# PLANT REQUIREMENTS FOR MANUFACTURE OF ASBESTOS – CEMENT PIPE

TECHNICAL AIDS BRANCH
INTERNATIONAL COOPERATION ADMINISTRATION
Washington, D. C.

# FOREWORD

This brochure is one of a series of reports resulting from overseas technical inquiries on factory or commercial establishments, operation, management, and engineering. The report is designed to provide only a general picture of the factors that must be considered in establishing and operating a factory of this type. In most cases, plans for actual installations will require expert engineering and financial advice in order to meet specific local conditions.

Mention of the name of any firm, product, or process in this report is not to be considered a recommendation or an endorsement by the International Cooperation Administration, but merely a citation that is typical in its field.

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This report was prepared in June 1960
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For further information and assistance, contact should be made with the local Productivity Center, Industrial Institute, Servicio, or United States Operations Mission.

Code Number
PR-65

## ACKNOWLEDGMENT

The author gratefully acknowledges the cooperation, assistance and technical information provided for the preparation of this report by the owner of --

Andre Dorlet Company

332 South Avenue 17

Los Angeles, California

This company engages in the art of silk screen printing on all types of fabrics for decorators and other users of such printed yard goods.

This report was reviewed and approved by Mr. Andre Dorlet.

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## INTRODUCTION

As indicated by the name, asbestos-cement pipe is made of asbestos fibre and Portland cement, usually in combination with some other material like silica. A curing agent may also be added but this is not always necessary.

In the United States the market for asbestos-cement pipe is large and growing steadily. This favorable situation has grown from the fact that these products meet many of the needs for pipe with the physical characteristics of asbestos-cement products. They are inexpensive and with unusual resistance to various corrosive fluids found in many pipe systems. Asbestos does not burn and is a very poor conductor of electricity.

## GENERAL ASSUMPTIONS

In order to make realistic estimates in this report; certain assumptions are made. These are:

1. The costs of the building and general facilities based on United States prices.

2. Material costs are based on sizes and specifications of materials used in the United States.

3. Labor costs are based on the average for the industry as recently published by the United States Bureau of Labor.

4. Adequate power and water are available at the plant site.

5. Adequate transportation facilities are available at the plant site.

6. The plant operates three 8-hour shifts a day, five days a week, fifty weeks per year.

7. No special provision is made for the training of new personnel. It is assumed that the learner's rates are paid in such cases.

8. The following items cannot be estimated realistically:

   A. Land value
   B. Distribution and selling costs
   C. In-freight and out-freight
   D. Taxes

   While general estimates will be made of each of these items, for the purpose of completing cost estimates, adjustment should be made in accordance with actual local costs.

   In fact, all cost estimates contained in this report should be adjusted to conform to local conditions.

9. Columns are provided in the tables included in this report to facilitate the conversion of cost figures to agree with local costs.

## DIRECT MATERIALS AND THEIR SOURCES

### ASBESTOS

Asbestos is a grayish material, a silicate of calcium and magnesium which occurs in long, threadlike fibres. Because it does not burn and is a nonconductor of electricity, it is used where such qualities are needed or advantageous. Because of the fibres, which are strong and flexible in some types of asbestos, it can be used with cement to make a combined structural element that will resist tension and shear stresses.

Asbestos is found in natural form in rock formations in many places throughout the world. It is mined from open surface pits and also from underground mines. The different mineral forms in which it occurs yield asbestos with different qualities. The types with long fibres are the most valuable because these can be woven into fireproof cloth, or cloth that is unburnable. The minerals which have short fibres are suitable for making asbestos-cement pipe. Large quantities are so used.

Chrysotile which contitutes 95% of the world production is a fibrous variety of serpentine. Its fibres are strong and flexible. Species other than chrysotile that are available for significant use are of the amphibole mineral group which includes such varities as anthophyllite, tremolite, amosite and crocidolite. The first two

usually have brittle and weak fibres. Crocidolite, a fibrous blue or bluish-green silicate of iron and sodium, occurs in Africa and is used in large quantities.

## LOCATION OF DEPOSITS

Sources of asbestos are widely scattered and deposits of suitable materials should be within reach of a pipe manufacturer in almost any part of the world. Chrysotile asbestos can be found in Australia, Canada, China, Cyprus, India, Italy, Japan, Natal, New Zeland, Switzerland, United States and Venezuela. Amphibole asbestos is found in Finland. Amosite asbestos is produced in Transvaal at the rate of 30,000 tons annually. Some crocidolite asbestos is from Bolivia but the largest producer is Cape of Good Hope, where 10 to 20% of the ore yields a fibre that is suitable for spinning. The shorter fibres would be satisfactory for use as part of the asbestos requirement in asbestos-cement pipe production. The proportions of asbestos of various qualities and characteristics are varied according to the purposes for which the pipe is to be used. Asbestos is shipped in pressure-packed bags which are marked with the grade number and letters.

For further details of the information about the various types of asbestos, the location of deposits, the milling of asbestos, the preparation of crudes, fiberizing, screening, grading and classification refer to International Cooperation Administration report "Plant Requirements For Manufacture of Asbestos-Cement Siding" (Revised May 1959). This reference also has information under the following heads:

Groups of Crude and Milled Asbestos

Crude Asbestos

Milled Asbestos

Subdivision of Groups of Milled Asbestos

7 Groups

Fibre is packed in bags of 100 to 125 pounds capacity which are marked with grade letter and number.

## PORTLAND CEMENT

In the United States, Portland cement is shipped to large users in bulk, in special railroad cars. Smaller shipments are in heavy paper bags, each containing one cubic foot and weighing 94 pounds. Export prices are usually quoted in barrel lots, each barrel weighing 380 pounds.

Cement must be kept dry. Even a small amount of moisture will cause it to set.

## OTHER DIRECT MATERIALS

Other materials are added in the manufacture of asbestos-cement products. Coloring matter is added in the manufacture of siding and shingles. For ordinary use that would not be done in making asbestos-cement pipe but if the same cylindrical shapes were to be used architecturally, then it would be practicable. The additive in such cases would be ferric oxide for brown color and chromium oxide for green.

Additives may be used for curing pipe if it is not practicable to have them cured by stock-piling.

The addition of silica is usually found desirable in pipe manufacturing. This may be done to increase the density of the pipe or it may be a means of decreasing cost of total direct materials. It may also improve the handling qualities of the material while in the course of manufacture and thus be reflected in a reduced cost.

## PRODUCT SPECIFICATIONS

Asbestos-cement is made in two different categories - high pressure and low pressure pipe. High pressure pipe is heavier, stronger and more expensive than low pressure pipe and is made on a larger and more expensive type of machine. The plant and machinery must be designed and built for the specific requirements to be met. Low pressure pipe on the other hand is lighter in weight and construction, cheaper in cost, and is made on smaller and less complicated machines. Low pressure pipe is particularly suitable for all types of sewage systems and connections, drainage projects, irrigation use, hot air ducts, venting for gas appliances, conduit. They can be used as low-cost lighting and telegraph poles, patio columns and for various purposes. Characteristics of both types of pipe are durability, long life, ease of handling and installation, imperviousness to seepage, and, in areas where iron and steel are costly, comparatively low cost. The most popular sizes of pipe range from 6" to 12" in diameter.

Asbestos-cement pipe differs from ordinary concrete pipe in that it is much stronger and lighter for comparable pressure limits. Ordinary concrete pipe can be cast only in short lengths, otherwise it cracks. Asbestos-cement pipe is formed in lengths up to 13 feet. Concrete pipe is rigid, asbestos-cement pipe is more flexible; concrete pipe has a rough interior, asbestos-cement pipe is smooth. These differences plus many others make asbestos-cement more similar to metal piping than to concrete, and it is used as a substitute for metal pipe in most of its applications.

The composition of the finished product is as follows:

| | |
|---|---|
| Asbestos | 14% |
| Portland cement | 80% |
| Additives such as silica | 6% |
| Total | 100% |

## MANUFACTURING UNIT

The unit used in manufacturing asbestos-cement pipe is a single piece, section or length, each of a specified dimension.

## PRODUCTION CAPACITY

The equipment described in this report will produce about 320,000 ten-foot lengths annually. About 5% of the total production may be broken in transit, the annual production of salable product would be about 304,000 ten-foot lengths. It is assumed that the average production would include pipes of various sizes. These estimates, however, are based on low pressure pipe 8" in diameter. The plant covered by these estimates can be used for low pressure pipes of other sizes and can be operated for one shift or two shifts if less production is desired.

## DIRECT MATERIALS

| | |
|---|---|
| Net weight of total annual production = 95% = | 16,000 tons |
| Loss -- 5% of gross | 842 tons |
| Gross weight of direct materials required per year | 16,842 tons |

| Item | Percentage | Tons Required | Cost per ton | Annual Cost |
|---|---|---|---|---|
| Asbestos (Mixture of selected grades) | 14 % | 2,357 | $200 | $471,400 |
| Portland cement | 80 % | 13,474 | 24 | 323,376 |
| Additive (Silica) | 6 % | 1,011 | 6 | 6,066 |
| | 100 % | 16,842 | | $800,842 |

Direct materials for 16,000 tons of pipe cost $800,842 or $.025 per pound of finished product.

## THE MANUFACTURING PROCESS

The process of manufacturing asbestos-cement pipe, as described in this report, includes the mechanical handling of the direct materials, the work in process and finished products wherever practicable.

The asbestos, cement, and silica or comparable inert filler are all relatively stable materials if they are properly stored. Cement, however, must be kept dry and should not be kept longer than really necessary. Storage of the other direct materials in relatively greater quantities is physically practicable. The process, therefore, begins with the movement of all the direct materials into storage as fast as received. If the asbestos has not been completely processed it should have whatever further treatment is required to fiberize it. Before it is stored it should have been crushed, screened, dried and cleaned. These constitute the steps required to make the crude product, as it comes from the mines, suitable for distribution on the market. They are standard processes and detailed descriptions are not repeated here.

From storage the direct materials are moved to the mixing room at the rate required by the manufacturing process. For the production contemplated in this report this would be daily rates of 9.4 tons of asbestos, 53.9 tons of cement, and 4 tons of silica or other additives. These are mixed in a cylindrical mixer which is provided with paddles.

This mixture is spread on an 18-inch conveyor belt and sprayed with water which has been heated to 180° F.

The mixture is levelled and made into a form of suitable dimensions and with a consistency that will result in a uniform cylindircal blanket around the steel forming mandrel. After being calendered (which is a smoothing process) and densified, the pipe is removed from the mandrel. The pipe after stripping from the mandrel is put through an autoclave until suitable for finishing and dry trimming. Manufactured pipe is stored for air curing until suitable for use.

## PLANT SITE

Because of the volume of raw materials required the site should be selected with due consideration given to the sources of such materials. The volume of finished product is great enough so that the probable market should also be given due weight in site selection. The availability of water, fuel, and a labor supply are less important factors. The site should be about two acres in extent and its cost is estimated at $1,000.

## BUILDING

A building 100 feet by 400 feet is required for the manufacture of asbestos-cement pipe. This should be a single-story building of local materials. It should have a 14-foot ceiling. The total floor area should be 40,000 square feet. which at $4.00 per square foot, including boiler, plumbing and wiring, would cost $160,000.

## POWER

The connected load amounts to 150 horse power or 112 kw.-hrs. per hour or 672,000 kw.-hrs. per year. With 80% load factor and a three cent rate the annual power cost is estimated at $16,128.

## WATER

Assuming that the plant will be located where 2,000,000 gallons of water will be available annually, at 30 cents per 1,000 gallons, the estimated annual cost will be $600.

## FUEL

A 40 hp low-pressure boiler is required to furnish wet steam. The fuel cost for operating such a boiler is estimated at $1.80 per hour. The operating time is 6,000 hours per year. The estimated cost of the fuel oil is $10,800 per year.

## TRUCK

A five-ton, general purpose, pick-up truck will be required. The cost of the truck is included in other tools and equipment. Wages for the truck driver are shown in indirect labor. The cost of operation and maintenance is included in supplies.

## DIRECT LABOR

### 3-Shift Operation

| Job Classification | Number Required | Hourly Rate | Estimated Annual Cost | Actual Cost |
|---|---|---|---|---|
| Machine Handling | 9 | $1.50 | $27,000 | _____ |
| Fiber Processing | 3 | 1.50 | 9,000 | _____ |
| Mixing and Blending | 6 | 1.50 | 18,000 | _____ |
| Forming Machine Operating | 10 | 1.85 | 37,000 | _____ |
| Densifying and Stripping | 6 | 1.50 | 18,000 | _____ |
| Mandrel Handling | 6 | 1.50 | 18,000 | _____ |
| Autoclaving | 4 | 1.50 | 12,000 | _____ |
| Finishing and Trimming | 6 | 1.50 | 18,000 | _____ |
| Relief | 6 | 1.50 | 18,000 | _____ |
| | 56 | | $175,000 | |

## INDIRECT LABOR

| Job Classification | Number Required | Hourly Rate | Estimated Annual Cost | Actual Cost |
|---|---|---|---|---|
| Manager | 1 | | $ 12,000 | _____ |
| Receiving and Shipping | 8 | 1.50 | 24,000 | _____ |
| Mechanics | 3 | 1.75 | 10,500 | _____ |
| Clean up | 1 | 1.50 | 3,000 | _____ |
| Extras | 7 | 1.50 | 21,000 | _____ |
| Superintendent | 1 | | 11,000 | _____ |
| Foreman | 3 | | 21,000 | _____ |
| Bookkeeper | 1 | | 5,000 | _____ |
| Clerk | 1 | | 3,800 | _____ |
| Secretary | 1 | | 3,600 | _____ |
| Maintenance | 3 | 2.00 | 12,000 | _____ |
| Boiler Room | 3 | 2.00 | 12,000 | _____ |
| Truck Driver | 1 | 1.50 | 3,000 | _____ |
| | 34 | | $141,900 | _____ |

## PRODUCTION TOOLS AND EQUIPMENT

| | |
|---|---|
| Cement and asbestos handling unit | $18,000 |
| Fiber processing plant | 24,000 |
| Cement and asbestos blending unit | 12,000 |
| Stock distributing system | 36,000 |
| Levelling and return system | 12,000 |
| Forming machine | 54,000 |
| Wet felt grinding and cleaning system | 3,000 |
| Vacuum systems | 21,000 |
| Pipe calender and densifier | 12,000 |
| Mandrel stripper | 9,000 |
| Forming mandrels | 9,000 |
| Hydraulic system, steam boiler and autoclaves | 54,000 |
| Finisher and dry trimmer | 9,000 |
| Pipe testing machine | 3,000 |
| Motors, pumps and electrical system | 12,000 |
| Pipe take-off and mandrel handling system | 12,000 |
| Total | $300,000 |

## OTHER TOOLS AND EQUIPMENT

| | |
|---|---|
| Maintenance tools | $ 500 |
| Truck | 6,000 |
| Maintenance equipment | 5,000 |
| Compressor | 800 |
| Lift truck | 600 |
| Skids | 400 |
| Total | $13,300 |

## FURNITURE A FIXTURES

| Description | Number Required | Estimated Unit Cost | Estimated Total Cost | Actual Cost |
|---|---|---|---|---|
| Desks and Chairs | 3 | $150 | $ 450 | _____ |
| Filing Cabinets | 6 | 70 | 420 | _____ |
| Typewriter | 1 | | 150 | _____ |
| Adding Machine | 1 | | 140 | _____ |
| Chairs | 2 | 60 | 120 | _____ |
| Total | | | $1,280 | |

## SUPPLIES

| Item | Estimated Cost | Actual Cost |
|---|---|---|
| Maintenance materials and parts | $15,000 | _____ |
| Tools | 500 | _____ |
| Lubrication | 200 | _____ |
| Office Supplies | 250 | _____ |
| Truck, gas, oil and repairs | 750 | _____ |
| Total | $16,800 | |

## DEPRECIATION

| Item | Estimated Cost | Years Life | Estimated Per Year | Actual Per Year |
|---|---|---|---|---|
| Buildings | $160,000 | 20 | $ 8,000 | |
| Production Tools and Equipment | 300,000 | 10 | 30,000 | |
| Other Tools and Equipment (Without truck) | 7,300 | 10 | 730 | |
| Furniture and fixtures | 1,280 | 10 | 128 | |
| Truck | 6,000 | 4 | 1,500 | |
| Total | | | $40,358 | |

## MANUFACTURING OVERHEAD

| Item | Estimated Cost | Actual Cost |
|---|---|---|
| Depreciation | $ 40,358 | |
| Power | 16,128 | |
| Water | 600 | |
| Fuel | 10,800 | |
| Supplies | 16,800 | |
| Indirect Labor | 141,900 | |
| | $226,586 | |

## MANUFACTURING COSTS

| Item | Estimated Cost | Actual Cost |
|---|---|---|
| Direct Materials | $800,842 | |
| Direct Labor | 175,000 | |
| Manufacturing Overhead | 226,586 | |
| Total | $1,202,428 | |

## FIXED ASSETS

| Item | Estimated Cost | Actual Cost |
|---|---|---|
| Land | $ 1,000 | |
| Building | 160,000 | |
| Production Tools and Equipment | 300,000 | |
| Other Tools and Equipment (Without Truck) | 7,300 | |
| Furniture and Fixtures | 1,280 | |
| Truck | 6.000 | |
| Total | $475,580 | |

## WORKING CAPITAL

| Item | | Estimated Cost | Actual Cost |
|---|---|---|---|
| Direct Materials | - 30 days | $ 66,700 | |
| Direct Labor | - 30 days | 14,600 | |
| Manufacturing Overhead | - 30 days | 18,880 | |
| Reserve for Sales Collections | - 30 days | 191,670 | |
| Total | | $293,490 | |

## CAPITAL REQUIREMENTS

| Item | Estimated Cost | Actual Cost |
|---|---|---|
| Fixed Assets | $475,580 | |
| Working Capital | 293,490 | |
| Total | $769,070 | |

## SALES REVENUE

The average selling price F.O.B. plant for this product is $6.90 each. It is estimated that about five percent will be broken in handling and in transit. Based on these factors the approximate annual sales revenue is shown below.

16,000 tons at 2,000 pounds = 32,000,000 pounds
32,000,000 pounds at 100 pounds per length - 320,000 lengths
320,000 - 5% broken in transit leaves 304,000 lengths
304,000 lengths at $6.90 each = $2,097,600.

## RECAPITUALTION OF COSTS, SALES AND PROFITS

| Item | Estimated Cost | | Actual Cost |
|---|---|---|---|
| Direct Materials | $800,842 | | |
| Direct Labor | 175,000 | | |
| Manufacturing Overhead | 226,586 | | |
| Total Manufacturing Cost | | $1,202,428 | |
| Interest on Loans | $ 18,000 | | |
| Insurance | 4,000 | | |
| Legal | 2,000 | | |
| Auditing | 3,000 | | |
| Unforeseen Expense | 110,000 | | |
| Total Unforeseen and Administrative Costs | | 137,000 | |
| Sales Costs, such as Commissions, Bad Debts, Discounts, Allowances Travel and Freight Out | | 200,000 | |
| Profit Before Taxes | | 558,172 | |
| Total Annual Gross Sales | | $2,097,600 | |

## BUDGET CONTROL

A requisition form designed to provide accurate records of procurement and indicate the purpose of procurement with the least amount of time and effort is shown on the following page.

This form has an account number for each type of the various expenditures which the manager will review in detail, monthly or oftener, in order to control his expense. Some items, such as power and water, are usually under contract and are easily checked by reference to monthly bills. For simplification, items marked with an asterisk below are omitted from the purchase requisition. Variations in the labor costs are easily reviewed by examination of the payroll vouchers. The simplified type of control thus provided makes certain that the manager can control expenditures promptly.

Following the requisition form, a sample voucher check is shown. Voucher checks should be used for the payment of all expenditures and the appropriate book account number placed on each voucher.

At the end of each month the manager will receive a statement of all expenditures broken down by budget accounts. If the expenditures exceed the budgeted monthly allowances of any of the accounts, the bookkeeper will furnish the manager with a break-down of all expenditures relative to the budgeted accounts exceeded. All these supporting data can be secured by reference to the purchase requisitions and the check vouchers. This reference will enable the manager to determine what caused the over-expenditure and take corrective action.

At any time during each month it becomes apparent that expenditures will exceed any of the budget accounts, the bookkeeper will bring this to the attention of the manager for his information and action.

### BUDGET CONTROL ACCOUNTS

| Account Number | | Monthly Expense | Monthly Budget | Annual Budget | Actual |
|---|---|---|---|---|---|
| 10 | Administrative | $_____ | $ 2,250 | $ 27,000 | $_____ |
| 20 | Sales | _____ | 16,667 | 200,000 | _____ |
| 30 | Direct Materials | _____ | 66,737 | 800,842 | _____ |
| 40 | Supplies | _____ | 1,400 | 16,800 | _____ |
| 51 | Power* | _____ | 1,344 | 16,128 | _____ |
| 52 | Water* | _____ | 50 | 600 | _____ |
| 53 | Fuel | _____ | 900 | 10,800 | _____ |
| 60 | Unforeseen Expense (Reserve Account) | _____ | 9,166 | 110,000 | _____ |
| 71 | Direct Labor* | _____ | 14,583 | 175,000 | _____ |
| 72 | Indirect Labor* | _____ | 11,825 | 141,900 | _____ |
| 80 | Depreciation (Reserve Account) | _____ | | 40,358 | |

Note: Administrative includes interest on loans insurance, legal and auditing.

| PURCHASE REQUISITION | COMPANY NAME | DATE |
|---|---|---|

☐ 10 ADMINISTRATION ☐ 40 SUPPLIES

☐ 20 SALES ☐ 50 UTILITIES

☐ 30 MATERIALS ☐ 60 UNFORESEEN EXPENSE

INDICATE BELOW THE USE OF MATERIALS

☐ DIRECT MATERIALS ☐ MAINTENANCE SERVICES

☐ MAINTENANCE MATERIALS ☐ OPERATING SUPPLIES

| | PLEASE ORDER THESE MATERIALS OR SERVICES | DELIVERY WANTED | |
|---|---|---|---|
| QUANTITY | DESCRIPTION | UNIT | TOTAL |
| | | | |
| | | | |
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| | | | |
|---|---|---|---|
| QUOTES FROM | | REQUISITIONED BY | |
| QUOTES FROM | | APPROVED BY | |
| QUOTES FROM | | ORDER NO. | ORDER DATE |

R. W. MITCHELL MANUFACTURING COMPANY

1422 BOSWORTH STREET, S. E.

65-22
514

ANYWHERE, U. S. A. _____ 19____ No. 10000

PAY _____ DOLLARS $ _____

TO THE ORDER OF

R. W. MITCHELL MANUFACTURING COMPANY

TO FIRST NATIONAL BANK
ANYWHERE, U. S. A.

BY SAMPLE CHECK
VICE PRESIDENT

ACCOUNT NUMBER

Sample voucher check to be used for the payment of all expenditures in connection with Budget Control.

R. W. MITCHELL MANUFACTURING COMPANY

## ENGINEERS:

The services of professional engineers are desirable in the design of this plant, even though the proposed plant is small.

A correct design is one which provides the greatest economy in the investment of funds and establishes the basis of operation that will be most profitable in the beginning and will also be capable of expansion without expensive alteration.

The addresses of professional engineers who specialize in industrial design, some of whom may be willing to undertake such work on low cost projects overseas, can be secured by reference to the published cards in various engineering magazines. They may also be reached through their national organizations, one of which is the

National Society of Professional Engineers
2029 K Street, Northwest,
Washington 6, D. C.

Manufacturers of industrial equipment employ engineers familiar with the design and installation of their specialized products. These manufacturers are usually willing to give prospective customers the benefit of technical advice by those engineers in determining the suitability of their equipment in any proposed project.

The equipment manufacturers also know, and can recommend, professional engineers in private practice, who are willing and able to provide appropriate consulting services.

## TRAINING:

Manufacturing an inferior quality of product during the training period could create sales resistance that might be difficult to cope with later. To avoid such possibilities, the quality of the product should be maintained at all times, including the training period.

In some areas skilled operators may be available locally. In other areas all the operators may have to be trained.

If skilled operators are not available, adequate training would be assured by using one or more of the following methods:

A. If the plant is designed and installed by a competent engineering firm, the contract should be negotiated, if possible, on a turn-key basis. On this basis the contractor agrees to operate the plant and produce the quality and quantity of the product stated in the contract for an agreed period of time. Such a contract would assure adequate personnel training, since full quantity and quality could not be produced with an untrained organization.

B. The engineering firm that designs and installs the plant can usually make training arrangements to have key personnel placed, for training purposes, in a foreign industry that produces the same type of product. This would provide training for the key personnel while the plant is being installed.

C. If neither of the above methods is possible, then qualified and experienced individuals should be employed for the key positions, either permanently or temporarily, to perform the key operations and assist in training the organization, even if they must be secured outside the country.

D. The manager should have years of successful experience in this type of business and be fully qualified in all phases of management, including the training of employees.

## SAFETY:

There is always danger of accident and injury in any industrial plant. Because of this, the manager should take specific action to bring to the attention of each employee the importance of safety precautions and intelligent first aid.

Practically all machines have safety appliances, and the manager should see that these are in good working condition and that the operators are making full use of them.

In addition to constant watchfulness to make sure that all practicable safety precautions are taken, first aid supplies should be readily available. One complete first aid kit should be maintained near the manager's office, and others at appropriate places throughout the plant. Some of the employees should be trained to provide first aid service.

The use of accident posters in the plant have proved to be of value in reducing accidents. It is recommended that such posters be used, and that some direct special action be taken by the manager, at least once each month, to bring to the attention of all personnel the importance of safety precautions.

A fire brigade should be established and each member trained as to his responsibility in case of fire. Fire drills should be conducted periodically.

It is recommended that the employees be encouraged to offer suggestions or recommendations relative to prevention of accidents, removal of fire hazards and maintaining general interest in all safety factors.

## SUMMARY

A small plant, built and operated according to the assumptions made in this report would be a profitable undertaking.

Provision is made for inserting local cost in connection with all cost figures shown in this report. A careful analysis should be made of all cost figures to determine the local potential profits in any location where such a plant is being considered.

There are some determinations, however, that should be made before a decision is reached to build and operate such a plant.

For example, what are the possibilities of future expansion within the country for this industry?

What other products could be manufactured with the machinery and equipment specified in this report?

Is there a market for such additional products?

How does this industry compare with other industries that may be needed in the country relative to the following factors:

1. The economic value to the country.
2. The needs of the majority of the people.
3. The amount of investment capital required.
4. The potential annual profits.

Careful attention should also be given to:

The amount of power required and the availability of a dependable supply. If an adequate supply is not available the installation of power equipment may be required.

The water requirements for all purposes including fire protection and potable water for drinking purposes.

The fuel requirements and availability. If local fuel can be used the boiler should be adaptable to such fuel.

The transportation facilities to and from the plant. If they are not adequate an investment in trucks may be required.

## OTHER CONSIDERATIONS

There are other important subjects, shown below, that should be fully investigated and considered. Information on these subjects is usually available from such sources as banks, government agencies, exporters and importer, wholesalers, retailers, transportation companies and manufacturers.

## MATERIALS AND SUPPLIES

1. Are all materials and supplies available locally?
2. Is the local material market competitive?
3. Is satisfactory delivery of local materials assured at reasonable prices?
4. What materials and supplies must be imported?
5. Are they available in world markets at competitive prices?
6. Would prompt delivery of imported materials and supplies be assured so that large inventories would not be required?

## MARKET FACTORS

1. Is there already a demand for the product?
   - A. Who are the principal consumers?
   - B. Who are possible new consumers?

2. How is demand for the product now satisfied?
   - A. By local production? If so, what is the volume of annual production?
   - B. What percentage of consumption is filled by local production?
   - C. By imports? If so, what is the volume of annual imports?
   - D. What percentage of consumption is met by imports?
   - E. From what areas are imports derived?

3. What is the estimated annual increase in local consumption over the next five years?
   - A. How were such estimates made?
   - B. By reference to official figures on population growth, family budgets, imports, etc.?
   - C. By consultation with trade or industry, ministries, associations, bankers, commercial houses, wholesalers, retailers, industrial consumers, etc.?

4. If the product is already being manufactured, can the existing and estimated future local market absorb production of the new plant without price-cutting or other dislocations?

5. Would the estimated sales price and quality of the new product make it competitive with an imported equivalent?
   A. After adjusting cost to local conditions, is the estimated sales price of the product so high that tariff protection is necessary to protect it from imports?

## EXPORT MARKETS:

1. Could the product compete in export markets on the basis of price, quality and dependability of supply?
2. Can export markets for the product be developed?
3. If so, in what areas and in what annual volume?
4. What procedures would be necessary to develop export markets?
5. What would it cost?

## MARKETING PROBLEMS:

1. In calculating costs of the product, has adequate allowance been made for the expense of a sales department, advertising and promotion that might be required?

2. Do consumer prejudices against locally manufactured products exist?
   A. If so, why?
   B. Would they apply to the new product?
   C. If so, how could they be overcome and what would it cost to do so?

3. Do marketing and distribution facilities for the product exist?
   A. If not, can they be set up?
   B. What would it cost to do so?

4. Will the product be sold to:
   A. Wholesalers?
   B. Retailers?
   C. Direct to consumer?
   D. Other industries?
   E. Government?

## ECONOMIC FACTORS:

1. How much foreign exchange (and in what currency) is required to import machinery, equipment and supplies:
   - A. How much foreign exchange (and in what currency) is required for annual interest payments and amortization of any loans contracted to import machinery and equipment, or for payment of royalties and technical services?
   - B. How much foreign exchange (and in what currency) is required for annual import of raw materials and supplies?
   - C. What are estimated annual foreign exchange earnings and in what currencies?
   - D. Has careful consideration been given to the possibility of depreciation in the foreign exchange value of the local currency?
   - E. Has careful consideration been given to the possibility of import controls, or restrictions on availabilities of foreign exchange necessary to operate the business?
   - F. What benefits would the new business bring to the economy in the use of local raw materials: in employment and in technology?
   - G. Do dependable facilities exist for transportation, power, fuel, water and sewage?
     - (1) If not, can existing deficiencies be eliminated satisfactorily?
     - (2) What would be the cost to do so?

## PERSONNEL:

1. Is there an adequate labor supply near the plant location?
   - A. If not, how can the problem be solved?

2. Can the problem of training competent management and supervisory personnel be solved?
   - A. Also, the training of skilled labor?
   - B. Is technical advice available in the locality?
   - C. If not, where can it be obtained and what will it cost?

## LAWS AND REGULATIONS:

1. Do existing labor laws, government regulations, laws and taxes favor establishment of new business?
   - A. If not, can existing obstacles be removed?
   - B. If so, how and when?

## FINANCIAL FACTORS:

1. Technical advice on selection of machinery and equipment.
   - A. In selecting the machinery and equipment for the new plant, have reputable and competent engineers and technicians been consulted?
   - B. Have they been asked for advice on the most suitable types of machinery and equipment for the process and locality?
   - C. Have they carefully compared costs of various suppliers?
   - D. Credit terms offered purchasers?

## FINANCIAL REQUIREMENTS OF THE PROJECT:

1. In estimating the cost of the project, has careful consideration been given to:
   - A. The effect on costs of delays in construction schedules?
   - B. In delivery and installation of machinery and equipment?
   - C. In import of essential raw materials and supplies?

2. In calculating cash flow and working capital requirements, has careful consideration been given to:
   - A. Maintaining adequate inventories of raw materials?
   - B. Supplies and spare parts?
   - C. Seasonal fluctuations in the business?
   - D. The time required to liquidate credit sales to customers and bad debts?
   - E. The period necessary to get the plant into production?
   - F. Cash required to amortize its principle loans?

3. If the economy is in a period of inflation, has full allowance been made for the influence of rising prices and wages on the cost of the project and on working capital requirements?

## SHORT TERM BANK CREDITS:

1. Has it been possible to make arrangements with local banks to finance short-time working capital requirements of the business?

## FINANCIAL PLAN:

1. Has a definite plan to finance the project been worked out?
   - A. Is sufficient capital available locally?
   - B. If not, what is the plan to obtain the required capital?

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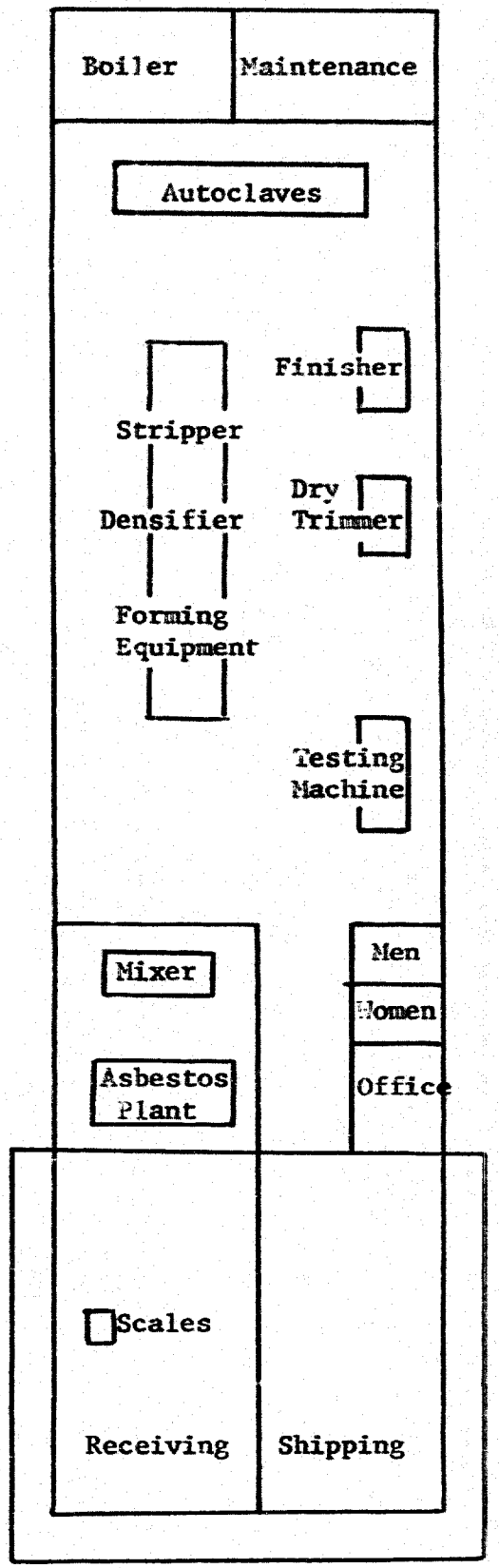
## PLANT LAYOUT




Scale
1" = 50'

WORK FLOW DIAGRAM