminium boxes or plastic lined cartons. Sometimes the loading into the boxes are done abeard the ship on the fishing grounds. After landing the fish, they are either sent directly to the production department for processing or they are stored in the raw material cold store until it will be time for their processing.

Unloading of fish is usually accomplished manually or with mechanical conveying systems. The better method of conveying in a large production like this industry is the mechanical conveying system.

4.02 COLD STORAGE

Fish requires lower cold storage holding temperature than most comparable commodities such as beef and pork.

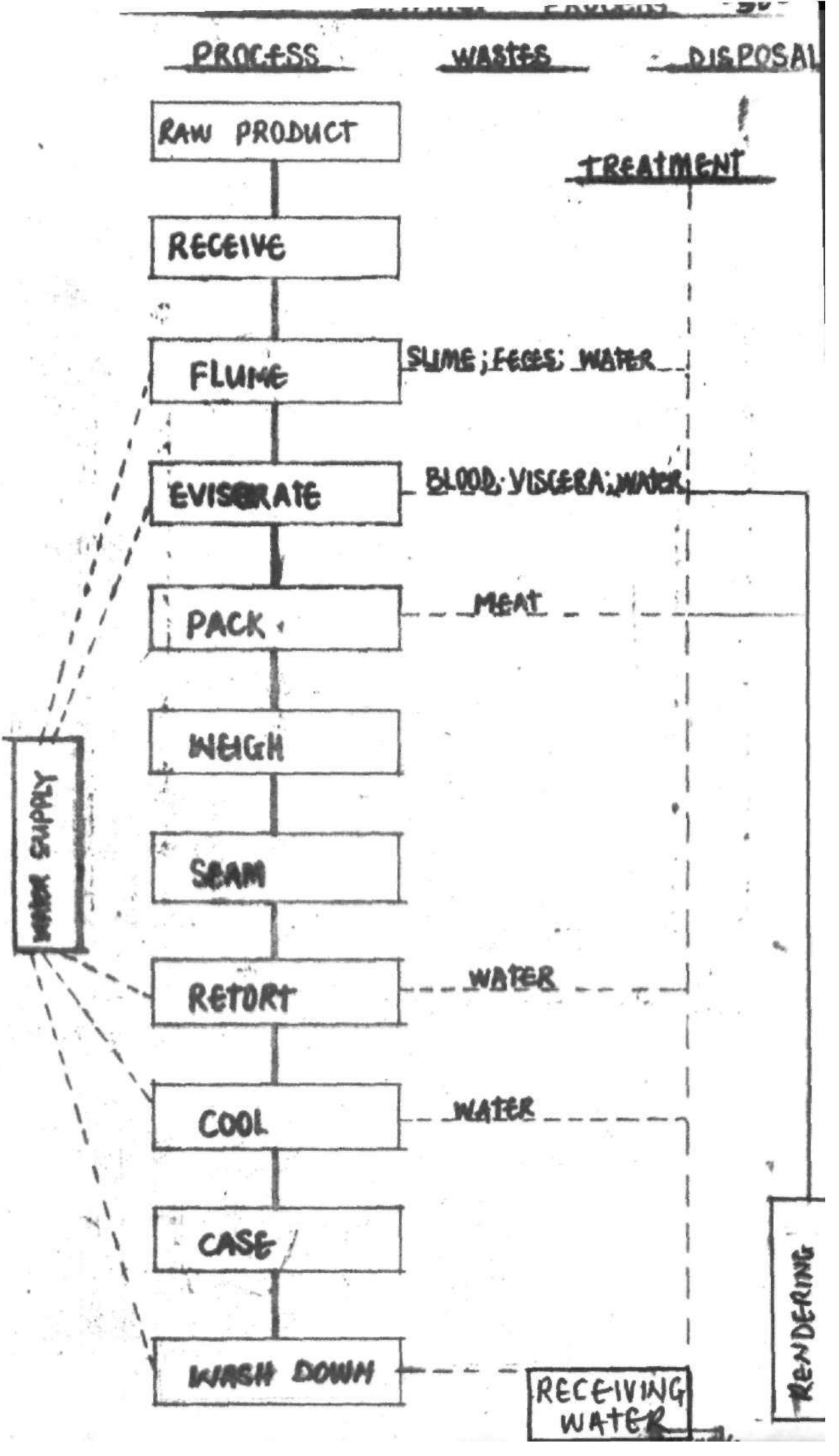
4.03 STORAGE LIFE OF SOME FISH IN COLD STORE

TYPE OF FISH	TEMPERATURE OF STORAGE		
	-9°C (15°F)	-21°C (-5°F)	29°C (20°F)
Fresh white fish			
(gutted)	1 Month	4 Months	8 Months
(Ungutted)	4 "	15 "	15 "
Fresh Herring			
(gutted)	1 Month	3 Months	6 Months
(Ungutted)	3 "	6 "	18 "
Kippers	2 Months	5 Months	9 Months

4.04 (1) FISH CANNING PROCESS

The fish commonly canned are the small species like sardine, herring, anchovies, mackerel etc. The fish are taken aboard the fishing vessel by means of suction pump. They are pumped into chilling tank containing salt brine. The density of the brine varies with the size and fatness of fish but usually runs from 4-8%. The fish are held in the tank for 2-12 hours. The period of holding them in the brine tank is called the prickling period. At the end of the period the fish are transported to packing tables where they are cut either mechanically or mannually and packed into cans. The cans are placed in specially designed racks that fit into a continous chain conveyor which takes them through a cycle of steam, cooling, draining and hot air drying. After drying the cans proceed to the saucing or oiling devices and there to the sealing machines.

The cans are sealed at the rate of 120 cans per minute and then pass directly to the retorts for processing. They are held at 245°F for 50 minutes. The cans are partially water cooled in


PROCESS
WASTES
DISPOSAL
RAW PRODUCT
TREATMENT
RECEIVE
FLUME
SLIME; FECES; WATER
EVISCERATE
BLOOD; VISCERA; WATER
PACK
MEAT
WEIGH
SEAM
RETORT
WATER
COOL
WATER
CASE
WASH DOWN
RECEIVING WATER
RENDERING

retorts. Final cooling is accomplished on slatted wooden racks or in slatted bin in air at room temperature.

4.05 FRESH FISH FREEZING PROCESS

There are two types of methods of freezing fresh fish.

(a) Freezing of whole fish

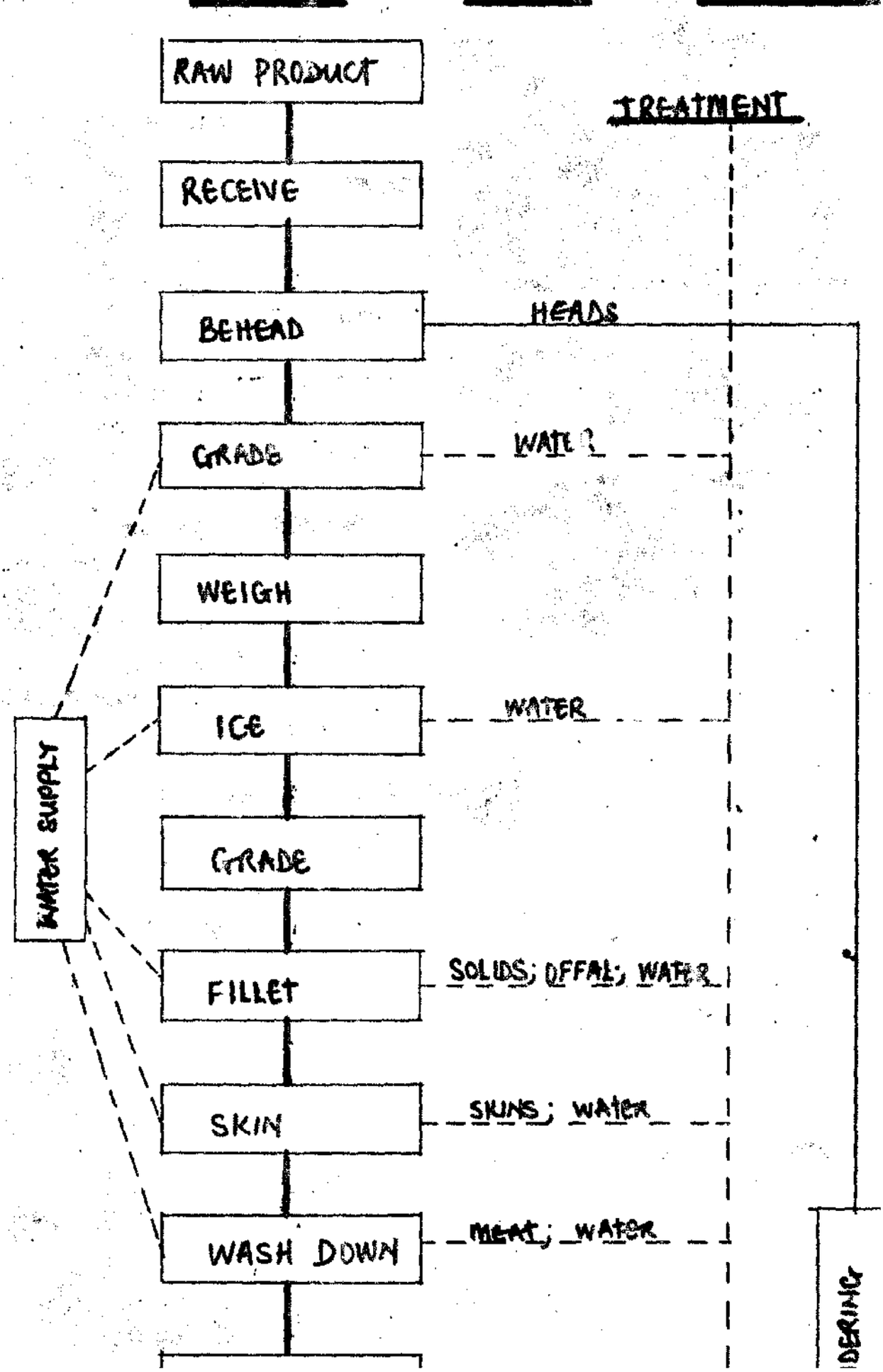
(b) Freezing of filleted fish.

(a) Whole fish Freezing:- After the fish has been landed from the vessel they are either mechanically conveyed to the cold storage of raw material awaiting processing or directly to the processing hall. At the processing hall, the fish are dressed by removing the viscera and cutting away the gills. After the dressing the fish are packed and passed to the finished product cold store.

(b) Filleted Fish Freezing:- Some large fish like hake, halibut etc are filleted before freezing. On arriving at the processing hall, the fish are washed by water sprays from large rotating tumblers.

Next the fish are passed to the filleting machines. After filleting they are passed to the skin removing machine. The skinned fillets are transported by conveyor belt through a washing tank and in some cases a brinning tank After inspection the fillets are packed into containers by hand or pass on through a quick freezing chamber at $30^{\circ}C$) before it is packed. After packing they are stored in the finished product cold room.

FISH FILLETING PROCESS



4.06 FISH DRYING

There are many ways by which fish could be dried :-

(i) Natural air drying

(ii) Drying on fire or smoking

(iii) Mechanical drying or dehydration.

The natural drying method is not very practicable at a commercial scale in Aiyetoro because of the high relative humidity and heavy rainfall under which a good percentage of the fish would spoil. The mechanical drying is the better method. The types of mechanical dryers that can be used are conveyor tunnel dryer, freeze dryer and cabinet dryer. Either the tunnel dryer or the freeze dryer can be used for a large commercial drying.

The fish are either passed for drying whole if they are of small size or filleted before drying if they are large in size. In the dryer, they are loaded directly on the conveyor belt which passes through the tunel of varying temperatures in the tunnel. The dried product are recovered at the [illegible] after the period of drying. They are packed and stored in the cold room after cooling down.

4.07 RENDERING PROCESS

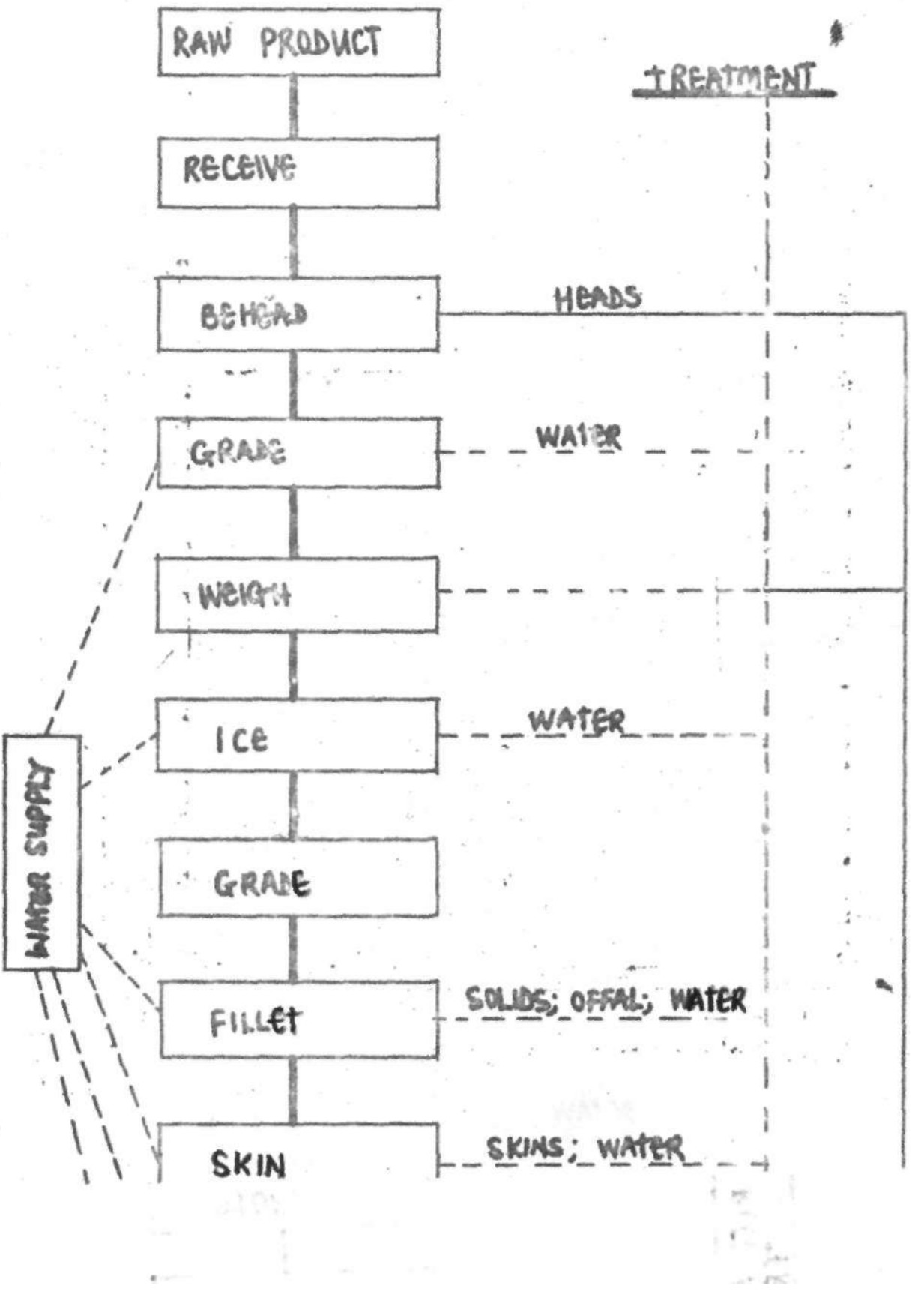
Rendering process is a way of processing the supposed waste parts of the fish for better use like animal feed, fertilizer and fish oil.

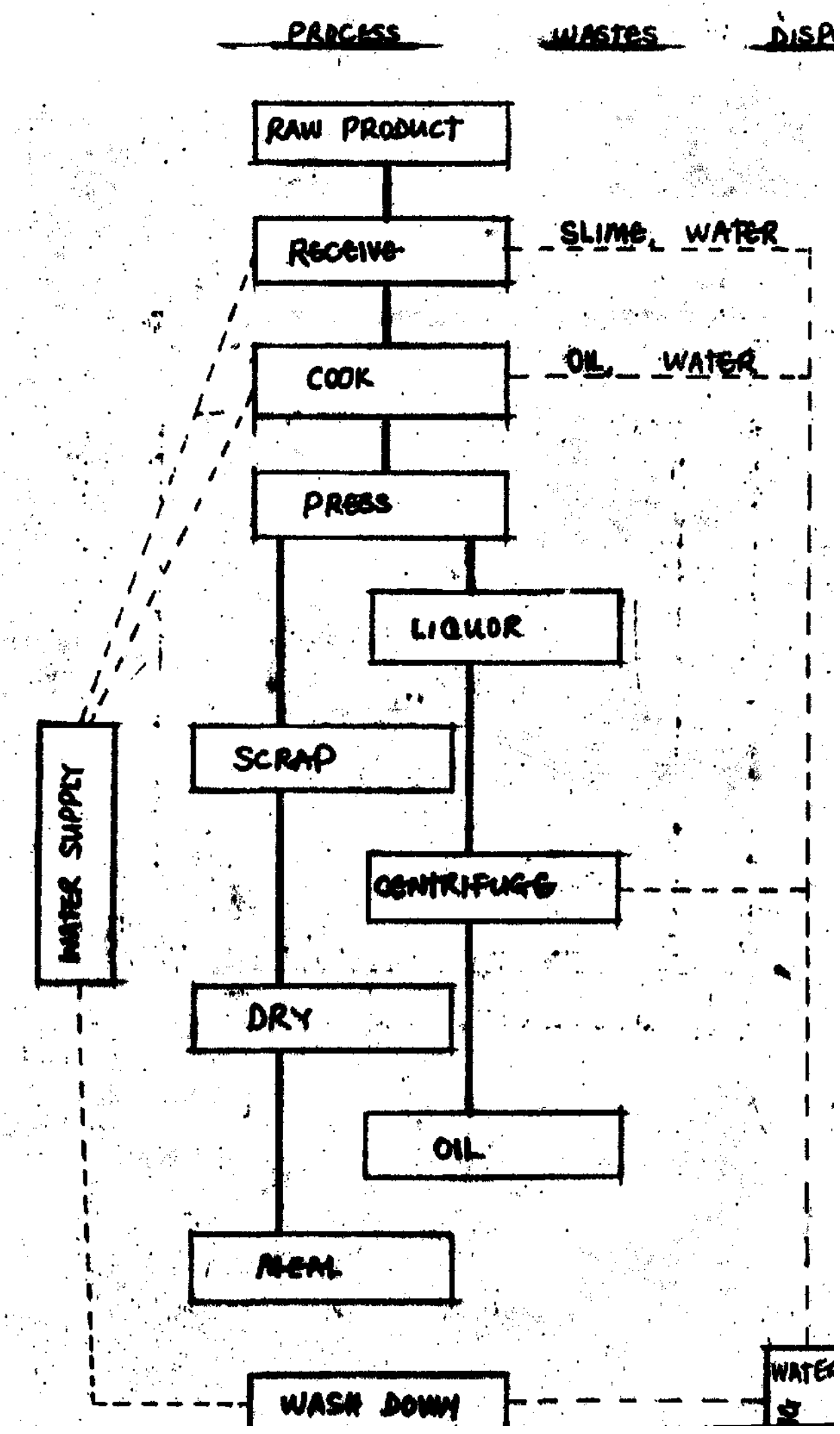
There are two types of rendering:

(1) the wet rendering process.

(2) the dry rendering process.

FISH FREEZE DRYING PROCESS




PROCESS
WASTES
DISP
RAW PRODUCT
Receive
SLIME, WATER
COOK
OIL, WATER
PRESS
LIQUOR
SCRAP
WATER SUPPLY
CENTRIFUGE
DRY
OIL
MEAL
WASH DOWN
WATE

A COMPLETE PLANT

consits of the following main components:

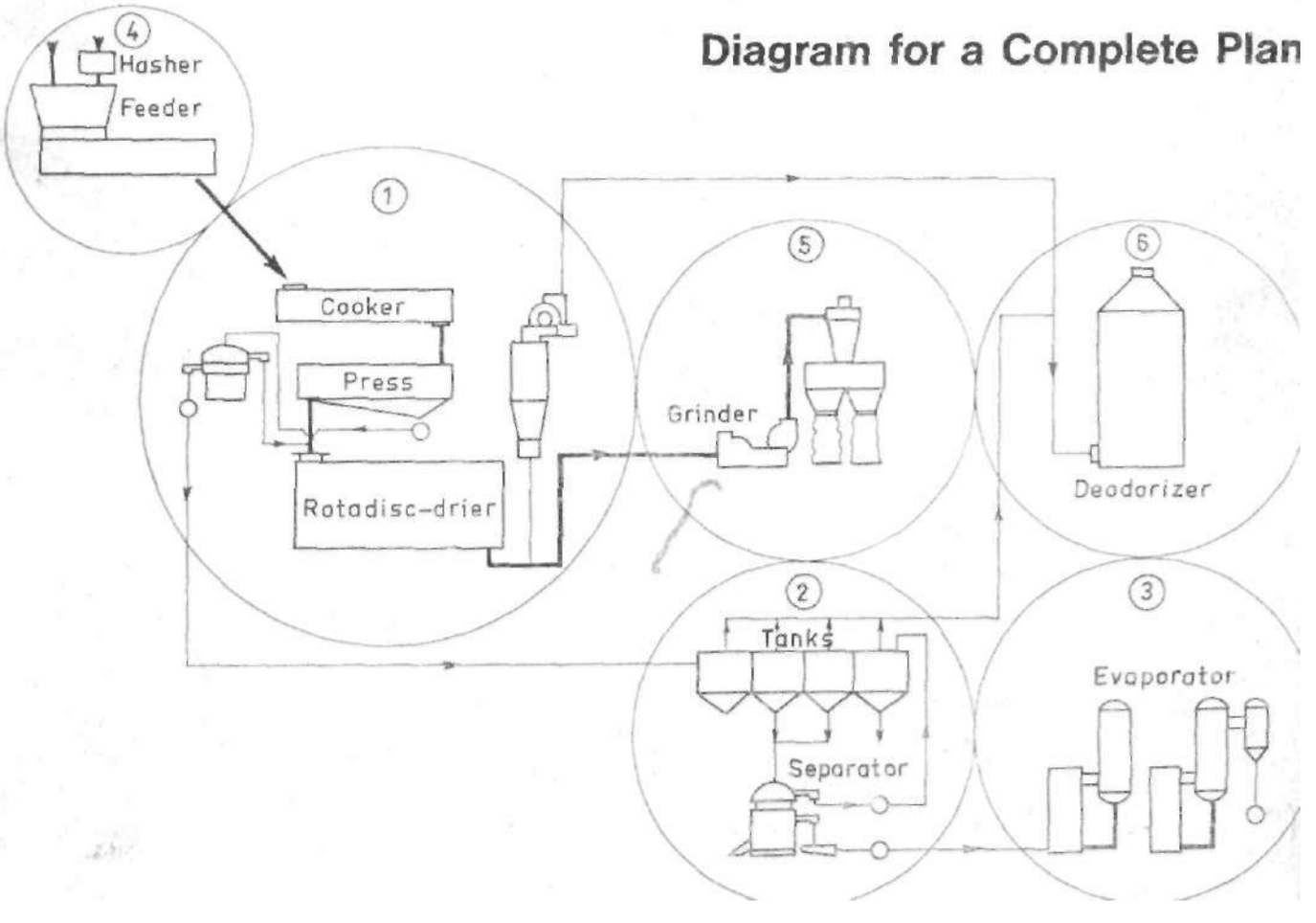
1. Packaged FISHMEAL UNIT comprising of cooker, press, drier, sludge seperator and auxilia equipment.
2. Packaged FISHOIL UNIT comprising of oil separator, pumps and tanks. This unit is used oily fish is processed.
3. Packaged EVAPORATING UNIT for stickwater if 100 per cent utilization of the raw materi is desired.

As auxiliary equipment may be supplied:

4. Feeding conveyor with hopper and cutting machine.
5. Fishmeal grinder and bagging equipment.
6. Deodorizing plant.

To which extent a plant shall include the above items is dependent on raw material, local cond tions etc.

Diagram for a Complete Plan



The wet rendering process is the method used in the large scale operation as in this proposed Aiyetoro fish industry.

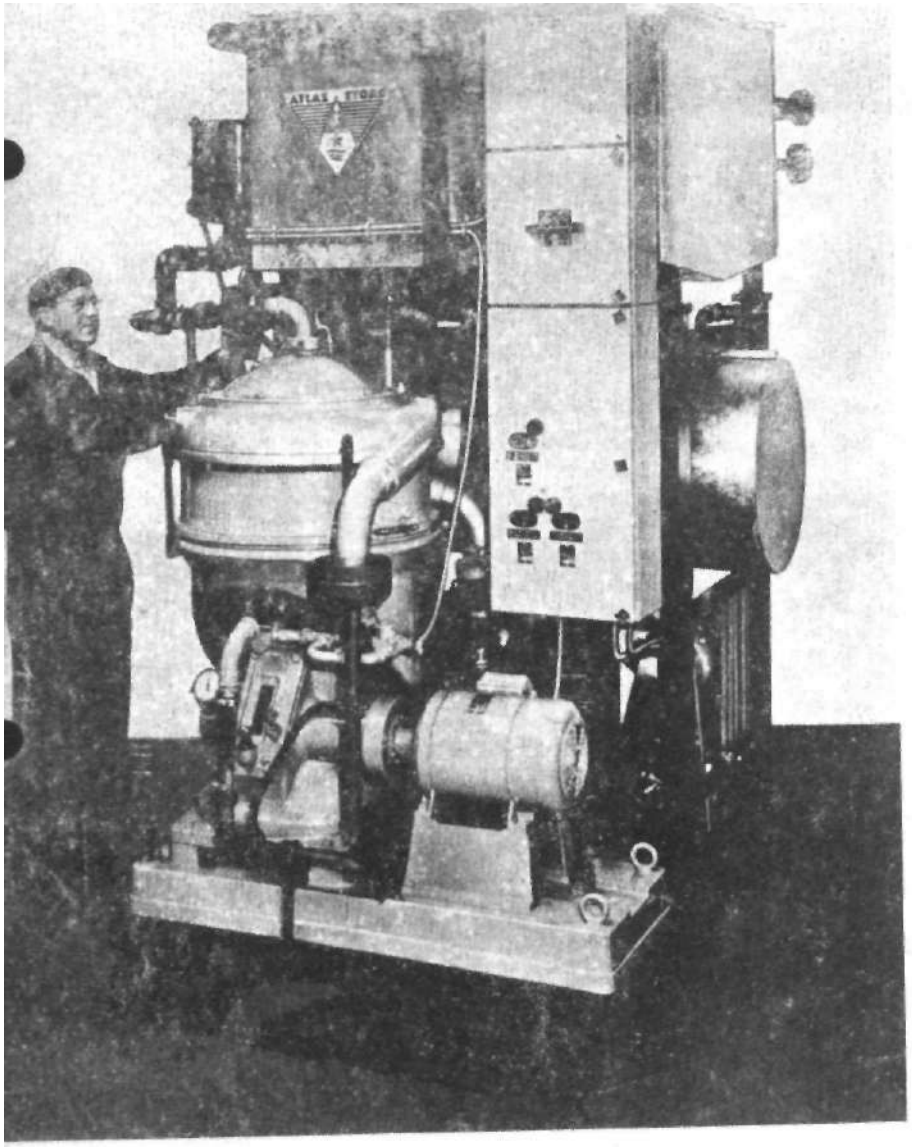
In the wet rendering process, the fish waste collected from the former processing methods; the whole small fish and the condemned fish are cooked by steam. After the cooking, the cooked products are conveyed to the press which pressed them into a solid cake - the fish meal and press liquor - the fish oil.

The press cake is dehydrated in a tunnel dryer to a meal containing about 8% moisture. They are then packed and passed for storage.

4.08 FISH WASTES.

In fish processing, there is an average of 30% waste. Much of the wastes like the offal and some condemned whole fish are converted to useful products like fish meal and oil by rendering process. Despite the conversion of some of the wastes into fish meal and fish oil, there is still substantial waste left which has to be taken care of or it would constitute problem of pollution. The wastes are in form of solid wastes, waste water flows resulting from butchering, washing and processing of the product. The volumes of solid and waste waters vary widely with species and processing method.

The Washington State Water Pollution control commission characterized (in general terms) fish processing waste waters as shown in the table in the next page.



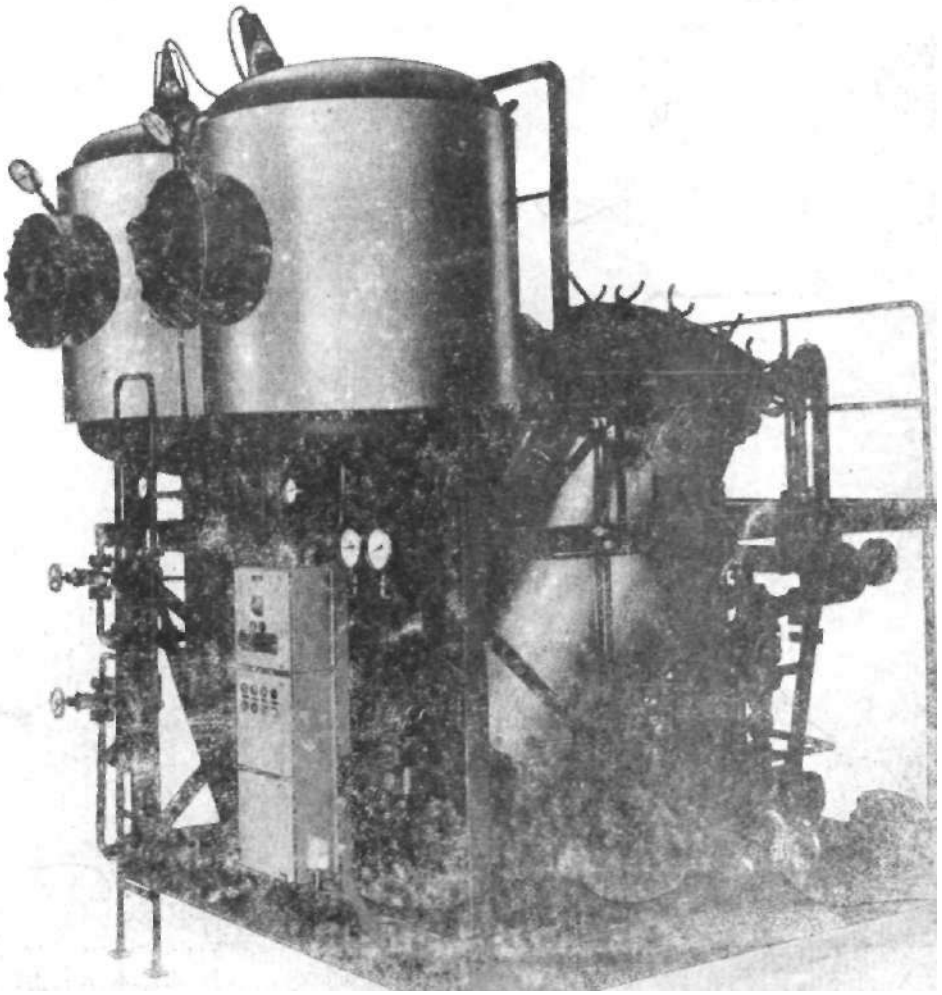
Atlas-Stord Packaged Fishoil Unit

If the Raw material is oily,

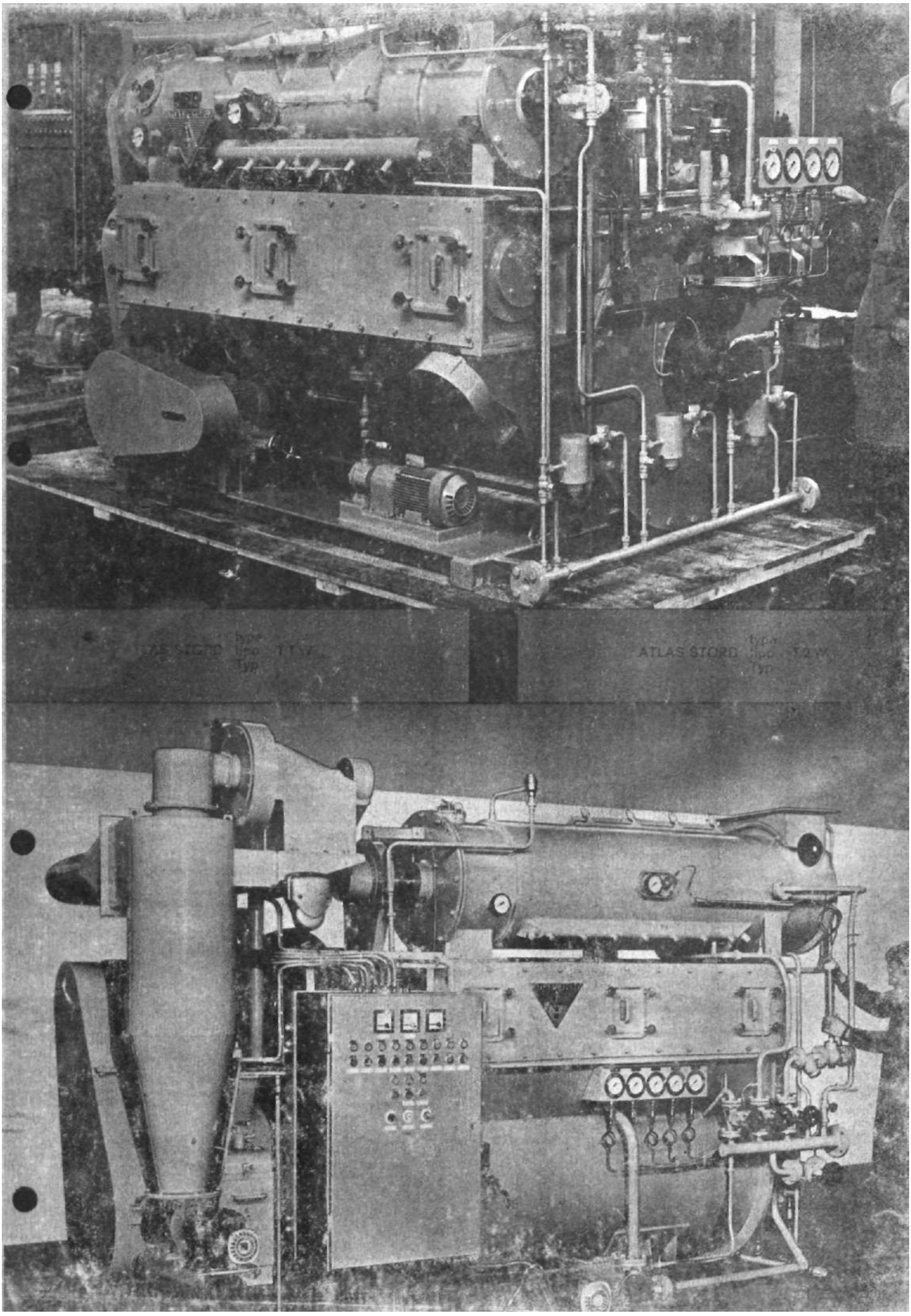
the fish oil can be extracted in an

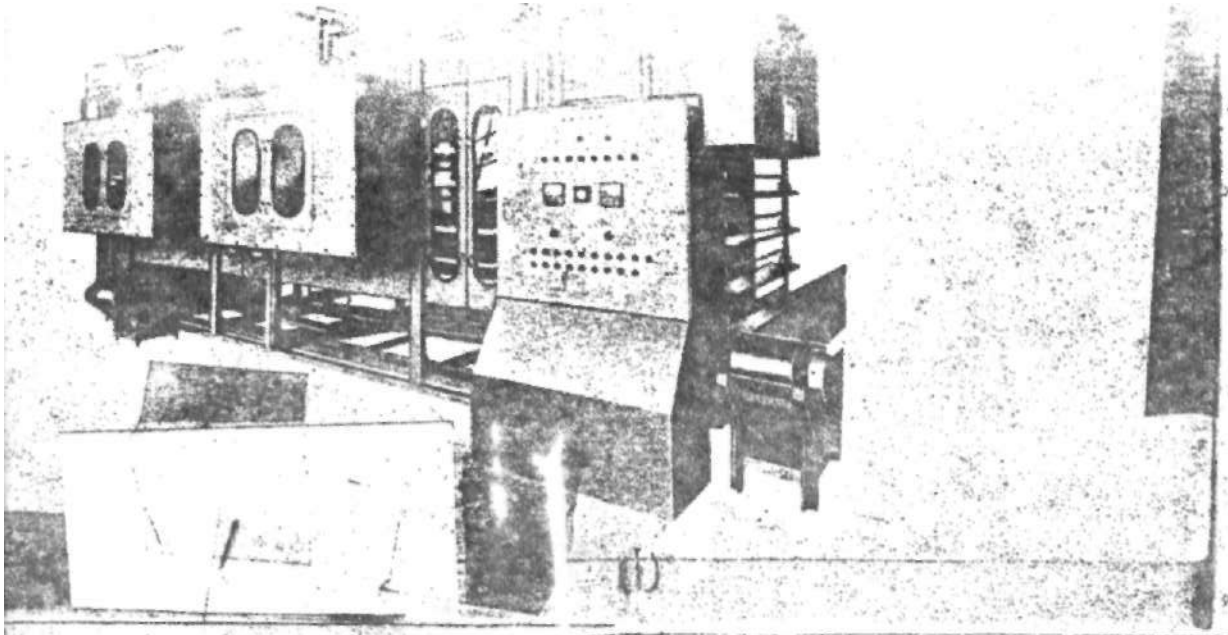
Atlas-Stord Packaged Fishoil Plant

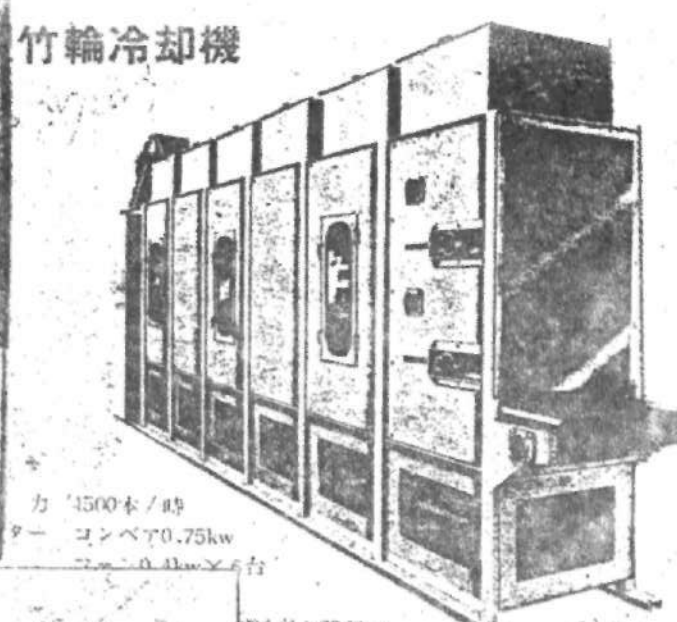
In order to be able to help our customers with a complete pre-erected Packaged Fishoil Unit, the ATLAS-STORD experts have developed our well-known Packaged Fishoil Plant. This plant is built on a bed frame and is a complete unit with automatically operated separator, tanks, pumps, pipes, valves, electric equipment, and automatic controls. You only have to connect steam, condensate, water and electricity, then the unit is ready for fully automatic operation.

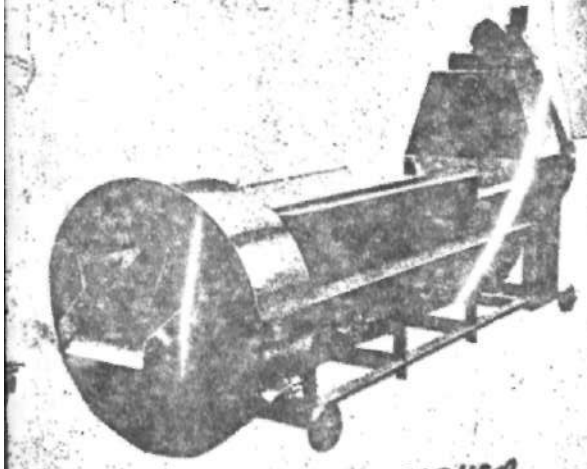


Atlas-Stord Stickwater Concentrating Unit

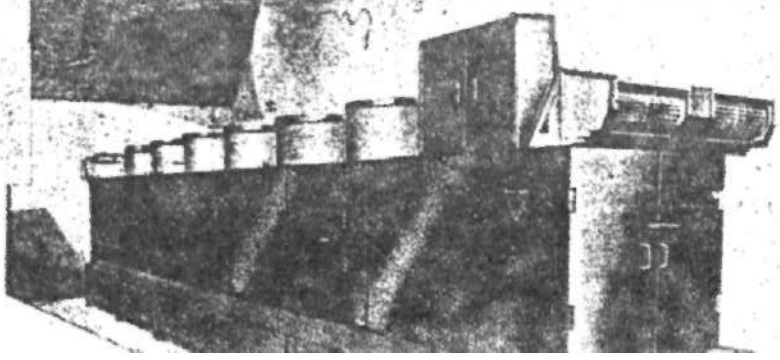


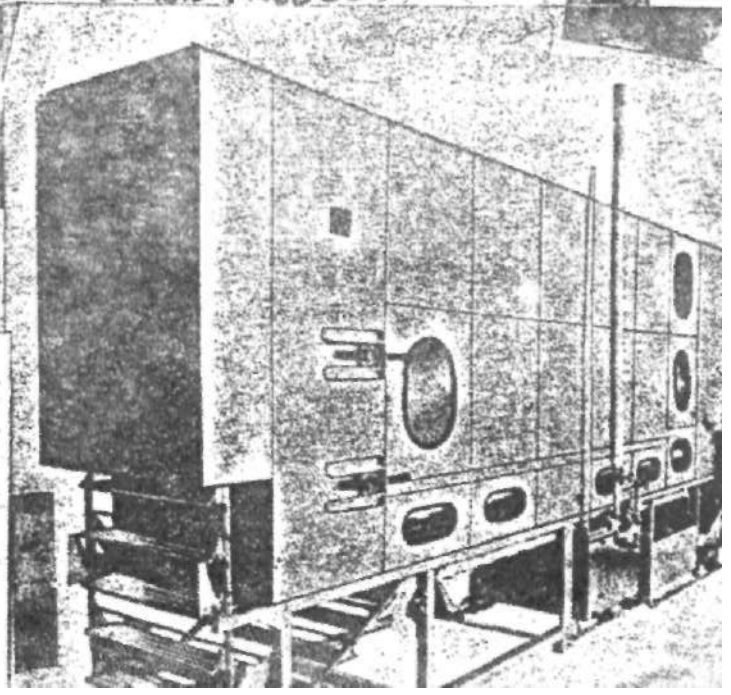












FISH WASHER
(iii)

SOME OF THE FISH
PROCESSING MACHINES

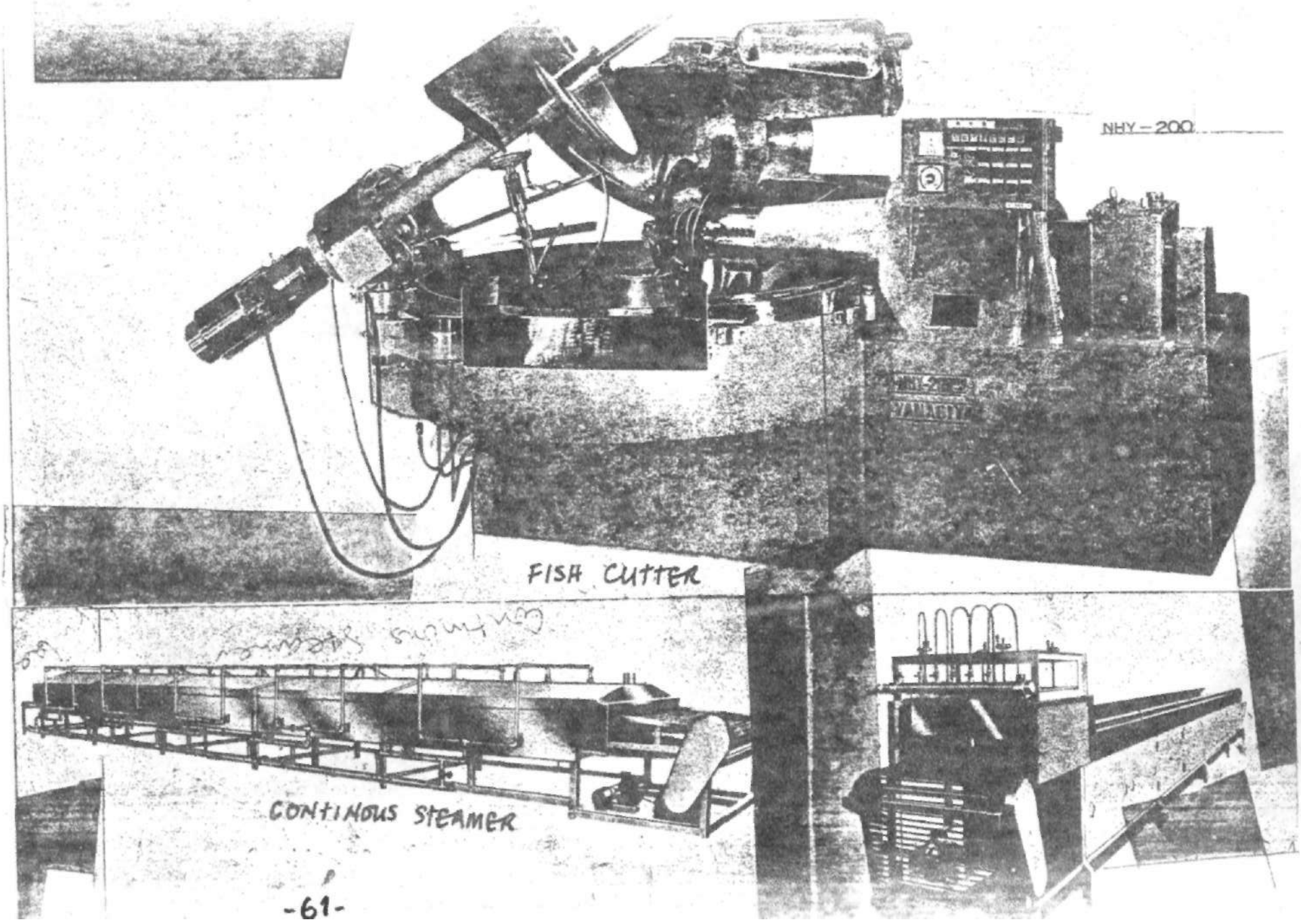
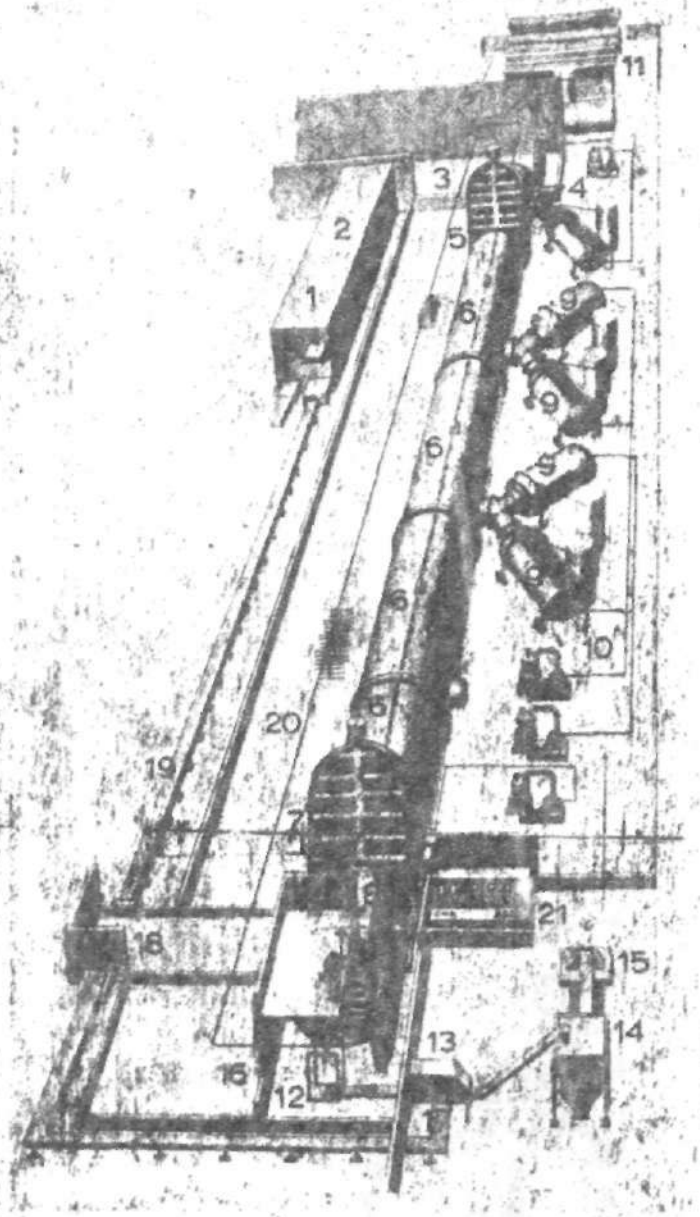

NHY-200
FISH CUTTER
CONTINOUS STEAMER

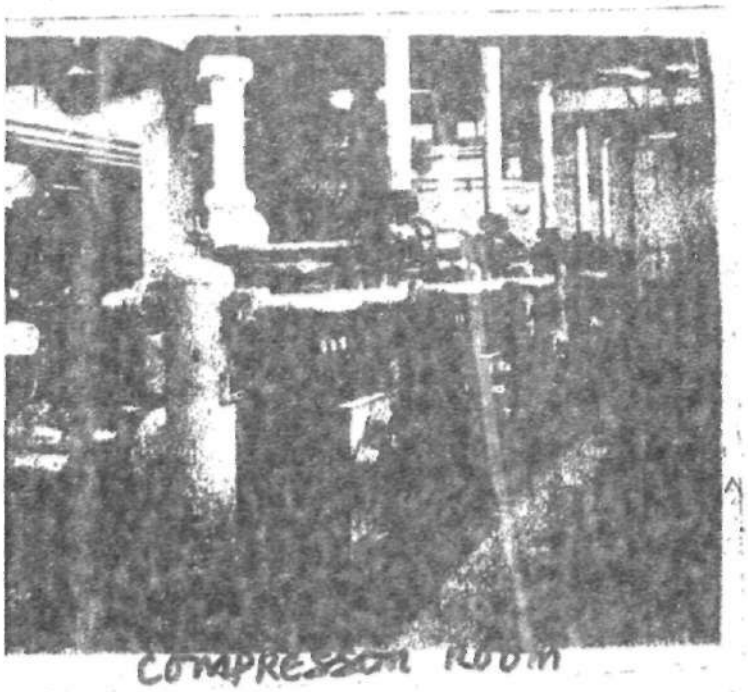
PLATE 37

Diagrammatic arrangement of a plant comprising four tunnel sections and incorporating facilities for pre-cooling of trays and, if required, freezing of product.

1 and 2. Precooling of trays and, if required, freezing of product.
3. Loading of carriers with filled trays.
4. Inlet lock and evaporative freezing, with condenser.
5. Vacuum-tight gate.
6. Four tunnel sections.
7. Vacuum-tight gate.
8. Measuring and outlet lock.
9. Two pairs of condensers.
10. Vacuum pumping sets. (Alternatively, steam ejector pumps.)
11. Refrigeration plant.
12. Carrier unloading station which is kept under inert gas pressure.
13. Equipment for automatically emptying trays.
14. Weighing and packaging equipment for large quantities.
15. Weighing and packaging machine for small packages.
16. Lock for removing the carriers from the protective gas chamber.
17. Lock for removal of the emptied trays from the protective gas chamber.
18. Automatic tray washing equipment.
19. Conveyor belt for empty trays.
20. Monorail for empty carriers.
21. Control cabinet.



FREEZE DRYER



COMPRESSOR ROOM

A COMPRESSOR ROOM

TABLE 14

FISH PROCESSING WASTE WATER CHARACTERISTICS

Parameter	Unit	Value
Volume	gal/ton fish	465-9100
BOD_5	mg/litre	2700-3440
BOD_5	lbs/1000 gallons effluent	2.6-29
BOD_5	lbs/ton fish	8-120
BOD_5	lbs/ton product	21-24
Suspended solid	mg/litre	2200-3020
Total solid	mg/litre	4198-21820
Population equivalent	BOD/based ton fish	47-706

* BOD = Biochemical Oxygen demand

BOD_5 = 5 day, 20°C biochemical Oxygen demand.

Of the fish processing methods, the canning and rendering processes use the greatest amount of water and they also give the greatest amount of wastes. From the fishing vessels the canned small species like sardine anchovies and mackerel are pumped into the storage tanks at the landing port.

From the receiving tanks fish are in turn pumped onto the cutting tables where the workers insert them into the slots of conveyor belt. The belt convey them to where the revolving knives trim and slit the fish and the viscera are removed by a suction process. The fish are then cleaned with water and they are then passed through the remaining stages of canning process,

All through the process plenty of water is used.

In the fish Rendering process, the fish are pressed to remove oil and most of the water after they might have been cooked by a continous steam method. The press water is screened to remove solids and centrifriged to seperate the oil, the remaining water called the STICK WATER is discharged or evaporated to produce condensed fish soluble. The solid residual from which the water and oil have been passed is known as pressed cakes. The pressed cake is dried to about 10% moisture and then ground for fish meal. The waste waters from the production of fish meal, soluble and oil from herring, anchovies etc can be divided into 2 categories:

(i) high volume low strength wastes

(ii) low volume high strength wastes

The high volume low strength wastes consists of the water used for unloading fluming, transporting and handling the fish plus the wash down water. It is estimated that the fluming flow is 2000 gal/ton of fish with a suspended solids contents of 5000 mg/litre. The solids consists of blood, flesh, oil and fats. The tables in the next pages give the waste water characteristics from fish meal and sardine packing plants.

FISH MEAL PROCESSING WASTE WATER CHARACTERISTICS TABLE 15

Parameter	Cooling Waters	Other Waste Waters
Discharge	1440 gal/min	680 gal/min
	240-480 gal/ton fish	510-1020 gal/ton fish
BOD_5	621 mg/litre	1005 mg/litre.

SARDINE PACKING WASTE WATER CHARACTERISTICS TABLE 16

Source	COD mg/lit	BOD_5 mg/lit	Suspended Solids mg/litre	Oil and Grease mg/litre	Flow gal/min
Flume water	500-1400	200-1150	400	300-360	130-300
Hold water	800	370	-	-	-
Pump water	170-340	10-45	-	-	800-1000
Waste flume Water	240-1700	100-2200	100-2100	60-1340	40-180

The wastes are divided into 4 categories pump water, flume water hold water and processing wastes flume water. Ranges are shown on the table of sardine packing waste water characteristics above

The pump waters transferred the fish from the shipboard holds to a screen separator in the plant. These wastes were lightly polluted as shown by a BOD_5 of under 50 mg/litre, but comprised the largest flow. The flume water conveyed the fish through the plant and became heavily polluted.

The hold water resulted from the storage of fish in the boats. The small volumes made this waste water of lesser consequence.

The processing waste waters were used to transfer the solid wastes for disposal. This waste flow could easily be eliminated through the use of dry capture techniques.

Other high-volume waste waters include the condensate from the cooking operation and the cooling water from the condensers.

The volumes are large, but the organic loads are small. These wastes contain small amounts of soluble and unsoluble solids, including fats. The chemical Oxygen demand is usually about 300 mg/litre and the wastes are not readily putrefiable. The drainage and rinsing waters from the storage bunkers are usually thick, slimy, highly coloured and strongly malodorous. These wastes have large amounts of insoluble and soluble solids with high nitrogen and phosphate levels. Active decomposition begins rapidly, resulting in the production of hydrogen sulfide. These wastes have an approximate volume of 36-48 gal/ton of fish.

The strongest segment of the fish meal wastes is the stick-water. In most instances stick-water is now evaporated to produce condensed fish solubles but in previous years it was discharged untreated.

The volume was estimated to be 120 gal/ton of fish processed.

It was also estimated through the study conducted that Stick-water is 6% solids consisting almost entirely of protein with very little oil.

STANDARD WASTE TREATMENT METHODS

The liquid wastes resulting from fish processing are most commonly discharged to adjoining waters. This practice has been resistricted in many areas in recent years as plants have consolidated and enforcement of water pollution control regulations has intensified. The high grease and protein levels produce the most serious treatment problems due to difficulty of removal. The presence of large quantities of facts and greases in the waste waters from the processing of oily fishes (sardine, herring etc) can also cause serious problems if the emulsified grease coalesces and rise to the surface of the receiving water. These can be removed by two methods:

(1) flotation and

(2) sedimentation.

Flotation method is quite adequate, in this method minute air bubbles are needed to float particles to the water surface. The resulting sludge blanket is continously skimmed from the surface. Mechanical aerators are used to "whipe" the air bubbles into solution. Apart from the mechanical method of entraining the air bubbles another good method if not better is the pressurization method.

In the pressurization method, water is pressurized by a centrifugal pump to about 40 psig. Air is added at the rate of about 2% by volume. The pressurization tank had a 1 minute detention time. The recovery sludge is then heated and the protein and oil fractions removed by centrifuges.

PART FIVE

PLANNING OBJECTIVES OF THE FACTORY

5.01 PLANNING OBJECTIVES OF THE FACTORY

The facilitating of the manufacturing processes ranks high in the list of layout objectives.

The Objectives:

(a) The planning is done in such a way as to provide increased productive efficiency and thus increased manufacturing capacity for a given floor space.

(b) The space allocated for machines, equipments and work areas are such that materials flow smoothly in as straight a line as possible with minimum back trackling.

(c) Spaces are economically generously allocated for all the functions so that there is room for layout of mechanical conveying systems like chain, Belt wheel and roller conveyors so as to eliminate where possible time wasted by productive labour in the manual handling of materials.

(d) The lines of travel are kept as short and direct as circumstances permit.

(e) The planning is done in such a way that extension of the production and storage sections can be carried out without hinderance to the operation of the plant during construction.

(f) The interior columns are generously spaced as far apart as economically possible to allow for free location of machines and also to prevent the interference of columns with the transportation of materials.

5.02 MATERIALS AND MATERIALS HANDLING

For raw materials to be converted to a finished product there would be movement of at least one of the three basic elements of production viz:- MATERIALS, MAN and MACHINE takes place. In most industrial processes it is the materials that move rather than the man or machines.

The materials can be in any form - gaseous, liquid, solid. Material handling has traditionally been broken down according to the various equipment classifications but recently an effort has been made to subject matter into functional activities. The materials handling handbook classified these functional areas as follows:-

(i) Bulk Handling

(ii) Unit Handling

(iii) Industrial Handling

(iv) Ware housing

(v) Carrier handling

(vi) Handling operation analysis

Material handling is a means of supporting and simplifying a manufacturing process. It is used to minimize overall costs, not just the local costs of handling. Improved working condition can be met by better materials handling in the following ways.

(i) Provide safer working conditions

(ii) Reduce workers fatigue

(iii) Improve personnels comfort

(iv) Upgrade Employees to productive work.

5.03 MATERIAL HANDLING EQUIPMENTS

The following basis have been suggested for classifying materials handling equipments.

(i) CONVEYORS - all types of conveyors indluding Belt, Chain, Cable, Roller Screw, Pipeline and Vibrating

(ii) CRANES, ELEVATORS and HOIST - all types of Cranes, elevators and hoists including fixed, travelling and portable cranes, elevators, cable - ways, hoists, winches and auxilliary crane equipments.

(iii) INDUSTRIAL VEHICLES - includes powered trucks, hand trucks industrial tractors, trailer, industrial cars and locomotives, bulk handling vehicles and other special vehicles.

Selection of handling equipments boils down to 2 types of problem=

(i) Economic problem

(ii) Technical problems

Technical problems that generally arise call for knowing the following informations about the handling systems under consideration.

(a) Floor Space required

(b) Vertical height required

(c) Source of power for movement

(d) Path of movement

(e) Direction of movement

(f) Form of material to be moved.

The next paragraph gives the technical data to be considered in industrial design.

For this proposed fish processing Industry, the required material handling are chain, belt, trough conveyor, crane and Fork lift.

(a) DESCRIPTION - Belt conveyor

USES AND LIMITATION -

(i) order make-up lines and checking transfer into store transfer to palletising point.

(ii) Vehicle loading can be fitted with control to collect from predetermined station.

(iii) Other forms of physical barrier to other movement. Some models have moveable and extension for withdrawal during vehicle loading.

SIZE & CAPACITY (i) length is limitless if booster motors are used.

(ii) corners may be negociated by gravity or power rollers on wheel conveyors.

(iii) Direct transfer at right angles to second belt is usual.

(iv) Belt widths vary from (35-76)cm in 8cm increments are usual. Standard speed 36cm per minute.

SPACE REQUIREMENT:-

Widths of Belt = (10-15)cm is normal. Belt height adjustable on some models.

(b) DESCRIPTION - CHAIN CONVEYOR

USES & LIMITATIONS:

(i) Into store transfer and order picking

(ii) Considerable usuage in production layout can not be altered or moved easily if changed is required.

(iii) The carriers provide a continuous barrier to independent moving trucks or personnel who can only when the Chain Speed is low.

SIZE & CAPACITY:

(i) Chain length is limitless

(ii) Standard curves are from 91cm radius loading up to 45.36 kilograms per hanger but hangers may be connected i.e. 2x45.36; 3x45.36 at (38.4-45.7)cm centres.

(iii) Speed up to 15.2m per minute.

SPACE REQUIREMENTS:

(i) Depends on width of carrier and forms a swept space at the fixed height above floor.

(ii) System can be elevated locally for cross aisle.

(iii) For order picking and transfer into a store a gangway would be (1.5-1.8)m plus width of carrier.

BUILDING NEEDS:

Adequate provision for roof or floor suspension, plus allowance for load in structure. 3-phase power at one or several motor points.

(c) DESCRIPTION - TROUGH CONVEYOR

USES & LIMITATIONS:

(i) Bulk handling of solids intake and despatch.

(ii) Can be used on inclines with some materials.

(iii) Forms physical barrier to other movement.

SIZES & CAPACITY:

(i) length is limitless

(ii) width up to 76cm in 15cm increments

(iii) Slight curve can be negociated but transfer to second is normal. Some models adjustqble in length for vehicles

(iv) Speeds up to 60m per minute.

SPACE REQUIREMENTS:

(i) Allow 30cm over belt width for conveyor width

BUILDING NEEDS - 3 - phase power supply.

(d) DESCRIPTION - ROLLER CONVEYOR

USES & LIMITATIONS:

(i) Order make up transfer to and from palletising points.

(ii) Vehicle loading

(iii) Movement of any form of rigid container or pallet.

SIZES AND CAPACITY -

(i) length is limtless but usually formed of standard 2.44m sections

(ii) Standard widths are 30cm, 38cm, 46cm, 60cm, 96.5cm 111.7cm, 127cm

(iii) Roller pitch from 7.6cm or 10cm in 10cm or 12.7cm

SPACE REQUIREMENT:

Allow 7.6cm over roller width for conveyor belt.

(e) DESCRIPTION: - MOBILE CRANE

USES AND LIMITATIONS:

(i) Lifting and carrying of containers non - palletising loads

(ii) Flexible in use if there is room for safe access.

(iii) Height limitation and labour needed to fix strings on simple unit loads D.C. power unit causes fumes in confined areas.

Thise crane will be used in harbour where there are no confinements.

SIZES & CAPACITY:

(i) capacity varies but for internal handling. 3,000 to 4,500kg is usual at 30° mast extension with a maximum lift of 6.7m and reach of 4.9m

(ii) This is suitable for unlading road vehicles and barges

(iii) Speed up to 30km/hour.

SPACE REQUIREMENT: -

Outside turning radius 4.4m. Minimum aisle width for 90° turn is 3.3m.

(F) DESCRIPTION:

Dual side loaders (Fork lift)

USES & LIMITATIONS:

(i) Lifting and carrying long loads or pallet handlings in very narrow aisles at height up to 8.53m.

(ii) Mast rotates forward through 180°.

(iii) It can be fitted with very wide range of attachments.

(iv) Out rigger forks are probably the greatest single advantage.

SIZES & CAPACITY:

(i) length 2.13m - 3.66m width 1.2m - 2.13m. Height with mast down (2.896 - 4.953)m

(ii) Height with mast extended 4.9m to 8.7m.

(iii) Height of lift (4.3 - 7.8)m

(iv) Maximum loads 2.26 tonnes to 5.2 tonnes.

SPACE REQUIREMENT:

(i) Minimum aisle width - width of truck + 15cm each side or if guide rail are used, width of truck + 10cm. Often steer at both ends.

BUILDING NEEDS:

(i) Level floors

(ii) Changing point and changing location in loading bay. Do not negotiate ramps well without very heavy dram on battery.

(G) DESCRIPTION - HIGH FORK LIFT TRUCKS

USES & LIMITATIONS:

(i) Lifting and carrying of all ware house loads up to 3.1 tonnes excluding long loads

(ii) Although they can be used for interwork in warehouse, they are not particularly suitable in enclosed conditions

(iii) Can be fitted with most attachments.

(iv) All trucks deviate as lift height increases e.g. 3.1 tonnes truck at 8.5m deviates to about 1 tonne.

SIZES & CAPACITY: - Small:

(i) length of face of forks 1.4m, width 0.86m

Height of mast 3m

Height with mast extended 4.9m

Height of lift 4.2m

Average maximum loads 0.5 tonnes

Large:

(i) length of face of forks 2.2m, width of 0.96m

Height of mast down 4.4m

Height of mast extended 9.296m

Height of lift 8.53m

(ii) Average maximum loads 3.1 tonnes

Electric trucks can be obtained up to a 9 tonnes capacity but are more suitable for production uses.

SPACE REQUIREMENT

Aisle width for stacking. Small truck with 1mx1m pallet 2.5m minimum

Large truck with 1.3m pallet - 4.1m working.

BUILDING NEEDS:-

(i) Level floors and ramps not exceeding 1:10 for intermittent working.

Changing location either in loading bay or maintenance shop.

5.04 DETERMINATION OF PLANTS SPACES

The spaces allocated to the plants are determined with due consideration to the vital factors like:-

(i) The size of the machines.

(ii) The number of production lines needed for each machinery layout which also depends on the production capacity required.

(iii) Necessary space allowance needed for servicing of plants.

(iv) Work stations for the operatives.

Shown below are some of the major machines and their dimensions and capacities.

TYPE	CAPACITY	NUMBER REQUIRED	LENGTH	WIDTH	HEIGHT
FISH CUTTER		10	2.9m	2.15m	1.39m
STEAMER	1.5ton/hr	4	7.2m	1.8m	3.9m
COOLER	3tons/hr	4	9m	1.1m	1.785m
FISH WASHER	3tons/hr	14	2.8m	0.84m	3.4m
FREEZ DRYER	1.04ton/hr	4	27.6m	8m	2.5m
THAWING MACHINE	3tons/hr	10	23m	2.6m	3.7m
QUICK FREEZING MACHINE	3tons/hr	10	9m	1.1m	1.785m
FISH MEAL PLANT	0.95ton/hr	10	4.6m	1.83m	2.87m
FISH OIL PLANT	0.95ton/hr	10	1.6m	2m	2.4m
CONCENTRATING PLANT	0.95ton/hr	10	2.9m	2.1m	3m

PART SIX

ANALYSIS OF DIFFERENT SECTIONS OF THE INDUSTRIAL COMPLEX.

6.01 ANALYSIS OF DIFFERENT SECTIONS OF THE INDUSTRIAL COMPLEX

This industrial complex is made up three major sections.

The sections are viz:-

(i) FACTORY SECTION:

This includes the products landing and shipping harbour, and finished products cold and dry store, production Hall, compressor, power and heat generating houses, some anciliary spaces as quality control laboratory, observation posts, changing or locker rooms, offices, First Aid room.

(ii) ADMINISTRATION SECTION:

This includes the administrative offices, staff development centre which has class rooms, laboratories, library and offices of the instructors.

(iii) COMMON FACILITIES SECTION:

This is made up of games hall, dining hall and snack bar.

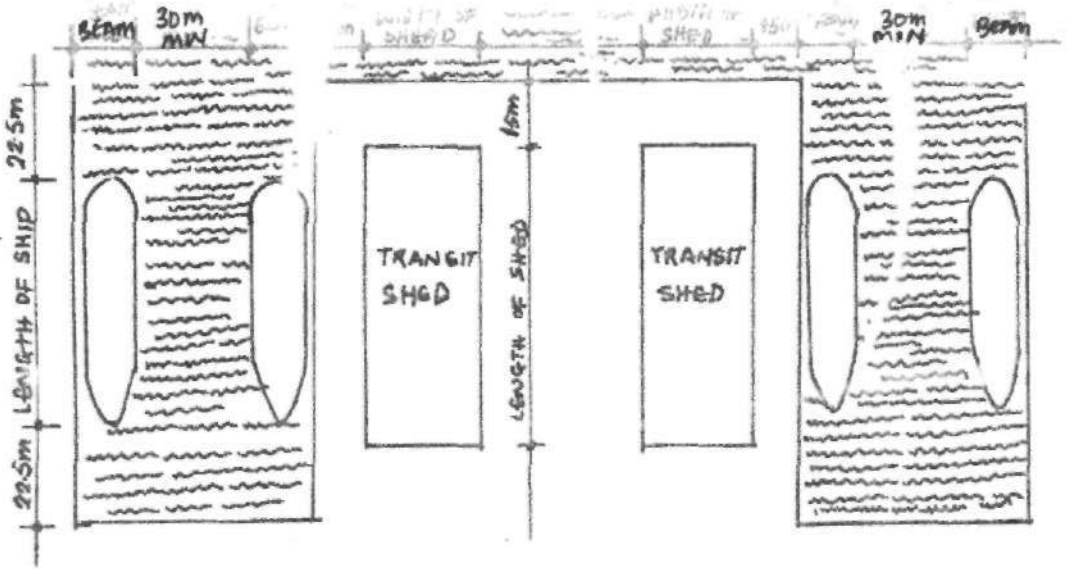
6.02 THE FACTORY

The factory is the largest single unit in the complex and it is the most important part of it. Other sections work together to keep the factory running.

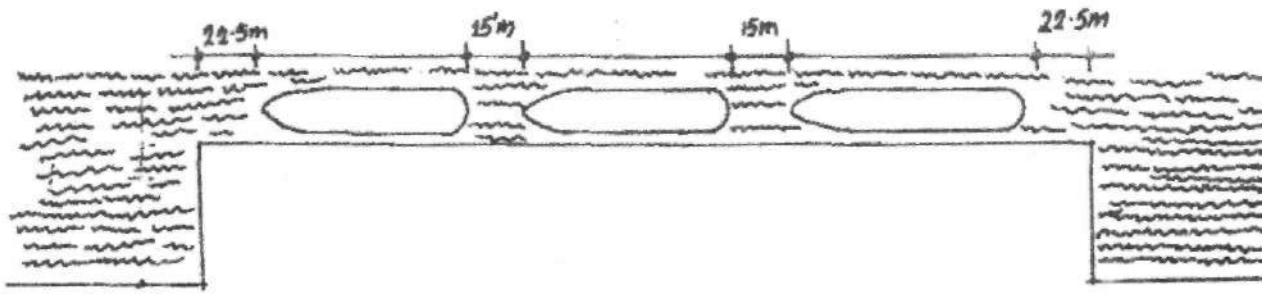
6.03 HARBOUR:

The factory can not run without the raw material supply. And since the raw material supply comes from the ocean, the need for a harbour for trawlers anchorage and landing of fish catch can not be over emphasised. The approach to the harbour is as important as the harbour itself. If trawlers are not able to get to the harbour because of lack of safe approach route, the harbour would be as good as useless. The approach to the harbour is liable to blockage due to the ocean current that carries along sand and other materials from the ocean towards shore as it moves towards the shore. The direction of the current movement is most pronounced in the direction of the prevailing wind. The prevailing wind in Aiyetoro is south West Wind. Prevention of Blockage of Harbour Entrance would be done by building a mole or breakwater into the sea from where the canal (which links the harbour to the ocean) discharges into the ocean. The break-water is built in such a way as to protect the harbour Entrance from the direct wave direction.

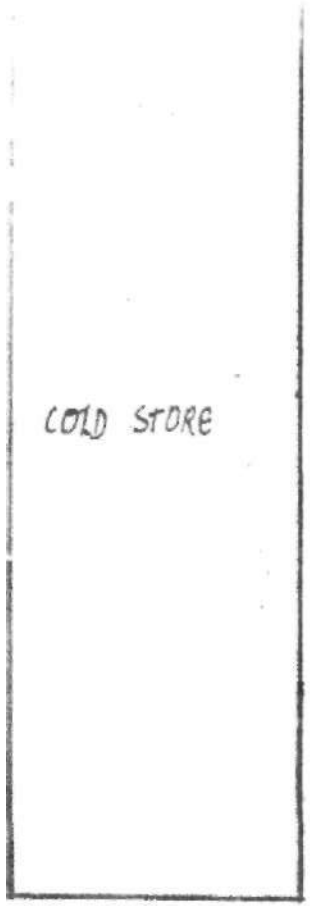
The harbour would at a time be able to cater for a maximum of 5 averagely large distant water trawlers with a length of about 60 metres and width of about 11 metres. Out of the 5 trawlers, 2 can be simultaneously unloaded while the remaining lie in berth.

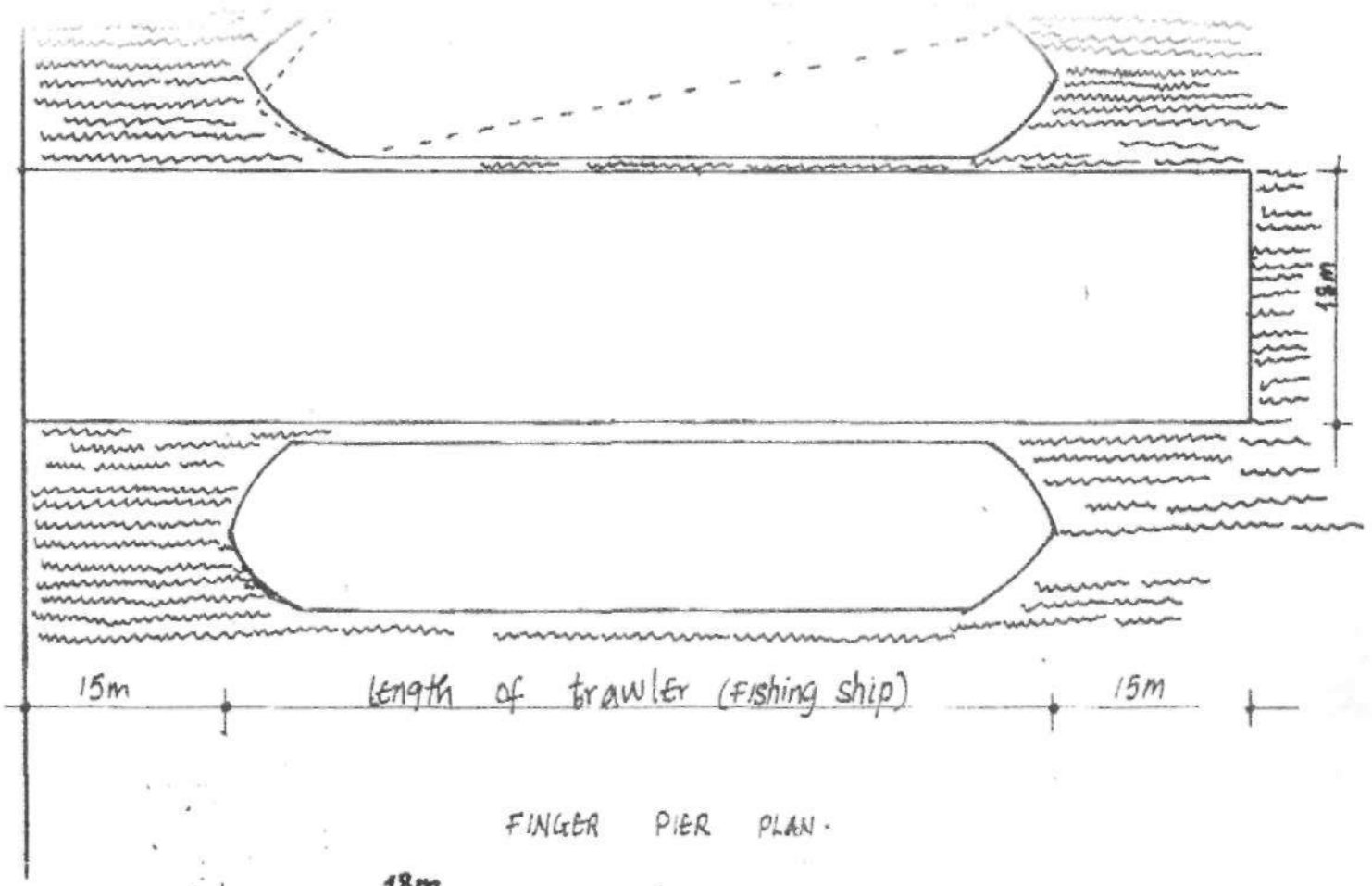


DIMENSIONS OF TWO-BERTH DOUBLE TRANSIT SHED PIER AND SLIP.

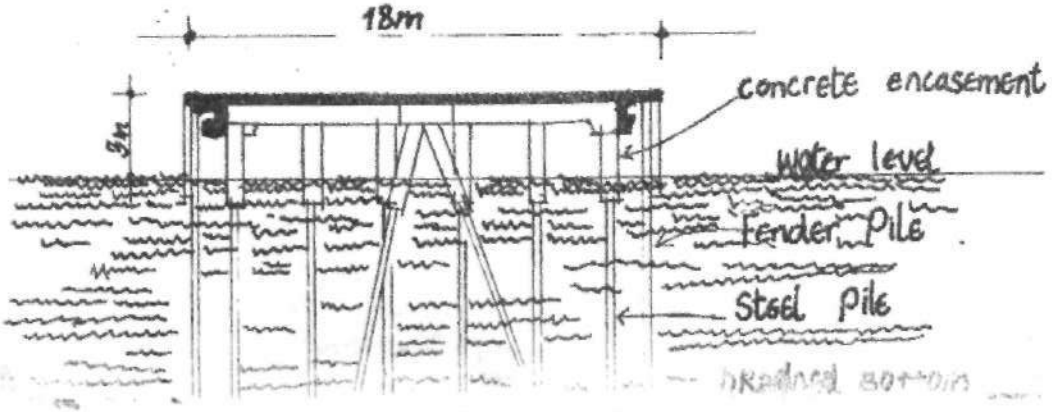


DIMENSIONS OF WHARF





FINGER PIER PLAN.



6.04 Raw Material (Cold) Store:

The factory production unit can cope with a maximum of 500 metric tons of raw materials daily. An averagely big distant water trawler such as the type referred to above has a fish-hold capacity of about (500-700) metric tons. They are able to make a catch of about 500 metric tons of Fish after about (3-4) weeks fishing. Fish is very delicate to handle once it is dead. Care has to be taken to keep it away from spoilage. As soon as the fishermen catch the fish (especially those in distant water trawlers which stay longer on the fishing ground) They pack them into fish boxes and stowed them in the trawlers cold store. On arriving at the harbour they are unloaded. Immediately after unloading, they are checked and weighed at the receiving hall and then either sent to processing hall or cold store where they remain until processing.

The cold store has a capacity of about 7 times the daily production. The reason for having it so big is to give room for factor of safety incase of unprecedented circumstances like:-

(i) Strike by the factory workers for about 3-6 days. The fishermen can still unload their catch and store them in cold store without having to waste time staying at the harbour while they ought to go back to the fishing grounds.

(ii) There is room at the harbour for simutaneous unloading of 2 trawlers which the production or processing unit can not cope with. The excess beyond the production capacity has to be stowed away.

(iii) Failure of supply by the trawlers for 3-4 days will not cause the factory to close down temporarily if there is raw product in the store.

6.05 Recovery Hall:

The recovery hall is the intermediate space between the cold store and production hall. The raw product in the cold store are in frozen state. They can not be taken to the processing Hall without thawing for easy processing. The recovery hall contains the thawing machines which can cater for need of the different processing zones of the production hall

6.06 The Production Hall

The production hall is the largest single space in the factory It has 4 zones of different types of fish processing.

The processes are viz.

(1) Fish filleting and Freezing

(2) Fish Freez drying after Filleting.

(3) Small Fish Canning (e.g. herring, sardine)

(4) Fish Rendering (Fish meal and fish oil production from the fish offal.)

The filleting of all the fish is necessary before processes 1,2, and 3 in order to extract parts which otherwise could have been wasted if sold to consumers without the offal removal.

6.07 Packing Spaces:

All the finished products go to the packing spaces located at the end of production lines. These packing spaces are next to the finihsed product cold and dry stores. At the packing spaces the finished products are packed and sent to the stores.

6.08 FINISHED PRODUCT STORE:

There are two types of finished product store

(i) The cold store

(ii) The dry store

The filleted fish and dried fish go into the cold store while the canned fish and the fish meal go to the dry store all awaiting shipping.

6.09 Shipping:

All the finished product are shipped to the general hinter land cold depot by barges with cold store facilities. The hinter-land depot is about 2½ hours away by water from the factory. From the major hinter-land cold depot, the fish are distributed to the traders.

6.10 THE HEAT GENERATING & POWER PLANT

The heat generating and power plant house forms an integral part of the factory building. This will reduce the length of pipes run. The Boiler is needed both in the fish meal and fish canning processes. The compressors are housed adjacent to the Boiler house. The compressors are needed for refrigeration purposes in the cold store and the cooling or air conditioning of the production Hall,

The power plant is needed not just as stand-by plant but as main source of power since the power plant of Aiyetoro will not be able to cope with both the needs of the community and the factory.

6.2 WATER RESERVOIR:

Fresh water tank is needed both for the factory workers use and for the supply of fishing ships before returning to the fishing grounds.

6.3 WASTE WATER TREATMENT:

As earlier pointed out, much water is used in fish processing. The waste water from fish processing contains fat and protein which has to be treated before discharging it into the river to avoid pollution. Because of much amount of water needed the space required for the treatment is correspondingly lare. For this reason the treatment will be carried out of the factory Island.

6.4 THE ADMINISTRATION SECTION

Apart from the offices of the administrative staff, the section also contains the staff development centre.

6.5 Staff Development Centre.

In a large industry like this where all the production methods are mechanised there is need for staff training centre where newly employed people could be trained before they are allowed to go into factory as operatives.

Apart from the training of the operatives, courses in practical seamanship would be offered to train fisheries Assistants Fishery Artisans. The proposal is that the factory would eventually be able to supply its own raw material needs and operates its own fleet of fishing boats. Man power development will be needed for effective running of the factory. The training centre would have a maximum population of about 25--30 trainees. The trainees would be non resident.

The factory will also have a section for research purposes. There will be two instruction rooms or class rooms, one chemistry laboratory and one bilogy laboratory. There will also be a demonstration workship.

Apart from the training of the fishery assistants courses will be run in mechanical and electrical engineering for Technicians and the operatives.

6.6 SOME OF THE CURRICULA OF THE FISHERY

Artisans and Fishery Assistants:-

(i) Fishing gear material

(ii) Net repairs and presefvation

(iii) Rope work and life saving

(iv) Fish handling,

(v) Handling and maintenance of outboard engines.

(vi) Biology and Chemistry.

SOME OF THE CURRICULA FOR SEAMANSHIP:

(i) Construction of fishing gear operated at great depths

(ii) Fire fighting on board

(iii) Important and use of sea anchor

(iv) International collision regulation signal of distress.

(v) The singal flag meanings of the International code of signals.

Because of the nature of their curricula the need to have worksl.op is as important as classrooms.

6.7 THE COMMON FACILITIES SECTION:

The common facilities section is to cater for the welfare of the workers the common facilities contains the recreation hall for games, Dining hall, and a snack bar.

6.8 The Maintenance Section:

The maintenance section contains the workship for electrical mechanical and general works like plumbing, carpentry, it also contains some offices of the senior engineers.

The maintenace block is linked with the shipyard. The shipyard is for carrying out of major repairs that might be necessary in damaged trawlers.

6.9 ESTIMATED STAFF POPULATION PER DEPARTMENT

DEPARTMENT	TYPE OF STAFF	NO OF STAFF/SHIFT	NO OF SHIFT	TOTAL NO OF STAFF
HARBOUR	SUPERVISORS	2	2	4
	DOCKERS	15	2	30
		Sub Total		34
PRODUCT STORES	SUPERVISORS	2	2	4
	FISH WEIGHING & SORTING STAFF	10	2	20
	CLEANERS	3	2	6
	LIFTS DRIVERS	3	2	6
		Sub Total		36
RECOVERY	SUPERVISOR	1	2	2
	OPERATIVES	24	2	48
	CLEANERS	4	2	8
		Sub Total		58
PRODUCTION	HEAD SUPERVISOR	1	1	1
	SUPERVISORS	4	2	8
	(A) FILLETING PROCESS STAFF			
	OPERATIVES Approx. 4 OPERATIVES PER LINE FOR 10 LINES	40	2	80
	(B) FREEZE DRYING PROCESS STAFF			
	OPERATIVES Approx. 4 OPERATIVES PER LINE FOR 5 LINES	20	2	40

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DEPARTMENT	TYPE OF STAFF	NO OF STAFF/SHIFT	NO OF SHIFT	TOTAL NO OF STAFF
PRODUCTION contd.	(C) CANNING PROCESS STAFF			
	OPERATIVES			
	Approx. 12 PACKERS/LINE FOR 5 LINES + 3 OPERATIVES/LINE FOR 5 LINES	15	2	30
		60	2	120
	(D) RENDERING PROCESS STAFF			
	OPERATIVES			
	Approx. 3 OPERATIVES PER LINE FOR 10 LINES	30	2	60
		Sub Total		239
PACKAGING	PACKERS			
	Approx 9 PER PROCESSING UNIT FOR 4 UNITS	36	2	72
		Sub Total		72
SHIPPING	FORMAN	1	2	2
	CLERKS	4	2	8
	LIFT DIRVERS	4	2	8
	HELPERS	2	2	4
		Sub Total		22
HEAT GENERATING AND POWER PLANT	BOILER HOUSE			
	FOREMAN	2	2	4
	OPERATORS	3	2	6
	HELPERS	3	2	6

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DEPARTMENT	TYPE OF STAFF	NO OF STAFF/SHIFT	NO OF SHIFT	TOTAL NO OF STAFF
HEAT GENERATING AND POWER PLANT contd.	(B) COMPRESSOR HOUSE			
	FOREMAN	2	2	4
	OPERATORS	3	2	6
	HELPERS	3	2	6
	(C) LABORATORY			
	LAB. SUPRITENDENT	2	1	2
	LAB. ASSISTANTS	4	2	8
	LAB. ATTENDANTS	4	2	8
		Sub Total		50
MAINTENANCE	(A) ELECTRICAL SECTION			
	TECHNICIANS	2		2
	STORE KEEPER	1		1
	DRAFTMAN	1		1
	(B) MECHANICAL STAFF			
	TECHNICIANS	2		2
	STORE KEEPER	1		1
	DRAFTMEN	2		2
	(C) GENERAL MAINTENANCE STAFF			
	CRAFT FOREMEN	4		4
	SKILLED FOREMEN	10		10
	TECHNICIANS	6	2	12
	JANITORS	10	2	20
	CLERKS & STORE-KEEPER	5	2	10

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DEPARTMENT	TYPE OF STAFF	NO OF STAFF/SHIFT	NO OF SHIFT	TOTAL NO OF STAFF
MAINTENANCE CONTD.	(D) MISCELLANEOUS			
	GUARDS	6	2	12
	LABOURERS	8	1	8
	TIME KEEPERS	2	2	4
		Sub Total		89
ADMINISTRATION	PRODUCTION MANAGER	1	1	1
	° CLERKS	6	1	6
	TYPISTS	2	1	2
	MESSENGERS	2	1	2
	TECHNICAL DIRECTOR	1	1	1
	CHIEF ENGINEER	1	1	1
	ELECTRICAL ENGINEER	1	1	1
	MECHANICAL ENGINEER	1	1	1
	INSTRUMENT ENGINEER	1	1	1
	CHIEF TECHNICIAN			
	° Ditto	8	1	8
	DRAFTMEN	2	1	2
	ADMIN. PERSONNEL			
	MANAGING DIRECTOR	1	1	1
	GENERAL MANAGER	1	1	1
	ADMIN. SECRETARY	1	1	1
	SECRETARIES	2	1	1
	MESSENGERS	2	1	2

Contd. next page.

DEPARTMENT	TYPE OF STAFF	NO OF STAFF	NO OF SHIFT	TOTAL NO OF STAFF
ADMINISTRATION Contd.	PERSONNEL MANAGER	1	1	1
	WELFARE OFFICER	1	1	1
	SALES MANAGER	1	1	1
	QUALITY CONTROL MANAGER	1	1	1
	" Ditto	10	1	10
	PUBLIC RELATION Officer	1	1	1
	STOREKEEPERS	2	1	1
	SAILORS	8	1	8
	CHIEF ACCOUNTANT	1	1	1
	ACCOUNTANTS	2	1	2
	PAY MASTER	1	1	1
	CASHIER	1	1	1
	" Ditto	10	1	10
	STORE KEEPERS	2	2	4
	RECEPTIONISTS	2	2	4
STAFF DEVELOPMENT	INSTRUCTORS	6	1	6
	FISHERY OFFICERS	4	1	4
	RESEARCH OFFICERS	6	1	6
	RESEARCH ASSITANTS	12	1	12
	LAB. ASSISTANTS	6	1	6
	" Ditto	10	1	10

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DEPARTMENT	TYPE OF STAFF	NO OF STAFF	NO OF SHIFT	TOTAL NO OF STAFF
CATERING	CATERING OFFICERS	2	2	4
	OTHER STAFFS	12	2	24
			Sub Total	152
			GRAND TOTAL	=752

FOR MORNING SHIFT = 453

FOR AFTERNNON " = 299

TOTAL STAFF = 752

PART SEVEN

THE DESIGN CONCEPT

7.01 DESIGN CONCEPT

The site layout - The industrial complex is situated on (partial) artificial Island or peninsula which is higher than the surrounding natural ground level. It is higher than the surrounding as a result of the dumping of dredged material from the channel and the harbour. It is a partial Island because the artificial water ways which could have completely surrounded the partion of land is broken by a narrow strip of land where possible future major expansion of the factory can be linked with the present complex.

People from Aiyetoro can gain access into the complex through a bridge which links the complex with the road from Aiyetoro town. The bridge terminates at the Entrance Hall where movement of people can be observed by the security guards before they enter or leave the complex.

The planning of the site layout is greatly influenced by the following concepts:-

(a) The grouping of the different sections in Zones according to their functions.

(b) The need to emphasize the interdependence of different sections.

(c) The integration of the different sections (which work together to keep the factory going) into a unified complex. The different sections to be compactly integrated as much as functionally and safely possible.

(d) Creation of interaction between the staff of different sections and department of the complex.

7.02 CIRCULATION AND BERTHING

The two major systems of circulation are:-

(i) by boat and

(ii) by foot.

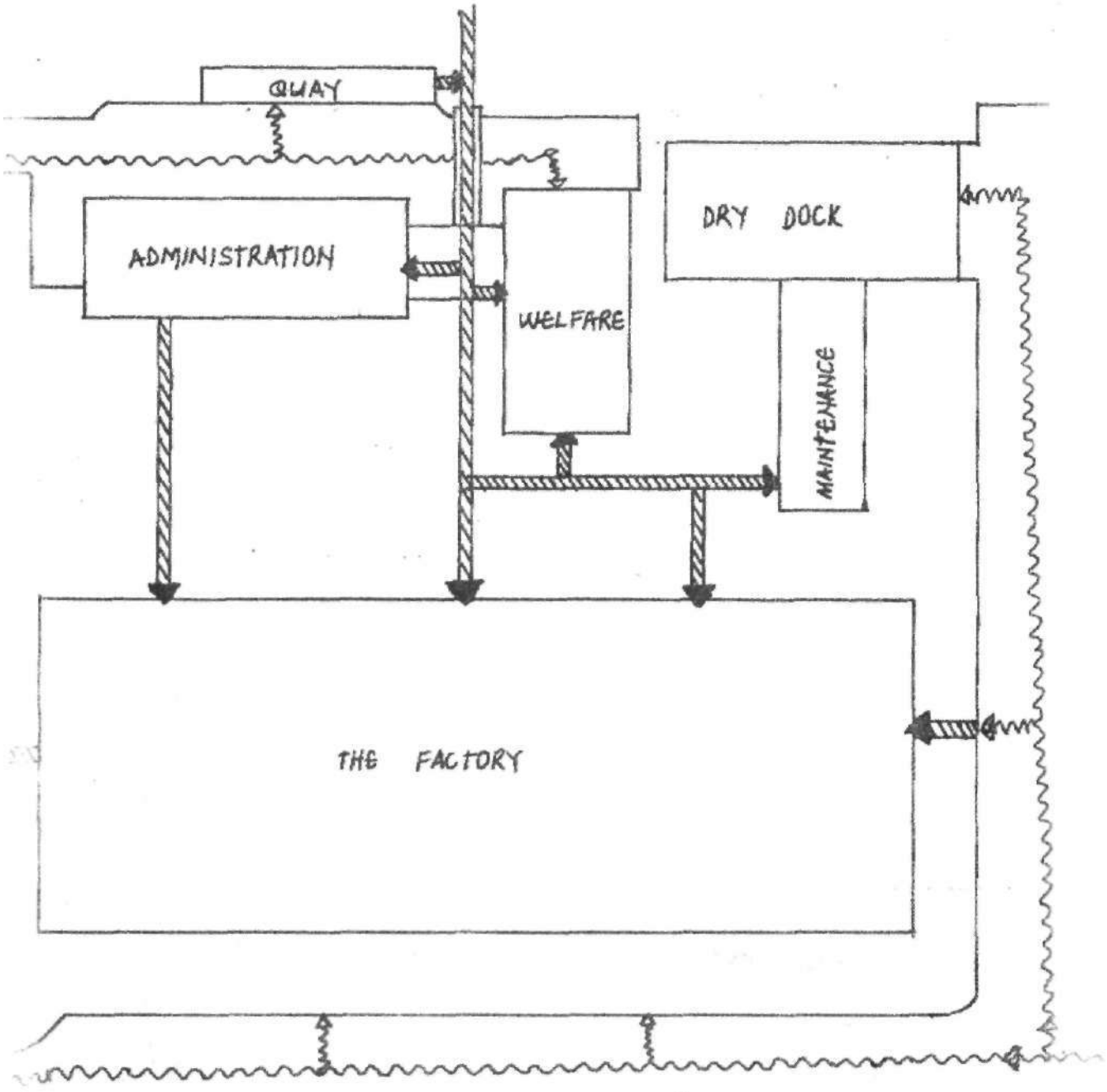
The only vehicular movement in the complex is that of fork lifts which operate within the warehouses. In circulation and berthing planning, the following objectives are achieved:-

(i) Reduction of walking distance between different parts of the complex as much as possible with due consideration to the functions of the different sections. The major walkway which links the Entrance hall to the production section is provided with covered walkway to protect people from sun and rain. The berthing places are located near the places where those who disembark from boats will not have to walk too long a distance before they get to their different working places.

(ii) For the factory, the berthing of trawlers and barges are just at the factory edges for easy unloading and shipping of raw and finished products.

(iii) Berthing jetties are provided for workers' public boats and launches near the bridge where they can easily join the pedestrians after disembarking and pass over the bridge into the entrance hall.

Small jetties are provided under the administration block for the very senior staff workers (like Director, Managers etc) to berth their private speed boats.

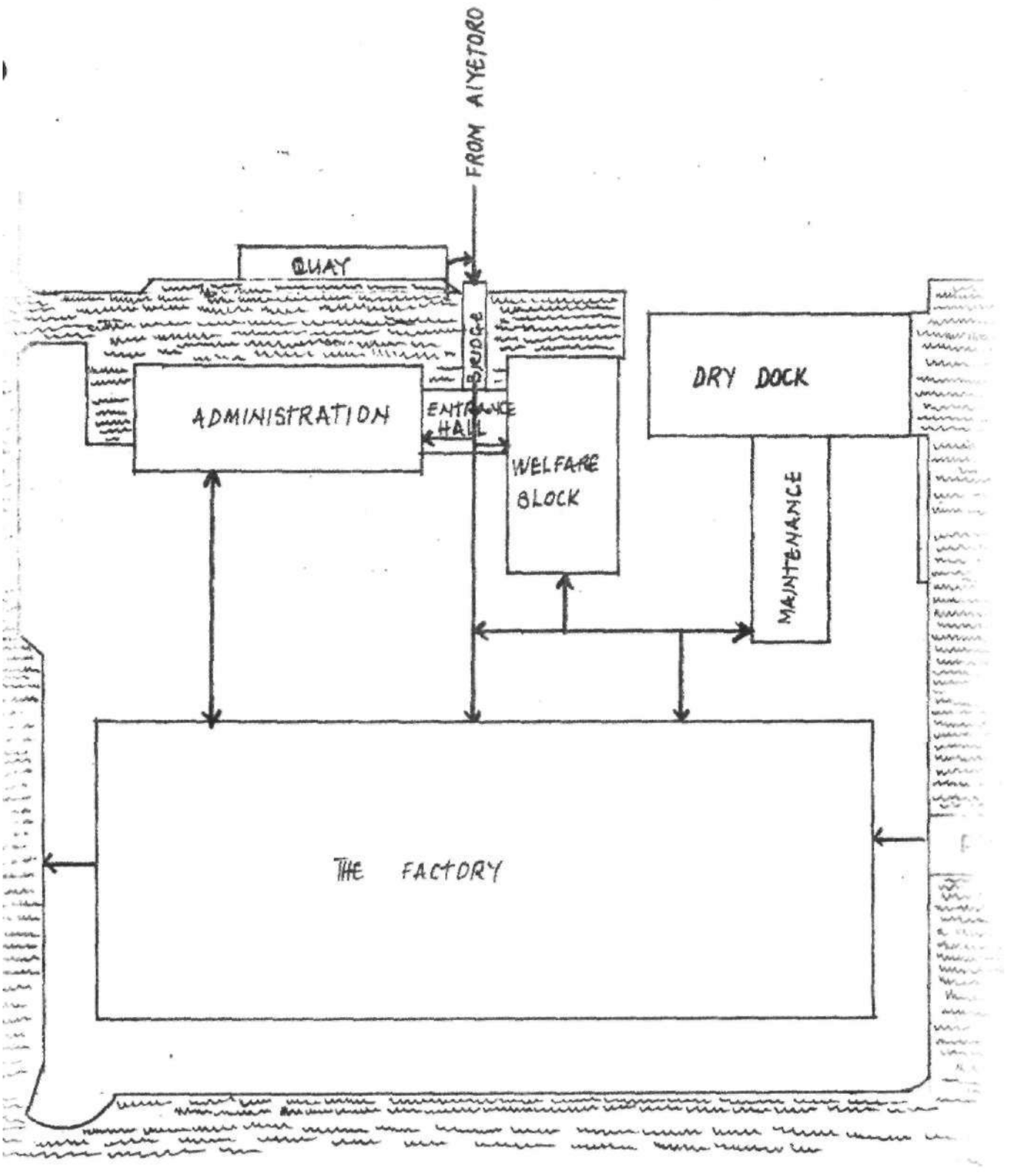


INTER ZONAL PEDESTRIAN & BOAT TRAFFIC

PEDESTRIAN TRAFFIC

BOAT TRAFFIC

* NOTE :- NOT DRAWN TO SCALE



SITE LAYOUT RELATIONSHIP DIAGRAM.

*NOTE:— DIAGRAM NOT TO SCALE

DESIGN ELEMENTS

7.03 STRUCTURE:

The factory is the largest single block. Because of the involvement of machines with heavy vibrations and mechanical conveying systems and movement of people, the wider the columns spacing the better. For this reason, a structural grid of 12m is chosen for column spacing. The columns, beams and roof slab are all precast elements. Prefabrication aids speedy erection with less labour force than insitu construction. The walls are non load bearing. They are merely curtain walls which are thermally insulated to prevent heat gain from outside since the whole plant is to be airconditioned.

7.04 R E F R I G E R A T I O N

In this plant, there are two types of cold stores or warehouses. One is for the raw product supply which has a capacity of about 4,000 metric tons (8 times the daily processing capacity of the factory).

The other type is the finished product cold warehouse with a capacity of 3,000 metric tons.

The computation of the cold stores spaces are based on the size and weight of international standard of sea fish boxes. The table below whows some of the standard sizes of fish boxes.

(SIZE) kg	(LENGHT) cm	(WIDTH) cm	(HEIGHT) cm	(ENDS MINIMUM) thickness mm
3.6	26.0	21.5	12.7	20mm
6.4	38.0	26.0	12.7	20mm
8.2	49.5	26.0	12.7	20mm
35	57.0	38	18.0	20mm
50	72.0	40.00	20	20mm
100	127.0	35.0	24	20mm

STANDARD SIZES OF SEA FISH BOXES

(TABLE 17)

*SOURCE: Commodity standard for fishery product F. A. O. Journal.

To provide maximum operating efficiency, the walls, floors and ceiling of the cold warehouse must have a sturdy and tight construction. The refrigeration machinery (compressors) is centrally located to serve both the two cold warehouses (raw - product and finished product) and to supply cold air to the cool the production hall. In the cold warehouses, about 25% of the floor area is devoted for circulation and aeration purposes.

7.05 COLD STORE FLOOR

Floor heaving is a common problem in cold stores which is located on the ground floor level.

Floor heaving is the result of the cumulative effects of ice pockets formed under the insulated floor as the ground is chilled below freezing. This formation of ice exerts an upward force on the floor slab resulting in cracking and bulging of floor.

To provide a positive method of protection, heat has to be added to the ground by one of the many possible methods:-

(i) A heated oil solution may be circulated through pipe coils in the slab below the insulation

(ii) Electric heating elements may be enclosed in conduits in the bottom of slab.

(iii) Flues may be formed in the ground by hollow tile and the use of natural or forced air circulation through these flues furnishes the necessary heat to prevent the ground from freezing.

A thermostat control employed in the above systems permits maintenance of proper temperature in the ground at all times.

7.05 REFRIGERATOR DOORS

There are different types of refrigerator doors like viz:

(i) infitting type

(ii) overlap type

(iii) Sliding type

The thickness of insulation, hardware and protective covering for each door varies with the particular installation.

Infitting or plug type doors are relatively compact and light. Air leakage because of the small amount of sealing area and of the build up of frost on the sides of the door has been a problem in the past. In recent years however, the construction of doors with a double seal on inside and outside and the use of suitable electric heating elements have overcome these difficulties. The infitting door is widely used for cooler rooms and is also suitable for freezer rooms.

7.06 INSULATION

The function of insulation is to restrict the flow of heat into the refrigerated room from the outside surroundings. The ability of a particular type of insulation to resist the flow of heat by conduction from the warm side to the cold side is measured by the thermal conductivity of materials.

The three types of insulation suitable for use in refrigerated warehouses are:

(a) Loose or fill material

(b) Rigid board or block materials

(c) Reflectant materials.

The available commercial products are numerous and offer a wide selection for specific installation.

An insulation material for use in cold storage room should have the following properties:

(a) Low inflammability

(b) Low thermal conductivity

(c) Low water absorption

(d) Good resistance to fungi and vermin

(e) Low water vapour transmission.

The most satisfactory insulating material is the one that offers the best combinations of the characteristics desirable for a specific set of local conditions at the most economical cost in installation and maintenance.

7.07 PRODUCTION HALL FLOOR

Floors of fish processing halls and rooms have to be hardwearing, non porous, washable, well drained, non-slip and resistant to possible attack from brine, weak ammonia, fish oils and offal. Concrete is attacked by animal oils and also by the continued action of strong brine. It is also attacked by acids The rate of the attack depends on the density of the concrete and on the amount of wear that removes the attacked material to expose fresh material.

Clay tiles make the most hard wearing floors for fish processing area. They have to be about 5cm thick and laid flush in jointing made from furane.

Latex cement may be substituted as a cheaper material but it is not very satisfactcry.

7.08 DRAINAGE

In fish processing industry, much water is used and floors are always wet. Adequate drainage is essential. A slope of 2cm in 2.5 m is enough. The slope is so arranged that traffic of workers is across the slop to prevent people from slipping. Floor drainage channels are provided with easily removable gratings which are wide enough to permit brushing out.

7.09 WALLS

The interior wall surfaces have to be smooth and waterproof Block of dense concrete block are preferable since they provide a good base for smooth washable finish. Using of ceramic tiles for wall finish is more satisfactory although expensive. As an alternative to ceramic tiles, clay tiles can be used for its lower cost.

The tiles have to be carried up the wall to about a height of 2.3m. The top edge of the tiles are finished with rounded tiles

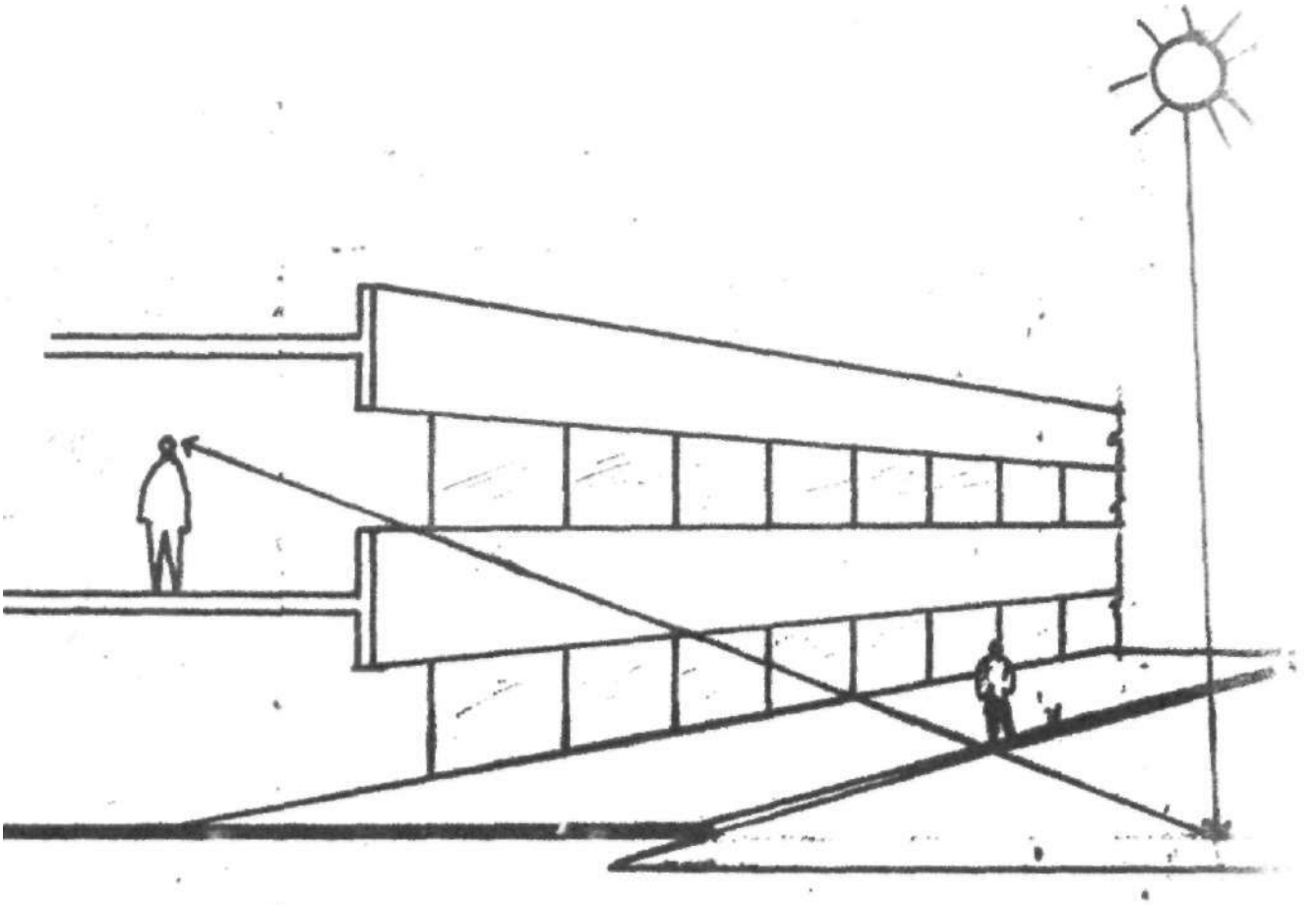
7.10 SERVICE DUCTS

Most services required in this factory would be run in ducts either vertically in the walls or horizontally under the floor. All inlets to the ducts would be insect proof and away from dusty places.

7.2 LIGHTING

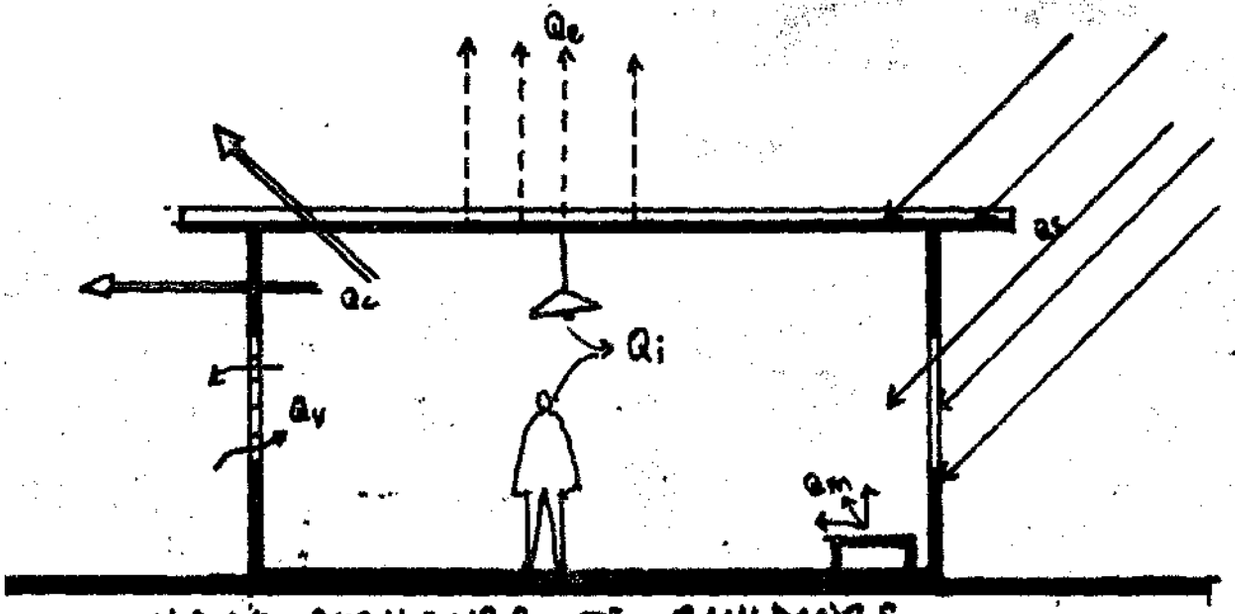
Good factory lighting will allow workers to do their work properly without strain. In this factory, less window openings are used than are required for effective natural lighting. This is because the production hall requires cooling or airconditioning for the processing to be carried out. Too many openings will make the cooling more expensive because much solar radiation would be able to penetrate into the interior. Artificial lighting would be mostly depended upon. Fluorescent lights would be effectively used to provide adequate lighting. An intensity of about 30 lumens per foot is usually adequate. That is roughly equivalent to 2-3 watts per square foot with fluorescent lighting In other sections of the complex where it is not necessary to artificially control the temperature, as many openings as possible are used for effective natural lighting.

The orientation of buildings are in north-south direction. This orientation will help to eliminate glaring effect of the sun as much as possible without using sun shading devices. The glaring effect of the sun on interior spaces is shown in the diagram following.



GLARE FROM SUNLIT SURFACES

Direct sunlight has to be excluded from building both for glare and thermal reasons.



HEAT EXCHANGE OF BUILDINGS.

$Q_i + Q_s \pm Q_c \pm Q_v \pm Q_m - Q_e = 0$

Q_i – Internal heat gain

Q_s – Solar heat gain

Q_c – Heat conduction by walls

Q_v – Heat exchange by ventilation

Q_m – Heat flow from mechanical appliances

Q_e – Heat exchange by evaporation

If the sum of the equation is less than zero (negative) the building will be cooling and if it is more than zero the temperature in the building will increase.

7.3 VENTILATION

The recommended temperature for fish curing ranges from (30-40)^{o}F. But 40^{o}F can be used as design temperature.

The mean annual temperature of Aiyetoro is 79.25^{o}F. This is quite higher than the required temperature of 40^{o}F. There is need for interior artificial temperature control in the production hall. For this purpose central air conditioning system would be used.

As much of Natural Ventilation as possible would be used in the non production section of the complex like welfare and administration sections.

7.4 SPACES AND ACCOMODATION SCHEDULE

All the spaces allocated to different sections and departments are done with due consideration for the type of activities that would be carried out within the spaces.

In the allocation, economy of space and comfort of the people who would work within the space are well considered.

In calculation of the spaces, references are made into architectural books of standards like Neufert architect's data, A. J. Metrics etc and technical books like Design and Construction of Ports and Marine Structures by Alonzo Def. Quinn.

7.5 SPACE AND ACCOMODATION SCHEDULE

DEPARTMENT	DESCRIPTION	APPROX. FLOOR AREA REQUIRED (m^2)
HARBOUR	(i) Raw product supply harbour Berthing Pier Area + Manoeuvring space	56,608
	(ii) Product shipping harbour Berthing area and manoeuvring space + workers berthing area	29,220
	TOTAL AREA	85,828 m^2
WAREHOUSE	(i) Receiving Hall + ancillary offices	240
	(ii) Raw product cold store	1,584
	(iii) Finished product cold store	1,110
	(iv) Finished product dry store	449
	(v) Dry Store for materials like fish boxes, cans etc	411
	TOTAL AREA	3,794 m^2
PRODUCTION DEPT AND POWER PLANT	(i) Recovery Hall	1520
	(ii) Production Hall + Packing spaces	6605
	TOTAL AREA	8,125 m^2

DEPARTMENT	DESCRIPTION	APPROX. FLOOR AREA REQUIRED (m^2)
PRODUCTION DEPT AND POWER PLANT	POWER PLANT	
	(i) Compressors house	282
	(ii) Boiler & Power Plant house	384
	(iii) Locker Rooms & Toilets	324
	(iv) Quality Control Lab.	60
	(v) First Aid Room	64
	TOTAL AREA	1,114
ADMINSTRATION AND STAFF DEVELOPMENT DEPTS.	(i) Entrance Hall	99
	(ii) General Offices + Stores + Conference Room	370
	(iii) Class Rooms + Laboratories + Demonstration Wrokshop + Ancillary Offices	354
	(iv) Corrdors + Stair Well area toilets + Lobby	381
	TOTAL AREA	1,204
WELFARE DEPT.	(i) Dinning	360
	(ii) Kitchen	56
	(iii) Store	34
	(iv) Snack Bar	48
	GYMNASIUM	
	(i) Sports Area	210
	(ii) Store & Changing Room	48
	TOTAL AREA	7,68 m^2

DEPARTMENT	DESCRIPTION	APPROX. FLOOR AREA REQUIRED (m^2)
MAINTENANCE DEPARTMENT:	(i) Offices & Store	624
	(ii) Dry Clock	992
	(iii) Water Tower Area	24
	TOTAL AREA	1640m^2
	APPROX. TOTAL AREA OF THE INDUSTRY PENUNSULA	30,000 m^2
	APPROX. TOTAL AREA OF THE BUILT-UP SPACE	16,086 m^2
	APPROXIMATE AREA OF OPEN SPACES FOR CIRCULATION AND LANDSCAPE AND POSSIBLE FUTURE EXPANTION	13,914 m^2