592

PLANT REQUIREMENTS FOR MANUFACTURE OF CERAMIC DINNERWARE

A.I.D.
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TECHNICAL AIDS BRANCH

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FOREWORD

This manual is a revision of an earlier report of the same type issued in 1955. This revised version includes current costs of labor, machinery, equipment and supplies, as well as additional information relative to engineering, training, safety, markets, sales, financial and economic factors.

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This manual is designed to provide a general picture of the factors which must be considered in establishing and operating a small-scale factory of this type. It should prove useful in creating interest in the subject, and serve to give enough understanding of the related considerations to help government officials, other leaders and businessmen to determine whether the potential deserves more-detailed attention.

However, it is important to note that in most cases plans for the actual development and installation of a plant will require expert engineering and financial advice in order to meet specific local situations. For further information and assistance, readers should contact their local Productivity Center, Industrial Institute, Servicio, or United States Operations Mission.

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

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C E R A M I C D I N N E R W A R E

INTRODUCTION

Dinnerware production in the United States ranges from very high production from highly mechanized factories to very small potteries which produce in small quantities. The smaller potteries generally depend on the unusual in design in marketing their ware, while the larger potteries rely heavily on competitive pricing.

Mechanization of the industry has eliminated some of the skills necessary in producing dinnerware and at the same time has made it possible to produce a relatively high quality ware at a reasonable price. The degree to which a plant can be mechanized depends, of course, on the size of the available market, and the availability and cost of skilled pottery labor.

To facilitate conversion to local cost figures, columns headed "actual" are provided in the tables in the report.

GENERAL ASSUMPTIONS

In order to make realistic estimates, certain assumptions must be made. These are:

1. The costs of building, equipment, and material necessary are based on United States prices.

2. Labor costs used are the average for the industry and skill described, based on recently published figures of the United States Bureau of Labor Statistics.

3. All other costs, statistics, and figures are based on current United States prices.

4. Adequate heat, light, water, and electricity are available at the plant site.

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

6. The plant operates 40 hours per week, 50 weeks per year, with a one-shift labor force, except for the kilns, which are of the continuous type with a 24-hour firing cycle.

7. No special provision is made for the training of new personnel. 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. 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. Each machine is set up to do one operation on one particular product most of the time. Apart from slight adjustments, no setup time is required and none is allowed in the unit cost calculations.

PRODUCT SPECIFICATIONS

The products of the plant discussed in this report are those comprising a line of relatively heavy, serviceable, semi-vitreous dinner ware. A representative assortment of products consists of cups, saucers, 6-inch and 10-inch plates, salad bowls, and large serving bowls. Items can be added to this list if the market demand justifies doing so.

The primary raw materials needed for the manufacture of dinnerware are clays and various minerals, such as flint and feldspar. The types of clays and minerals determine the quality of the dinnerware. For the serviceable ware to be manufactured in the plant under consideration, the specifications of the raw materials are not critical. The essential requirement is to balance the proportions of those used so the resulting mixture will fuse together well upon firing. Since the composition of the clays and mineral deposits available in any one country or area may differ, the services of a clay scientist or ceramic engineer will be necessary to determine the formula for a clay mixture that will produce dinnerware of the desired quality.

A hard, non-porous, glass-like coating or finish is used on the dinnerware so it can be kept clean and sanitary in use. The color of this glaze or finish can be varied in order to provide dinnerware of various colors.

MANUFACTURING OPERATIONS

The clays and minerals used to prepare a potter's clay of the proper body for dinnerware are received at the plant in a finely ground state, ready for use. They arrive either by truck or railroad and are then transferred into large indoor storage bins by an elevator conveyor, where they remain until a batch of potter's clay is to be prepared.

To prepare a batch, each material called for by the formula is weighed out of its storage bin in the correct proportion to the other materials. A hopper-type car called a batch car that travels on tracks in front of these bins is used to collect the various materials. When all the materials have been collected, the hopper body of the car is lifted off its chassis by a hoist and is moved to a mixing machine called a blunger. There the clays and pulverized minerals are dumped into the blunger, water is added, and all ingredients are stirred and blended into a homogeneous, watery solution called slip.

Figure 1 is a cut-away view of a blunger, showing the paddles, or stirrers that accomplish the blending.

Before this slip can be used to make dinnerware, injurious impurities and lumps must be removed, the excess water must be filtered out, and a plastic clay obtained. To accomplish the first of these requirements — the removal of injurious impurities and lumps — the slip is filtered twice. A slip screen filter, such as is illustrated on figure 2, removes any lumps or large particles that will not pass through its screen. Then a magnetic filter removes any particles of iron or iron oxide that remain in the solution. Figure 3 illustrates a magnetic filter. Finally the purified slip is stored in an underground tank where it is agitated until needed by a paddle similar to the paddle in the blunger of figure 1.

The next step is to remove the excess water. This is accomplished by filtering the slip in a filter press. Figure 4 shows one of these presses. The slip is actually pumped through the filter under pressure. The clay collects on cloths while the water passes through and is discharged. When sufficient clay has collected on these cloths, the filter press is opened and the clay is taken off them in cakes, called filter cakes. The filter cakes are then fed into a de-airing pug mill such as is shown in figure 5.

In the de-airing pug mill, the moist clay is kneaded and squeezed under a vacuum to remove all the air that may be entrained in it. The clay is extruded from this machine as a homogeneous bar or pug of plastic consistency that is entirely free from lumps. Sections of this pug are cut off into what are called rolls. These are stored for a short period in a bin until needed for making dinnerware.

The first step in forming the clay into flat dinnerware is performed on batter-out machines such as the one in figure 6. These machines spread slugs of clay (portions of a roll) into flat discs or bats of the size required for the dish, saucer, or platter to be made. The bats are mounted on jiggers such as those illustrated in figure 7. The jiggers rotate the molds rapidly so that the operator can press a form or template against the clay on the mold and thus form the shape desired. The mold forms the inside of the flatware, while the template or jigger forms the outside.

When the item is properly formed, it and the mold are removed from the jigger and are placed on a shelf in the mold release dryer. As its name indicates, this dryer is an oven that dries the clay, thus causing it to shrink so that it can be removed from the mold. The shelves in the dryer are mounted on a chain conveyor that carries them through the oven. At the opposite end, the dinnerware is removed from the molds and is taken to finishing stations.

At these finishing stations the ware is placed on a power driven circular table, the rotation of which can be controlled by the operator. Using a moist sponge while the ware rotates on this finishing wheel, the finisher removes the imperfections and marks left on the ware by the jigger.

The ware is then moved to a spray booth where the glaze is applied. Figure 8 shows a spray booth of the type used. While the glaze is sprayed on, the individual pieces of dinnerware are carried on three-pronged supports. These supports permit the glaze to cover the entire surface of the ware.

After the glaze has been applied, it must be dried so the ware can be handled. This drying is accomplished in an oven through which the ware is carried on a conveyor. As it leaves the oven, the ware is removed from the three-pronged supports and placed into saggers for firing.

Saggers are containers that carry the dinnerware as it is fired in the kilns. Figure 9 shows two operators loading saggers onto a kiln car at the kiln entrance. Saggers are made of a special refractory material that has a higher melting point than the dinnerware.

When a kiln car is loaded, it is pushed to the entrance of the kiln. There automatic pushers convey the car through the kiln at the proper speed for correct firing.

Upon leaving the kiln, the ware is taken out of the saggers and moved on carts to the Shipping Department. As it is packed for shipment, the dinnerware is inspected.

The process just described is followed for all items of dinnerware excepting cups and their handles. Instead of being jiggered, handles are slip molded. This process involves the use of plaster molds into which a thickened slip is poured. By heating the molds in the mold release dryer, or allowing them to dry on racks, the water is evaporated from the slip and the handles can be removed from the molds. They are then touched up as necessary to remove casting seams, and are applied to the cup bodies, using a slip for a bonding agent. Upon firing, the handles fuse into the cups.

The process for making cup bodies is similar to that for making flatware. Instead of using a batter-out machine to form the clay roughly into shape, however, a pottery whirler is used. This piece of equipment is similar to a finishing wheel, except larger. A roll of clay is placed on the wheel by the operator. As the wheel rotates, the operator uses his hands to form a slug of clay into approximately the shape of the cup mold used on the jigger. The jigger operator places these slugs into the mold on the jigger and forms the cup by pressing a template or form against the clay. The mold forms the outside of the cup, while the template forms the inside.

After the cups and their molds have passed through the mold release dryer, the cups are taken to finishing lathes. There they are placed over a rotating mold and the operator trims and finishes the cup to remove any loose clay, imperfections, or ragged edges. Figure 10 shows this operation. The handles are finally applied and the complete cup is then sent to the spray booth for glazing.

This dinnerware plant prepares its own glazing materials in a process similar to that used for preparing slip. The primary difference is that the raw material, called frit, is ground into a fine powder right at the plant. This grinding is accomplished in a machine called a ball mill. Figure 11 illustrates one such machine. The frit is loaded into the drum of the machine, together with balls of porcelain. This mixture is then tumbled together as the drum rotates. The porcelain balls crush the frit between themselves and against the sides of the drum until a fine powder results. Water is added to the powder and the solution is filtered to remove large particles and iron and iron oxides in the same manner as slip. It is then stored in underground concrete tanks and constantly agitated until it is needed. At that time, the solution is pumped into spray booth tanks from which it is sprayed onto the dinnerware.

Another process carried on within the plant is the preparation of plaster molds for slip molding and jiggers. As the initial step in this process a plaster model of the item to be manufactured is prepared. A block of plaster is cast in a cottle with dimensions slightly larger than those of the finished piece of dinnerware to be produced. When the plaster has set, but before it is completely hard, the model is turned to rough shape on a modeler's wheel. When it is completely dry, a variety of modeling tools are used to turn the model to the exact dimensions desired.

From this model a block mold is made by casting plaster around it. Then this block mold is used to cast a working case. The molds actually used to make the dinnerware are, in turn, cast from the working case. Working molds are constantly replaced on the production lines to insure accurate dinnerware.

In some dinnerware plants, the saggers used to carry the ware during firing are also produced. However, due to the investment in equipment required for this, and because of the relatively small volume of dinnerware being produced, the plant under consideration purchases its saggers already made.

MANUFACTURING UNIT

The plant in this report is capable of producing 1500 dozen pieces of finished ware a week. This total consists of the following items:

Item	Weekly Production	Annual Production
Plates	375 Dozen	18,750 Dozen
Cups	375 "	18,750 "
Saucers	375 "	18,750 "
Salad-desert bowls	200 "	10,000 "
Serving bowls	175 "	8,750 "
	Total Annual Production -	75,000 "

Actually, the jiggers available in the plant are capable of producing ware from the smallest pieces up to large oval platters. This versatility will make it possible to broaden the line as the sales situation demands.

This production will provide 18,000 families per year with a complete set of dinnerware averaging 50 pieces per set.

DIRECT MATERIALS

Material quantities are based on an average use of 1.16 tons per one ton of ware. A representative body would consist of the following materials and proportions:

Flint	36%
Feldspar	12%
Kaolin	24%
Ball Clay	28%

Direct materials required for one year's production:

Material	Quantity	Unit Price	Annual Cost	Actual
Flint	187.50 Tons	$ 15 Ton	$2,812.50	_____
Feldspar	162.50 "	23 "	1,437.50	_____
Kaolin	125.00 "	15 "	1,875.00	_____
Ball Clay	147.00 "	20 "	2,940.00	_____
Glaze Materials	1,500.00 "	25¢ lb.	18,750.00	_____
Packing "			1,375.00	_____
Total			$29,190.00	_____

PRODUCTION TOOLS AND EQUIPMENT:

The following list of equipment considers that clays and glaze materials are purchased already partially processed. This is done to keep initial capital expenditures for equipment at a minimum. If the sales volume warrants, a study should be made to determine the economic advantage of processing these materials at the plant.

Department	Description	Units	Unit Price	Total Price	Actual Unit Price	Actual Total Price
Clay preparation	Storage bins (home-made)	4	$ 600	$ 2,400	_____	_____
	Elevator conveyor	1	2,000	2,000	_____	_____
	Batch car and rail	1	1,250	1,250	_____	_____
	Hoist	1	1,100	1,100	_____	_____
	Blunger	1	4,000	4,000	_____	_____
	Slip Screen	1	750	750	_____	_____
	Pump	1	700	700	_____	_____
	Storage tanks	2	175	350	_____	_____
	Agitators	2	1,800	3,600	_____	_____
	Magnetic filter	1	830	830	_____	_____
	Filter press 30"	1	5,000	5,000	_____	_____
	De-airing pug mill	1	4,000	4,000	_____	_____
Forming						
	Batter-out machine	1	900	900	_____	_____
	Batter-out machine	1	1,000	1,000	_____	_____
	Batter-out machine	1	1,100	1,100	_____	_____
	Oval hand jigger	1	2,200	2,200	_____	_____
	Standard hand jigger	2	1,000	2,000	_____	_____
	Clay bin	3	75	225	_____	_____

Machinery and tools required (Continued)

Department	Description	Units	Unit Price	Total Price	Actual Unit Price	Actual Total Price
Forming (cont'd)	Slip molding bench	1	$ 75	$ 75	____	____
	Cup assembly bench	1	50	50	____	____
	Finishing lathe	1	150	150	____	____
	Finishing wheel	3	75	225	____	____
	Pottery whirler	1	125	125	____	____
	Plaster molds	1200	.50	600	____	____
Drying	Mold release dryer	1	11,000	11,000	____	____
	Glaze dryer	1	700	700	____	____
Glaze prep-aration	Ball mill 36" x 48"	1	3,500	3,500	____	____
	Porcelain balls	1000 lbs	.23	230	____	____
	Glaze tubs	2	50	100	____	____
	Liquid screen	1	400	400	____	____
	Magnetic filter	1	400	400	____	____
	Portable mixer	2	250	500	____	____
Glaze appli-cation	Spray gun	2	55	110	____	____
	Oil and water extractor	2	45	90	____	____
	30 gallon agitators	2	400	800	____	____
	24" diameter bench turntable	2	50	100	____	____
	Galvanized spray booth	2	500	1,000	____	____
	Hose	2 sets	95	190	____	____
	Exhaust fan	2	300	600	____	____
	Compressor and tank	1	800	800	____	____
Firing	Oil fired straight kiln with cars	1	32,000	32,000	____	____
	Kiln furniture	25	60	1,500	____	____
General	Piping		1,000	1,000	____	____
	Hand trucks	7	50	350	____	____
	Total			$90,000		

OTHER TOOLS AND EQUIPMENT

Department	Description	No.	Unit Price	Total Price	Actual Unit Price	Actual Total Price
Maintenance	Miscellaneous tools	Set	$ 200	$ 200	_____	_____
Mold room	Modeler's wheel	1	200	200	_____	_____
	Miscellaneous hand tools	Set	100	100	_____	_____
	Mixer	1	400	400	_____	_____
Packing and shipping	Hand truck	2	50	100	_____	_____
Office	Typewriter	1	150	150	_____	_____
	Adding machine	1	150	150	_____	_____
Receiving & shipping	1-ton pickup truck	1	2,500	2,500	_____	_____
						_____
	Total			$3,800		_____

FURNITURE AND FIXTURES

Department	Description	No.	Unit Price	Total Price	Actual Unit Price	Actual Total Price
Forming	Storage Shelves for molds	1000 cubic feet		$ 300	_____	_____
Mold room	Storage shelves	250 cubic feet		80		
	Benches	2	$ 75	150	_____	_____
Glaze preparation	Storage bin	1	200	200	_____	_____
Packing	Tables	2	75	150	_____	_____
	Storage bins	2	50	100	_____	_____
Miscellaneous	Stools	4	10	40	_____	_____
Office	Desks and Chairs	4	125	500	_____	_____
	Filing Cabinets	3	80	240	_____	_____
	Total			$1,760		_____

PLANT LAYOUT

A plant layout, Figure Number 12, is shown on Page Number 35.

PLANT SITE

To provide space for eventual expansion, a site of level, well drained land comprising at least 20,000 square feet would be desirable. The site should be as advantageously located as possible with respect to transportation, power, water, fuel, sources of materials, labor and markets. The value of the land is estimated at $2,000.

BUILDING

About 9,000 square feet of floor space are desirable for this plant, with the space allotted as shown in Figure 12. The height of the mold release dryer is 19 feet, a fact which must be considered in planning the structure. In the United States, a building of minimum requirements can be built for approximately $3.50 per square foot. The cost of this building, including basic wiring and plumbing, is estimated at $31,850.

POWER

A dependable supply of power is required for the operation of a ceramic dinnerware plant. The estimates in this brochure do not include provision for a power generating unit, but are made on the assumption that the power requirements will be purchased from outside sources. A diesel engine generator set would be practicable, however, if power from local sources is not adequate. It is estimated that annual cost of purchased power will amount to $2,400.

WATER

An adequate supply of good water must be available for the operation of this plant. It is estimated that the annual cost of water will amount to $1,000.

FUEL

Oil will be required for the kilns. The annual estimated cost is $4,000.

TRUCK

A 1 ton pickup truck is included in the tools and equipment required other than for production. Gas, oil and repairs on this truck are estimated at $500 per year, and is included in the overhead. The cost of a truck driver is included in the indirect labor. The cost of the truck is estimated at $2,500.

DIRECT LABOR

Department	Number Required	Hourly Rate	Annual Payroll	Actual
Clay Preparation	2	$ 1.75	$ 7,000	_____
Forming	6	2.00	24,000	_____
Drying	2	1.50	6,000	_____
Glaze Preparation	1	1.75	3,500	_____
Glaze Application	2	2.00	8,000	_____
Firing	3	2.00	12,000	_____
Ware Handling	7	1.50	21,000	_____
Packing	2	1.50	6,000	_____
Total	25		$87,500	_____

INDIRECT LABOR

Department	Number Required	Hourly Rate	Annual Payroll	Actual
Manager	1	$	$10,000	_____
Chemist Foreman	1		8,000	_____
Bookkeeper	1		6,000	_____
Secretary Clerk	1		4,000	_____
Maintenance	1	2.00	4,000	_____
Truck Driver	1	1.50	3,000	_____
Total	6		$35,000	_____

SUPPLIES

Item	Estimate	Actual
Office Supplies	$ 300	_____
Grease, oil, tools	1,400	_____
Maintenance and Repair Materials	800	_____
Total	$ 2,500	_____

DEPRECIATION

Item	Actual Cost	Estimated Cost	Years' Life	Depreciation per Year	Actual Depreciation per Year
Building	_____	$ 31,850	20	$ 1,593	_____
Production tools and equipment	_____	58,000	10	5,800	_____
Kilns	_____	32,000	15	2,133	_____
Other tools and equipment	_____	1,300	10	130	_____
Furniture and fixtures	_____	1,760	10	176	_____
Pickup truck	_____	2,500	4	625	_____
Total				$ 10,457	_____

MANUFACTURING OVERHEAD

Item	Estimated Cost per Year	Actual Cost per Year
Depreciation	$ 10,457	_____
Indirect Labor	35,000	_____
Supplies	2,500	_____
Power	2,400	_____
Water	1,000	_____
Fuel	4,000	_____
Truck, Gas, Oil and Repairs	500	_____
Total	$ 55,857	_____

COST OF MANUFACTURING

Item	Annual Cost	Actual
Direct Labor	$ 87,500	_____
Direct Materials	29,190	_____
Manufacturing Overhead	55,857	_____
Total	$172,547	_____

FIXED INVESTMENT

Item	Estimated	Actual
Land	$ 2,000	_____
Building	31,850	_____
Production Tools and Equipment	58,000	_____
Kilns	32,000	_____
Other Tools and Equipment	1,300	_____
Furniture and Fixtures	1,760	_____
Pickup Truck	2,500	_____
Total	$ 129,410	_____

WORKING CAPITAL

Direct Material Inventory --30 days	$ 2,400	_____
Manufacturing Overhead --30 days	4,650	_____
Reserve Sales Collections --30 days	22,500	_____
Total	$ 29,550	_____

TOTAL INVESTMENT REQUIRED

Fixed Investment	$ 129,410	_____
Working Capital	29,550	_____
Total	$ 158,960	_____

PROVISION FOR EXPANSION

Production for a plant of this type is determined by, or restricted by, the kiln, which is the most expensive piece of equipment. Therefore, adding products that will make use of any excess kiln time resulting from seasonal fluctuations in sales of dinnerware would be the logical step in utilizing the plant to its fullest. The type of products which might be made would depend upon available markets and their production requirements -- e.g., firing temperatures, skilled labor, and the like. These products may range from novelty items to technical equipment such as insulators.

If an analysis of labor costs and market demands for dinnerware indicates the raw materials should be processed at the plant instead of purchased in the ready-to-use condition, additional plant area and machinery will be necessary. The cost of the building enlargement and the new equipment will be approximately $30,000.

SALES REVENUE

Dinnerware is usually sold directly to the retailer in sets suitable for seating a given number of people at the dining table. The sets usually are for 4, 6, 8 or 12 persons.

The average price per piece for all pieces included in a set of dishes of the quality of product to be produced in this plant is $ .30 each.

On this basis, the annual gross sales of this plant would amount to 900,000 x $ .30 or $270,000.

RECAPITULATION OF COSTS, SALES AND PROFITS

	Estimated		Actual
Direct Materials	$ 29,190		_____
Direct Labor	87,500		_____
Manufacturing Overhead	55,857		_____
Total Manufacturing Costs		$ 172,547	_____
Interest on Loans	$ 4,500		_____
Insurance	1,500		_____
Legal	1,000		_____
Auditing	2,000		_____
Unforeseen Expense	14,453		_____
Total Administrative Costs		23,453	_____
Sales commissions, discounts, allowances, freight out, returns, bad debts, travel and other		30,000	_____
Profit before Taxes		44,000	_____
Annual Gross Sales		$ 270,000	_____

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	$_____	$ 750	$ 9,000	$_____
20	Sales	_____	2,500	30,000	_____
30	Direct Materials	_____	2,432	29,190	_____
40	Supplies	_____	250	3,000	_____
51	Power*	_____	200	2,400	_____
52	Water*	_____	83	1,000	_____
53	Fuel	_____	333	4,000	_____
60	Unforeseen Expense (Reserve Account)	_____	1,293	14,453	_____
71	Direct Labor*	_____	7,291	87,500	_____
72	Indirect Labor*	_____	2,750	35,000	_____
80	Depreciation (Reserve Account)	_____	——	10,457	_____

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

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

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R. W. MITCHELL MANUFACTURING COMPANY

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VICE PRESIDENT

ACCOUNT NUMBER

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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 manual would be a profitable undertaking.

There are some determinations, however, that should be made before a decision is reached to build and operate such a plant. Among the necessary determinations to be made are those with respect to the following items:

MATERIALS AND SUPPLIES

1. Are all materials and supplies available locally?
2. Is the local material market competitive?
3. Are 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?

GLOSSARY

Ball mill	A machine designed to grind into fine particles materials loaded into its rotating drum. The grinding is accomplished by the crushing action of solid spheres also contained in the drum.
Batch car	A tub or bin mounted on a chassis that travels on wheels along a track. It is used to receive and measure or weigh materials loaded into it and to transfer the materials to a subsequent operation.
Batter-out machine	A machine used to form slugs of potter's clay into bats of the approximate shape of the item to be manufactured.
Blunger	A tank having power operated paddles that is used to blend the dry constituents of potter's clay with water to form slip.
Body	1. The mixture of clay and powdered rock of which clayware is composed. 2. The consistency of the above mixture.
Cottle	A flexible form used to cast plaster to approximately the size of an item of dinnerware.
De-airing pug mill	A machine that removes air entrained in a plastic mixture of clay and water and extrudes a homogeneous material of smooth texture.
Filter press	A device used to remove water from slip.
Glaze	A glass-like coating on pottery or ceramic ware.
Jigger	A machine that revolves a mold against which clay is pressed and shaped by a tool called a profile.
Kiln	A heated chamber used for firing potter's clay.
Magnetic filter	A device used to remove undissolved iron or iron compounds from slip.
Mold release dryer	An oven used to dry clay that has been shaped on a mold. Through drying, the clay shrinks and can be removed from the mold.
Potter's clay	A pure kind of clay that is nearly free of iron and is used to manufacture ceramic ware.

Sagger	A box or tray made of fire clay in which ceramic ware is placed while being fired in a kiln.
Semivitreous	Ceramic ware that is fired in a kiln at a temperature of about 1800° F. As a result, its body is more porous than ceramic ware fired at a higher temperature.
Slip	Potter's clay in a liquid state.
Slip screen	A device used to filter slip in order to remove large particles.

BIBLIOGRAPHY

Textbook

Ceramic Data Book	Industrial Publications, Inc., 5 South Wabash Avenue, Chicago 3, Illinois.

Periodical

Ceramic Age	Pinover Publications, Inc., 114 East 32 Street, New York 16, N. Y.
Ceramic Industry	Industrial Publications, Inc., Chicago 7, Illinois.

ABBREVIATIONS

°F	Degrees Fahrenheit
%	Percent
'	Foot or feet
"	Inch or inches
e g	For Example

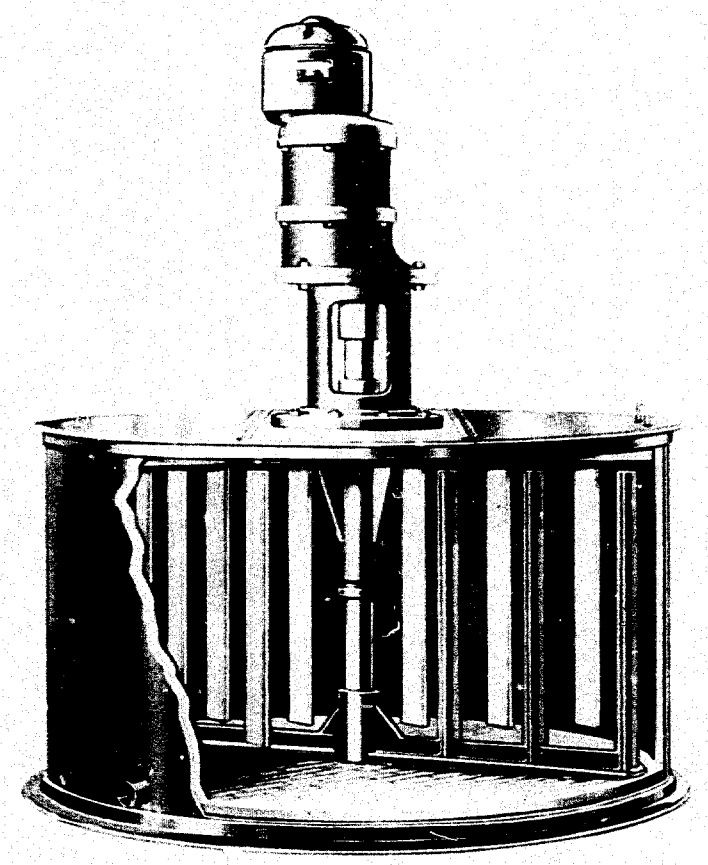


Figure 1 - A blunger used to prepare slip

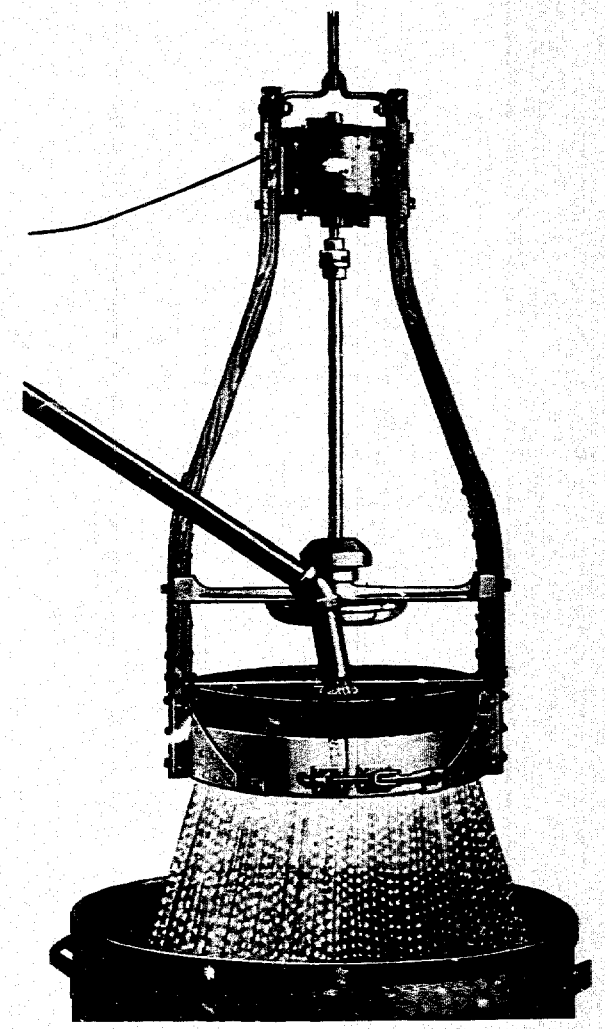


Figure 2 - A slip screen

Figure 3 - A magnetic filter for removing iron from slip

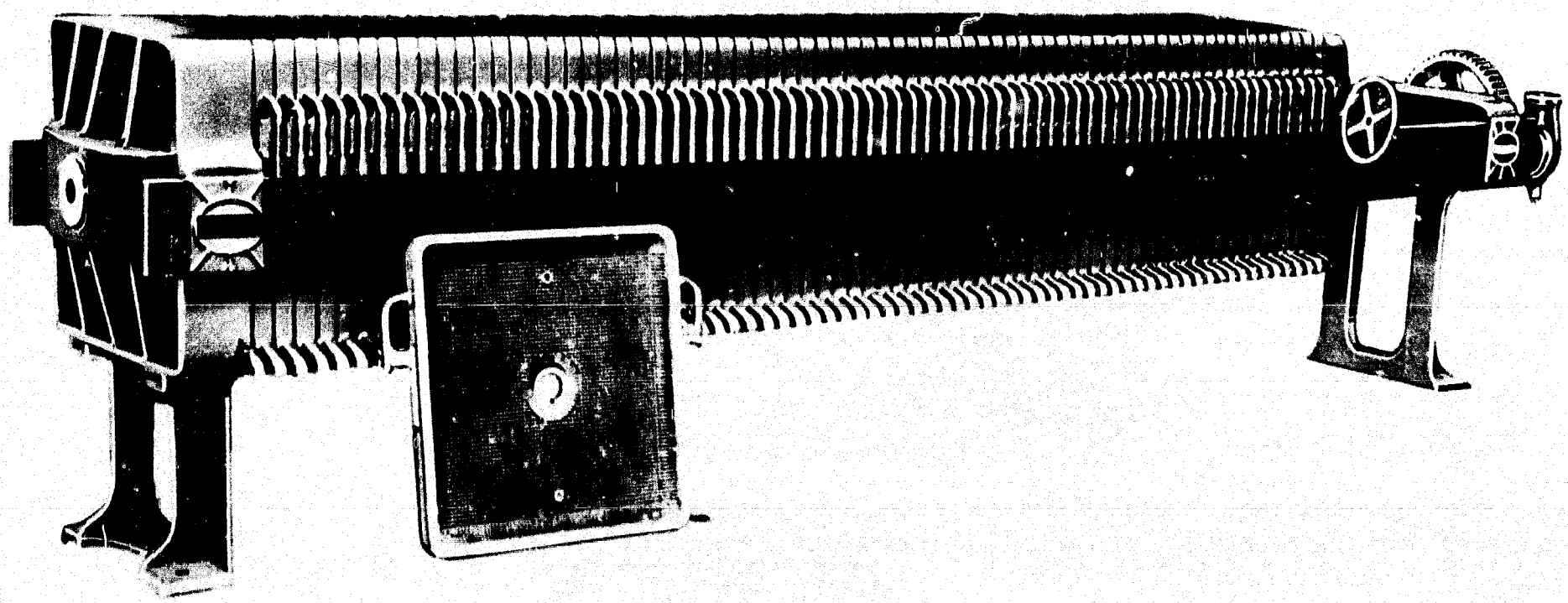


Figure 4 - A filter press

Figure 5 - A de-airing pug mill

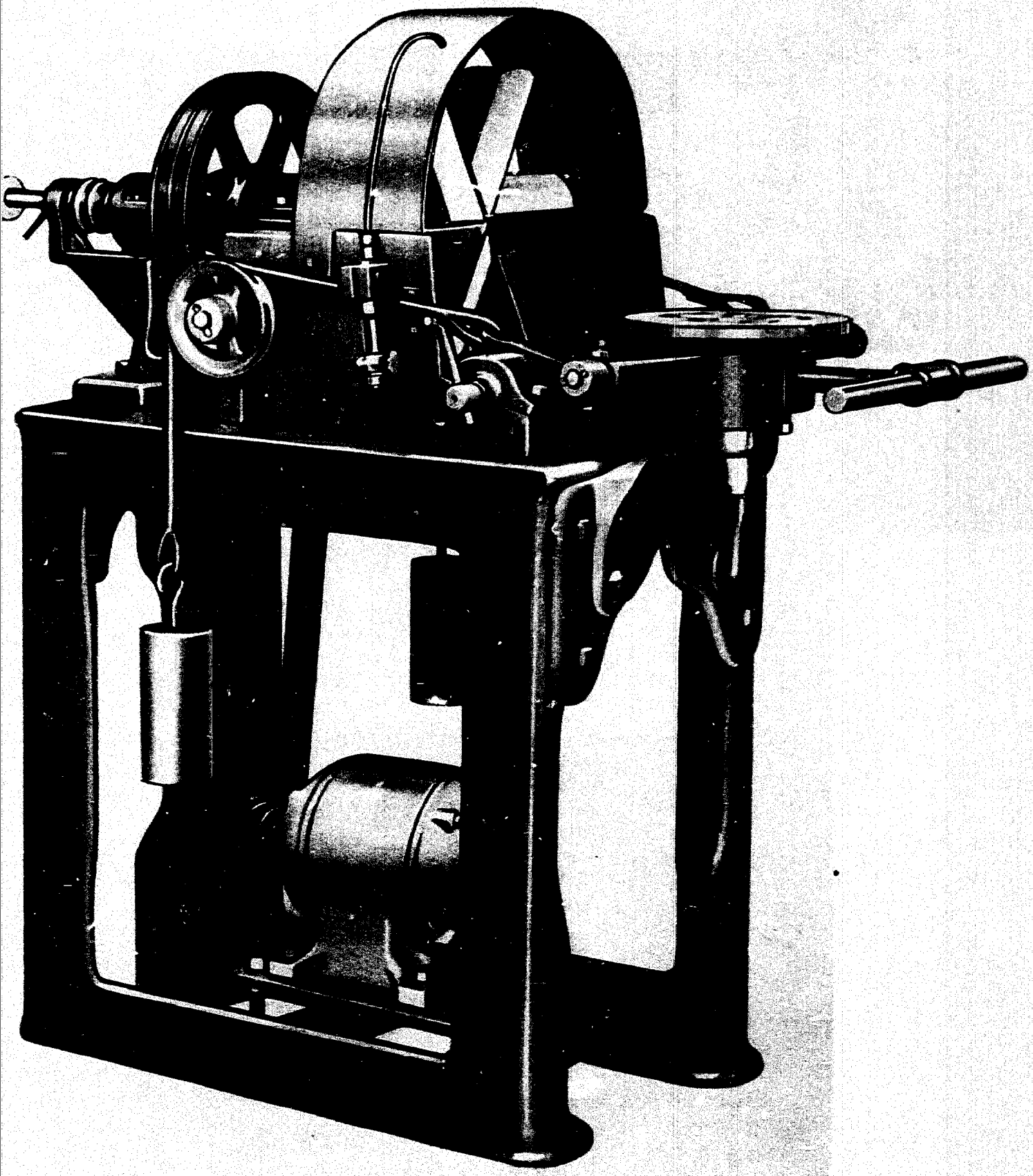
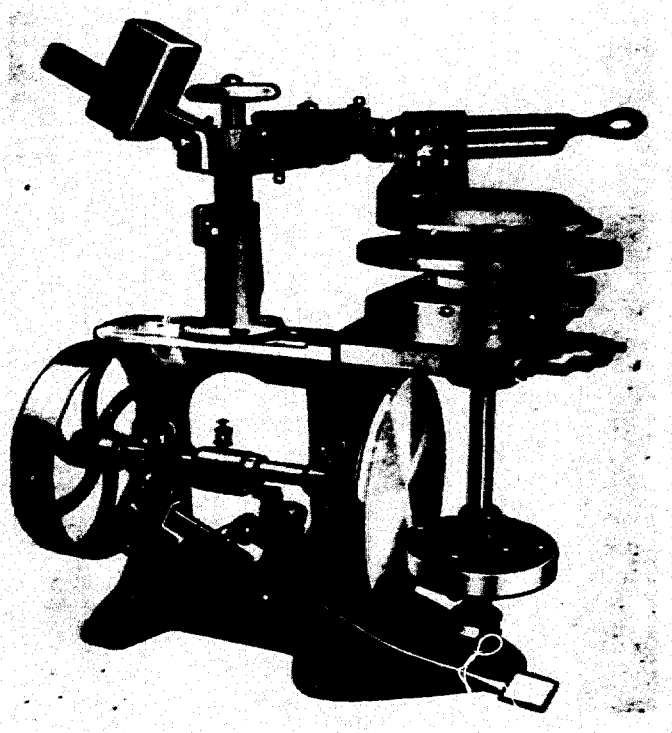


Figure 6 - A batter-out machine



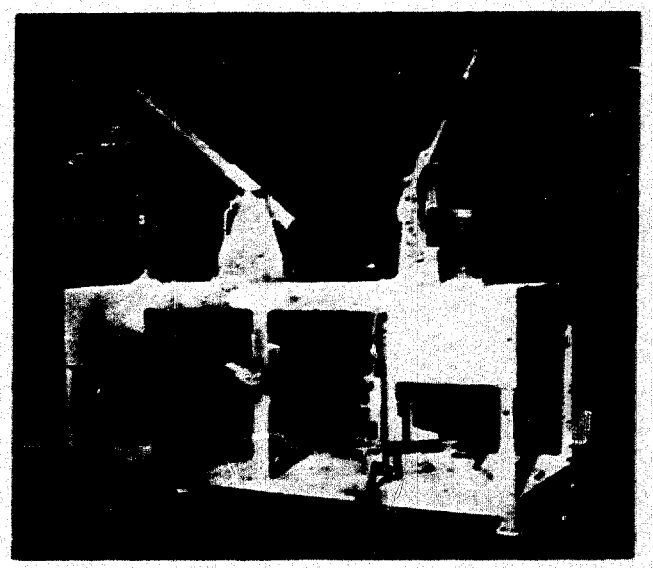


Figure 7 - An oval hand jigger (left) and a standard two-station jigger (right)

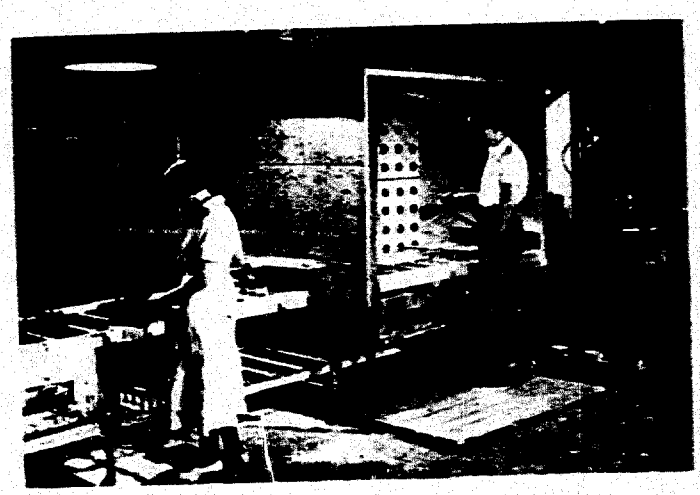


Figure 8 - A spray booth for applying glaze

Figure 9 - Saggers being loaded onto kiln cars

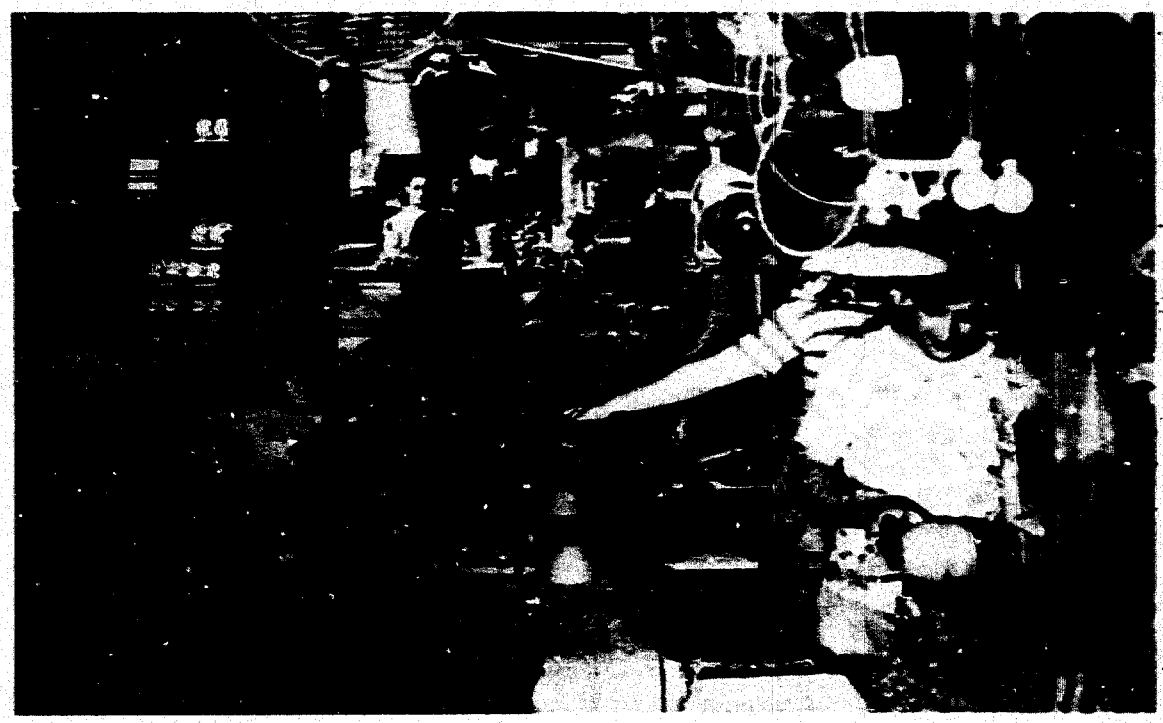


Figure 10 - Finishing cups on finishing lathes

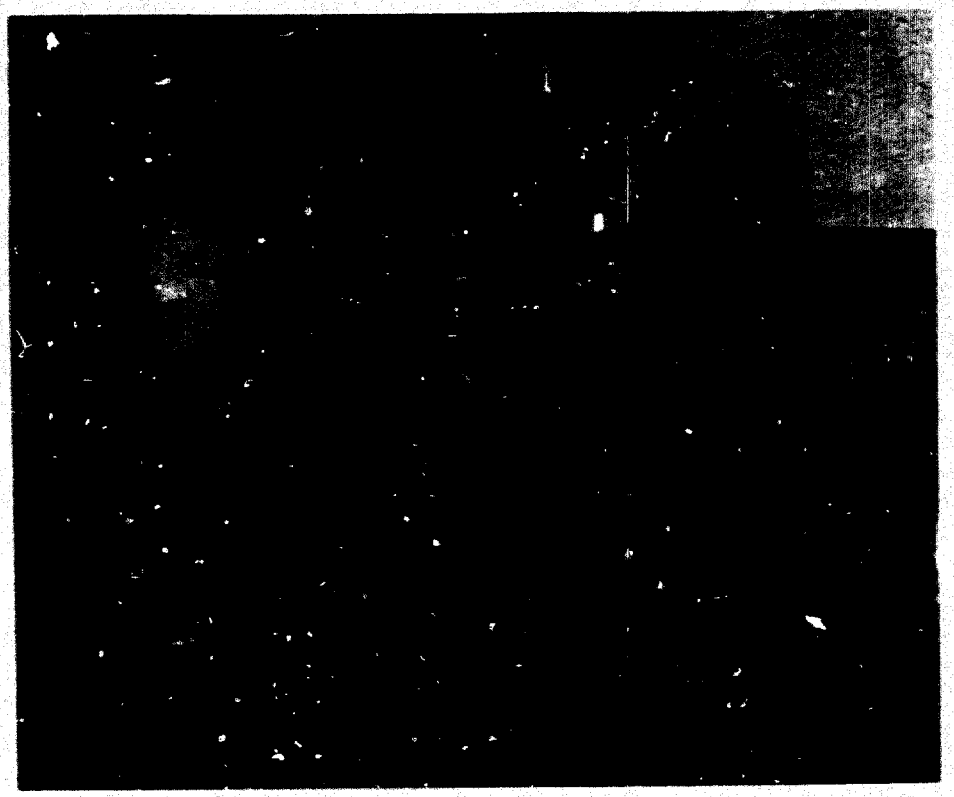
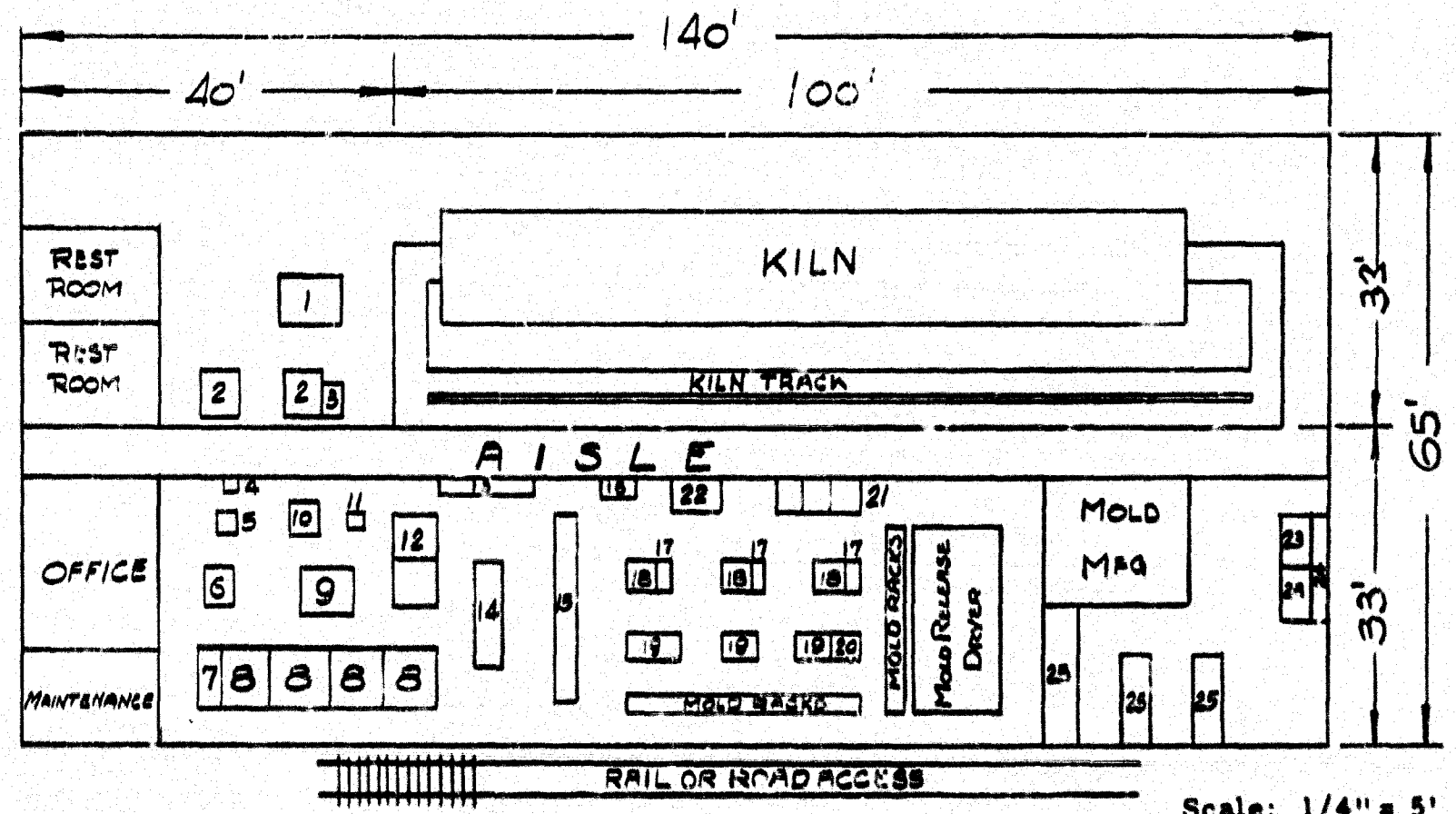


Figure 11 - A ball mill used to prepare glaze



Scale: 1/4" = 5'

Key

1. Glaze oven
2. Glaze spray booths
3. Glaze tubs
4. Glaze magnetic filter
5. Glaze liquid screen filter
6. Glaze ball mill
7. Glaze storage bin
8. Storage bins for clays
9. Blunger
10. Slip screen filter
11. Slip magnetic filter
12. Slip storage tanks
13. Slip molding bench
14. Filter press
15. De-airing pug mill
16. Cup assembly bench
17. Clay storage bins
18. Batter-out machines
19. Jiggers
20. Pottery whirler
21. Finishing wheels
22. Finishing lathe
23. Packing tables
24. Packing materials bins
25. Storage racks

Figure 12 - Preliminary plant layout

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