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OPPORTUNITIES FOR A PACKAGING INDUSTRY IN THE WEST AFRICAN SUB-REGION

M66-1334

TABLE OF CONTENTS

	Page
1. INTRODUCTION: SCOPE OF STUDY	1
2. FUTURE PACKAGING IN THE WEST AFRICAN SUB-REGION	1 - 2
3. BASIC ASPECTS OF PACKAGING	3
4. USES OF PACKAGING	3 - 4
5. INDUSTRY APPROACH	5
6. CORRUGATED BOARD	5 - 20
7. FOAMED PLASTIC PACKAGING MATERIAL	21 - 27
8. CONCLUSIONS	27 - 28

Annex I	BIBLIOGRAPHY
Annex II	POPULATION DATA
Annex III	WEST AFRICAN SUB-REGION POPULATION PROJECTIONS
Annex IV	TOTAL PAPER AND BOARD IMPORTS BY COUNTRY - 1964
Annex V	MAJOR WORLD SUPPLIERS OF EXPANDABLE POLYSTYRENE

1. INTRODUCTION

This study has been prepared for the Economic Commission for Africa by Mr. Joseph J. Tomassi, President of the Corning Packaging Company, a Division of the Corning Glass Works, Corning, New York.

It is specifically concerned with the following fourteen African nations which comprise the West African Sub-Region: Dahomey, Gambia, Ghana, Guinea, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta.

The study explores the opportunity for two separate manufacturing industries in the region - a paper corrugating and converting industry and an expandable polystyrene (foam film) extruding and thermoforming industry.

The study is based upon the most current information available to the writer and uses the following data sources: United Nations publications, trade magazines and associations, U.S. Department of Commerce publications, information supplied by raw material and equipment suppliers, the American Management Association, current books on the various subjects contained in the report and the in-plant experience of the Corning Packaging Company, Corning, New York. A complete list of information sources is found in Appendix I.

2. FUTURE PACKAGING IN THE WEST AFRICAN SUB-REGION

A projection analysis of the future demand for industrial paper[1/] in the Sub-Region was made in the United Nations' Food & Agriculture Report: Review of Past Developments and Future Demand Estimates, dated January 29, 1965. The report was based upon methodology developed in the Food & Agriculture Report: World Demand for Paper to 1975. The report established a relationship between average per capita income and per capita consumption of paper and paperboard. The increase in average per capita income is a function of population growth and Gross Domestic Product with population growth the key factor in the Sub-Region. Appendix II shows the

1/ It is assumed that this represents paper for corrugated board or the board itself.

recent annual population rate of increase for the countries of the Sub-Region which are generally high ranging from 0.3 per cent for Gambia to 6.2 per cent for Ghana. Appendix III has projections of population growth for the countries of the Sub-Region from 1960 through 1980. During the 20-year (1960 to 1980) period, population for the entire region will increase by almost 50 million people or 70 per cent. Greatest growth will take place in Nigeria, Ghana and Mali and to a far lesser extent in the other 11 countries.

Future demand projections of the Sub-Region were arrived at starting from the average level of consumption in the period 1960 - 1962 and then calculating the growth of average per capita income. The following table is a projection of industrial paper and paperboard consumption in Western Africa:

Projection of Industrial Paper Consumption in Western Africa

(1,000 Short Tons)

1960-62	1970	1975	1980
38.7	84-98	112-147	154-220

The projection shows a three to over fourfold increase in consumption in 20 years or from 15 to 24 per cent annually. The range in the consumption projection is based upon low, medium and high per capita income projections.

While this is a situation showing considerable growth, it must be remembered that actual consumption during the base period is very low and will remain low during the first decade. Within this decade, however, a corrugated packaging industry should be established to provide for projected consumption.

While there is no foamed plastic packaging material industry in the Sub-Region, the growth of agricultural exports and the establishment of new industries should create the necessity for such an industry.

3. BASIC ASPECTS OF PACKAGING

Packaging may be defined as the process of placing a product in a container or wrapping in order to market it. Another definition is that packaging is the use of containers and components plus decoration or labeling to protect, contain, identify, merchandise and facilitate use of products. One or a combination of these elements may be involved.

Containers go back to the dawn of history. Any item to be stored or transported called for packaging and led to the use of leaves, hollowed-out limbs, gourds, skins, reed baskets, earthenware vessels and similar materials.

In time, containers were improvised or developed to meet the special needs of nomadic tribes, agrarians, merchants, traders and for religion and war. The antecedents of some modern containers, such as glass bottles and packaging practices like labeling are very old. Glass bottles were used in Egypt more than 4,000 years ago. Marks, signatures, symbols and seals were employed for the very first products involved in trade.

Until 1800, the making of packages was essentially a craft or art. The industrial revolution produced great advances in container invention and fabrication, resulting in the development of most of the standard container forms used today. Corrugated board and boxes were first used over 100 years ago. Extruded expandable polystyrene (foam film) is a relatively new development having been introduced in the early 1950's.

4. USES OF PACKAGING

The following discusses packaging in more specific terms.

Primary packaging refers to the essential container immediately enclosing the product. The product is usually put into this container soon after it is manufactured although in certain instances, the final stages of manufacture occur while the product is whithin the package. This primary package remains with the product from the time of its

manufacture or preparation at least through distribution to retailers, and very often continues through the entire life of the product. This is in evidence in a glass container for mouthwash, a collapsible tube for toothpaste, and a folding paper box for detergent; all of these remain an essential part of the product during its entire life. Other primary containers end their function after the product is brought home. This is the case with a polyethylene package of clothing or a gift package.

Secondary packaging refers to the additional containers and wrappings that are added for protective or marketing requirements. These accompany the primary package to the consumer's home and then removed. This is typical of the outer folding box which, in the above case, contains a glass bottle for mouthwash. The glass bottle is retained as part of the product, but the box is destroyed.

Display packaging functions to display products with a selling message. These displays differ from the permanent type in that they are shipped with the product inside and are not made to be refilled.

Shipping packaging involves those packaging components beyond primary and secondary packaging whose function is essentially that of protection during distribution. These packages are not destroyed immediately after their shipping function is completed. They serve to store the product, identify it, and often to display it.

The corrugated box and foam plastic industries discussed in the next sections of this study would offer an economy of the Sub-Region facilities capable of producing shipping, display, primary and secondary packaging.

5. INDUSTRY APPROACH

The approach this study takes is to plan for a minimum sized industry with one manufacturing plant initially and proposes additional facilities when expansion merits them. The concept of a parent plant and one or more satellite plants located within the Sub-Region consuming the output of the parent plant should have considerable merit in the Sub-Region. It is extremely flexible and allows for growth in those areas requiring it. Economies are achieved as only one expensive facility in each industry is required — a corrugator for the corrugating and converting industry and an extruder for the foam film and thermoforming industry. Each element of the industry - parent plant or satellite plant - may, in turn, be integrated upwards or downwards in the future. The corrugating and converting industry lends itself to this concept particularly well as the industry basic raw material, cellulose, is found in abundant supply within the region.

A foam film plastic industry would lend itself to the above concept by utilizing a centrally located extruder and a number of satellite thermoforming operations close to population centers. The extruder would provide the raw material (foam film) for the thermoforming operation. The thermoforming operations could, in turn, produce a wide variety of products for local or national or regional markets.

Figures 1 and 2 show a vertically integrated paper industry and a foam film extruding and thermoforming industry.

6. CORRUGATED BOARD

Corrugated board is the raw material from which corrugated containers are made and usually consists of at least three elements — two liners and a fluted corrugating medium. All three are glued together to make a rigid structure (termed single wall). Variations of the basic board are single-faced corrugated which is a single liner glued to the corrugating medium. This is used for wrapping and

Figure 1

VERTICALLY INTEGRATED PAPER INDUSTRY
INDUSTRIE DU PAPIER A PRODUCTION VERTICALE

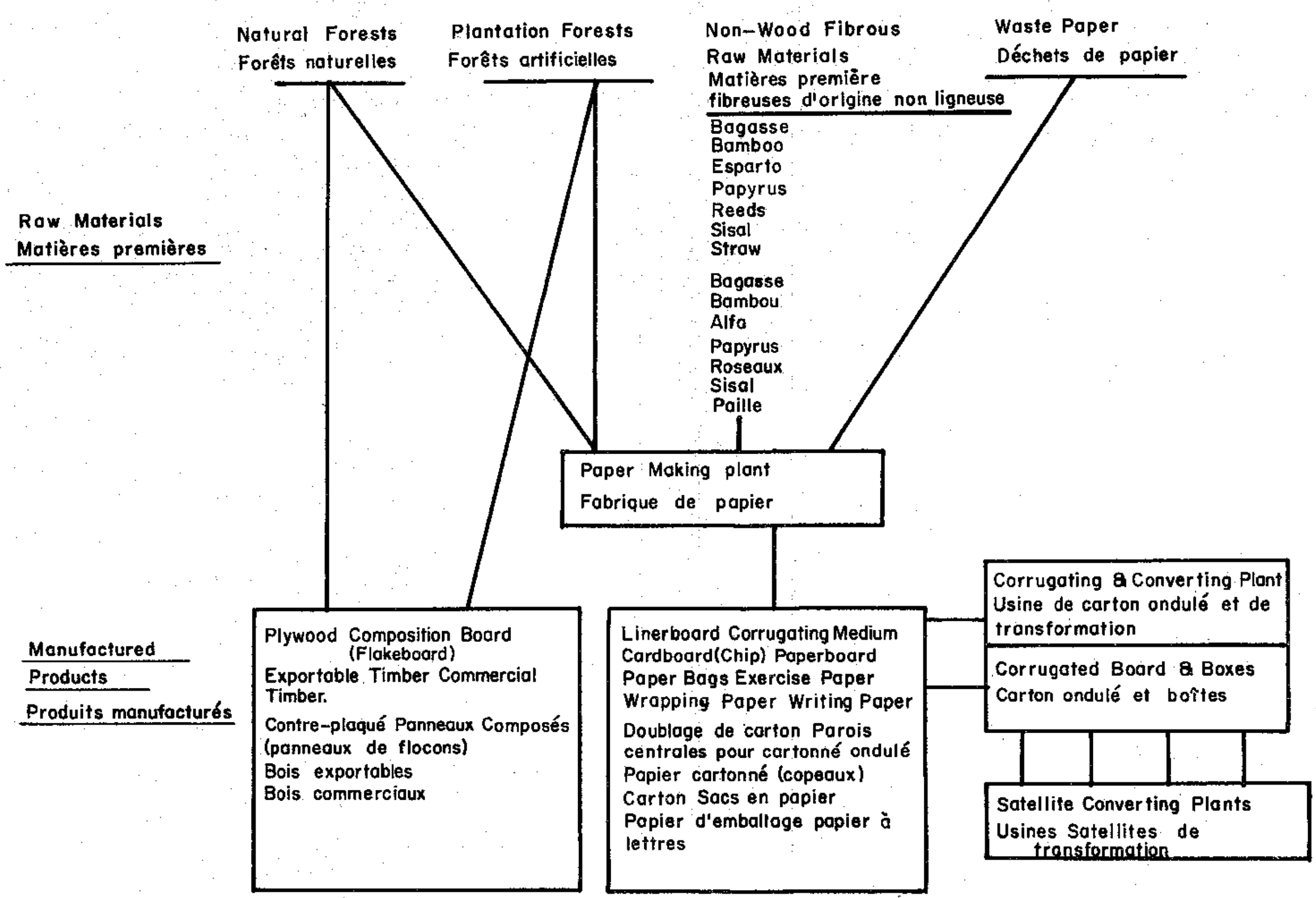

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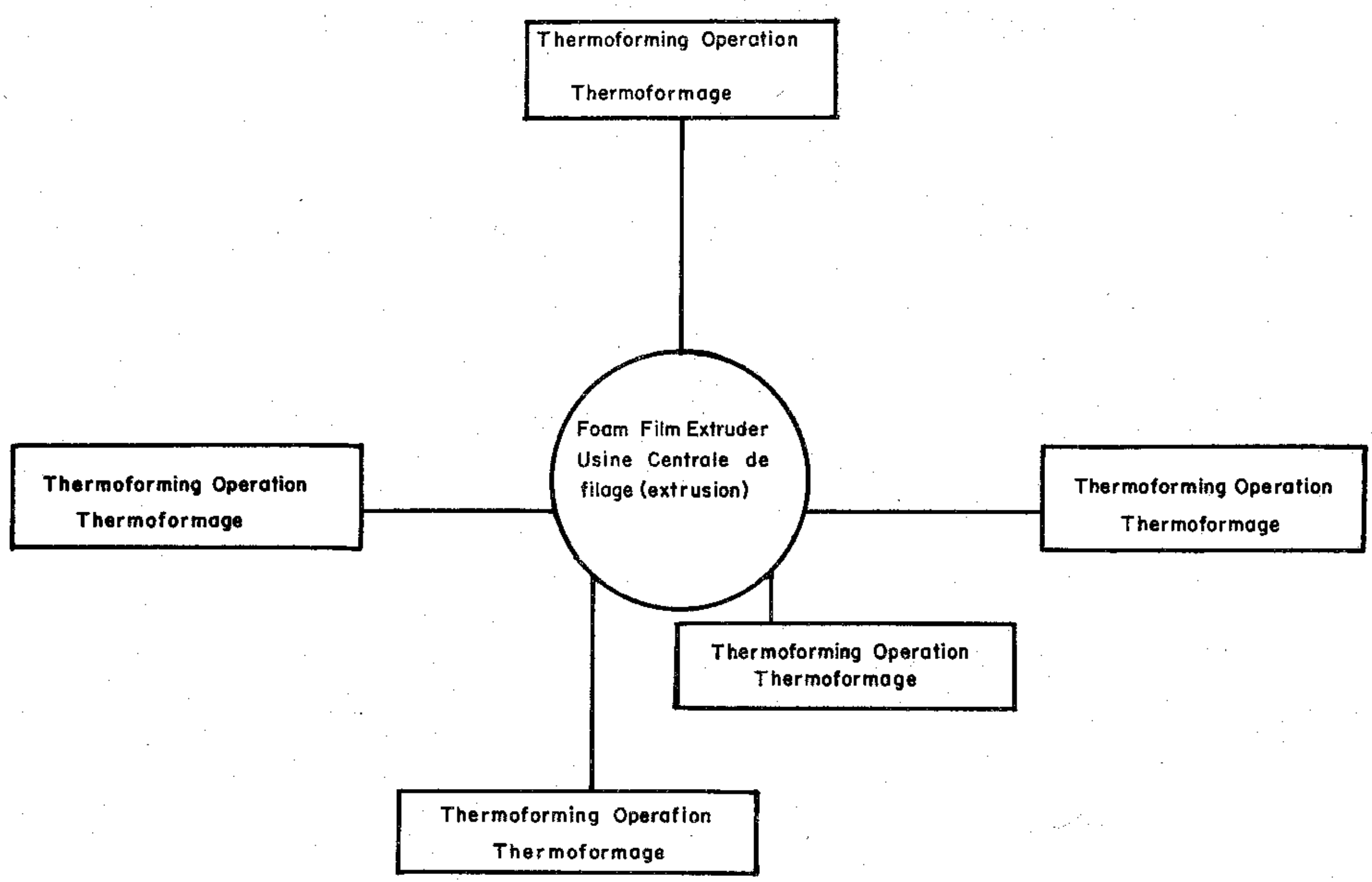
FIGURE 2

FOAM FILM PARENT-SATELLITE INDUSTRY CONCEPT
INDUSTRIE DE LA MOUSSE PLASTIQUE USINE CENTRALE ET USINES SATELLITES



interior packing. Double-wall corrugated consists of five elements — three liners and two corrugated members. Its principal use is in boxes where greater strength is required.

The basic raw material necessary for the production of corrugated board liner and corrugating medium is cellulose fibre which is found in many varieties of growing plants and trees. Wood is primarily used if available and both soft woods and hard woods are used today.

The cellulose fibres in soft woods are longer than those in hard woods making possible a stronger board.

Another important commercial source of cellulose fibres is waste paper which can be re-pulped to make the fibres available for re-use. Reclaimed fibres are generally inferior in strength, appearance and uniformity to fibres in virgin pulp.

Other possible sources of cellulose fibres are grain or cereal straws and wood pulp imported from producing countries. The corrugating medium is usually made from reclaimed fibres and the liner from virgin material.

On a world basis, it was found that wood pulp made up 77 per cent of raw materials used, non-wood fibrous materials 5 per cent and waste paper 18 per cent. The Food and Agriculture Organization of the United Nations has made studies of the availability of raw materials in the Sub-Region suitable for paper manufacture. As there are only modest paper-making facilities in the Sub-Region, efforts to establish a source of raw materials have been minimal. Virgin raw materials are primarily imported. The area has a variety of wood raw materials inluding conifer, eucalyptus, rubber wood and broad-leaved trees as well as such non-wood materials as bamboo and papyrus. Development of existing resources will ensure an adequate supply of raw material for future paper industries.

A decision must be made whether paper for the corrugating process is to be imported, manufactured from native materials or wood pulp imported and the paper manufactured in the region. Assuming the paper is imported, a corrugated board manufacturing and converting plant could be built as the first step in creating an industrial complex. At a later date when market demand is established, a paper mill could be built supplying paper for the corrugating plant. In addition, other paper products could be produced for a variety of markets such as writing paper, wrapping paper, exercise paper, packaging bags, cardboard (chipboard), etc. Raw materials for this plant could be imported wood pulp or native materials.

A number of machines are required to make a corrugated shipping container. First, rolls of paper must be converted into corrugated board. This is done on a corrugating machine which is a combination of various machines placed in line to produce scored and trimmed corrugated board blanks from rolls of paper. The blanks are then converted into corrugated containers. Four corrugated machine widths are standard: 68", 80", 87" and 98".

The following table shows output and related data for corrugating machines:

Corrugating Machine Data

Monthly Production Required (Million Square Feet)	Number Of Corrugators	Machine Width	Production Time
6	One	68"	One Shift
10	One	80"	One Shift
15	One	87"	One Shift
15	One	80"	One Shift + Over-time
20	One	87"	One Shift + Over-time
20	One	80"	Two Shifts
30	One	87"	Two Shifts

Corrugating Machine Data

Monthly Production Required (Million Square Feet)	Number Of Corrugators	Machine Width	Production Time
30	One	80"	Two Shifts + Overtime
40	One	87"	Two Shifts + Overtime
40	One	80	Three Shifts
50	Two.	87"	Two Shifts

For the purposes of this study, an 80" machine was selected. Single shift monthly production of this machine amounts to 10 million square feet or 120 million square feet annually. Using a conversion factor of 128 pounds per 1,000 square feet of board, this amounts to 640 tons per month or 7,680 tons annually. Assuming a 22 day month, daily production would amount to approximately 29 tons.

Assuming an average of seven square feet of board per carton, approximately 1.3 million cartons would be produced monthly or 15.6 million cartons annually.

Other necessary equipment is a printer-slotter which converts a blank sheet of corrugated board, a joiner for taping, a slitter for cutting out components, a die-cutter for cutting out shapes, a stitcher for stitching or stapling the container, a slotter for producing interior packaging, a baler for waste materials and various materials handling equipment.

A flow chart of the production process is shown on page 11.

A complete list of suppliers of the above equipment may be found in the Modern Packaging Encyclopedia, 1966. (See Bibliography Appendix I.)

Plant Layout

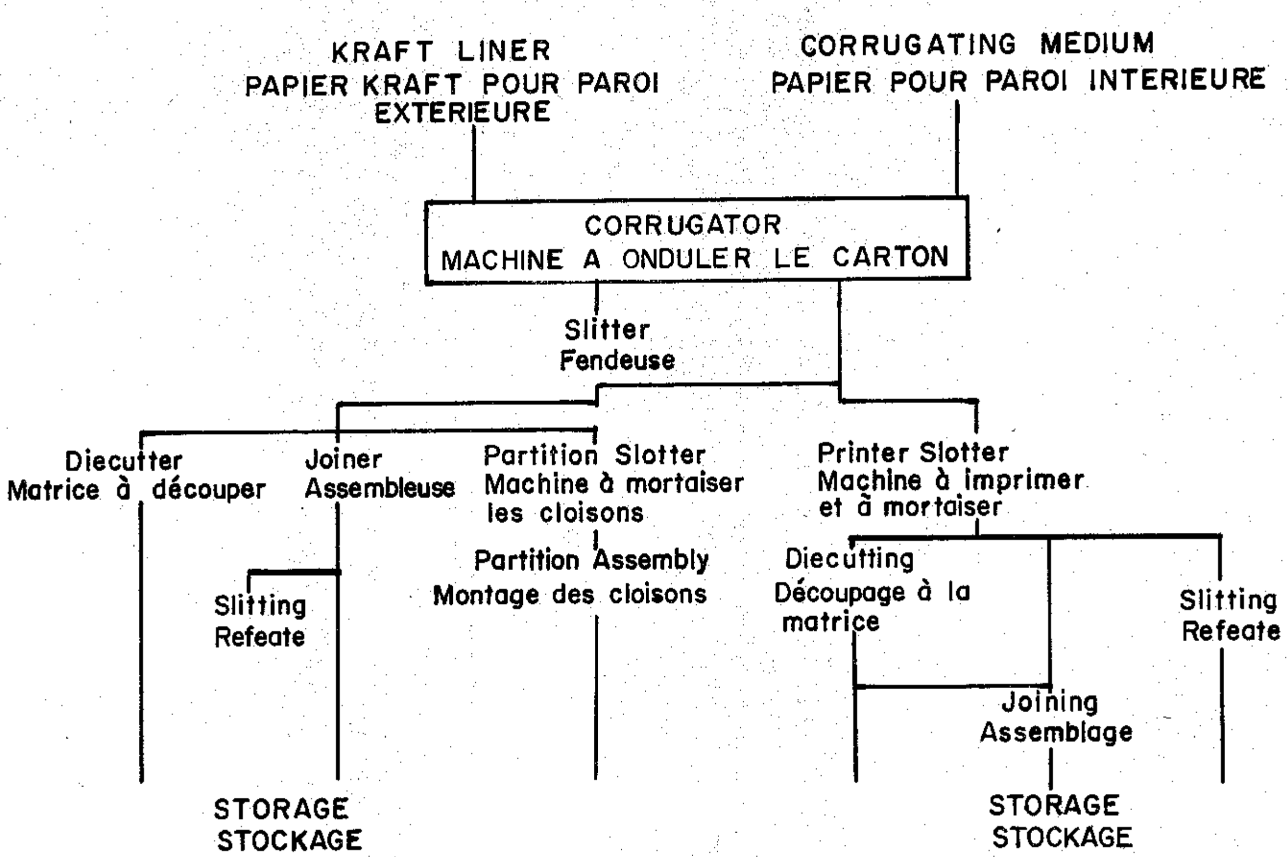
The following three diagrams present possible corrugating and converting plant layouts. Plan A is long and narrow and affords ample railroad siding along one side of the building for receiving roll stock and shipping finished products. While straightline production is possible. The plan does not provide for space required for specialty work.

Figure 3

CORRUGATED BOARD MANUFACTURE
FABRICATION DU CARTON ONDULE

Flow Chart of a Corrugated Board Manufacturing and Converting Plant

Circuit de production d'une usine de fabrication et de transformation du carton ondulé

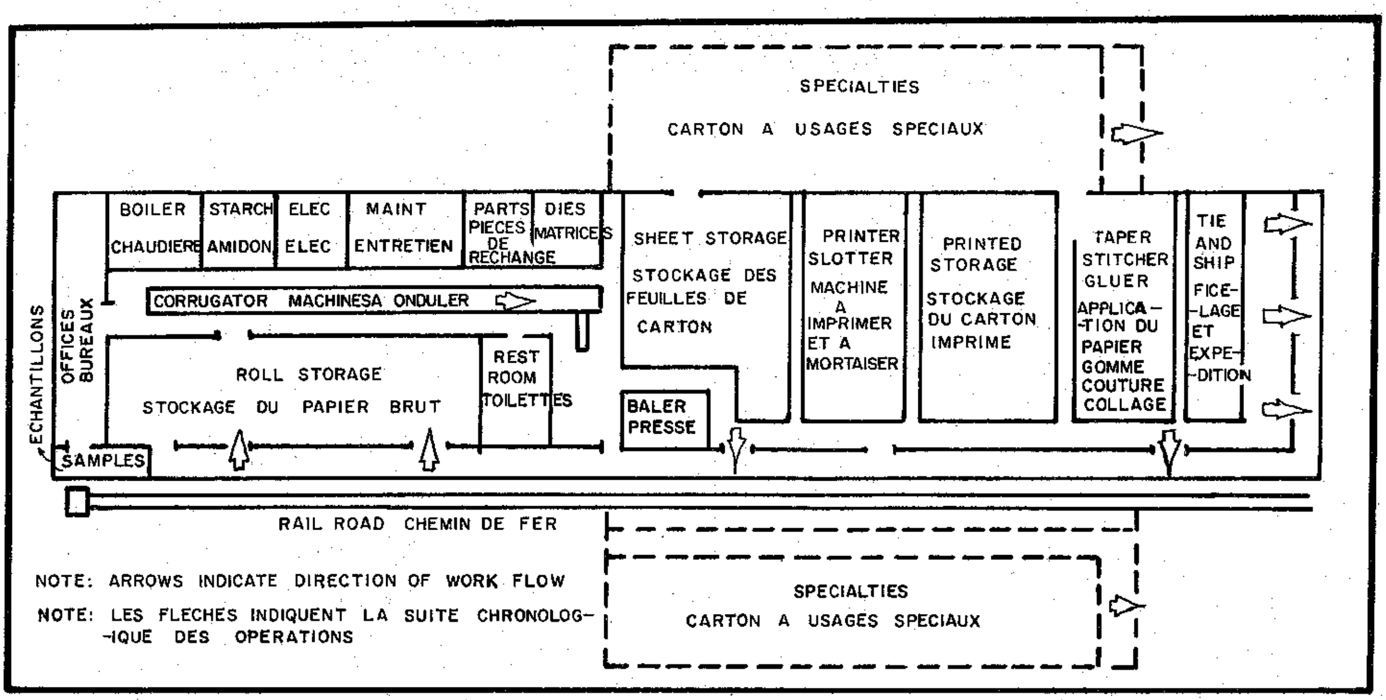


Objections to this type of building are lack of compactness, supervision is difficult, excessive length needed for roll and sheet storage areas and poor conveyorization.

More popular plant layouts are Plans B & C. They are more nearly square than Plan A with sufficient width for specialty work. Advantages of these designs are ease of truck and rail shipments, ample space for unloading rolls of paper and supplies, ease of material handling, compactness and easier supervision. Estimated Capital Investment for a Corrugating and Corrugated Converting Plant in Leased Facility (10 million square feet per month capacity).

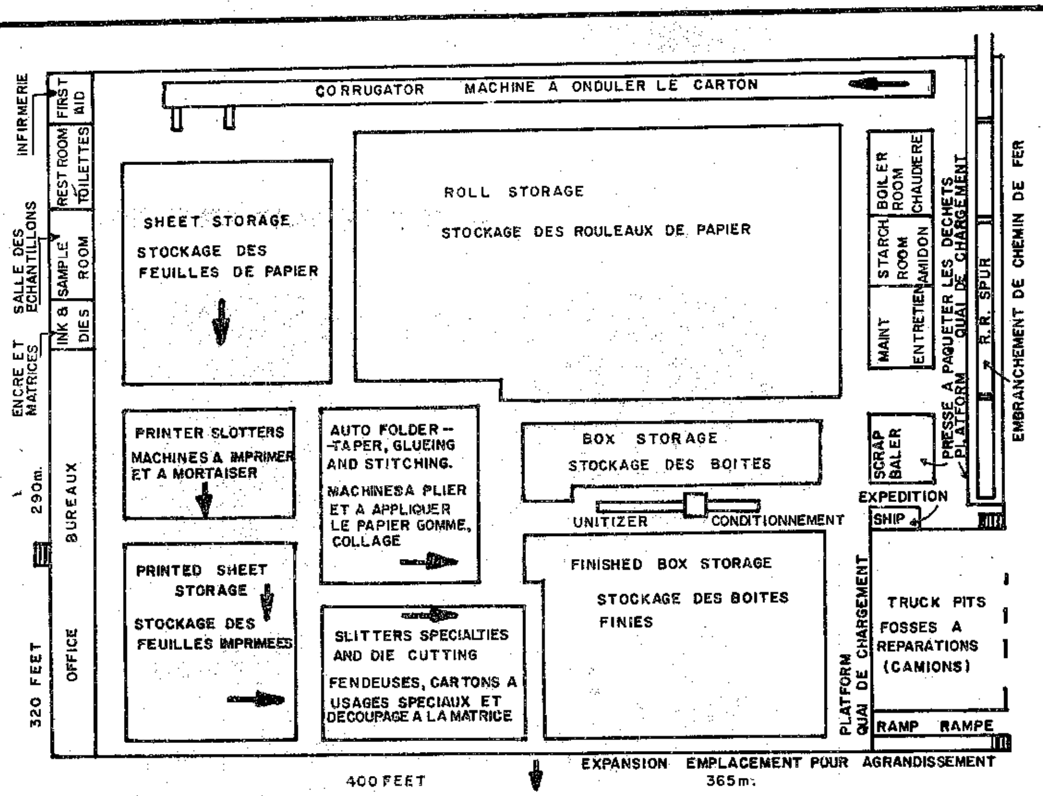
Equipment	
1 - Corrugating Machine (80" possibly used)	US $200,000
1 - Printer Slotter	75,000
2 - Universal Joiners	15,000
1 - Slitter	10,000
1 - Thomson Die-Cutter	16,000
1 - Stitcher	10,000
1 - Slotter	10,000
1 - Baler	10,000
Material Handling Equipment	25,000
Total Equipment	$ 371,000
Services	
1 - Water Well	$ 25,000
1 - Water Accumulator plus Softener	5,000
1 - Package Boiler	25,000
1 - Compressor (50 h.p.)	15,000
Miscellaneous Handling Equipment	10,000
Total Services	$ 80,000

FIGURE 4



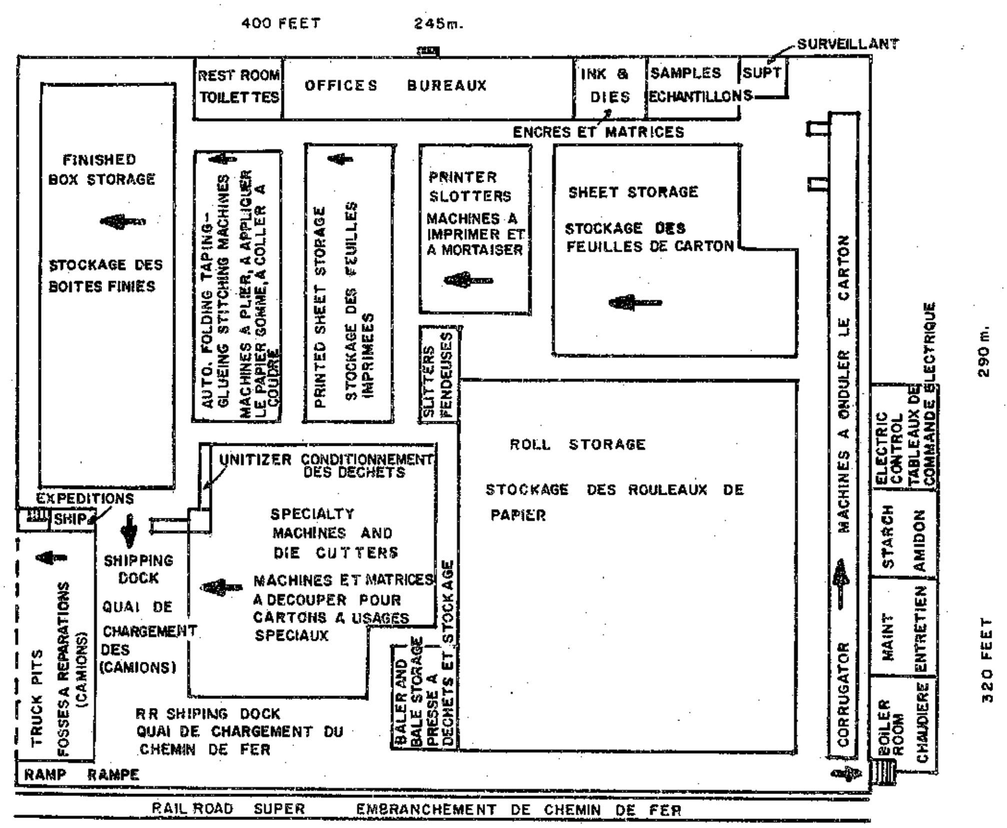
PLAN A. LONG AND NARROW TYPE OPERATION
USINE EN LONGUEUR

FIGURE 5



NOTE: ARROWS INDICATE DIRECTION OF WORK FLOW.
LES FLECHES INDIQUENT LA SUITE CHRONOLOGIQUE DES OPERATIONS

PLAN B. U TYPE OPERATION USINE enU



NOTE: ARROWS INDICATE DIRICTION OF WORK FLOW.
LES FLECHES INDIQUENT LA SUITE CHRONOLOGIQUE DES OPERATIONS

Shipping Costs

U. S. to West African Port	$ 43,000

Other Expenses

Office Equipment	$ 15,000
Supplies	15,000
Contingency	40,000
Working Capital	375,000
Total	$ 445,000
Total Investment	$ 939,000

For the purposes of this study, it is assumed that there would be no duty on imported equipment and initial supplies due to preferential treatment as a new industry.

Plant

In choosing a plant site, a number of factors should be considered.

1. Market

(a) Existing market in area.
(b) Future market in area.
(c) Types and sizes of boxes required for service customers.

2. Transportation and Shipping

(a) Average distance to customers.
(b) Proximity to main roads.
(c) Trucking facilities and railroad sidings.
(d) Proximity to metropolitan centres.

3. Plant

(a) Size and type of building.
(b) Sufficient land for expansion.
(c) Capacity of electric supply.
(d) Water and sewer facilities.

The type of plant can be light or heavy construction with average heights in the production area and depending on method of paper storage considerably greater ceiling height in the storage area. To withstand concentrated machine loads and stored paper, floor thickness should be sufficiently reinforced.

A factor of four square feet of floor space per thousand square feet of board produced per month is average for the industry. On this basis, to produce 10 million square feet of board a month, at least 40,000 square feet of floor space is required.

Raw Materials Required

For 10 Million Square Feet Per Month

Paper - depending upon grade 1.2 - 1.4 million pounds.

Water Resistant Adhesive - 15,000 gallons.

(a) 5,000 lbs. cornstarch
(b) 600 lbs. borax
(c) 735 lbs. caustic
(d) 21,000 lbs. tapioca
(e) 735 lbs. catalyst

Water - Makeup for boiler and miscellaneous — 15,000 gallons, using an estimated factor of 1.5 gallons per 1,000 square feet of board.

Power - All equipment is powered by electric motors. Power consumption will be dependent upon the type of motor, drive, load, machine requirement and operating speed.

Corrugated Board and Container Converting Manpower Requirements

(10 million square feet per month capacity)

Personnel	Number Required	Skill Level
Manager - Engineer	1	Skilled
Foreman	2	Skilled
Clerk-Typist	1	Semi-skilled
Electrical Maintenance	1	Skilled
General Maintenance	1	Semi-skilled
Warehouseman	1	Unskilled
Shipping	2	Unskilled
Hand Assembly & Misc.	2	Unskilled
Corrugator Crew	12 (6 men per shift; machine run 2 shifts)	2 Skilled
Material Handler	1	Unskilled
Printer Slotter	6 (2 men per shift; machine run 3 shifts)	3 Semi-skilled
Slitter	3	Unskilled
Die-Cutter	2	1 Semi-skilled 1 Unskilled
Stitcher	2	2 Unskilled
Universal Joiner	4 (2 per machine; 2 machines)	4 Unskilled
Slotter	2	2 Unskilled
Baler	2	2 Unskilled
Total Personnel	45	
Totals	6	Skilled
	8	Semi-skilled
	31	Unskilled
	45	

Skill levels are based upon the time necessary for training. It is assumed that unskilled personnel would require less than one month's training, semi-skilled personnel 1 - 6 months' training and skilled personnel 6 or more months of training.

Possible Industry Projection Using Satellite Plant Concept

If we assume that the regional demand for finished containers will increase at a 15 to 24 per cent annual rate[1/] during the twenty year period from 1960 to 1980 and a satellite plant concept is used, the following industry projection can be made.

Projection of Personnel Required

	Skilled	Semi-skilled	Unskilled	Total
1968	6	8	31	45
1969 - 1970	12	16	62	90
1970 - 1975	18	24	124	180
1975 - 1980	30	40	155	225

Sheet plants are assumed to have approximately half the personnel complement of a corrugating plant or 3 skilled, 4 semi-skilled and 15 unskilled personnel.

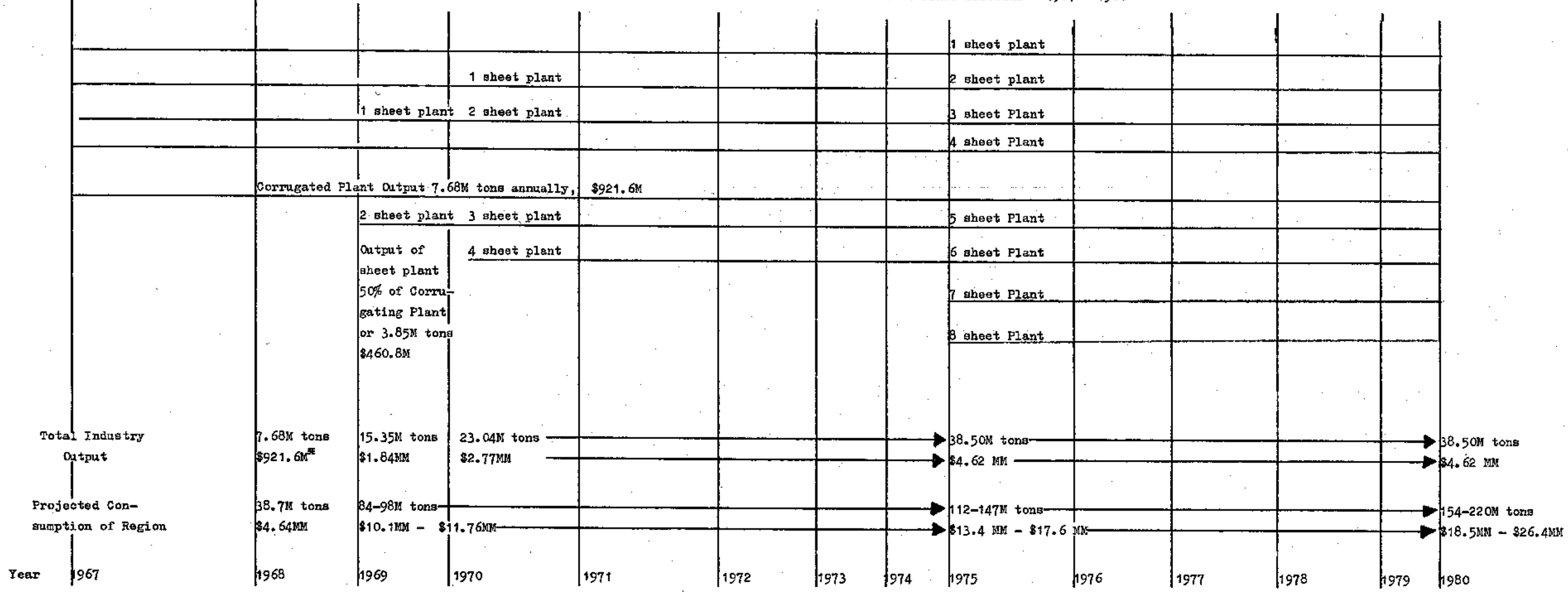
Products

A number of products may be manufactured in a corrugated board and converting plant. The primary product would be the corrugated board which is consumed during the manufacturing process and converted into corrugated boxes and various components such as interior packaging, partitions, folders, tubes, etc.

The following table presents an analysis of corrugated box use in the United States by industry in 1965.

1/ See Page 2.

PROJECTION OF CORRUGATED BOARD AND SHEET PLANT INDUSTRY - 1967 - 1980



* Corrugated board is assumed to have a value of $120/ton.

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Industry	Per Cent of Total Corrugated Box Production
Food and Kindred Products (Except Beverages)	25.6 per cent
Stone, Clay and Glass Products	9.9
Paper and Paper Products	9.7
Metal and Metal Products	7.2
Electrical Products	6.0
Chemicals, Drugs and Soaps	5.6
Textiles and Apparel	5.3
Furniture and Household Products	4.3
Toys, Sporting, Athletic Goods and Building Materials	3.9
Automotive and Transportation	3.3
Beverages	3.1
Machinery - Except Electrical	2.3
Miscellaneous	13.8
Total	100 per cent

The corrugating function of the plant could also serve to provide the raw material for a number of satellite sheet or converting plants located in other parts of the region creating a number of small commercial enterprises, termed sheet plants. These sheet plants would, in turn, supply local markets. As the demand for the board increased, the output of the corrugating plant could be doubled or tripled by running the corrugating machine two or three shifts.

In addition to corrugated boxes and their components, a number of other products could be produced from corrugated board. Some of these are furniture such as storage containers, filing cabinets, chests of drawers, coffins and structures in which people could live or products stored.

7. FOAMED PLASTIC PACKAGING MATERIAL

Several foamed plastic packaging materials are in use today with polystyrene foam of primary importance. This material may be moulded, fabricated, laminated, or extruded for a wide variety of packaging applications. This study will discuss extruded expandable polystyrene which is formed into sheets. The sheets may then be cut to size and used as is or formed into a wide variety of packaging products.

The extrusion of expandable polystyrene involves the plastication of polystyrene granules containing a hydrocarbon blowing agent and forcing the molten material through a die to cause expansion and continuous forming of the plastic. The process creates a yield with densities lower than that of unexpanded polystyrene. Foam polystyrene extrusion is one of the most economical and versatile plastic fabrication processes available today. It is capable of producing on a continuous basis extremely large and economical volume outputs of foam polystyrene in a variety of shapes such as film, tubing, sheet, rods, tubes and others.

As film or sheet, the lowest commercially practical thickness is 5 mils (five thousandths of an inch). The corresponding yield per pound of this gauge is 86,400 square inches (600 square feet). Greater thickness or higher densities correspondingly diminish the area of the yield per pound.

The raw material for extruded expandable polystyrene is a cylindrical pellet, 1/16 inch in diameter by 1/8 inch long of polystyrene containing a hydrocarbon blowing agent. The Modern Plastics Encyclopedia, 1966 (See Bibliography, Appendix I) contains a list of world suppliers.

The extrusion process involves the plastication within an extruder of polystyrene in which a hydrocarbon blowing agent is incorporated. This is followed by a 13-fold volume expansion of the fluid mass as it leaves the die. The hydrocarbon blowing agent in the polystyrene acts as a plasticizer and, thus, permits relatively low extrusion temperatures with moderate working of the material.

Expandable polystyrene can be extruded by extruders currently on the market and used for other plastics such as polyethylene. A single screw extruder with a minimum barrel length to diameter (L/D) ratio of 20/1 is preferred although shorter barrel extruders with L/D ratio of 16/1 is also suitable. The extruder size is dependent on the production rate and the dimensions of the final product desired.

The output ranges for various machines is given below:

Machine Size Bore, Inches	Output Rate Lbs/Hr.	Typical Drive H.P.
1 ½	35 - 40	5
2 ½	100 - 120	10 - 20
3 ½	180 - 220	25 - 40
4 ½	280 - 320	40 - 60

A general **guide** for output in terms of sheet area is as follows:

Sheet Thickness (Mils)	Pounds Resin/Per Thousand Sq. Ft.
30	15
60	30
90	60

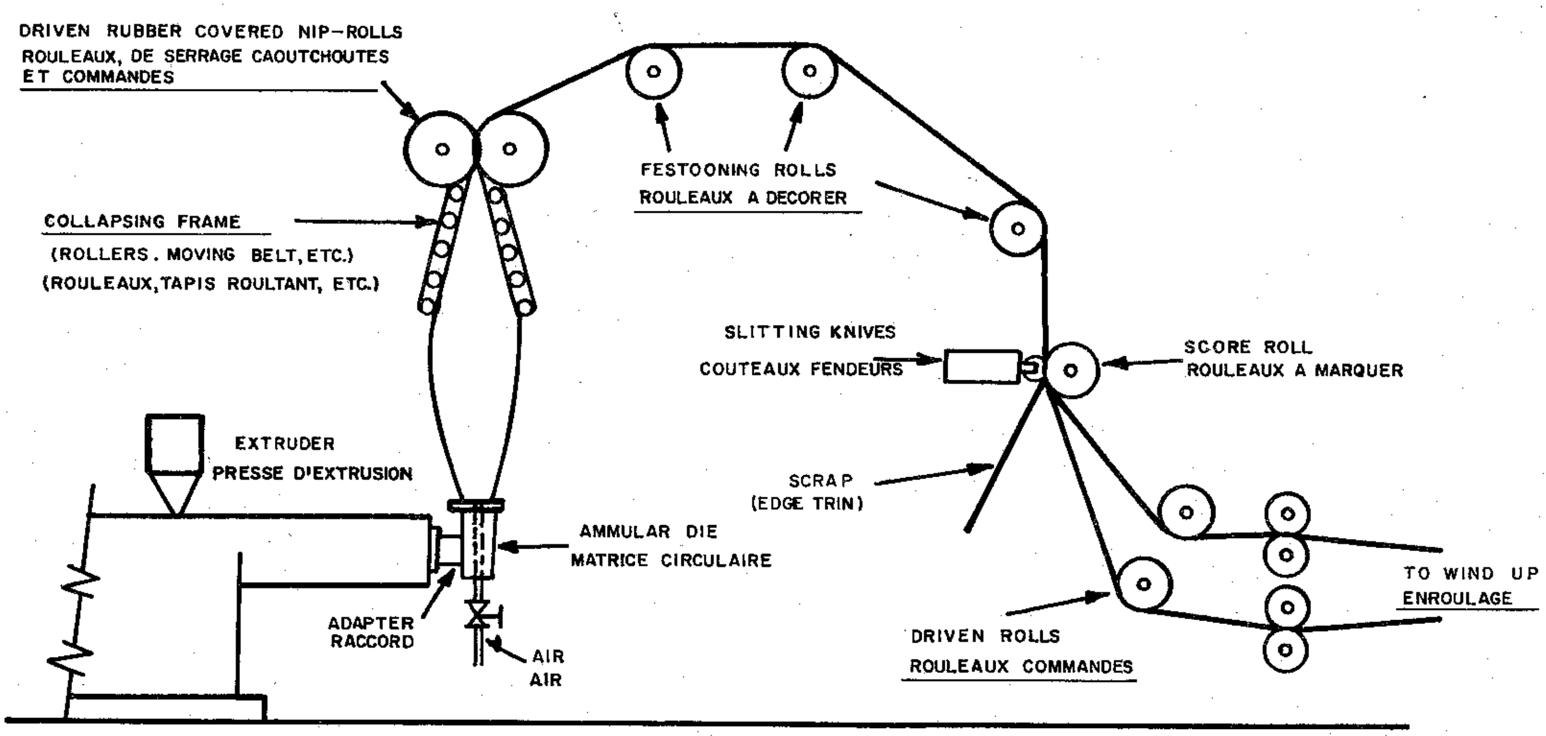
The take-off, auxiliary sheet treating and windup equipment of the extrusion process are dependent upon the physical requirements of the product. One well accepted method is to entrap air similar to polyethylene tubular film extrusion. The blown tube cools rapidly due to high volume expansion.

The process consists of an extrusion line shown in the diagram and a thermoforming line. The extrusion line consists of an extruder, die and take-off apparatus. Thermoforming equipment depends upon the method of forming. Five methods are used to form sheet:

FIGURE 6

The following diagram shows a typical expandable polystyrene tubular extrusion operation:
Schéma d'une usine type d'extrusion tubulaire de polystyrène expansé

VERTICAL OPERATION
PRODUCTION VERTICALE



Vacuum Forming
Drape Forming
Plug Assist Forming
Matched Mould Forming
Pressure Forming

In general, these methods involve a mould, heat and a vacuum. The sheet is placed over the mould, heat applied and a vacuum drawn. The heated sheet conforms to the shape of the mould and is removed. Variations of this method assist the sheet in conforming to the shape of the mould.

Additional thermoforming equipment required is a trim press with roll feed. A complete list of suppliers of the above equipment may be found in the Modern Plastics Encyclopedia, 1966. (See Bibliography in Annex I).

Estimated Capital Investment For An Extruding and Thermoforming Plant in Leased Facility[1/]

Equipment

Extrusion line consisting of an extruder, die and take-off apparatus. European manufacture F.O.B. Europe

US $30,000 to $40,000

Thermoforming apparatus including a complete thermoforming line and trim press with roll feed. European manufacture F.O.B. Europe

US $10,000 to $20,000

Services

Water Well	1$ 25,000
Air Compressor (10-15 H.P.)	1,000

1/ A floor area of approximately 20 feet by 40 feet would be sufficient for the above equipment not including a storage area.

Other

Lift Truck	$ 5,000
Office Equipment	5,000
Supplies	10,000
Contingency	25,000
Working Capital	75,000
	$120,000

Shipping Costs to West African Port (Estimated at 15 per cent of equipmnet costs)	$ 9,000
Total Investment (Equipment F. O. B. Europe)	$195,000 to 215,000

Working Capital is estimated at 15 per cent of annual sales.

For the purposes of this study, it is assumed that there would be no duty on imported equipment and initial supplies due to preferential treatment as a new industry.

Personnel

As this process is highly mechanized, a relatively small number of personnel is required for handling the raw material, loading the extruder, operating the equipment and handling the finished products.

Products

Foamed extruded sheet may be used as is and cut to various sizes for many packaging applications or may be further processed by thermoforming into a variety of configurations.

Applications

Application of extruded sheet and extruded thermoformed sheet is based upon some or all of the unique properties of the material.

Weight Reduction - Since the material has a high strength-to-weight ratio, substantial freight savings result from their use as entire packages or packaging components with conventional

cartons or boxes. Complete mailing tubes molded of expandable polystyrene save postage in mailing pharmaceuticals and light machinery replacement parts.

Shock Absorbency - Foamed extruded sheet has excellent energy-absorbing properties which vary according to density. Tests have shown the material to have some of the highest energy absorption values of any available cushioning materials.

Thermal Insulation - Due to a unicellular structure, the material provides excellent thermal insulation properties. Since foamed plastic resists moisture, the protective advantage is maintained under high humidity conditions. Because of this property, such things as blood plasma, bull semen, pharmaceuticals, frozen foods and printing inks may be shipped without damage or loss of quality despite exposure to wide temperature and humidity extremes.

Chemical Inertness - This property makes possible the shipment of products which may be corroded in shipment or those which are corrosive in nature such as acids and other chemicals.

Economy - Foamed sheet has a low density and high volume yield often permitting savings. At a delivered cost of approximately thirty cents per pound of raw material, a thirty mil gauge material would cost approximately nine cents per 1,000 square inches.

The number of applications of extrudable expandable polystyrene are many. An important use of the material in South Africa is tray packing of apples for export. In this application, the exterior container is a corrugated box. The apples are packed in layers with a tray of foamed plastic between each layer. The trays have been thermoformed to effectively stack the apples. Tests are also being made for packaging of other tropical fruits. It is reported that the current South African apple export market requires some 45 million trays each weighing 21 - 22 grams. By 1970, this is expected to increase by 80 per cent.

Other applications of this material are egg trays, cups, plates and interior packaging platforms of varying sizes and shapes. Cups, plates and similar utensils are end products in themselves and can open up additional markets.

8. CONCLUSIONS

A Packaging Industry As A Factor In The Growth Of The Economy Of The West African Sub-Region

A packaging industry would perform a number of functions for the developing economies of the West African Sub-Region. Establishing such an industry would reduce and, perhaps, eventually eliminate the imports of such materials as boxex, linerboard, corrugating medium or wood pulp. In 1964, approximately 117,000 short tons of paper and board were imported by the Sub-Region. See annex III for total paper and board imports by country. While this figure represents total paper imports, the writer estimates that more than half is packaging material. At a cost of 120 dollars per ton (United States' price) a local industry would save the economies of the Sub-Region an estimated seven million dollars annually in foreign exchange at present consumption levels. Based upon the consumption projections determined earlier in this study, imports of packaging materials would be expected to increase at similar rates. Thus, it can be expected that imports will grow at a 15 to 24 per cent annual rate. The following is a projection of imports:

1965		1975		1980	
Short Tons (000)	$MM	Short Tons (000)	$MM	Short Tons (000)	$MM
58.5	$7	146.5 - 198.5	$17.6 - 23.8	190.5-268.5	$22.9-32.2

It is apparent that a local packaging industry would serve an ever increasing local market.

In addition to the economic advantages gained from establishing a local industry, there would be a number of other benefits.

The new industry will create additional employment and, more importantly, trained personnel capable of establishing and managing future manufacturing facilities.

A local packaging industry would more adequately serve local industries creating greater efficiencies and, perhaps, new markets for their products.

Products of the plastic industry such as cups, plates and utensils could establish new industries and markets. The same is true of a corrugated container industry with such products as furniture, storage containers and so on.

New packaging industries would offer many advantages to the economy of the Sub-Region. It is recommended that the feasibility of establishing such industries be explored in much greater depth by economists and industy experts with a first hand knowledge of the area.

ANNEX I

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ANNEX II

POPULATION DATA

Population By Sub-Region - 1960

Sub-Region	Population (Millions)	Per Cent
North Africa	54	21
West Africa	79	31
Central Africa	32	12
East Africa	57	23
South Africa	30	13
Total	252	100

Population By Country - Annual Rate of Increase

1953 - 1960

Country	Per Cent
Dahomey	2.8
Gambia	0.3
Ghana	6.2
Guinea	4.3
Ivory Coast	4.4
Liberia	Not Given
Mali	2.1
Mauritania	Not Given
Niger	4.1
Nigeria	1.9
Senegal	5.1
Sierra Leone	2.6
Togo	4.8
Upper Volta	1.6

The annual compound percentage change in the total African population pre-war to 1960 was 1.7 per cent and from 1950 to 1960 - 1.9 per cent.

ANNEX III

WEST AFRICAN SUB-REGION POPULATION PROJECTIONS

(In Millions)

Country	1960	1965	1970	1975	1980	Total Increase 1960-1980	% Increase 1960-1980
Dahomey	1.92	2.10	2.32	2.62	2.99	1.07	55%
Gambia	0.28	0.32	0.37	0.43	0.50	.22	78
Ghana	6.78	7.81	9.05	10.50	12.25	5.47	80
Guinea	3.07	3.43	3.83	4.32	4.96	1.89	61
Ivory Coast	3.23	3.56	3.93	4.40	5.00	1.77	54
Liberia	0.98	1.04	1.10	1.16	1.23	.25	26
Mali	4.10	4.52	4.99	5.60	6.40	2.30	56
Mauritania	0.69	0.72	0.74	0.79	0.86	.17	25
Niger	2.82	3.12	3.46	3.90	4.46	1.64	58
Nigeria	35.09	40.79	47.37	55.09	63.86	28.77	82
Senegal	3.11	3.33	3.61	3.97	4.44	1.33	43
Sierra Leone	2.45	2.71	3.00	3.31	3.66	1.21	49
Togo	1.44	1.58	1.76	1.99	2.29	.85	59
Upper Volta	4.34	4.69	5.09	5.62	6.29	1.95	45
Total Region	70.84	80.25	91.33	104.52	120.12	49.28	70 per cent

Source: UNECA Secretariat Paper I, Conference on Pulp & Paper Development in Africa and Near East, March 20, 1965.

ANNEX IV

TOTAL PAPER AND BOARD IMPORTS BY COUNTRY - 1964

Country	Paper & Board Imports (Short Tons)
Dahomey	720
Gambia	115
Ghana	30,000
Guinea	3,520
Ivory Coast	11,645
Liberia	3,100
Mali	308
Mauritania	150
Niger	260
Nigeria	50,000
Senegal	11,500
Sierra Leone	4,200
Togo	872
Upper Volta	900
Total	117,290

ANNEX V

MAJOR WORLD SUPPLIERS OF EXPANDABLE POLYSTYRENE

Badische Anilin - & Soda-Fabrik AG
Ludwigshafen/Rhine, West Germany

Dow Chemical Company
Midland, Michigan, U. S. A.

Foster-Grant Company
Leominster, Massachusetts, U. S. A.

Sinclair-Koppers Company, Inc.
Pittsburgh, Pennsylvania, U. S. A.