PEI Bulletin C-11

A Study of COST REDUCTION POSSIBILITIES *in the* PORCELAIN ENAMELING PROCESS *by the* REDUCTION OF LABOR

Published 1968

Porcelain Enamel Institute, Inc.

1900 L Street, N.W., Washington, D.C. 20036

FOREWORD

Comments from PEI's President . . .

For over two years, the PEI Technical Programs Committee has systematically studied the entire Porcelain Enameling process to determine those areas where costs might be reduced through technological advances. The major areas selected for specialized attention are:

1. Consistent (and predictable) high yield

2. Metal surface preparation

3. Labor used in materials handling (its reduction or elimination)

Each of the eleven members of TPC has a leadership assignment for a subcommittee which is at work to develop a program related to these three categories. All these efforts are aimed at making a contribution toward lower unit costs. This pamphlet represents the initial work of the subcommittee responsible for the project shown as Item 3 above.

During the early analyses by the full committee, it was apparent that—if this work were to be meaningful—it would be necessary to draw upon the knowledge and experience of qualified men, both from within and from outside our industry. This is especially true regarding the objectives in the "Reduction of Labor" category.

The following study provides initial data which relates the amount of investment in capital equipment which can be made in offsetting labor costs. We believe this is an excellent start—one which can serve as a basis for further work. In this further activity, especially, it is essential that the best efforts of our own industry be contributed to, and involved with, expertise from outside our industry.

We believe this available information can be of particular help to management officials in Porcelain Enameling plants. In addition to helping pinpoint areas where unit costs may be lowered, we hope it will also serve as a stimulus for further attention on an individual basis toward cost reduction.

JAMES B. WILLIS
Glidden-Durkee Div. of SCM Corp.
President
Porcelain Enamel Institute, Inc.

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A Publication of the Labor Costs Subcommittee of the

Technical Programs Committee

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PREFACE

In recent years, the Technical Programs Committee of the Porcelain Enamel Institute has given much attention to the investigation of opportunities for reducing costs in the Porcelain Enamel process through improvements in the known technology. Lower unit costs through a reduction in labor used in materials handling is considered to be one of the desirable objectives.

Early in this present investigation, the committee recognized that customized handling systems would be required, due to the many differences in plant arrangements and product variations. Yet, after analyzing background information on plant operations accumulated over a period of years, there seems to be a basis for determining areas where handling labor can be reduced or eliminated with subsequent overall cost reductions.

The Technical Programs Committee and its subcommittee on labor costs are pleased to present this data—hoping that it will help management representatives to focus on their individual conditions and on the attendant potential cost-saving benefits.

E. E. HOWE, Chicago Vitreous Corp.
Chairman
Technical Programs Committee

E. E. BRYANT, Ferro Corporation
Chairman
Subcommittee on Labor Costs

A Study of Cost Reduction Possibilities in the Porcelain Enameling Process by the Reduction of Labor

A review of progress as new types of equipment have been introduced into Procelain Enamel Plants is of value to:

1. Show what is possible at this time.

2. Serve as a base point of consideration beyond the present best performance.

3. Indicate ranges of capital investment as related to reduction in manpower which have been involved, these being at today's cost.

The best available information is for plants running part ground coat finish and part cover coat finish. This also might be considered as the most typical. The following summary of man hours and capital investment for a selected unit of production covers most available types of equipment.

Codes for the type of equipment are as follows:

Pickle
- b — batch
- c — continuous

Ground Coat
- h — hand dip
- f — flow coat
- e — electrostatic spray

Cover Coat
- h — hand spray
- m — mechanized spray
- e — electrostatic spray
- dm — direct-on mechanized spray
- de — direct-on electrostatic spray

Plant No.	Process: Pickle	Process: Ground Coat	Process: Cover Coat	Size Total Men	Production Men Per Unit	Capital Per Unit
1	b	h	h	50	20.00	$224,000
2	c	h	m	122	14.35	212,900
3	b	h	m	132	15.52	148,200
4	c	h	e	114	13.41	210,600
5	c	h	dm	82	11.71	201,400
6	c	f	dm	80	11.43	212,900
7	c	e	de	84	8.75	181,300
8	b	e	de	92	9.57	124,800

Plant No. 1 is included to indicate how a small shop with hand operations compares to more modern larger plants. The rate of production does not allow logical comparison with Plants Nos. 2 thru 8.

Relationship of men and capital per unit of production may be determined for Plants Nos. 2 thru 8 by comparing plants with different processing methods. For example:

A comparision of Plants Nos. 2 and 3 shows that the continuous pickle reduced men per unit by 1.17 with $64,700 added to capital for equipment.

Plant No. 3, the poorest labor efficiency, compared to the most efficient (Plant No. 7), shows that manpower is reduced by 6.77 men while capital is increased by $33,100. This involves equipment and direct-on operation.

Various other comparisons may be made, and it can be assumed that factors other than labor and equipment might influence the results to a limited degree. If we consider one man at $8000 per year cost, and a five year payback of investment, there would be an even break at $32,000 capital expense for man replaced. We recognize that some accounting departments wish to figure payback out of profits after taxes, which reduces the per year cost per man by approximately 50%. Also, some wish to pay off investment in three years. We suggest that the more liberal approach should be considered as stated.

The extreme in the data, Plants Nos. 7 and 8, capital expense is $70,000 per man replaced. An assumption that labor rates will continue to increase would supply justification for some increase in capital expense over current calculations.

Considering the above, we suggest that somewhere between $32,000 and $50,000 should be available for added equipment to replace one man.

It is generally stated that handling parts makes up a large part of the labor cost for porcelain enameling. A breakdown of labor per unit production involved in transfer, loading, etc., in the data for Plants Nos. 2 thru 8 is as follows:

	Total Transfer		Dryer to Furnace	
Plant No.	Men	% of Men	Men	% of Men
2	2.82	19.6%	1.64	11.2%
3	3.76	24.3%	1.64	10.3%
4	2.58	19.2%	1.41	10.3%
5	2.00	17.0%	1.15	9.9%
6	2.00	17.4%	1.15	10.0%
7	1.45	16.6%	.83	9.5%
8	2.29	23.0%	.83	8.7%

If we assume that in addition to presently known equipment and processes, transfer labor offers the best possibility for reduced labor, we estimate that elimination of all hand transfer would replace 20% of the labor and elimination of dryer-to-furnace transfer labor would replace 10% of the labor. These are averages from the examples. Also, since these plants average 100 men, the elimination would be 20 and 10 men respectively. Taking into account our previous estimate of capital investment per man replaced, it would be possible to invest $640,000 to $1,000,000 to eliminate all transfer labor, or $320,000 to $500,000 to eliminate dryer-to-furnace transfer labor.

Having developed the above background, we will now explore methods which might eliminate the transfer labor. First, we will consider the dryer-to-furnace transfer, which seems to be more promising for some success. Since the product mix must be considered in every case, the following will serve as an indication of methods which might be developed:

1. When parts can be run with the same spacing on the application-drying line and on the furnace as, for example, spray application on refrigerator liners, conveyor and tooling could be revised. The requirement would be that the furnace chain, shoe-plates, etc., be kept free of any enamel accumulation as it passed thru the spray area and hooks, hanging ears, etc., be designed so that excessive cost is not involved in replacement or cleaning.

2. When panels are hung in multiple width on the furnace conveyor, there are three possibilities which we visualize. In the case of 2a and 2b, revisions, as in No. 1 above, must also be devised.

   a. Rebuild the furnace to accommodate more than one conveyor or provide furnaces to fire panels two wide as they could be hung for electrostatic spray.

   b. Devise a bunching-indexing conveyor to spread panels parallel to conveyor travel during spray and at 90 degrees to travel and closer together in the dryer and furnace.

   c. With a flange or standard easily hooked area or bracket on each part, a mechanized transfer unit might be devised to pick up ware from the spray conveyor and hook it on the furnace conveyor. Some set ratio of spray conveyor speed to furnace conveyor speed would be required depending on the furnace capacity.

NOTE:

Double decking on any conveyor including the furnace would seem to be impractical for ideas 1, 2a, and 2b above. The transfer idea, 2c, could be considered. It might be wise to recommend that double decking be avoided unless economies are definitely established, for there is at least an opinion that more labor per unit of production is involved in double deck operations for application of enamel, and for loading and unloading a double deck conveyor. Obviously, the type of product or products will have major influence on results obtained with double deck operations.

Now, if we turn our attention to other transfer labor, the pickle process must be considered. Labor involved in unloading the pickled ware and making the ware available on the enamel application line is not easily broken out from operating records since some other functions may be performed; however, 5 to 8% of the labor appears to be used for this transfer.

A one-conveyor process for single coat work would require that the conveyor must either be protected from or withstand conditions in the pickle, spraying, drying and firing. We have not found reference to materials or evidence of new equipment which might be economical for a single conveyor system.

In the industry, there is a limited use of mechanical transfer from the pickle to the work area where the application conveyor is loaded. For certain types of ware, mechanical transfer, as suggested for consideration in 2c, could also be adapted for transfer from a pickle conveyor to an enamel application conveyor.

As we study the problem of elimination of transfer labor in the pickle area, it is obvious that a complete change of metal preparation eliminating presently used corrosive solutions could radically change the problem as it relates to conveyor design and investment in pretreatment equipment. It has been proposed that preconditioned steel might be processed by cleaning only. We suggest that success in this area without excessive price penalties for the steel would justify further consideration of a single conveyor, no transfer, operation for single coat porcelain enameling.

An example of an approach to a preconditioned steel is the announcement, recently, of a new steel which appears to be a step in the right direction by reducing corrosive type treatment to one minute in hydrochloric acid. The surface of this product is prepared first for direct-on enameling. It is then coated with a closely controlled, predetermined thickness of zinc, which serves as a protective film for the prepared surface. The suggested in-plant treatment is clean, rinse, hydrochloric acid (one minute to remove zinc), rinse, neutralize. Quite possibly there are other equally promising preconditioned steels in various stages of development within the steel industry at the present time.

Turning our attention to another area, even the most efficient plant (Example No. 7) uses some hand reinforcing during application of enamel. This may amount to 10% of the labor. Reduction of labor in this area might be accomplished by:

1. Improvement of enamel suspensions for electrostatic spray or for flow coating. No indication of a promising approach to this has been found.

2. Mechanical spray systems to replace hand operators are employed to a limited extent where uniform grouping of parts is normal practice. More use of this system should be considered.

The mill room and enamel preparation are other areas where long-range reduction in labor can be considered. Powdered materials which are mixed with water in a high speed blender have proven successful with enamels used for hot water tanks. With established demand, it could be assumed that other types of enamels could be developed to be handled in this manner. When the operation is performed in a mill room area, the extra cost of powder about equals the savings in labor. It seems that the combination of mixing of enamel batches could in some operations be combined with the operation of application equipment to obtain further reductions of labor and eliminate the central mill room and storage area. Methods for supplying materials to the application area and for mixing at the point of use would have to be developed to suit various plant layouts.

Selection of porcelain enamels with particular characteristics may, in the case of certain products, permit processing practices which result in reduction of labor.

Direct-on cover coats are included in Plant Examples Nos. 5, 6, 7 and 8. The use of extra low carbon steel, direct-on pickle methods, and a direct-on type cover coat with application on one side only results in elimination of all labor required for application of ground coat for cover coat parts. When the back side must be covered, the labor required for the extra operation will reduce total labor savings.

Combinations of base coat and overspray porcelain enamels are employed in some cases to produce a two coat single fire coating, thus eliminating the labor involved in firing the ground coat. This process is limited to medium dark grey, blue and green colors, and is mainly used for dishwasher tanks and doors.

Ware which is run thru a normal enamel application line for rework processing frequently results in poor labor efficiency. Enamels which permit spot spraying without objectionable color variation may permit spot spraying on the furnace chain. This is most easily adapted to refrigerator liner production. Other variations from normal processing for rework only are frequently developed to reduce labor.

Recommendations

Conveyor or transfer systems to eliminate dryer-to-furnace transfer labor should be developed.

Any development in the area of pretreated steel and/or changes in cleaning and pickling should be evaluated in relation to possible elimination of transfer labor as well as for reduction in pickling expense or predictability.

Attention should be directed to additional use of mechanized spray to reduce hand reinforcing labor.

Engineering studies of enamel mixing at the point of use should be considered. Information from such studies would be expected to promote activity in development of powders and enamel systems.

Presently available systems (direct-on cover coats, two coat single fire and special processing for rework) should be considered to determine if these may result in labor savings in excess of other costs involved.

We are unable to specify organizations capable of developing these ideas for application in all types of porcelain enameling plants. The same is true of costs for modified or new equipment; however, we feel that availability of this information and these ideas to the industry and suppliers to the industry will assist in promoting activity in these areas. Future surveys in this area could also be expected to keep the programs alive and encourage continued or additional activity.

PEI

TECHNICAL PROGRAMS COMMITTEE

This Committee shall be responsible for the planning, supervision, and coordination of PEI's technical activities into a program offering maximum benefit to the Porcelain Enameling industry. It shall be responsible for policy recommendations in the technical area. In this capacity, it shall serve as the policy group to which other Institute technical committees and subcommittees shall report. Technical groups which report to the Technical Programs Committee are the Forum, Process and Standards Committees.

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Porcelain
Enamel
Institute inc.

• 1900 L Street, N.W.
• Washington, D.C. 20036
• (202) 296-0450

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