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PLANT REQUIREMENTS FOR MANUFACTURE OF RUBBER FLOOR TILE

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
COMMUNICATIONS RESOURCES DIVISION
Washington 25, D. C.

A.I.D.
Reference Center
Room 1656 NS

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 Agency for International Development, but merely a citation that is typical in its field.

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The original report was prepared by the Gidley Research Institute, Fairhaven, Massachusetts, for the technical aids program through the facilities of the Office of Technical Services, U.S. Department of Commerce.

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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-86

December 1961

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RUBBER FLOOR TILE

INTRODUCTION

The purpose of this report is to present basic information for establishing a manufacturing plant in a foreign country to produce rubber floor tile.

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 are 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 Statistics.

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 eight hours a day, five days a week, and fifty weeks a year. However, the plant may be operated any desired number of hours per day.

7. No special provision is made for the training of new personnel. It is assumed that 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. Administrative costs;
   E. 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 conform with local costs.

PRODUCT SPECIFICATIONS

The plant described in this report is designed to produce standard rubber floor tile, nine inches by nine inches by one-eighth inch thick. Other sizes and other products may be produced in this plant, but for the purposes of this report only the nine-inch floor tile will be considered.

PRODUCTION CAPACITY

The capacity of this plant is 1,000,000 rubber floor tiles per year which is equivalent to 500 per hour or 4,000 per day.

MANUFACTURING UNIT

The manufacturing unit of this plant is one floor tile nine inches by nine inches by one-eighth inch. Other sizes can be produced with the necessary changes in the molds.

MANUFACTURING OPERATIONS

The steps in the manufacturing of asphalt tile may be listed and described as follows:

1. Raw materials receiving and storing -- A rubber tile is really a rubber-like tile, as Buna S. Neoprene and other elastomers are used as part of the raw materials in addition to rubber. Fillers, colors and other materials used do not present any unusual problem in connection with receiving or storing because of the volume of materials, danger of breakage or damage.

2. Weighing and compounding -- The small size of the plant makes it advisable to prepare the mixture in batches by weighing or measuring the required amount of each of the ingredients for each batch.

3. Mixing -- Basically this step involves mixing the fillers with a resin and colors. The weighed, or measured, ingredients are then combined and mixed in the order determined by the formula used. The mixing is done in a small mixer.

4. Sheeting and cutting preforms -- Sheeting involves rolling out the mixed ingredients in sheet form. This is followed by cutting the sheet into approximate shapes or preforms.

5. Pressure molding -- These preforms, approximate shapes, are placed in molds, and vulcanized or baked.

6. Finishing -- The vulcanized tiles are trimmed to exact size, cleaned, and buffed if necessary.

7. Packing and shipping -- The finished tiles are packed in cartons of 48 tiles each, ready for shipping.

8. Miscellaneous controls and processes -- Laboratory control is associated with all these steps and includes a periodical check on the quality of the final product. This is a relatively small part of the operation if only a few types of tiles are manufactured.

In cutting rubber preform stock, the preform should be slightly thicker and less in area than the finished tile or tile slab. In each case, the exact thickness, size and weight for <u>each particular compound</u> must be carefully established to produce the best result and; thereafter, these three factors should be always carefully controlled (size, thickness and weight).

Rubber tiles are often laminated. The reasons for lamination are as follows:

1. To use a cheap under-side stock to reduce cost.
2. To use a cushion-like under-side stock.
3. To use a "conforming" under-side stock to adapt each tile better to irregular surfaces.
4. To get the under-side layer to adhere better.

In molding tiles, the maximum amount of mold release agent should be used on the top side of tile. It is important to use as little as possible of the mold-release solution. Also, keep mold solutions clean, change frequently and use a mold solution which will have a minimum adverse effect on (a) adhesion on bottom and (b) gloss on top.

Mold solution is best sprayed on the hot mold surface with an air-pistol.

It is sometimes advisable to wash the under sides of tiles with one-half per cent of hydrochloric acid solution in water or acetone, then rinse with clear water. (This removes soap film and bloom which adversely affect adhesion.)

Alternatively, the under side of the tile may be driven by a conveyor belt under a wire rotating brush. This brush is made by mounting a dozen standard wire brushes on a single mandrel.

The top surface of tiles may be advantageously buffed to improve gloss. This is done by carrying the tile down a conveyor belt against a revolving cloth buffing wheel (mount 18 cloth buffs, each 6" in diameter, on a single mandrel with side flanges to hold tight).

On high quality tiles or tiles containing a good grade of wax internally, these polishing buff wheels (either cloth or lambskin) are used dry. Some companies arrange the delivering conveyor so the tiles pass under a series of infrared lamps in a tunnel before they

reach the polisher. These tunnels vary in length, depending on the tile compound, the speed of the conveyor and the wax melting point.

The purpose of this pre-heating is to improve polishing and to bring the wax to the tile surface. Usually it is good practice, when using pre-heating systems, to have a forced air fan over the tile after it leaves the polisher to cool the tile before it is packed.

For competitive quality tile, for tile with insufficient internal wax, or tile with poor surface gloss, it is advisable to apply hot wax (beeswax, ceresin, montan or carnauba) directly to the buffing wheel from time to time. Alternatively, a wax emulsion of high grade waxes may be employed.

Cheap tile; or rough tile of considerable hardness; or tile with pits, encrusted deposits, mold-solution mottling, or bad blooming is sometimes treated by buffing with a remedial wax on the wheel. These remedial waxes contain finely pulverized (300 mesh or less) pumice, rottenstone, or tripoli as abrasives. These abrasives are carefully stirred into liquified hot waxes, then chilled to form blocks.

Highest quality tiles are often packed with a sheet of waxed paper between each tile, when placed in shipping containers. This is also recommended when a cheap bottom reclaim base is used on a tile (so the reclaim surface will not chemically affect the adjacent top surface of the next tile). Or, alternatively, it is recommended that

tiles be packed with the two top surfaces together in a sandwich, and then another similar sandwich. In this way, the polished wax surface does not contact the rough bottom surface. This also is important for adhesion as sometimes the wax will rub off on the rough surface and spoil adhesion.

DIRECT MATERIALS

The direct materials required for the manufacture of rubber floor tile include the following:

Item	Annual Requirements Tons	Unit Cost	Annual Cost Estimated	Annual Cost Actual
Rubber (smoked sheets)	62	$ 700	$ 43,400	_____
Zinc oxide	4	290	1,160	_____
Whiting	32	30	960	_____
Clay	170	20	3,400	_____
Mineral oil	3	117	350	_____
Stearic acid	1	360	360	_____
Carbon black and iron oxide	2	215	430	_____
Sulfur	2	55	110	_____
Accelerator	1	220	220	_____
Hard wax	2	580	1,160	_____
Cartons	12,500 (cartons)		2,125	_____
TOTAL			$ 53,675	_____

PLANT LAYOUT

A plant layout indicating the location of the equipment and the flow of work is shown on the last page of this report.

PLANT SITE

To provide for eventual expansion the plant site should have an area of one-half acre.

The cost of the land is estimated at $500.

BUILDING

A one-story building will be required. It should be about 60 feet wide by 80 feet long, or 4,800 square feet of floor space. The building may be constructed of any suitable local materials.

The cost of the building is estimated at $3.50 per square foot or $16,800.

POWER

It is assumed that a dependable supply of electric power will be available from public power service lines. The total connected load is about 112 kilowatts. On this basis the annual cost of power is estimated at $2,240.

WATER

The water requirement is estimated at 1,000,000 gallons annually. The annual cost of water is estimated at $300.

FUEL

The fuel requirements for this plant are estimated at 3,000 gallons of oil for heating, vulcanizing and calender operation.

The estimated annual cost of fuel is $300.

TRUCK

No truck, owned and operated by the company, is considered necessary for this plant. Local builders will pick up any tiles they buy at the factory. Deliveries to dealers and out of town purchasers will be made by public transportation systems. Good highway facilities will be necessary because the combined shipments in and out are estimated at 60 tons per month.

* * * * * * * * * * *

PRODUCTION TOOLS AND EQUIPMENT

Description	Cost Estimated	Cost Actual
Two-roll mix mill with apron	$ 12,000	_____
Sheeting mill	10,000	_____
Hand cutter (preforms)	300	_____
Curing press	5,000	_____
Compounding equipment	600	_____
Cutting machine	2,500	_____
TOTAL	$ 30,400	_____

NOTES:

Explanation of equipment.

1. The mixer in a large U.S.A. factory would be preferably a large Banbury, but the cost and productivity would not be economically sound overseas in most areas. Therefore, the above two-roll mixer is intended to mean a small, sturdily-built two-roll mixer. A 40" mill will serve. A 75 horse-power motor is recommended.

2. Sheeting mill - This is a standard two-roll rubber or plastic mill with cast iron chilled rolls or steel rolls (hardened); the steel rolls are to be preferred. The size of these rolls will be from 14" to 20" in diameter and from 40" to

about 50" long. The rolls rotate at the same speed -- even friction ratio. This mill will require about a 50 horsepower motor.

3. Hydraulic presses - In curing rubber floor tile, a hydraulic press should provide sufficient pressure to close the mold with a flash or overflow not over 5/1000 of an inch. In molding individual tiles (9" x 9"), the press (and the mold) equipment should be such as to produce a tile of uniform thickness. The difference in thickness of a 9" x 9" (measured in four corners, center of one side and in exact center) should not exceed two or three thousandths of an inch. In molding larger sheets (36" x 36" or 48" x 48"), the measured difference in thickness (four corners, center point of four sides and exact center) should not vary over five thousandths of an inch -- difference between maximum and minimum readings. The press plates should be checked weekly with an exact steel straightedge to determine trueness of the platen surface. Any tendency to curvature should be investigated and corrected at once. A large diameter ram (18" or more) and at least 300 tons pressure are recommended for molding yard-square tile slabs. Such a press is best equipped with the following valves:

   a. Low pressure for raising press almost to contact point.

b. High pressure needle valve for automatically and slowly closing press.

c. High pressure for holding molds closed during cure.

d. Discharge valve.

4. Molds -

Molds may be made so that a single 9" x 9" tile will be pressed at a time. They may be made to press several tiles at one time. These larger molds may be for nine tiles or 16 tiles, the larger press being 36" x 36." The bottom side of each cavity is often made so the tile will not have a smooth surface. For this purpose the surface of the cavity is often stippled, pebbled, cross-hatched or otherwise patterned for better adhesion. Also, the bottom of each cavity may contain a name, trade-mark or emblem. Individual molds are of tool steel, highly polished and each tile cavity is surrounded by a cut-off edge and an over-flow groove (semi-circular in cross-section about 1/8" wide x 1/8" deep).

Slab molds (alternate to individual molds) - Most common today are slab tile molds producing slabs about a yard or a meter square. Some molds are 42" x 42", 48" x 48" and 50" x 50." Larger slab molds are seldom used, although some companies are producing slab tiles successfully on

belt-type presses (presses in gangs) to make tiles 38" or 40" wide x 4', 6', 9', 12', and longer. Slab molds should be carefully made of excellent steel and highly polished (on top side). In many instances, the top of the slab tile mold is chrome or nickel plated or, alternatively, the whole top part of the mold is made of stainless steel or nickel-clad steel plate. Slab molds are made slightly over size to allow for cutting. Every precaution should be made to keep the top mold surface (that is, the surface that produces the top side of the tile) clean, polished and free of marks or deposits.

5. The cutting press is a small model 42" automatic tile cutter and will produce 500 tiles per hour with an experienced operator.

6. Compounding equipment - This will consist of one heavy weighing scale (floor type) of up to 200 pounds capacity and a smaller, more accurate, scale for weighing colors, which will be about ten pounds capacity. Various metal containers, benches and bins are included.

7. Hand cutter (used for preforms primarily) - This is for two commercial tile cutters with a warming steel plate to soften tile slightly before cutting. The tiles produced by a hand cutter are not as accurate and the edges are not so smooth as those cut by a cutting press.

OTHER TOOLS AND EQUIPMENT

Laboratory equipment -

A 4" x 9" two-roll mill with motor is needed for control tests; new formulations and matching colors.

A plastometer, glassware, thermometer, and testers are also required.

Estimated cost of miscellaneous laboratory equipment -- $2,500.

FURNITURE AND FIXTURES

Item	Number Required	Unit Cost	Cost Estimated	Cost Actual
Desk and chair	1	$150	$ 150	_____
File cabinets	2	75	150	_____
Typewriter	1	150	150	_____
Adding machine	1	150	150	_____
TOTAL			$ 600	_____

SUPPLIES

Item	Annual Cost Estimated	Annual Cost Actual
Lubricants and hand tools	$ 100	_____
Maintenance materials and repair parts	1,400	_____
Office supplies	100	_____
TOTAL	$ 1,600	_____

DIRECT LABOR

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Annual Cost Actual
Mixer	1	$1.50	$ 3,000	_____
Compounder and storesman	1	1.50	3,000	_____
Sheeter operator	1	1.50	3,000	_____
Calender operator	1	1.50	3,000	_____
Cutter operator	3	1.50	9,000	_____
General operator	2	1.50	6,000	_____
TOTAL	9		$ 27,000	_____

INDIRECT LABOR

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Annual Cost Actual
Manager	1	$3.00	$ 6,000	_____

The manager buys, sells, keeps books and supervises the nine operators.

DEPRECIATION

Description	Estimated Cost	Years Life	Annual Cost Estimated	Annual Cost Actual
Building	$ 16,800	20	$ 840	_____
Production tools and equipment	30,400	10	3,040	_____
Other tools and equipment	2,500	10	250	_____
Furniture and fixtures	600	10	60	_____
TOTAL			$ 4,190	_____

MANUFACTURING OVERHEAD

Item	Annual Cost Estimated	Annual Cost Actual
Depreciation	$ 4,190	_____
Indirect labor	6,000	_____
Supplies	1,600	_____
Power	2,240	_____
Water	300	_____
Fuel	300	_____
TOTAL	$ 14,630	_____

MANUFACTURING COSTS

Item	Annual Cost Estimated	Actual
Direct material	$ 53,675	_____
Direct labor	27,000	_____
Manufacturing overhead	14,630	_____
TOTAL	$ 95,305	_____

FIXED ASSETS

Item	Cost Estimated	Actual
Land	$ 500	_____
Building	16,800	_____
Production tools and equipment	30,400	_____
Other tools and equipment	2,500	_____
Furniture and fixtures	600	_____
TOTAL	$ 50,800	_____

WORKING CAPITAL

Item		Cost Estimated	Cost Actual
Direct materials	30 days	$ 4,500	_____
Direct labor	30 days	2,300	_____
Manufacturing overhead	30 days	1,200	_____
Reserve for sales collections	30 days	11,700	_____
TOTAL		$ 19,700	_____

CAPITAL REQUIREMENTS

Item	Cost Estimated	Cost Actual
Fixed assets	$ 50,800	_____
Working capital	19,700	_____
TOTAL	$ 70,500	_____

SALES REVENUE

The current selling price, f.o.b. plant, for rubber floor tiles is $0.14 per piece. The annual production is 1,000,000 tiles.

Based on these figures, the gross annual sales would amount to 1,000,000 x $0.14, or $140,000.

RECAPITULATION OF COSTS, SALES AND PROFITS

Item	Estimated Cost		Actual Cost
Direct materials	$ 53,675		_____
Direct labor	27,000		_____
Manufacturing overhead	14,630		_____
Total manufacturing cost		$ 95,305	_____
Interest on loans	2,200		_____
Insurance	200		_____
Legal	500		_____
Auditing	900		_____
Unforeseen expense	3,195		_____
Total administrative costs		6,995	_____
Sales expense		1,800	_____
Travel, bad debts, discounts and allowances, freight-out		2,100	_____
Profit before taxes		33,800	_____
Total annual gross sales		$140,000	_____

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 expenses. 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.

If 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	$_____	$ 317	$ 3,800	$_____
20	Sales	_____	325	3,900	_____
30	Direct Materials	_____	4,473	53,675	_____
40	Supplies	_____	133	1,600	_____
51	Power*	_____	186	2,240	_____
52	Water*	_____	25	300	_____
53	Fuel	_____	25	300	_____
60	Unforeseen Expense (Reserve Account)	_____	266	3,195	_____
71	Direct Labor*	_____	2,250	27,000	_____
72	Indirect Labor*	_____	500	6,000	_____
80	Depreciation (Reserve Account)	_____	350	4,190	_____

PURCHASE REQUISITION	COMPANY NAME	DATE

- ☐ 10 ADMINISTRATION
- ☐ 20 SALES
- ☐ 30 MATERIALS
- ☐ 40 SUPPLIES
- ☐ 50 UTILITIES
- ☐ 60 UNFORESEEN EXPENSE

INDICATE BELOW THE USE OF MATERIALS

- ☐ DIRECT MATERIALS
- ☐ MAINTENANCE MATERIALS
- ☐ MAINTENANCE SERVICES
- ☐ OPERATING SUPPLIES

	PLEASE ORDER THESE MATERIALS OR SERVICES	DELIVERY WANTED	
QUANTITY	DESCRIPTION	UNIT	TOTAL

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 eq[illegible] 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.

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 importers, 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?

BIBLIOGRAPHY

Textbooks -

"Introduction to Rubber Technology"
Edited by Maurice Morton, 553 pp. 1959 $10.00
Reinhold Publishing Corporation
430 Park Avenue
New York 22, New York

An introduction to the basic aspects of rubber technology. The book accomplishes broad coverage of the subject.

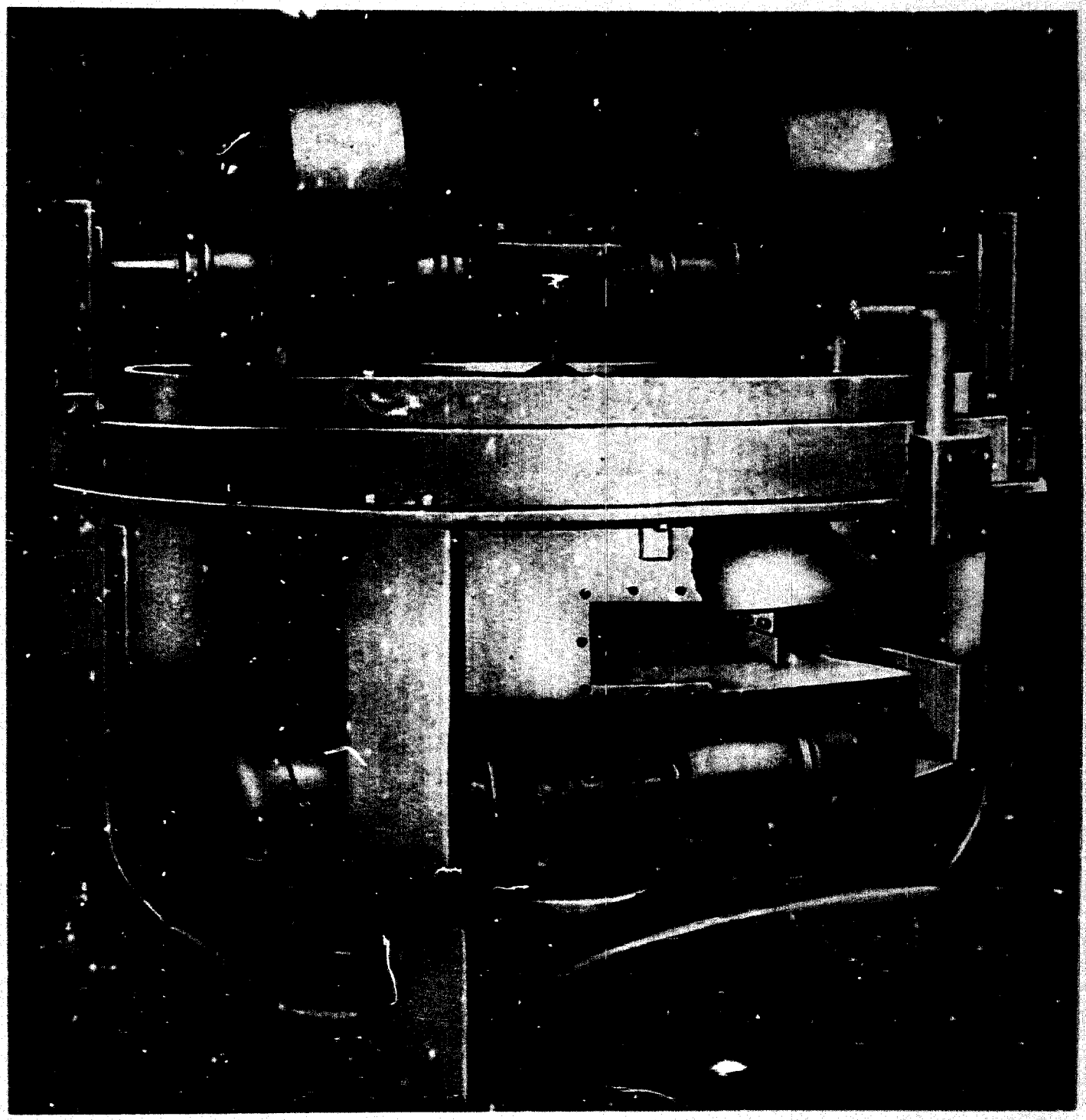
"Engineering with Rubber"
Edited by Walter E. Burton, 461 pp.
Tables and illustrations. 1949
McGraw-Hill Book Company
330 West 42d Street
New York 36, New York

A convenient source of technical information concerning practical uses and applications of molded pieces of rubber.

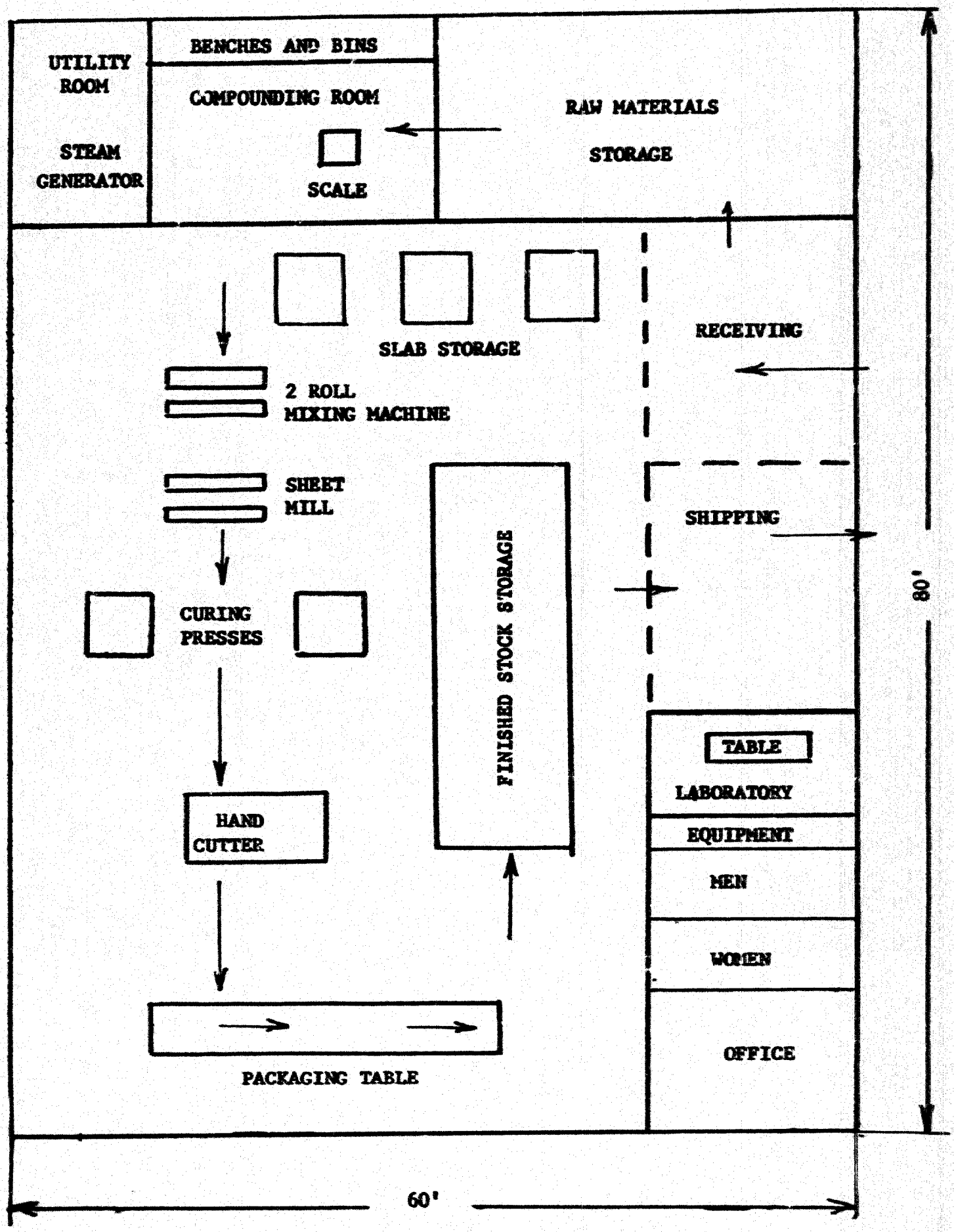
Periodicals -

Rubber Age Monthly, $5.00 in U. S.
Palmerton Publishing Company
101 West 31st Street
New York 1, New York

Rubber World Monthly, $5.00 in U. S.
Bill Bros. Publishing Corporation
386 Fourth Avenue
New York 16, New York



Courtesy:
Clearfield Machine Company
Clearfield, Pennsylvania

PLANT LAYOUT

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