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PLANT REQUIREMENTS FOR MANUFACTURE OF MINERAL WOOL

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
COMMUNICATIONS RESOURCES DIVISION
Washington 25, 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 Agency for International Development, but merely a citation that is typical in its field.

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The original report was prepared by Morris and Van Wormer, New York, New York, 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 **AID Mission.**

Code Number
PR-95

March 1962

ACKNOWLEDGEMENT

The author gratefully acknowledges the cooperation of the following company in providing technical information, current prices, and illustrations for this report:

U. S. Mineral Wool Company
Stanhope, New Jersey

The manuscript was reviewed by Mr. J. P. Verhalen of U. S. Mineral Wool Company, and his comments and suggestions assisted greatly in the preparation of the report.

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MINERAL WOOL

INTRODUCTION

The purpose of this report is to present basic information relative to the establishment of a mineral wool plant in a foreign country.

Mineral wool may be manufactured from rock, slag, or glass, any one of which may be processed from a molten state into a fluffy, light-weight mass of fine intermingled mineral fibers composed of complex silicates.

This report pertains to the fabrication of loose and granulated mineral wool from slag. These materials are used mainly for thermal insulation by the building trades. When mineral wool is to be supplied to manufacturers of specialized acoustical and filter products, chemical analysis and control of the fiber and completed wool will be necessary to assure conformance to the customer's specifications.

This plant will require a substantial capital investment and a reasonable number of skilled workmen. Raw materials should be available locally, particularly slag and coke. Generally, the less developed countries do not offer particularly favorable conditions for the production of mineral wool, nor a large enough domestic market to lead to a profitable venture. However, such a plant would be feasible in an industrially developing country where a large volume of new construction and industries would create a sufficient demand. A favorable factor would be association of the mineral wool plant with a factory processing high and low temperature mineral wool felts, industrial batts, blankets, blocks, boards, and molded pipe insulations.

If conditions warranted it, this mineral wool plant could also manufacture felts, batts, and blankets. However, this would have to be planned for before installating the final stages of the mineral wool processing

equipment. Additional machinery requiring 140 feet, including a 50 foot working area, would have to be installed beyond the blow chambers and the granulator. Although the same building layout would be adequate, the equipment, materials, and labor costs would be considerably greater, and these additional products would necessitate a more complex market.

GENERAL ASSUMPTIONS

In order to make realistic cost estimates, the following assumptions must be made:

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

2. Material and equipment costs are based on sizes and specifications current 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. This plant operates on three eight-hour shifts a day, five days a week, and fifty weeks a year.

7. The plant manager and chemist are capable and experienced men capable of doing all the necessary labor training with the aid of the other skilled workmen. It is assumed that learner's rates will be 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

Although approximate estimates are made for each of these items with the exception of taxes, for the purpose of completing cost estimates, adjustments should be made in accordance with actual local costs.

9. All cost estimates contained in this report are to be adjusted to conform to local conditions. Columns are provided in the tables included in this report to facilitate the conversion of cost figures to those existing locally.

PRODUCT SPECIFICATIONS

All information and figures contained in this report are based on the production of mineral wool processed from slag. This wool is produced in two forms -- loose wool suitable for hand packing, and granulated (nodulated) wool suitable for blowing or pouring.

The raw materials necessary to produce slag wool are slag and coke. Limestone or silica rock may be required as additives to the slag depending on its composition. The slag is usually obtained from an open hearth steel operation, although slag from iron, copper, or lead operations can be used. The limestone serves as a flux, and the quantities employed depend on the ash content of the coke and the chemical and physical characteristics of the slag. Silica rock may be required if the slag is more basic than acidic. These characteristics also determine the ratio of slag to coke. In this report, a ratio of six parts of slag to one part of coke, by weight, is assumed and the limestone is added at the rate of 4% of this total slag and coke weight. The wool is treated with paraffin oil to allay the dust after fiberization.

The mineral wools are packaged in strong two-ply paper bags; 30 pound bags being used for the loose wool, and 25 pound bags for the granulated type.

There are no applicable specifications available on mineral wool and it is customary for quality control to be maintained by the plant chemist according to his training and experience and in conformance with customer's specifications. However, the American Standards Association (ASA) and the American Society for Testing Materials (ASTM) provide the following methods for testing and analysis of coke and limestone:

ASA K181-1948 - Laboratory Sampling and Analysis of Coal and Coke, Standard Methods of (ASTM D271-58)

ASA K67.3-1960 - Chemical Analysis of Limestone, Quicklime, and Hydrated Lime, Standard Methods of (ASTM C25-58)

PRODUCTION CAPACITY

This plant is designed to produce 18,000 tons of mineral wool per year -- 9,000 tons of loose wool and 9,000 tons of granulated wool. Allowance has been made for manufacturing losses, and this production represents the minimum for efficient and economical use of the equipment.

Each cupola has an estimated output of 1-1/2 tons per hour resulting in 72 tons for a 24-hour day. This production rate represents about 60% of the actual potential output. As market demands increase, the total output can be stepped up to 120 tons or more a day.

The plant should reach its rated production in about two months, with all labor training being accomplished by the manager, chemist, and foremen, assisted by other experienced workers.

MANUFACTURING UNIT

The manufacturing unit for mineral wool is the pound.

MANUFACTURING OPERATIONS

Production Unit

Dual-type processing equipment is used in this operation. The correct combination of raw materials is weighed and fed into each of two lines of processing machinery which run continuously and simultaneously, except for an allowance of 10% for repair or down time. This does not seriously interfere with production capacity because these units can easily be operated at rates higher than 1-1/2 tons per hour. This twin processing action starts with the charging of the two cupolas and proceeds

through to the ends of the two blow chambers. Loose wool emerges from each blow chamber and is combined for the following single processing operations. The loose wool is either weighed directly and packed in bags or it is processed further to become granulated wool, which is then air lifted, screened, weighed and bagged. The detailed operations are described in the following paragraphs.

Raw Materials

The slag, coke, and limestone are delivered to the plant by truck and dumped into an outside yard hopper and transported to the receiving area on a 24-inch wide conveyor. They are then transferred to an inclined conveyor belt for delivery to the appropriate steel storage bins.

Proportioning

The slag, coke, and limestone are proportionally fed in the correct ratios to the weigh station hopper. After weighing, this mixture is delivered in steel hoist buckets to the top of each of the two cupolas.

Hand Labor

Although, in the proposed plant, all the operations up to this point are carried out mechanically, it would be possible to do this work by hand labor in areas where such labor is available and cheap. This practice would reduce equipment cost considerably.

Charging

The two cupolas (furnaces) are charged in alternate layers with the combined materials. Each cupola is 54 inches inside diameter and 35 feet high measured to the top of the stack. Each one is equipped with a 4-1/2 inch water jacket requiring 25 - 50 gallons per minute of circulatory water at pressures ranging from 25 - 100 pounds per square inch. Figure 1 shows the bottom of a typical cupola of this type.

Melting

In the cupolas, the slag is melted by burning coke in an air blast. The melted slag pours down through the cupola column and flows out through the tap hole in a carefully regulated thin stream.

Spinner, Sprayer, and Blow Chamber

These three equipments form two integral units each about 40 feet long and 6 feet wide. Their functions are briefly discussed below.

Spinner (fiberization) - The liquid slag falls on a wheel which is turning at a moderate speed. This wheel is placed at such an angle that it exposes a peripheral edge surface to the slag and starts spinning it. The fiberization process is continued from the small wheel by impinging the molten slag upon one or more larger wheels which revolve at high speed. The centrifugal force spins the molten metal into fine filaments or fibers.

Oil Sprayer - The resulting fluffy, fibrous mass is pneumatically conveyed by suction from the spinner wheels into the collection or blow chamber where it is sprayed with paraffin oil (kerosine) to allay the dust.

Blow Chamber - The treated wool is carried through the blow chamber (see figure 2) on a floor belt where it settles and cools. Figure 3 shows the suction fan required for the blow chamber. It emerges on a conveyor belt from each chamber as loose wool. These twin belts then discharge onto one common cross-belt.

Loose Wool

If loose wool is desired, the cross-belt conveys it direct to the weigh station hopper for weighing and packaging in 30 pound bags.

Bagging

The bags are automatically weighed and compressed by the bagging machine, and are then stitched, after which they are either placed on a conveyor for delivery to the shipping platform, or on pallets for delivery to storage. Figure 4 illustrates an automatic bagging and weighing machine.

Granulated Wool

If granulated wool is desired, the cross-belt conveying the loose wool material is reversed in direction and discharges it on a belt which carries it to the granulator machine. Loose and granulated wool cannot be processed simultaneously.

Granulator

This machine contains meshing teeth, as shown in figure 5, which cut and press the wool into pellet form.

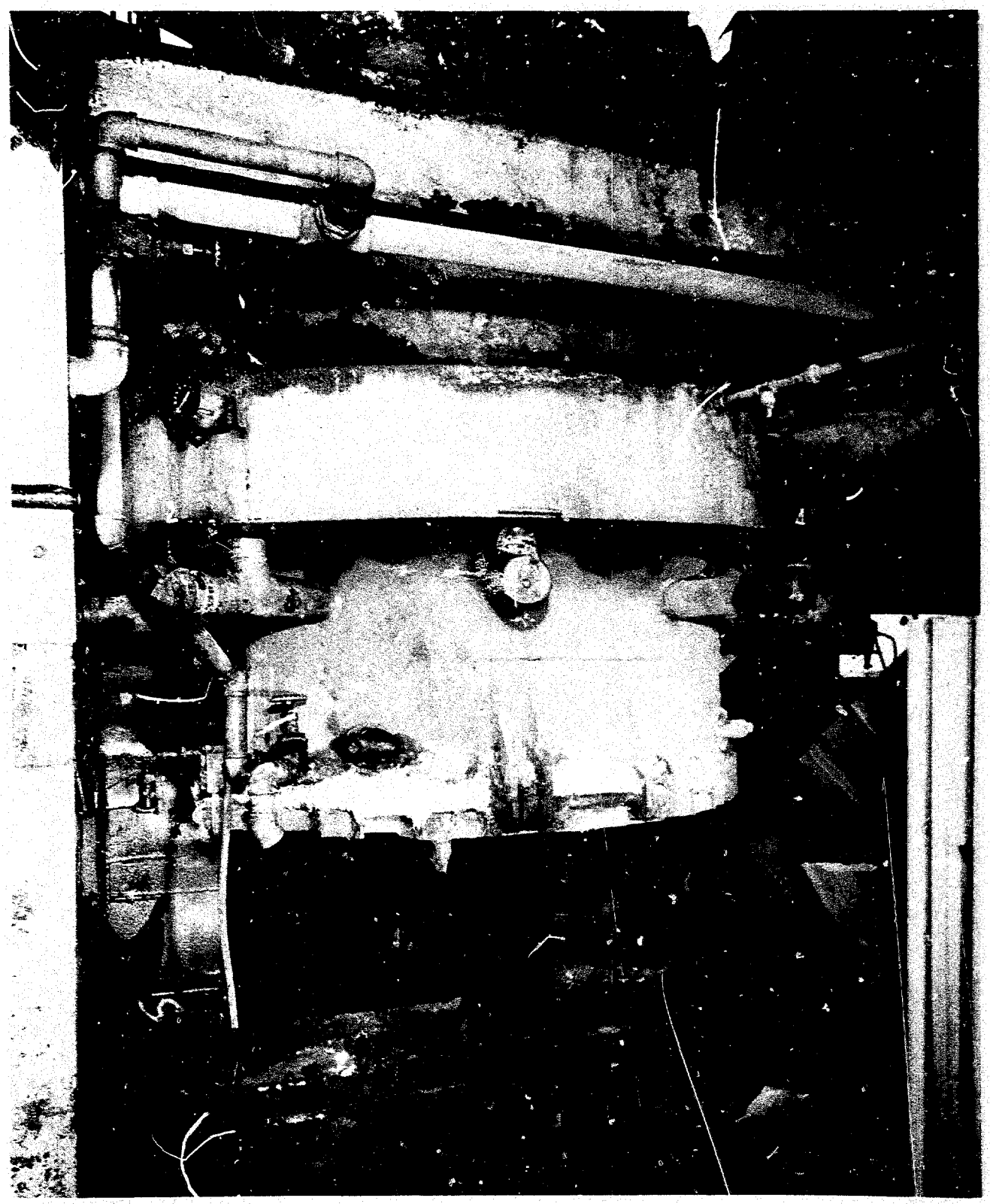

Figure 1. Bottom of Cupola

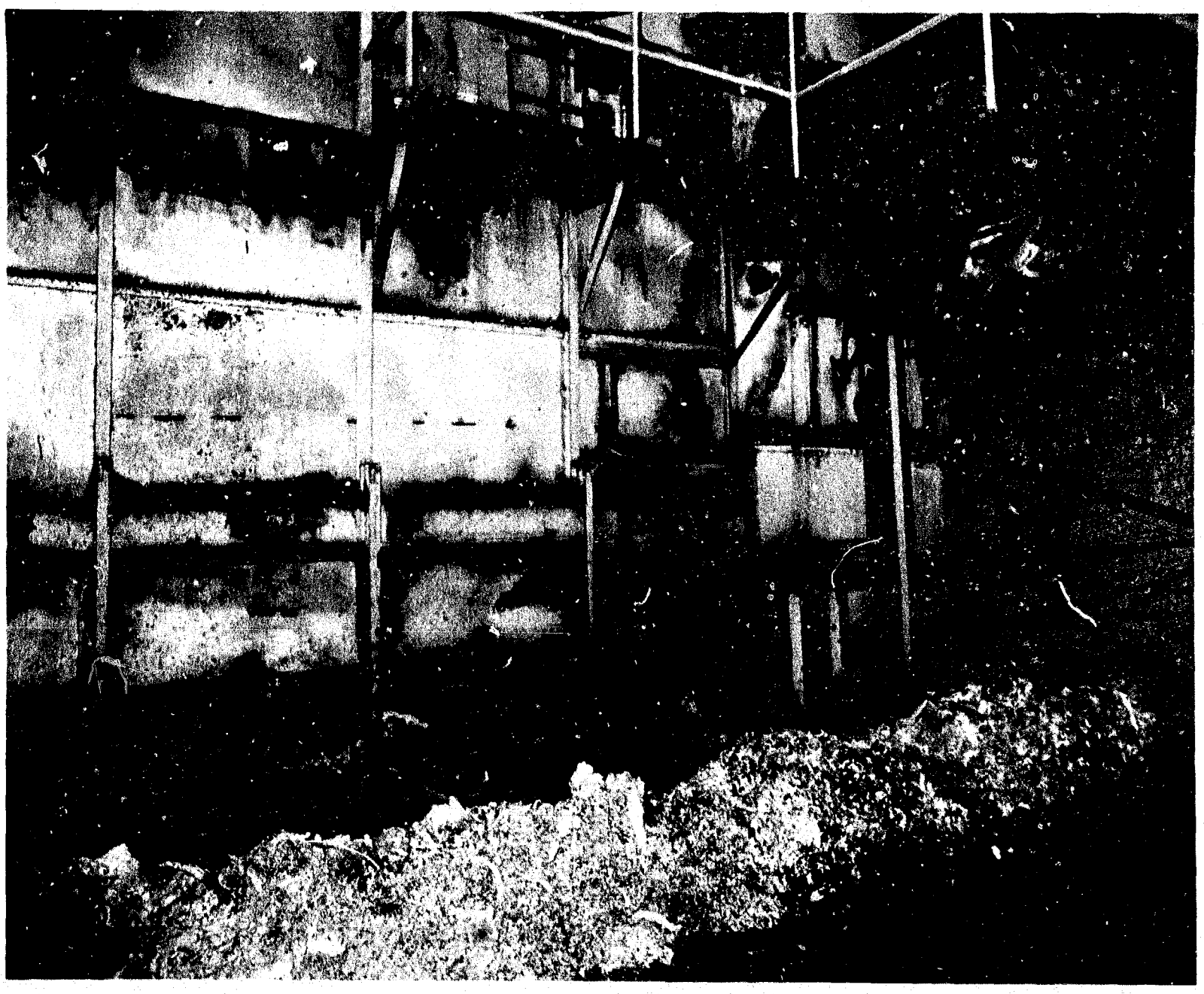

Figure 2. Collection or Blow Chamber

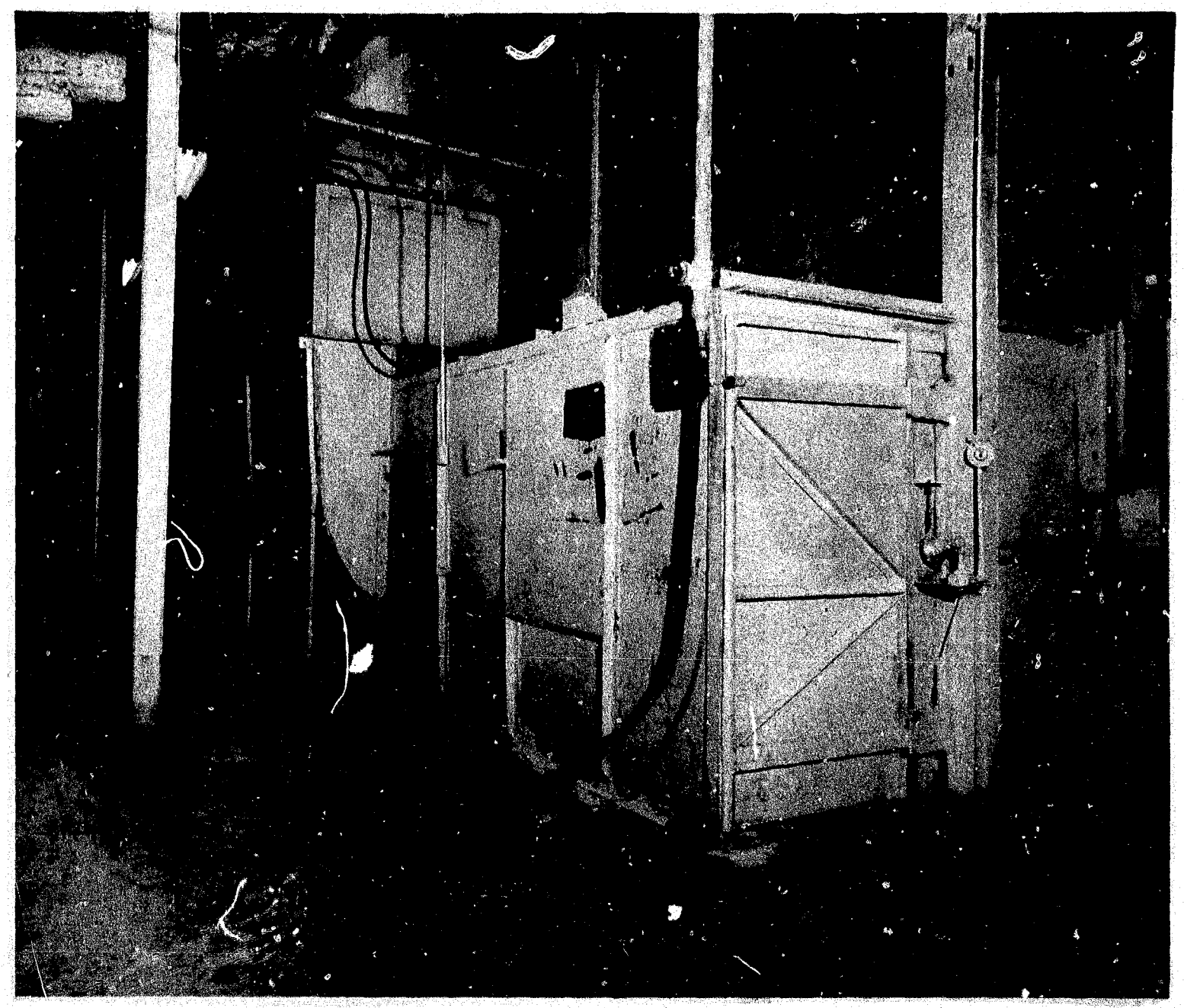

Figure 3. Suction Fan for Blow Chamber

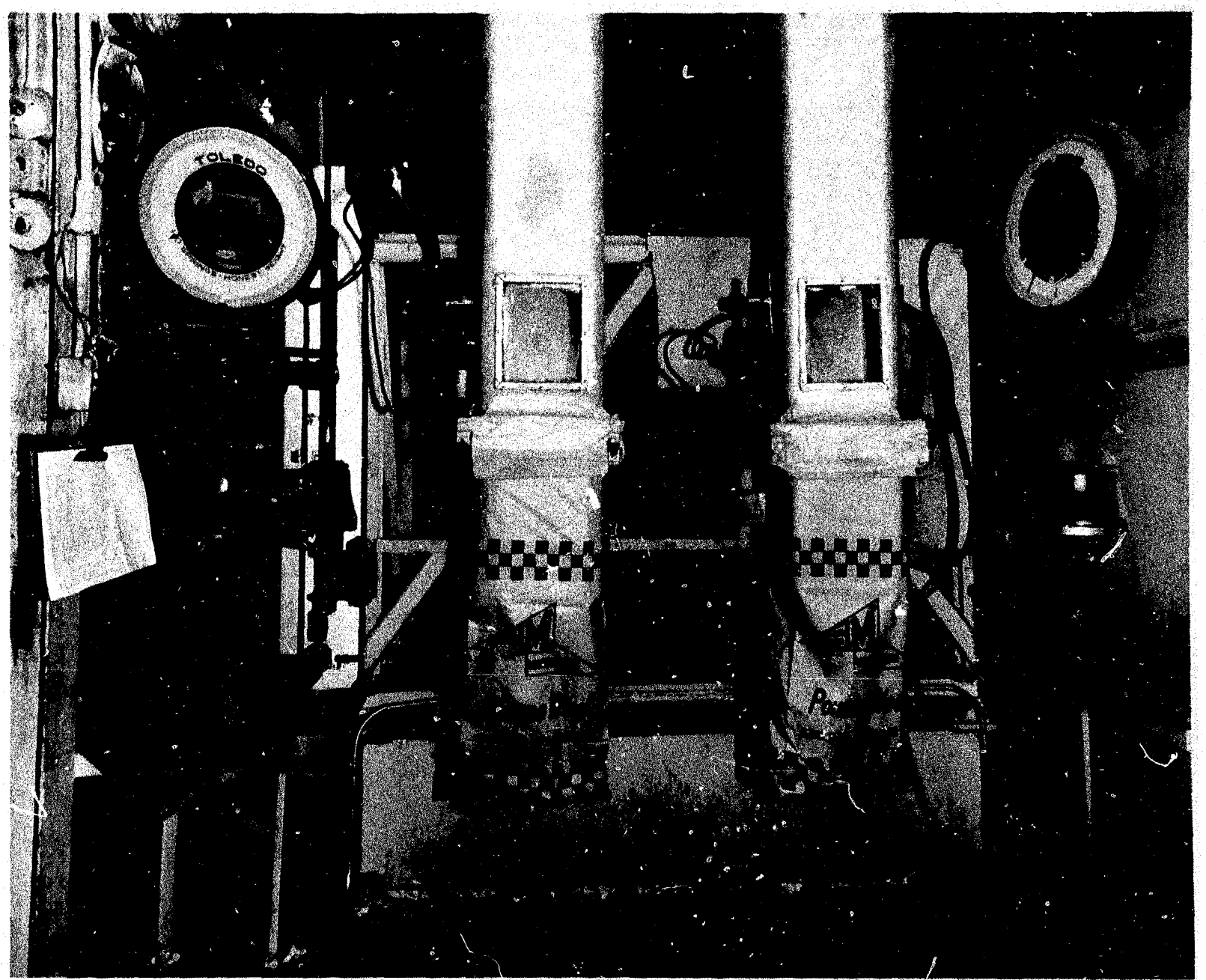

Figure 4. Automatic Bagging and Weighing Machine

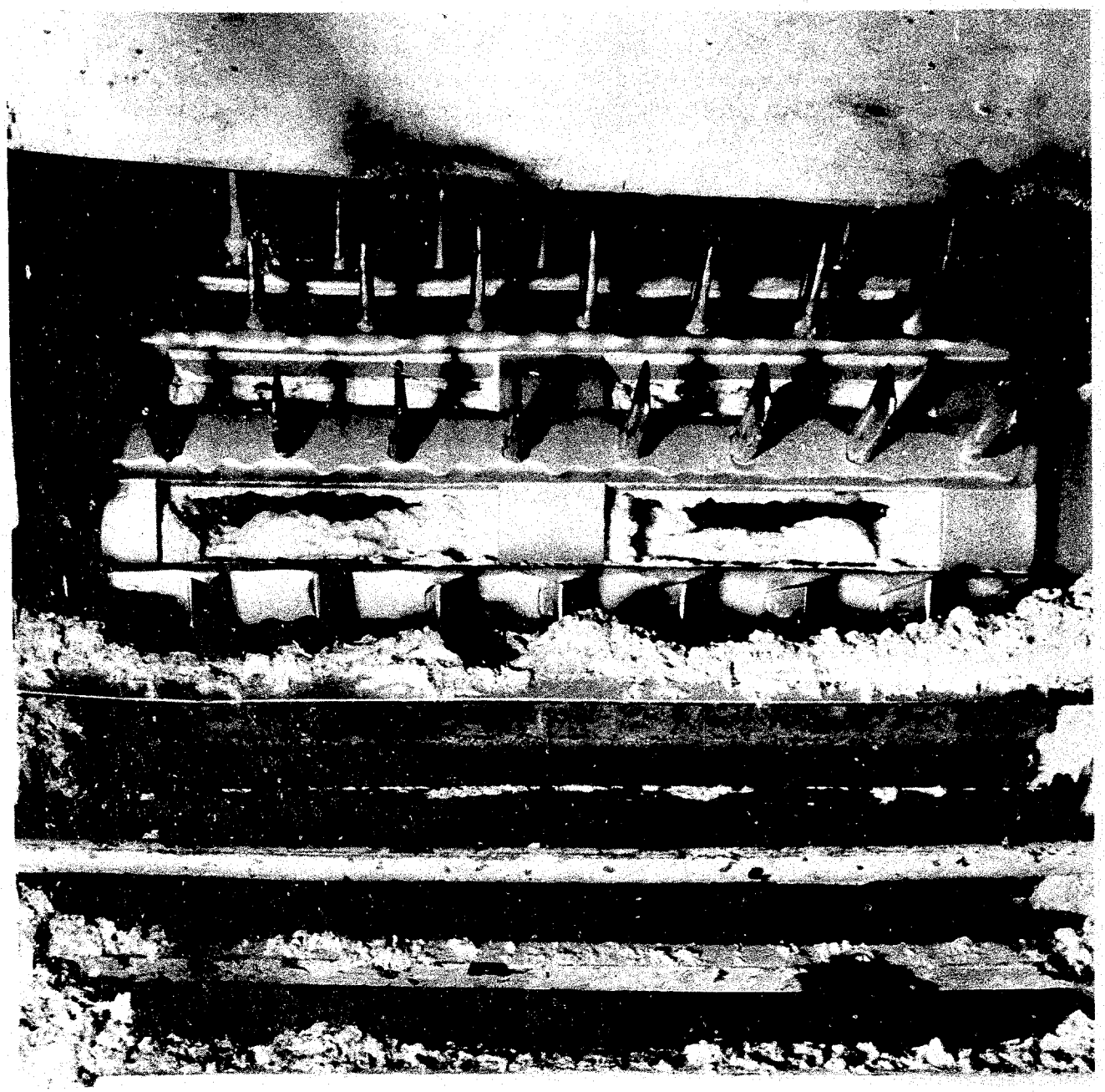

Figure 5. Granulator Showing Meshing Teeth for Cutting and Pressing Wool into Pellet Form

Cyclone Air Lift

The pellets are conveyed under a large suction pipe which draws them up into a cyclone (see figure 6) measuring about 8 by 10 by 15 feet. It is discharged from this chamber into the 6-foot receiving end of a trommel screen.

Trommel Screen

This is a horizontally mounted circular screen covered with 8-mesh wire, measuring about 12 to 16 feet in length, as shown in figure 7. This screen sifts out the "shot" (unfilamented, faulty wool), and the relatively "shot-free" wool is discharged through the 3-foot tapered end.

Weighing, Packing

The granulated wool enters the weigh hopper either by a gravity drop or by means of a conveyor. It is weighed into 25 pound bags, stitched, and delivered to either shipping or storage in the same manner as the loose wool.

PLANT SITE

Approximately three acres will be required to accommodate the building, to provide a suitable trucking area, and to allow for normal future expansion. The site should be located as advantageously as possible with respect to transportation, power, water, fuel, sources of labor, and a substantial market for its finished products. The cost of the land is estimated at $2,000.

BUILDING

A one-story building of sheet steel construction, H columns, and monitor roof will house this operation adequately. Suggested dimensions are 200 by 400 feet, giving an over-all floor area of 80,000 square feet. Cost of the building, including all utilities, is estimated at $326,000. Figure 8 shows a proposed layout for a typical mineral wool plant such as that discussed in this report.

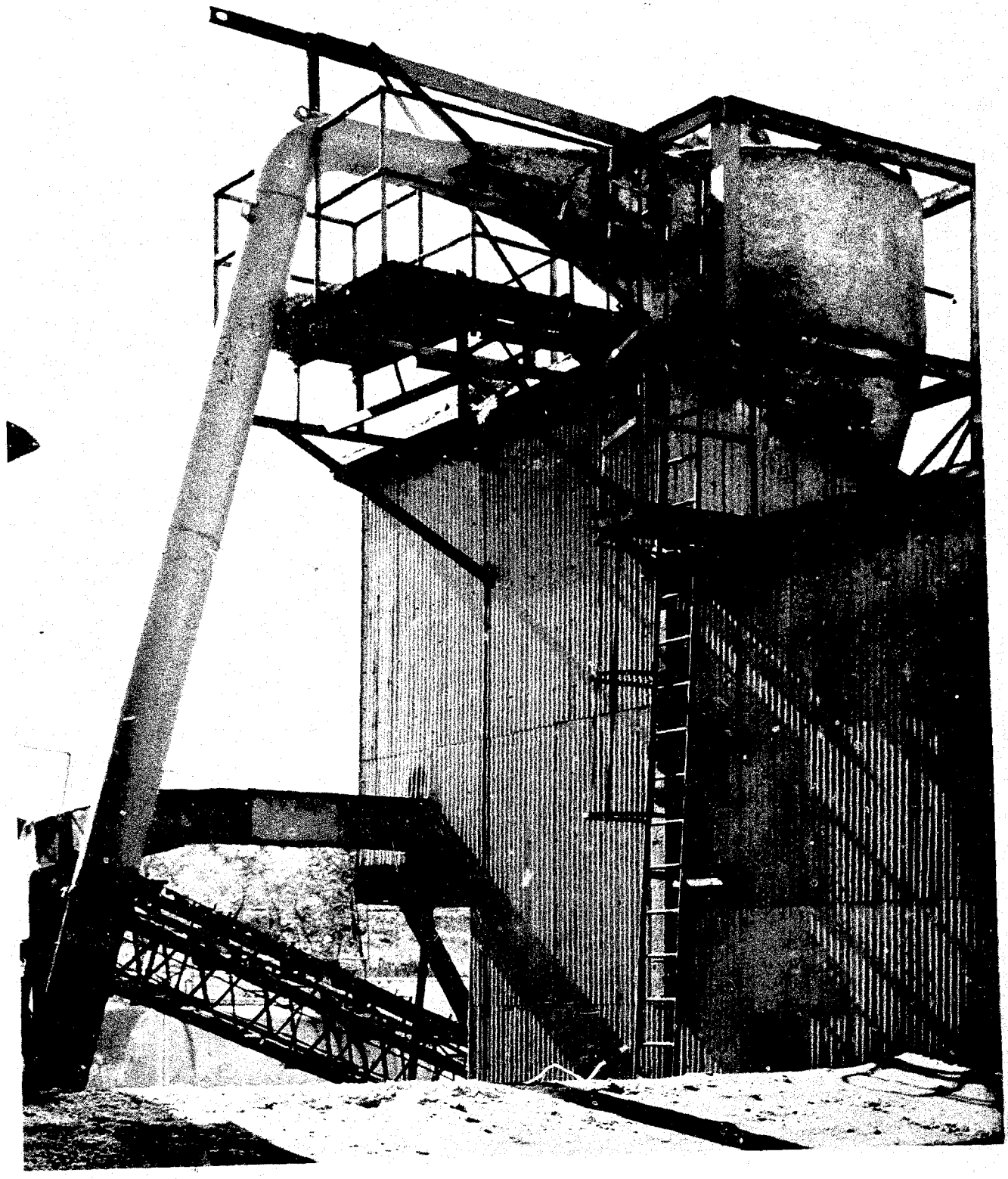

Figure 6. Cyclone

Figure 7. Trommel Screen

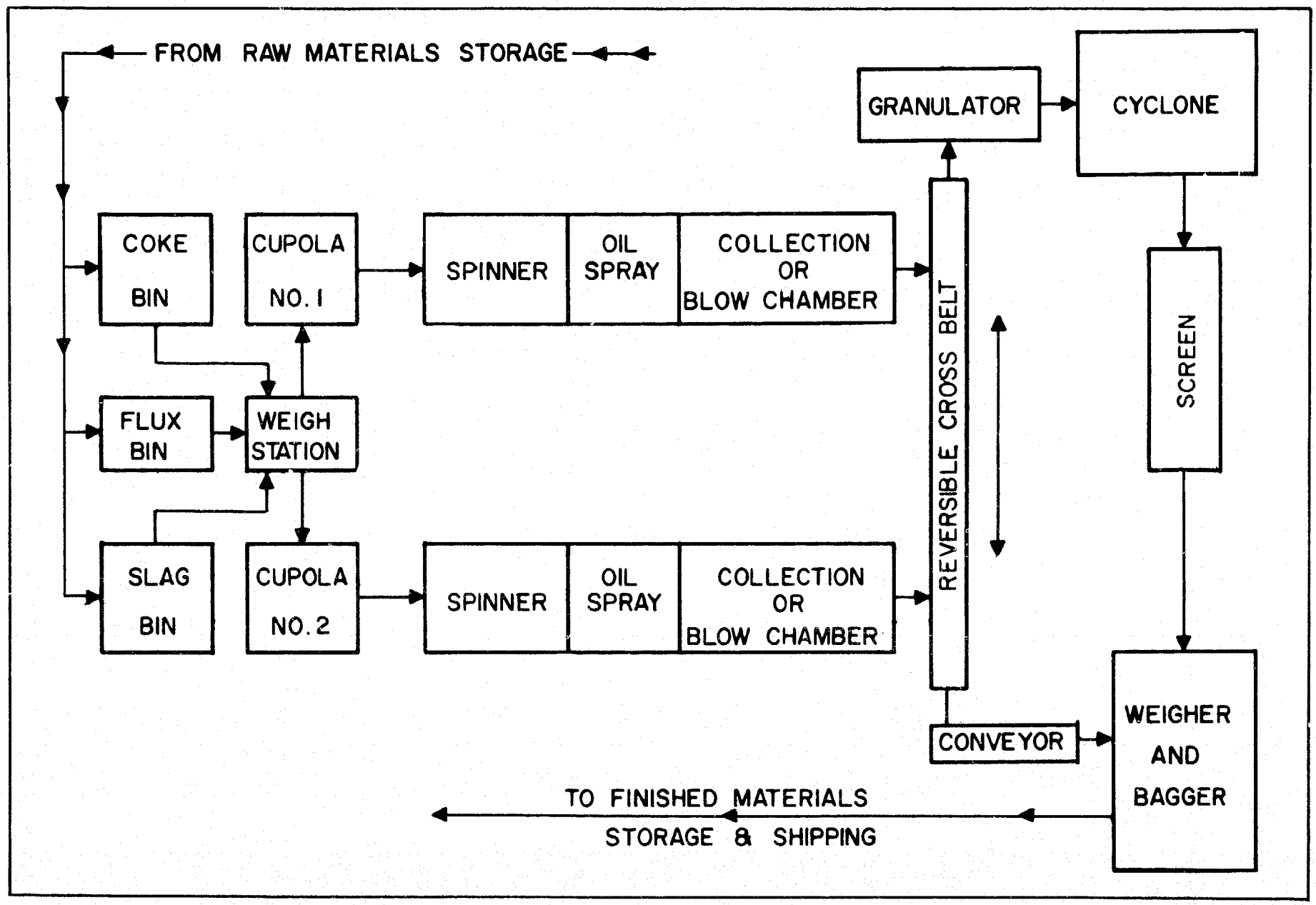

Figure 8. Proposed Plant Layout

POWER

The total connected power requirements for this plant are approximately 225 kilowatts per hour. The annual power cost is estimated at $17,600 based on 1.3 cents per kilowatt hour. Even in the United States, power costs vary considerably with locality.

WATER

The annual water requirements for production and general purposes are approximately 20 million gallons. On this basis, the annual water cost is estimated at $4,600.

FUEL

The annual cost of fuel, most of which is used in the production process, is included under direct materials.

LABOR REQUIREMENTS

Three skilled, six semi-skilled, and twelve unskilled workmen are necessary in the manufacturing process. Their titles, duties and the labor cost estimates are given in the following table entitled "Direct Labor".

Thirteen persons, as listed in the following table, entitled "Indirect Labor", are sufficient for the overhead labor force.

The cost estimates contained in these two tables are based on the fully mechanized process described previously in this report. The conveying and loading equipment could be replaced by cheap hand labor, if this is in large supply and capital limitations demand it. If such a replacement is effected, the table listing production tools and equipment should be revised accordingly.

DIRECT LABOR

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Annual Cost Actual
Foreman	3	$3.50	$ 21,840	
Cupola Operator	6	2.50	31,200	
Charge Operator	3	2.25	14,040	
Bagger	6	2.00	24,960	
Yard & Cleaning Men	3	1.50	9,360	
Total	21		101,400	

INDIRECT LABOR

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Annual Cost Actual
Plant Manager	1	$	$ 12,000	
Control Chemist	1	4.00	8,320	
Maintenance Mechanic	3	2.50	15,600	
Fork-Lift Operator	3	2.00	12,480	
Warehouseman	3	1.50	9,360	
Bookkeeper-Typist	1	2.50	5,200	
Shipping Clerk	1	1.75	3,640	
Total			$66,600	

DIRECT MATERIALS

Item	Unit	No. of Units	Unit Cost	Annual Costs Estimated	Annual Costs Actual
Slag	ton	21,600	$ 5.00	$108,000	
Coke	ton	3,765	25.00	94,125	
Limestone	ton	987	2.25	2,220	
Paraffin Oil (Kerosene)	pound	400,000	0.04	16,000	
Total				$220,345	

NOTE: In-freight charges are included in above prices

SUPPLIES

Item	Annual Cost Estimated	Annual Cost Actual
2-ply Bags (1,320,000 at $80 per 1,000)	$105,600	
Lubricants and Hand Tools	1,000	
Maintenance and Spare Parts	25,000	
Office Supplies	500	
Total	$132,100	

PRODUCTION TOOLS AND EQUIPMENT

Description	Number Required	Estimated Cost Unit	Estimated Cost Total	Actual Cost
Yard Hopper and Conveyor	1	$ 5,000	$ 5,000	
Conveyor to Bins	1	4,000	4,000	
Slag Bin	1	2,500	2,500	
Coke Bin	1	2,500	2,500	
Limestone Bin	1	500	500	
Proportional Feeders	4	900	3,600	
Weigh Station and Hopper	1	2,000	2,000	
Cupola Hoist	1	7,500	7,500	
54-inch Cupola	2	15,000	30,000	
Spinner	2	7,500	15,000	
Oil Sprayer	2	2,500	5,000	
Cupola Blowers and Air Weight Controls	2	2,300	4,600	
Preheaters and Ducts	2	800	1,600	
Cupola Duct Insulation	2	200	400	
Blow Chamber - Complete	2	15,000	30,000	
Cross-Conveyor with Directional Switching	1	6,000	6,000	
Granulator	1	2,500	2,500	
Cyclone Air Lift	1	6,000	6,000	
Trommel Screen - Complete	1	3,000	3,000	
Gravity Drop	1	300	300	
Automatic Bagging Machine	1	8,000	8,000	
Miscellaneous Conveyors	3	1,500	4,500	
Air Compressor	1	1,500	1,500	
Total			$146,000	

OTHER TOOLS AND EQUIPMENT

Description	Number Required	Unit Cost	Cost Estimated	Cost Actual
Miscellaneous Tools, Pallets, etc.			$ 4,000	
Fork Lift Truck	1		6,500	
Laboratory Equipment			5,000	
Total			$15,500	

NOTE: Laboratory equipment can be much simpler, and therefore less expensive, if only thermal insulation is manufactured.

FURNITURE AND FIXTURES

Description	Number Required	Unit Cost	Cost Estimated	Cost Actual
Executive Desk and Chair	2	$130	$ 260	
Standard Desk and Chair	2	100	200	
Typewriter and Stand	1	110	110	
Calculator	2	110	220	
File Cabinet	4	50	200	
Clothing Locker	33	20	660	
Garment Rack	1	30	30	
Storage Cabinet	1	30	30	
Chair	6	15	90	
Drinking Fountain	2	100	200	
Miscellaneous			100	
Total			$2,100	

DEPRECIATION

Description	Estimated Cost	Years Life	Annual Estimated	Annual Actual
Building	$ 326,000	20	$ 16,300	
Production Tools and Equipment	146,000	10	14,600	
Other Tools and Equipment	15,500	10	1,550	
Furniture and Fixtures	2,100	10	210	
Total	$ 489,600		$ 32,660	

MANUFACTURING OVERHEAD

Item	Estimated	Actual
Depreciation	$ 32,660	
Indirect Labor	66,600	
Power	17,600	
Water	4,600	
Supplies	132,100	
Total	$ 253,560	

MANUFACTURING COST

Item	Estimated	Actual
Direct Materials	$ 220,345	
Direct Labor	101,400	
Manufacturing Overhead	253,560	
Total	$ 575,305	

FIXED ASSETS

Item	Estimated	Actual
Land	$ 2,000	
Building	326,000	
Production Tools and Equipment	146,000	
Other Tools and Equipment	15,500	
Furniture and Fixtures	2,100	
Total	$ 491,600	

WORKING CAPITAL

Item	Estimated	Actual
Direct Materials, 30 Days	$ 18,352	
Direct Labor, 30 Days	8,450	
Manufacturing Overhead, 30 Days	21,130	
Reserve for Sales Collections, 30 Days	4,450	
Total	$ 52,392	

CAPITAL REQUIREMENTS

Item	Estimated	Actual
Fixed Assets	$ 491,600	
Working Capital	52,392	
Total	$ 543,992	

SALES REVENUE

The selling price of loose wool is estimated at $0.025 per pound, giving an annual sales revenue of $450,000. The selling price of granulated wool is estimated at $0.030 per pound, giving an annual sales revenue of $440.000. On this basis, the total annual sales revenue would be $890,000.

RECAPITULATION OF COSTS, SALES AND PROFITS

Item	ANNUAL COSTS Estimated	Total	Actual
Direct Materials	$ 220,345	$	
Direct Labor	101,400		
Manufacturing Overhead	253,560		
Total Manufacturing Costs		575,305	
Interest on Loans	4,000		
Insurance	2,000		
Legal Fees	4,000		
Auditing	1,000		
Unforeseen Expenses (Bad Debts, Etc.)	8,300		
Total Administrative Costs		19,300	
Total Sales Costs *		53,400	
Profit Before Taxes		241,995	
Total Annual Gross Sales		$890,000	

* Includes Sales Commissions, Travel, Freight-out, Discounts and Allowances, Etc.

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 page 26.

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 in the table on page 25) 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.

In addition to the requisition form, a sample voucher check is shown on page 27. 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, as shown on page 25. If the expenditures exceed the budgeted monthly allowances of any of the accounts, the bookkeeper will furnish the manager with a breakdown 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		$ 915	$ 11,000	
20 Sales		4,450	53,400	
30 Direct Materials		18,362	220,345	
40 Supplies		11,008	132,100	
51 Power*		1,467	17,600	
52 Water*		383	4,600	
53 Fuel		-0-	-0-	
60 Unforeseen Expense (Reserve Account)		692	8,300	
71 Direct Labor*		8,451	101,400	
72 Indirect Labor*		5,550	66,600	
80 Depreciation (Reserve Account)		2,722	32,660	
Totals		$54,000	$648,005	

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 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 b 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.

Consideration should also be given to such factors as :

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 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?

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?

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?

BIBLIOGRAPHY

Mechanical Engineers Handbook, 5th Edition, Lionel S. Marks, McGraw-Hill Book Company, 330 West 42nd Street, New York 36, New York

Commercial Standard, CS-131 - Industrial Mineral Wool Products, All Types, Testing and Reporting, U. S. Department of Commerce, Washington 25, D. C.

Bureau of Mines Report of Investigation 5203 - Laboratory Results on Testing Mineral Wool Raw Materials, H. Kenworthy and M. L. Moreland, March 1956

Bureau of Mines Report of Investigation 4821 - Raw Materials for the Mineral Wool Industry, G. H. Gorski

Bureau of Mines Information Circular 6984 - Mineral Wool, J. R. Thoenen

The above Bureau of Mines Publications may be obtained from: U. S. Department of the Interior, Washington 25, D. C.

TECHNICAL AND TRADE ASSOCIATIONS

National Mineral Wool Insulation Association, 1270 Sixth Avenue, New York 20, New York

American Standards Association, Inc., 10 East 40th Street, New York 16, New York

American Society for Testing Materials, 1916 Race Street, Philadelphia, Pennsylvania