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William E. Goble

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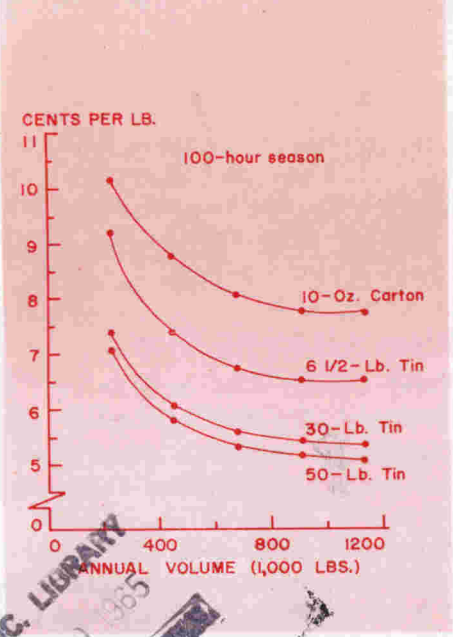

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COSTS OF PROCESSING STRAWBERRIES FOR FREEZING IN TENNESSEE

by
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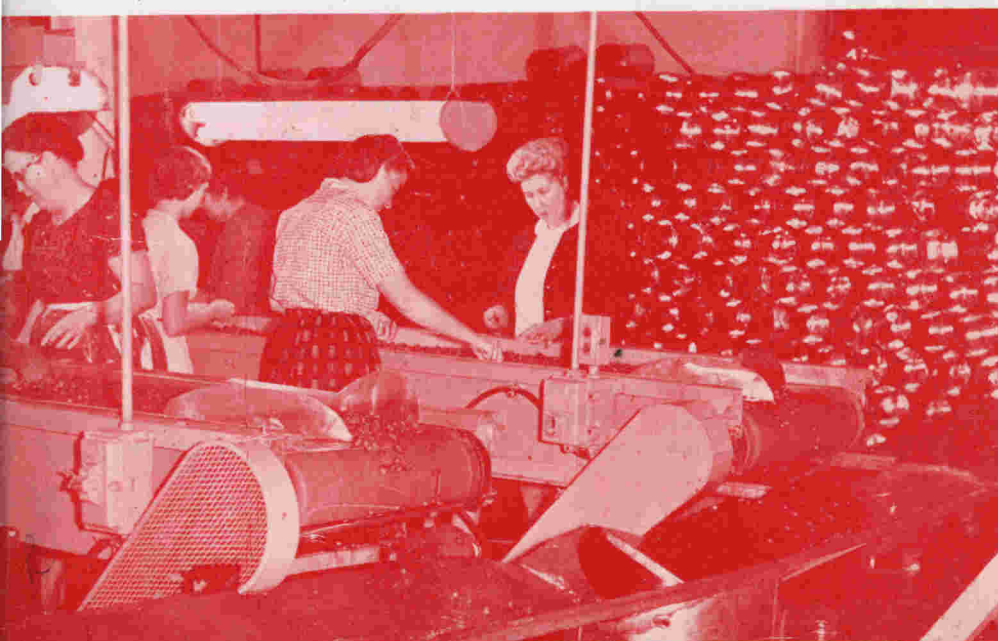

SUMMARY

THIS report presents information on the cost and methods of improving efficiency in processing strawberries for freezing in 20 Tennessee plants and 5 model plants.

Costs and Efficiency in Existing Plants

Variable, Fixed and Total Costs. The variable cost of processing in the existing plants included cost of sugar, processing labor, containers, freezing, storage, electricity, water, and transportation. Sugar, processing labor, and container costs comprised 84% of variable costs.

The plant and equipment costs comprised 82% of the fixed costs. Equipment costs averaged 1.49 cents per pound for the 20 plants. Total costs ranged from 5.65 to 13.72 cents and averaged 8.74 cents per pound of processed product. Total cost per pound of the processed product including strawberries ranged from 15.79 to 24.54 cents per pound.

Efficiency. The output per man-hour ranged from 39 to 179 pounds of processed product. The first and third highest outputs per man-hour, 179 and 158 pounds, respectively, were in plants in which strawberries were stored in 50-pound tins.

Costs of Processing Related to Plant Size Groups. The plants were divided into four size groups (Group I, 2,000-3,999 pounds; Group II, 4,000-4,999 pounds; Group III, 5,000-6,999 pounds; and Group IV, 7,000-12,999 pounds) on the basis of volume of output to compare costs of processing. Increases in average volume processed from 3,000 to 10,500 pounds per hour reduced the average total unit cost from 9.60 to 6.79 cents per pound.

Investment in Buildings and Equipment. Average investment in buildings by size groups ranged from $19,700 in Group I to $27,500 in Group IV. Average equipment costs ranged from $32,503 in Group I to $37,373 in Group IV.

Costs in Model Plants

Plant Size and Use of Capacity. Each plant—from 1 to 5 belts—has a cost advantage over the next smaller plant. For the 5 model plants—in the order listed, 1 to 5 belts—operating 200 hours per season and packaging in the 10-ounce carton, the respective total processing costs at 50% of capacity are: 11.46, 9.34, 8.49, 8.30, and 8.03 cents per pound. At 100% of capacity the

costs for the 5 plants in the order listed are: 8.67, 7.70, 7.23, 7.15, and 7.02 cents per pound, respectively, or a difference of 2.79, 1.64, 1.26, 1.15, and 1.01 cents per pound compared with 50% of capacity.

Containers Packed. Packing in larger containers resulted in lower processing costs per pound. For example, with a volume of 400,000 pounds and a 200-hour season, processing costs in the 10-ounce, 6½-, 30- and 50-pound containers would be 8.67, 7.59, 6.29 and 5.98 cents, respectively. This is a difference of 2.69 cents per pound from the cost of the 10-ounce to the 50-pound container.

Length of Season. At volumes of about 100,000 and 500,000 pounds, and a 50-hour season, the processing and packaging costs for the 10-ounce carton are 13.18 and 9.09 cents per pound, respectively. For volumes of about 450,000 and 2,250,000 pounds and a 200-hour season, the costs are 8.67 and 7.02 cents per pound, respectively.

Amount of Sort Out. The percent of culls removed from the inspection belt materially influences the processing costs. If 3 inspection belts are operated at full capacity for 100 hours and packing is in the 10-ounce carton, the cost per pound is 7.80, 8.04, and 8.30 cents per pound for 5%, 10%, and 15% sort outs, respectively. With a 200-hour season, the cost is 7.04, 7.23 and 7.44 cents per pound for the listed sort outs, respectively.

Method of Dumping. The potential savings on dumping strawberries in a 2-belt and 5-belt plant by the "jig" method over the "conventional" method with a 100-hour season would be $182.97 and $457.43, respectively. With a 200-hour season the potential savings would be $393.97 and $984.93 for dumping by the jig method over the conventional method. If growers make a deposit on lugs, losses of about $350 per 2,000 12-quart lugs may be eliminated. The use of a mechanical dump is not justified unless the plant is operated 500 or more hours per season.

Casing and In-Plant Transportation. Mechanical casing equipment and electric forklift trucks were not used in model plants because hand-operated equipment was more economical when the processing was less than 500 hours.

Efficiency and Costs in Existing and Model Plants. Costs per pound of processed product are appreciably lower in the model plants than in existing plants. For example, costs of processing and packing in 30-pound containers for six existing plants—packing an average of 300,486 pounds—averaged 8.61 cents per pound and ranged from 7.08 to 11.89 cents per pound. If 300,480 pounds were

packed in a model plant the savings would be 1.21 cents per pound or $3,636 per plant. When packing in the 50-pound container, at an average volume of 1,263,300 pounds, the savings in the model plant would be 1.02 cents per pound, or $12,886 for a plant packing in the 50-pound container.

The output per man-hour ranged from 39 to 179 pounds of processed product in existing plants. The average outputs per man-hour for 6 existing plants and a model plant when packing a volume of 300,480 pounds in 30-pound containers were 83 and 107 pounds, respectively. When packing 300,480 pounds in 50-pound containers the outputs of processed product per man-hour in 2 existing plants and a model plant were 168 and 187 pounds, respectively.

Building and equipment costs averaged $64,873 for existing plants studied that processed the largest volumes. Considering the costs of establishing a new plant, and the short season in the Southeast, it would be more economical to process strawberries in multi-product plants. Costs which are incurred when the plant is not operating could be spread over other products.

ACKNOWLEDGMENTS

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William H. Dyke, a senior in the Industrial Engineering Department, University of Tennessee, contributed to the development of the flow charts, plant layouts and made suggestions for improving plant efficiency. Ivon E. McCarty, Food Technology Department, made very constructive suggestions on the study and in the preparation of this manuscript.

Appreciation is also expressed to staff members of the University of Tennessee and to members of the Technical Committee of the Southern Regional Project SM-8 for suggestions on this study.

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Costs of Processing Strawberries for Freezing In Tennessee[1]

by

William E. Goble*

INTRODUCTION

The Problem

THE farm value of strawberries in Tennessee averaged $3,648,000 annually for the 10-year period 1951-1960. Approximately 50% of the strawberries produced in Tennessee during the 10-year period were processed.

Processors of strawberries in the Southeast have relatively much shorter seasons than processors in the Pacific Coast states. As a consequence, plant managers who are considering improving the efficiency of existing plants need data on relative costs. Also, processors interested in establishing new plants need to know the type of equipment that is economical to operate in the Southeast. Some of the equipment and techniques utilized in the Pacific Coast states cannot be justified in the Southeast because of the relatively short season and low volume per plant.

Objectives of Study

The objectives of this study were:

1) To determine the cost of processing and packing strawberries for freezing in 20 existing plants.
2) To determine how the level of cost varies in model plants with important factors associated with costs of processing strawberries for freezing.

Operations in a Processing Plant

Several operations are conducted in the processing of strawberries for freezing. These operations are shown in Figure 1. Figure 2 shows the floor plan in a typical Tennessee plant. Figures 3, 4, 5, 6, 7, and 8 show typical strawberry processing equipment in use in Tennessee.

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*Assistant Professor of Agricultural Economics.

[1]This was one phase of the Tennessee project that contributed to Regional Project SM-8, "Evaluation of Alternative Vegetable Marketing Organizations and Handling Methods."

The berries are weighed in the lugs or crates when they are unloaded by the grower on the platform at the processing plant and then stacked nearby until processing operations start. (In one plant, the berries are placed in a cooling room to await processing.) Next, the berries are transported to the dump station in the plant where they are dumped on a conveyor which transports them to a shaker-washer (at some plants the berries are dumped directly into a shaker-washer) and moved over conveyor belts where they are manually sorted to remove defective berries and foreign matter.

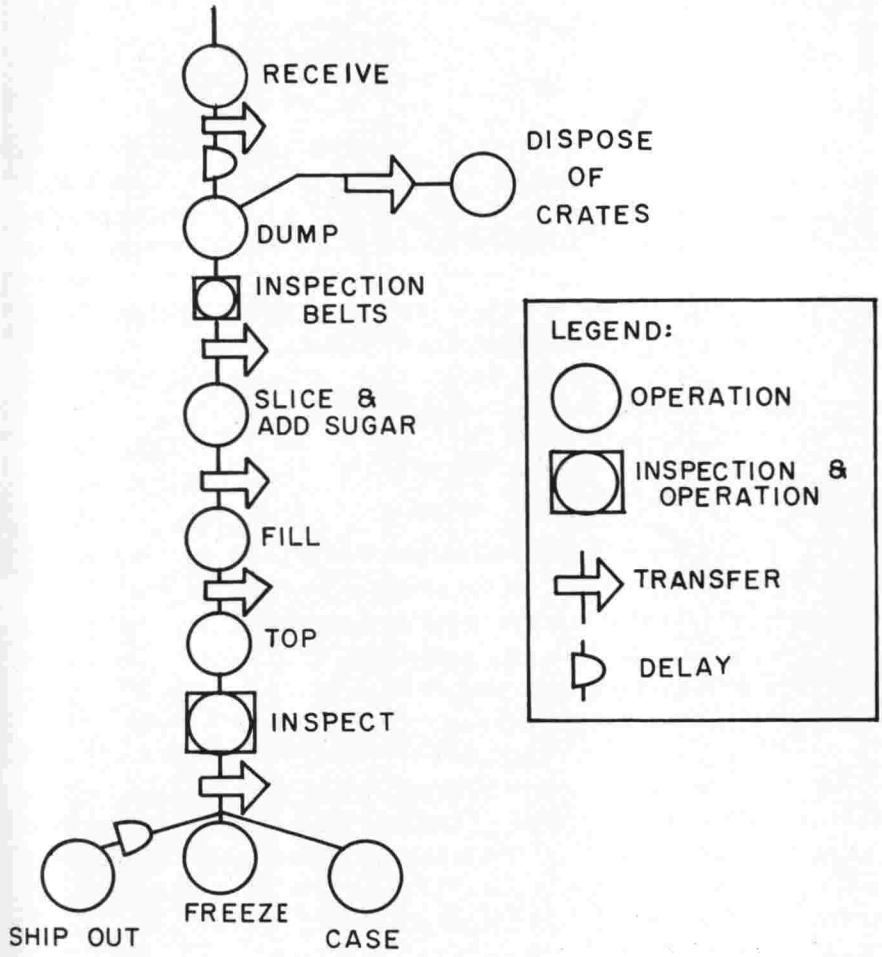

Figure 1. Operations in processing strawberries for freezing in Tennessee.

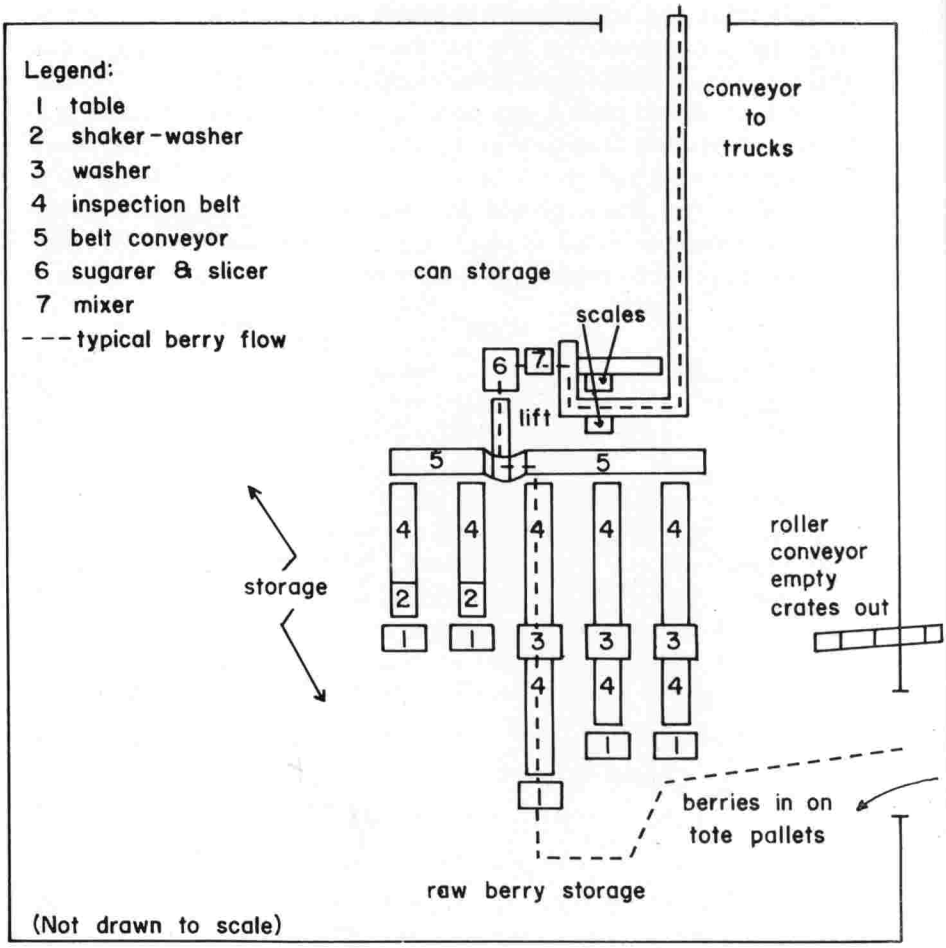

Figure 2. Floor plan of a typical strawberry processing plant in Tennessee.

The berries are then conveyed to a sizer for whole berries or to a slicer and sugar mixer. Whole berries are moved from the sizer to the container filler, where sugar is added. Sliced berries — mixed with sugar—are moved to other container fillers.

If the plant has a freezing unit, the processed strawberries in small containers, such as the 10- and 16-ounce cartons and 6½-pound tins, are frozen and then cased in corrugated containers. If there is no freezing unit at the plant, the berries are usually stored in 30- and 50-pound containers at a commercial freezer plant. Later, some of the berries may be packaged in smaller containers or used in other products. Six of the 20 plants had their own

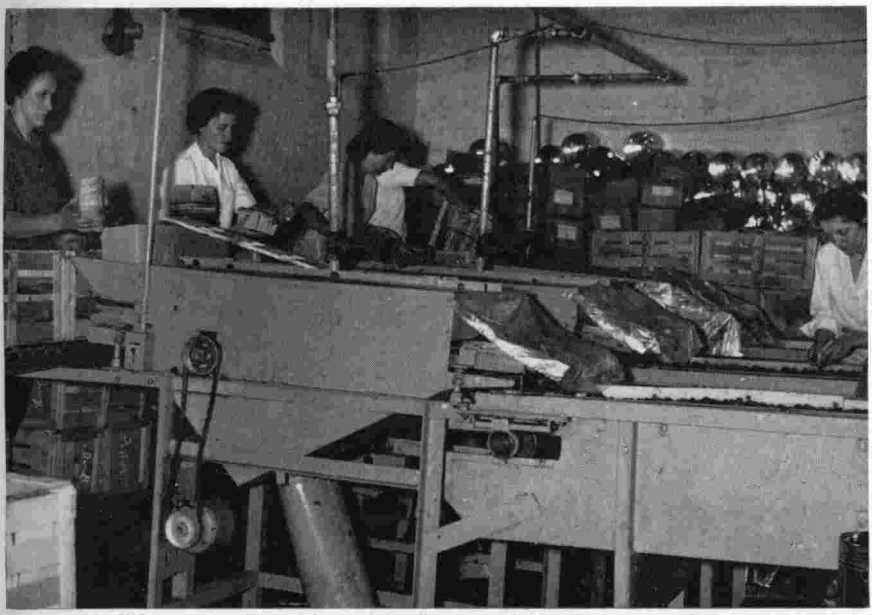

Figure 3. Dumping strawberries into shaker washers.

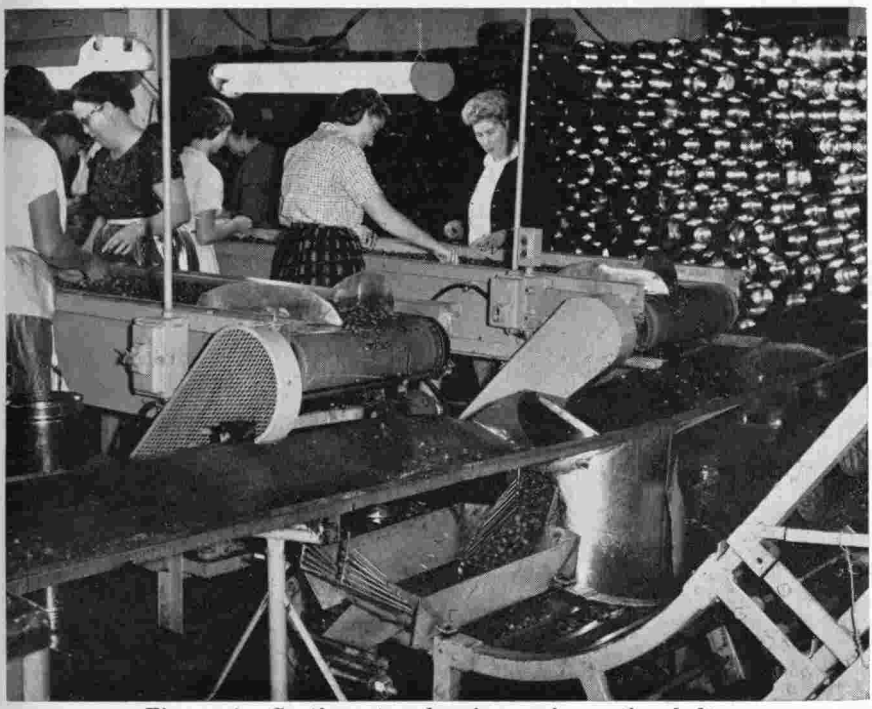

Figure 4. Sorting strawberries on inspection belt.

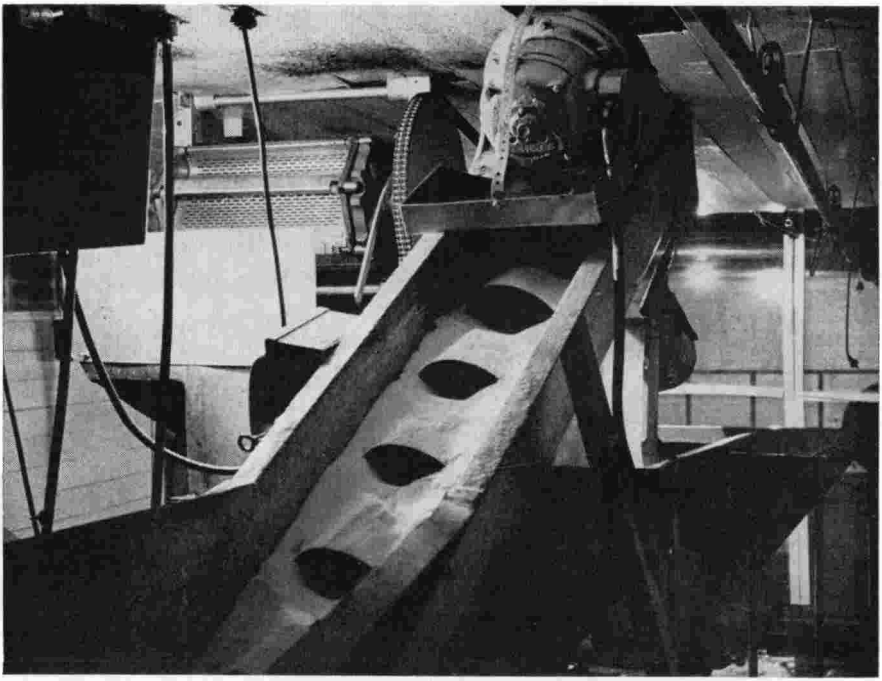

Figure 5. Sugar being moved by conveyor to fruit-mixing machine.

freezing facilities. Freezing and storage facilities, maintained in all major cities of Tennessee, were available for storing strawberries for plants not having those facilities.

Analytical Procedure

The plants studied had several variations, other than the volume of production, which directly influence processing costs. These variations fell into two classes: 1) those that were independent of the processing operation, and 2) those that were dependent on it.

Some examples of variations that were independent of the processing operation were 1) differences between wage rates paid in the plants; 2) variations in original building and equipment costs; and 3) variations in depreciation rates on buildings and equipment.

Some examples of variations that depended upon the processing operations are 1) two processing plants having the same output but with one of them having a larger labor force than the other; 2) two processors having the same output but having plants with

equipment of different hourly capacities; and 3) two processors having about the same output but filling containers of different sizes.

Three analyses were performed in this study:

1) The identities of the 20 sample plants were retained. Two of the variable costs—sugar and containers, and five of the fixed costs—depreciation, repairs, insurance, taxes, and interest on buildings and equipment, were standardized.
2) The 20 sample plants were divided into four groups and wages were standardized in addition to all of the items listed under the first analysis.
3) All variations other than those attributed to volume of output were eliminated through the design and analysis of five model plants.

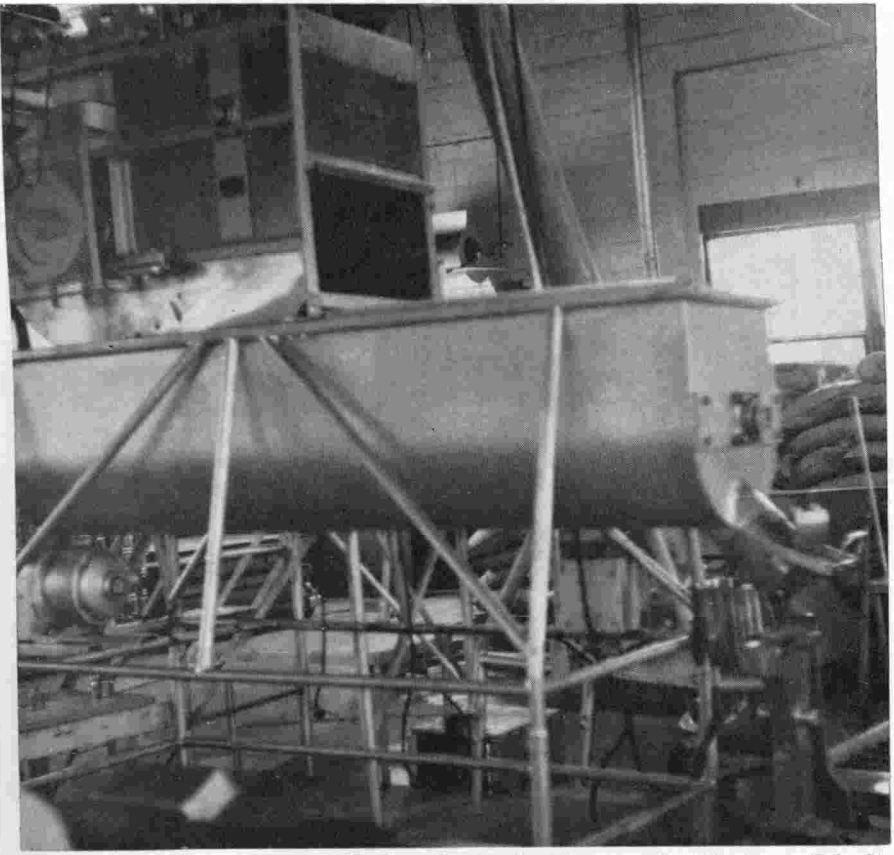

Figure 6. Strawberries are sliced and mixed with sugar in this type of fruit-mixing machine.

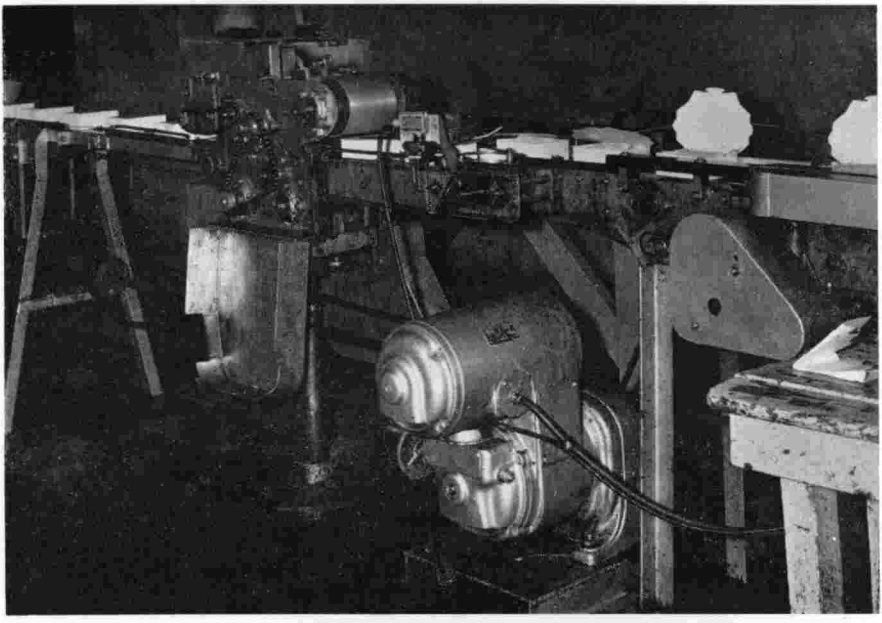

Figure 7. Cartons are closed by carton handling machine at left foreground.

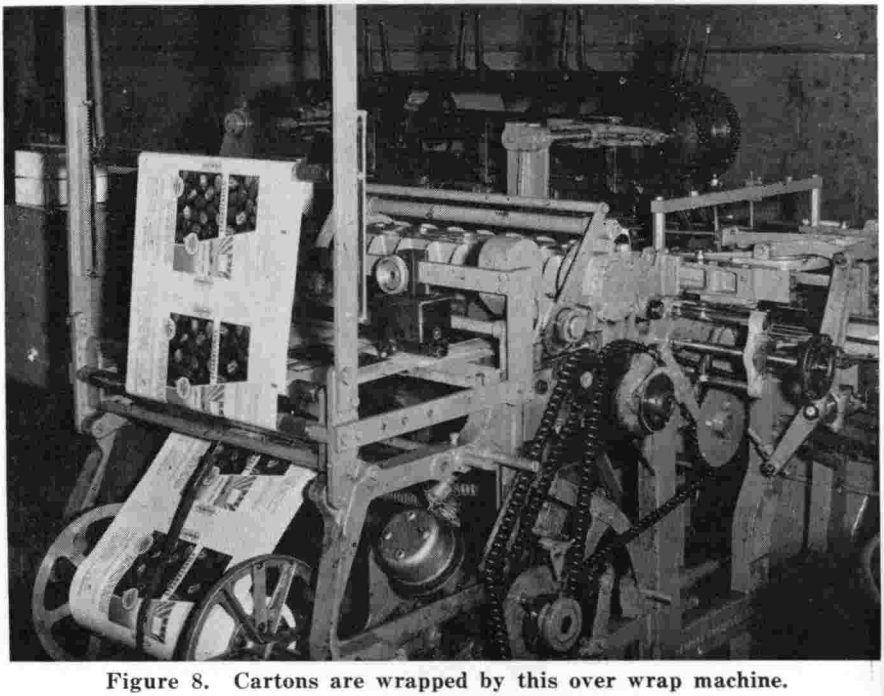

Figure 8. Cartons are wrapped by this over wrap machine.

Existing Plants

In the first analysis the sugar cost was standardized at 9 cents per pound. The container cost was also standardized as indicated in Table 1.

Table 1. Size and cost of containers

Size of container	Cost
10-oz. carton	46¢ per 24
16-oz. carton	49¢ per 24
6½-pound tin	13.2¢ each
10-pound tin	29¢ each
30-pound tin	40¢ each
50-pound tin	56¢ each
450-pound tin	$5.00 each

Some processors paid more for sugar than did others. In addition, some processors varied the proportions of strawberries and sugar in the ratios of 3 parts of strawberries and 1 part of sugar, or 7 parts of strawberries and 3 parts of sugar.

The annual building charges were based on building replacement costs, as follows: depreciation based on 2.5% of building replacement cost; repairs, 1.8%; insurance, 0.6%; taxes, 0.5%; and interest, 3.0% (about 5.5% on the undepreciated balance) making a total of 8.4%. These standardized costs were applied to the costs for buildings with the dimensions of those in use.

The annual building charges were based on an expected life of 40 years. The current replacement costs for the buildings were based on estimates obtained from managers of processing plants. Equipment, replacement, and installation costs were obtained from accounting records at each plant. The costs of maintenance, insurance, interest on investment, property tax, and depreciation were computed for each plant at uniform rates. Fixed repair cost was computed at 1.5% of the cost of the equipment; insurance, 1%; interest on investment, 3%; property tax, 0.5%; and depreciation according to estimated use life.

In the second analysis, the 20 existing plants were divided into four groups according to the volume of output per hour, as shown in Table 2.

Table 2. Strawberry processing plants classified by output per hour, Tennessee, 1959

Size group	Number of plants in each group	Pounds of strawberries processed per hour	
		Range	Average
I	5	2,000- 3,999	3,000
II	6	4,000- 4,999	4,500
III	5	5,000- 6,999	6,000
IV	4	7,000-12,999	10,500

The standardized wage rates used for each classification of labor were as follows:

Superintendent	$700.00 per month
Engineer & foreman	$ 95.00 per week
USDA inspector	$ 4.50 per hour
Stenographer & clerk	$ 1.25 per hour
Plant workers	$ 1.00 per hour[2]

Payroll tax was computed at the rate of 5.5% of wages paid.

Model Plants

With model strawberry processing plants it is possible to determine: 1) the least-cost for a given level of output and technology, and 2) the variation of costs with size of plant.

In the short-run, the size of plant is regarded as constant. In the long-run, technologies and capacity of plant can be altered. The long-run costs may be represented by a curve that shows the lowest cost of production for the specified levels of output and is applicable when all factors of production are permitted to vary. The long-run cost curve is tangent to a number of short-run cost curves. The short-run and long-run cost curves are illustrated in Figure 11, page 30.

Plant capacity may be examined from either a technical or economical standpoint. Technical capacity relates to the maximum rate of output for the plant irrespective of costs. Economic capacity refers to the least average cost of operation.[3]

In determining the output of a particular plant, it is often possible to change the rate of production by changing the number of workers employed in certain production activities (in the short-

[2]Wage rate when the study was made.

[3]Dean, Joel, **The Long-Run Behavior of Costs in a Chain of Shoe Stores**, A Statistical Analysis, University of Chicago Press, Chicago, 1942, p. 6.

run), or by adding a completely separate processing line (in the long-run), or by shifting to alternative technologies.

A second dimension of output, other than the rate dimension mentioned above, is the time of operation. The distinction between changes in time and rate dimensions is made to define the relevant cost functions. The importance of the time dimension varies among types of processing operations. For example, in crops that are processed, much variation is possible in the number of hours the processing plant is operated per season.

Five model plants with capacities of 2, 4, 6, 8, and 10 thousand pounds of raw product per hour of operation were used as a basis for estimating processing costs. A range of 50-200 hours was used to evaluate the influence of different lengths of operating seasons. Three different levels of losses from sort out, 5%, 10%, and 15%, were included in the analysis. Costs were estimated when strawberries were packed in the 10- and 16-ounce, and 6½-, 30-, and 50-pound containers. In addition, three rates of plant capacity were considered: full capacity, 75%, and 50% of capacity.

Buildings and Equipment

Buildings and equipment costs were standardized. This was done to eliminate cost variations attributed to factors other than volume. The same type of equipment was used in the 1- through 5-belt plants. The same rates were used, as in the 20 existing plants, for depreciation, repairs, insurance, taxes and interest. The building space was estimated from the following equation: $A = 420 + 1112.6X$ where A is the enclosed area in square feet and X is the strawberry-input capacity in thousand pounds per hour. The planning cost for buildings was estimated by the following equation: $C = 1{,}070 + 307.7X$ where X is the strawberry-input capacity in thousand pounds per hour.[4]

Labor Standards

As a basis for the design of model plants, labor standards were prepared for each of the operations in processing strawberries. It was assumed that these standards would be the continuous output rate of a reasonably efficient worker.

[4]Dennis, Carleton C., **An Analysis of Costs of Processing Strawberries for Freezing**, Mimeographed Report No. 210, California Agricultural Experiment Station, University of California, Berkeley, July 1958, p. 51.

Time Studies

Where necessary, time studies were utilized to ascertain the time requirements for performing each processing job. It was necessary to allow 15% of the total work time for nonproduction time, such as unavoidable delay, rest periods, and personal time. To illustrate, an average of 16 seconds was required to dump a 12-quart lug of strawberries by the jig method. The time required to dump the same quantity manually from a 24-quart crate—2 quarts at one time—averaged 25 seconds. After making an allowance for nonproductive time, the work standard for 60 minutes was estimated to be 190 12-quart lugs by the jig method, and 122 12-quart lugs by the manual method. Accounting records were also used as a basis for determining job standards where time and production studies were not available.

COSTS AND EFFICIENCY IN EXISTING PLANTS

Costs may be classified into five groups: variable operating, constant-unit operating, fixed operating, fixed overhead, and total costs. All costs in this report are grouped under variable, fixed, and total costs.

Variable Costs

Variable costs are those costs which vary with output. In this study, the cost of sugar, labor, containers, freezing and storage, electricity and water, and transportation were classified as variable costs. The first analysis retained the identities of the 20 plants, except that the following variable costs were standardized: sugar, containers, and rate of interest, taxes, insurance, depreciation, and repairs on buildings and equipment.

In the 1959 season the volume of the 20 plants ranged from 140,808 to 1,411,700 pounds (Table 3). Plants differed considerably in processing costs for labor, ranging from 0.66 to 3.34 cents per pound of strawberries processed. Labor, container, and sugar costs accounted for 84% of the variable costs. Freezing and storage, transportation, electricity, and water accounted for the remaining 16% of variable costs, in the order named.

Fixed Costs

Fixed costs are any costs that do not vary with output. In this study, the costs of building, equipment, and administration and office supplies were classified as fixed costs.

Table 3. Variable costs of processing strawberries per pound in 20 Tennessee plants, 1959

Plant	Annual volume of strawberries processed	Variable cost						Total variable cost
		Sugar	Processing labor cost[a]	Containers	Freezing and storage	Electricity and water	Transportation	
	Pounds				Cents			
A	140,808	1.45	1.86	1.56	0.64	0.03	0.54	6.08
B	142,215	1.80	1.10	1.33	0.64	0.03	0.34	5.24
C	192,438	2.21	2.76	1.49	0.30	0.17	0.40	7.33
D	259,290	0.97	3.34	1.09	0.42*	0.20*	0.48	6.50
E	296,313	1.84	1.09	1.14	0.64	0.07	0.41	5.19
F	296,420	2.70	1.54	1.33	0.64	0.09	0.36	6.66
G	301,020	1.60	1.20	1.33	0.62	0.02	0.41	5.18
H	326,002	1.91	1.56	1.83	0.34*	0.24*	0.26	6.14
I	328,818	1.42	1.60	1.58	0.21*	0.29*	0.24	5.34
J	330,720	1.26	2.01	1.19	0.06*	0.30*	0.48	5.30
K	347,262	2.19	1.95	2.75	0.64	0.09	0.21	7.83
L	393,699	1.97	1.72	2.64	0.64	0.07	0.20	7.24
M	473,520	2.03	1.49	1.27	0.64	0.03	0.48	5.94
N	642,590	2.01	1.27	1.38	0.19*	0.12*	1.17	6.14
O	762,142	2.12	1.93	2.06	0.65	0.05	0.37	7.18
P	925,743	1.60	1.79	2.04	0.65	0.03	0.46	6.57
Q	1,034,300	2.70	1.01	1.16	0.64	0.04	0.42	5.97
R	1,114,900	2.34	0.66	1.12	0.64	0.04	0.10	4.90
S	1,235,090	2.03	1.51	2.33	0.09*	0.12*	0.19	6.27
T	1,411,700	2.67	0.85	1.12	0.64	0.04	0.10	5.42
Average	547,750	1.94	1.61	1.59	0.50	0.10	0.38	6.12
Percent each item is of total variable cost		31.7%	26.3%	26.0%	8.2%	1.6%	6.2%	100.0%
Standard deviation		.46	.61	.50	.21	.12	.22	0.81

[a]Includes paroll taxes @ 5.5% of wages paid.

*Plant has its own freezing compartment.

See Appendix Table 1 for variable costs in dollars.

The building costs ranged from 0.11 cent per pound of processed strawberries for plant "O" to 3.06 cents for plant "C" (Table 4). Plant "D" also had unusually high building costs of

Table 4. Fixed costs of processing strawberries per pound of processed berries in 20 Tennessee plants, 1959

Plant	Annual volume of strawberries processed	Fixed cost			Total fixed cost
		Plant equipment cost[a]	Building cost[b]	Admin. expenses	
	Pounds		Cents		
A	140,808	1.42	0.48	0.85	2.75
B	142,215	1.92	0.24	1.15	3.31
C	192,438	2.44	3.06	0.89	6.39
D	259,290	3.10	1.88	0.41	5.39
E	296,313	0.97	0.43	1.06	2.46
F	296,420	0.88	0.74	0.83	2.45
G	301,020	0.88	0.50	0.38	1.76
H	326,002	2.79	0.77	0.41	3.97
I	328,818	1.36	0.51	0.31	2.18
J	330,720	0.88	0.51	0.39	1.78
K	347,262	2.74	0.21	0.44	3.39
L	393,699	2.58	0.64	0.40	3.62
M	473,520	1.38	0.53	0.31	2.22
N	642,590	0.39	0.65	0.18	1.22
O	762,142	1.84	0.11	0.26	2.21
P	925,743	1.29	0.45	0.43	2.17
Q	1,034,300	0.68	0.20	0.24	1.12
R	1,114,900	0.32	0.19	0.24	0.75
S	1,235,090	1.44	0.68	0.26	2.38
T	1,411,700	0.43	0.18	0.19	0.80
Average	547,750	1.49	0.65	0.48	2.62
Percent each item is of total average fixed cost		56.9%	24.8%	18.3%	100.0%
Standard deviation		0.84	0.66	0.28	1.40

[a]Based on installed cost. The items included and rates are listed on p. 13.

[b]Based on building replacement cost. The items included and rates are listed on p. 13.

See Appendix Table 2 for fixed costs in dollars.

1.88 cents per pound of processed strawberries. The very high building costs were attributed to the greater than average building replacement costs and the small seasonal volume of strawberries processed. For example, the building replacement costs for plants "C" and "D" were $70,000 and $58,000, respectively, whereas the average building replacement cost for the 20 plants was $31,375. Plant equipment, administrative expenses, and office supplies comprised 75.2% of the total fixed costs.

Total Costs

Total costs, including the cost of the strawberries, ranged from 15.79 to 24.54 cents per pound and averaged 19.88 cents (Table 5). The total unit cost of processing strawberries was not highly associated with the annual volume of strawberries processed. The coefficient of correlation (r value) was .5172. The coefficient of determination (r^2) was .2675.

Table 5. Total costs of processing strawberries per pound of processed berries in 20 Tennessee plants, 1959

Plant	Annual volume of strawberries processed	Total variable cost	Total fixed cost	Total cost	Total cost including raw strawberries
	Pounds			Cents	
A	140,808	6.08	2.75	8.83	19.86
B	142,215	5.24	3.31	8.55	20.19
C	192,438	7.33	6.39	13.72	24.54
D	259,290	6.50	5.39	11.89	24.38
E	296,313	5.19	2.46	7.65	17.51
F	296,420	6.66	2.45	9.11	19.27
G	301,020	5.18	1.76	6.94	18.28
H	326,002	6.14	3.97	10.11	21.09
I	328,818	5.34	2.18	7.52	20.41
J	330,720	5.30	1.78	7.08	19.03
K	347,262	7.83	3.39	11.22	22.44
L	393,699	7.24	3.62	10.86	23.24
M	473,520	5.94	2.22	8.16	18.55
N	642,590	6.14	1.22	7.36	17.92
O	762,142	7.18	2.21	9.39	20.52
P	925,743	6.57	2.17	8.74	20.68
Q	1,034,300	5.97	1.12	7.09	17.69
R	1,114,900	4.90	0.75	5.65	15.79
S	1,235,090	6.27	2.38	8.65	19.77
T	1,411,700	5.42	0.80	6.22	16.41
Average	547,750	6.12	2.62	8.74	19.88
Percent each average is of average total cost		70.0%	30.0%	100.0%	
Standard deviation		0.81	1.40	1.97	2.36

See Appendix Table 3 for total costs in dollars.

Types of Containers Related to Costs

Table 6 shows the costs per pound and relative rank for processing strawberries and packing them in the different size containers. The average variable cost was lowest—5.16 cents per pound—when the 50-pound tins were packed. More labor, electri-

Table 6. Average costs per pound of processing strawberries in 20 Tennessee plants, by size of containers packed, 1959

Size of containers		Variable cost	Fixed cost	Total cost	Rank based on total cost
Ounces	Pounds		Cents per pound		
	50	5.16	.78	5.94	1
	30-50	5.97	1.12	7.09	2
	6½-30	5.34	2.18	7.52	3
	30-450	5.19	2.46	7.65	4
	10-30	6.11	1.98	8.09	5
	30	5.80	2.82	8.62	6
10-16	6½-10-30	6.27	2.38	8.65	7
10-16	6½-30	6.63	2.78	9.41	8
10-16	6½	7.83	3.39	11.22	9
16	10-30	7.33	6.39	13.72	10

city, and containers were used when smaller containers were packed. The wide range in fixed costs was due to excess capacity and to additional cost of automatic equipment for packaging in small containers. Total cost per pound was lowest—5.94 cents per pound—when packing was done in the 50-pound tins and highest—13.72 cents per pound—when packing was done in the 16-ounce, 10-, and 30-pound tins.

Labor Utilization and Efficiency

The efficiency of labor in processing plants is one of the few areas where management can make substantial savings, since labor comprises about one-fourth of total variable costs. The output per man-hour of labor in processing strawberries is affected by several factors, such as the type, amount and condition of equipment, size of containers packed, plant capacity utilized, and the ability and industry of processing labor.

In Table 7, for example, the output per man-hour ranged from 39 to 179 pounds of processed product. Plant "R," with the highest output, packaged only 50-pound tins. The second highest output per man-hour was in a plant where 10- and 16-ounce cartons were used.

PLANT-SIZE GROUPS RELATED TO COSTS

Average Varaible Costs

Labor Costs

The processing labor costs included the salaries of an engineer, a foreman, and USDA inspectors, in addition to the wages of labor

Table 7. Annual volume and output per man-hour by size of containers packed in 20 strawberry processing plants in Tennessee, 1959

Plant	Annual volume of strawberries processed	Size of containers packed		Output per man-hour
	Pounds	Ounces	Pounds	Pounds
R	1,114,900		50	179
S	1,235,090	10-16	6½-10-30	177
T	1,411,700		50	158
E	296,313		30-450	127
Q	1,034,300		30-50	125
N	642,590		10-30	119
G	301,020		30	116
M	473,250		30	102
C	192,438	16	10-30	101
I	328,818		6½-30	98
B	142,215		30	94
L	393,699	10-16	30	80
F	296,420		30	79
A	140,808		10-30	79
H	362,002	10-16	6½-30	77
P	925,743	10-16	6½-30	73
J	330,720		30	69
K	347,262	10-16	6½	68
O	762,142	10-16	6½-30	64
D	259,290		30	39

used in proccssing. Labor costs were the largest components of variable costs. When the plants were grouped by output per hour, as in Table 8, plants in Group I ranked first, while plants in

Table 8. Average variable costs of processing strawberries, 20 plants classified into four size groups, Tennessee, 1959

Item	Size of plant (pounds processed per hour)			
	Group I 2,000-3,999	Group II 4,000-4,999	Group III 5,000-6,999	Group IV 7,000-12,999
	Cents per pound of processed berries			
Labor[a]	1.97	1.81	1.50	1.00
Sugar	1.57	1.87	1.99	2.44
Containers	1.66	1.54	1.91	1.17
Freezing and storage[b]	0.51	0.44	0.44	0.64
Electricity and water[b]	0.13	0.14	0.09	0.04
Transportation	0.36	0.40	0.47	0.28
Average variable cost	6.20	6.20	6.40	5.57
Raw strawberries	11.85	11.19	11.01	10.33
Average variable cost including raw strawberries	18.05	17.39	17.41	15.90

[a]Includes USDA inspector @ $4.50 per hour; engineer, and foreman @ $95.00 per week.

[b]The six plants having their own freezing units were evenly distributed among the first three groups.

Group II were second and plants in Groups III and IV were third.

Sugar Costs

Sugar costs were computed on the actual ratios of the sugar and strawberries mixed by the existing plants. It was found that the most common mix used by the 20 sample plants was 4 parts of strawberries to 1 part of sugar. Other mixes included 3 parts of strawberries to 1 part of sugar and 7 parts of strawberries to 3 parts of sugar. The price differentials for sugar were so small that the price of sugar was standardized at 9 cents per pound. The actual cost differentials were attributed to plants using more sugar in the mixes. For example, plants using a mixture of 7 plus 3 used 5 pounds more sugar per hundred pounds of berries than plants using a mixture of 3 plus 1.

Container Costs

Containers are a major cost item in processing strawberries. Container costs did not decline consistently by size of plant because all plants did not use the same types of containers. For example, the highest cost containers were in Group III plants. The plants in this group packed in the most expensive containers—the 10- and 16-ounce cartons, and the 6½- and 10-pound tins.

Freezing and Storage

Freezing and storage costs were 0.13 cent per pound more in Group IV plants than in Group I, and 0.20 cent per pound more in Group IV plants than in Groups II and III. These cost differentials are explained by the operation of freezer units in some of the plants in each of the first three groups, whereas all of the plants in Group IV stored their processed berries in commercial freezer plants.

Electricity and Water

Because of the small amount of cost involved, the items of electricity and water were combined. The costs were based on those reported by the 20 sample plants. Table 8 shows that these costs decreased as the size of plant increased, except in one instance. There were plants with their own freezing units in Groups I, II, and III which used relatively more electricity than did the plants in Group IV that operated without freezing compartments. The packaging of 10- and 16-ounce cartons required more electricity than 6½-, 10-, 30-, and 50-pound tins. Some of the plants in each

of the first three groups packaged 10- and 16-ounce cartons, while all of the plants in Group IV packed in tins.

Transportation Cost

Sizable volumes of the strawberries were purchased at country buying points. After buying the berries, it was necessary to pay transportation costs on the berries from the point of purchase to the plants. Table 8 shows that the transportation costs did not decline relative to size of plant for Groups II and III. The plants in these groups transported the strawberries from production areas that were located farther from their plants than did plants in Groups I and IV.

Average Total Variable Cost

The average variable costs were the same for the plants in Groups I and II, and 0.63 cent higher than for the plants in Group IV. Table 8 also shows that labor, container, and sugar costs were the major items contributing to the cost of processing for all plants.

Fixed Costs

Equipment

Table 9 shows that the charges for equipment constitute the

Table 9. Average fixed costs of processing strawberries, 20 plants classified into four size groups, Tennessee, 1959

Item	Size of plant (pounds processed per hour)			
	Group I 2,000-3,999	Group II 4,000-4,999	Group III 5,000-6,999	Group IV 7,000-12,999
	Cents per pound of processed berries			
Equipment charge[a]	2.11	1.53	1.44	0.70
Annual building charge[b]	0.66	1.00	0.50	0.28
Administration	0.63	0.56	0.43	0.24
Average total fixed cost	3.40	3.09	2.37	1.22

[a]Based on installed cost. The items included and rates are listed on pp. 00-00.
[b]Based on building replacement cost. The items included and rates are listed on p. 00.

largest component of fixed costs. These charges declined from 2.11 cents per pound of processed berries for Group I plants to 0.70 cent per pound for Group IV plants. Costs in Group II and III plants, however, differed by only 0.09 cent per pound.

Building

When the plants were classified by pounds of berries processed per hour, the building costs ranged from 0.66 cent per pound for plants in Group I to 0.28 cent for the plants in Group IV. The plants in Group II had the highest average building costs, which averaged 1 cent per pound.

Administration

Administration costs were an important part of fixed costs. They decreased per pound of processed strawberries as output per hour increased but not in the same proportion. The average costs per pound for plants in Groups II, III, and IV were lower by 0.07, 0.20, and 0.39 of a cent, respectively, than for the plants in Group I.

Average total fixed costs decreased from Group I to Group II by 0.31 cent per pound of strawberries processed, and declined steadily as plant size increased. The average fixed cost in Group I was almost three times that in Group IV.

Investment in Buildings and Equipment

The average investment in buildings was not in direct proportion to the size of each group of plants. For example, the average investment for the plants in Group I was $19,700; Group II, $35,667; and Group III, $41,000; however, investment for Group IV was only $27,500.

Average investment costs for equipment showed a range of only $233.00 from Group I to Group II. However, the average cost of equipment was almost $25,000 higher for plants in Group III than for plants in Group I or II. The differential in average cost of equipment was only about $4,900 more for plants in Group IV than those in Group I (Table 10).

Table 10. Average investment in buildings and equipment, 20 plants classified into four size groups, Tennessee, 1959

Size group	Investment per plant		
	Buildings	Equipment	Buildings and equipment
	(dollars)	(dollars)	(dollars)
I	19,700	32,503	52,203
II	35,667	32,736	68,403
III	41,000	57,242	98,242
IV	27,500	37,373	64,873

Total Cost

An estimate of total cost by the four size groups is obtained by adding variable costs to fixed costs. Table 11 shows that Group

Table 11. Average total cost of processing strawberries, 20 plants classified into four size groups, Tennessee, 1959

Item	Size of plant (pounds processed per hour)			
	Group I 2000-3999	Group II 4000-4999	Group III 5000-6999	Group IV 7000-12,999
	Cents per pound of processed berries			
Average variable cost excluding raw strawberries	6.20	6.20	6.40	5.57
Average fixed cost	3.40	3.09	2.37	1.22
Total cost	9.60	9.29	8.77	6.79
Total cost including strawberries	21.45	20.48	19.78	17.12

I had the highest average total costs of 9.60 cents per pound. This is because of both high fixed and variable costs. Group II had the second highest average cost of 9.29 cents per pound. The low fixed costs more than offset the high variable costs. Group III had the third highest average cost of 8.77 cents per pound. The higher variable and fixed costs of Group III over Group IV were due to differences in labor, containers, transportation, equipment, building charges, and administration.

COSTS AND EFFICIENCY IN MODEL PLANTS

Plant Capacity

Figure 9 illustrates how the percent of capacity used influences variable and fixed costs. The cost changes are based on a 4-belt model plant operating 100 and 200 hours annually with the product packed in 10-ounce containers.

Variable Costs

Costs of wages, electricity, water, and variable repairs increase in total as volume increases, but decline slightly per pound. Payroll and volume data show that output per dollar of input increases and cost per unit of output decreases as utilization of capacity increases from 50% to 100%. Cost per unit of electricity and water decline as plant volume increases. The cost of these two

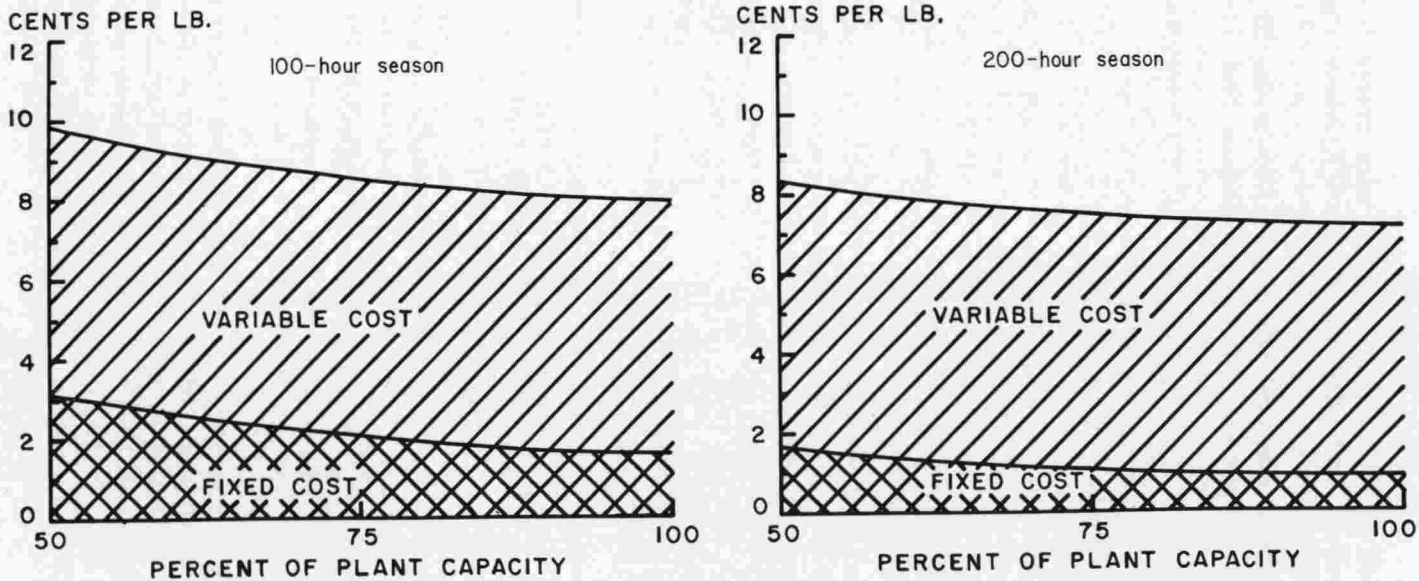

Figure 9. Relationship of use of plant capacity to costs for a 4-belt model plant packaging in the 10-ounce carton, Tennessee, 1963.

Assumptions: Input, 2,000 pounds per hour per belt at 100 percent of capacity; sort out, 10 percent; operating season, 100 and 200 hours.

items usually has a fixed initial charge and lower rates to a minimum level as volume of processed products increases. Containers and expendible supplies are used in direct proportion to volume.

Using a 4-belt plant operating 100 hours, and packing in the 10-ounce container with 10% sort out, the variable costs at 50%, 75%, and 100% capacity are 6.67, 6.42 and 6.34 cents per pound, respectively, or 0.33 cent per pound range as use of capacity goes from 50% to 100%. For the same size plant operating 200 hours, the costs are 6.62, 6.38, and 6.31 cents per pound at 50%, 75%, and 100% of capacity, respectively.

Fixed Costs

The costs over the planning period primarily include those costs related to the ownership of building and equipment: depreciation, taxes, interest on investment, insurance, and maintenance. In addition, fixed costs include salaries for management, and supervisory and office workers. Fixed costs per unit of product decline in direct proportion to increases in volume.

Using the model plant, as specified, the fixed costs for the plant operating 100 hours are 3.17, 2.11, and 1.59 cents per pound at 50%, 75%, and 100% of capacity. There is a reduction of 1.58 cents per pound when the plant operation is changed from 50% to 100% of capacity. When the operating period is changed to 200 hours for the same plant, the fixed costs are 1.68, 1.12, and 0.84 cents per pound at 50%, 75%, and 100% of capacity. (Appendix Tables 4 and 5 show unit and dollar costs).

Plant Size and Use of Capacity

The degree to which the use of capacity affects the average total cost per pound depends to some extent on the size of the processing plant. Figure 10 shows that total costs per unit of processed strawberries are successively lower for each percentage of plant capacity used. But, the cost spread is minimized as the annual output increases because the relative importance of plant wages and costs of capital ownership and use declines. In addition, some equipment and personnel may be more under-utilized in the small plants. The cost spread between operating at 50% and 100% of capacity for a one-belt, 200-hour season plant is 2.79 and 2.14 cents per pound for the 10-ounce cartons and 30-pound tins, respectively; for a 5-belt plant the difference is 1.01 cents per pound for the 10-ounce carton and 0.73 cent per pound for the 30-pound tin. (See Appendix Tables 6 and 7 for unit and dollar costs).

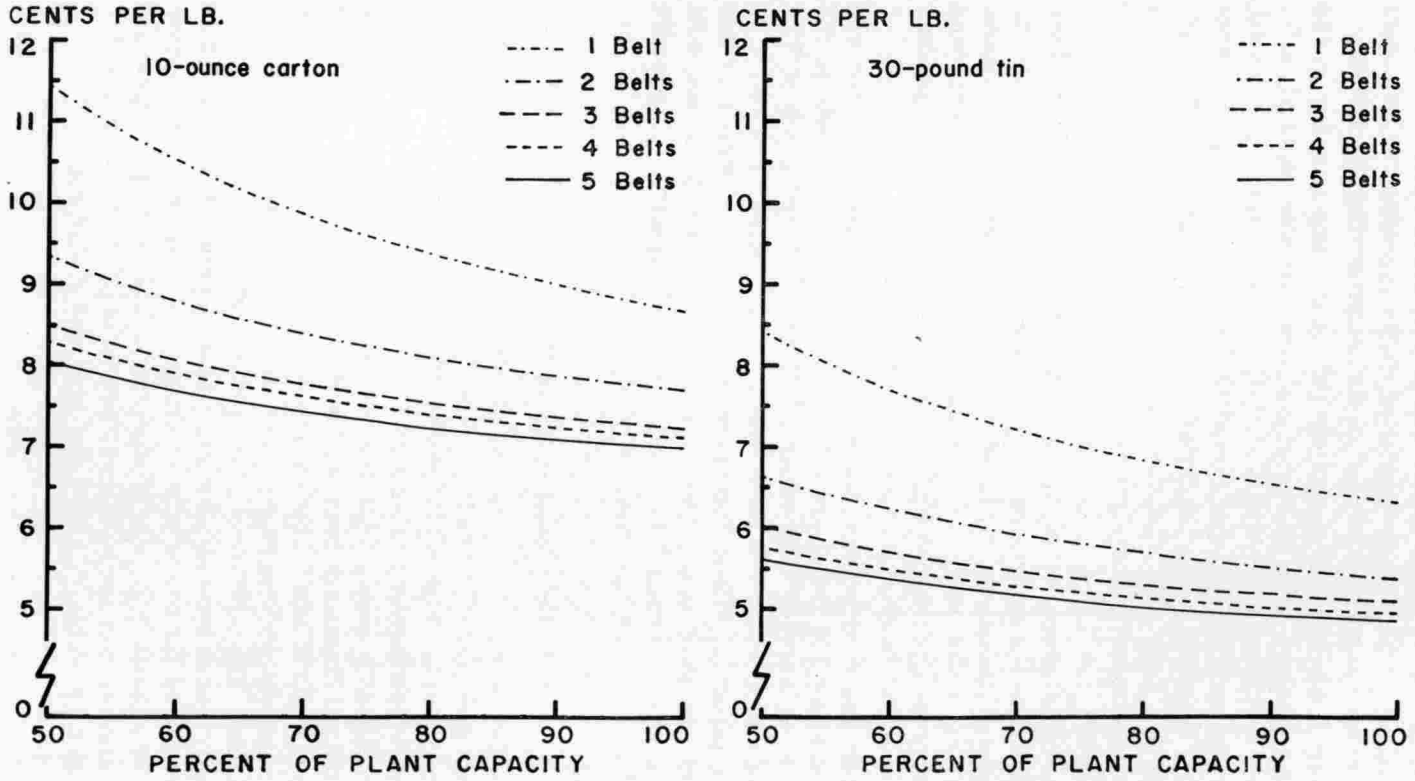

Figure 10. Relationship of plant size and use of capacity to average total costs per pound for five model plants packaging in the 10-ounce and 30-ounce containers, Tennessee, 1963

Assumptions: Input, 2,000 pounds per hour per belt at 100 percent of capacity; sort out, 10 percent; operating season, 200 hours.

Plant Size and Volume

Appreciable economies of scale are shown in processing strawberries. Average total costs decline as plant capacity increases. The model plants developed had 1 through 5 inspection belts with each belt having a capacity of 2,000 pounds per hour.

Packing in the 10-Ounce Container

Assuming that the five model plants operated at full capacity with a 10% sort out for a 100-hour season, the potential processing cost savings from the 1- to 5-belt plant (2,000 to 10,000 pounds per hour input) would be 2.47 cents per pound, and for a 200-hour season, 1.65 cents per pound. About 59% of the savings—0.97 cent per pound—was shown as plant size increased from 1 to 2 inspection belts for the 200-hour season. However, there was only 0.13 cent per pound difference in processing cost between plants with 4 and 5 belts. The annual volumes of strawberries processed for plants with 1, 2, 3, 4, and 5 inspection belts under the above specified assumptions and operating for 200 hours would be about 454, 907, 1,361, 1,814, and 2,268 thousand pounds[4] respectively (Figure 11). Appendix Tables 8 and 9 show unit and dollar costs.

Packing in the 30-Pound Container

The potential processing cost savings from the 1- to 5-belt plant would be 2.06 and 1.42 cents per pound when the plants operate at full capacity with a 10% sort out for 100- and 200-hour seasons, respectively. The greatest savings—about 65%—occurred from the 1- to the 2-belt plant (Figure 12). Appendix Tables 10 and 11 show unit and dollar costs.

Containers Packed and Plant Size

Figure 13 presents the average total unit costs for the 10-ounce, 6½-, 30-, and 50-pound containers. The chart expresses the fact that packing in larger containers results in lower processing costs per pound. For example, at a volume of 400,000 pounds and a 100-hour season, costs for processing strawberries in the 10-ounce, 6½-, 30-, and 50-pound containers would be 10.18, 9.20, 7.39, and 7.08 cents, respectively, or a difference of 3.10 cents per

[4]The annual pounds processed were computed by subtracting the sort out from the annual input and adding a 5% allowance for water retention. The amount of sugar was added to this. Example: 2,000 pounds of strawberries per hour for 200 hours equals 400,000 pounds input for the season. 400,000 − 10% (sort out) = 360,000 + 5% (water) = 378,000 + 20% (4 + 1 sugar) = 453,600 pounds processed.

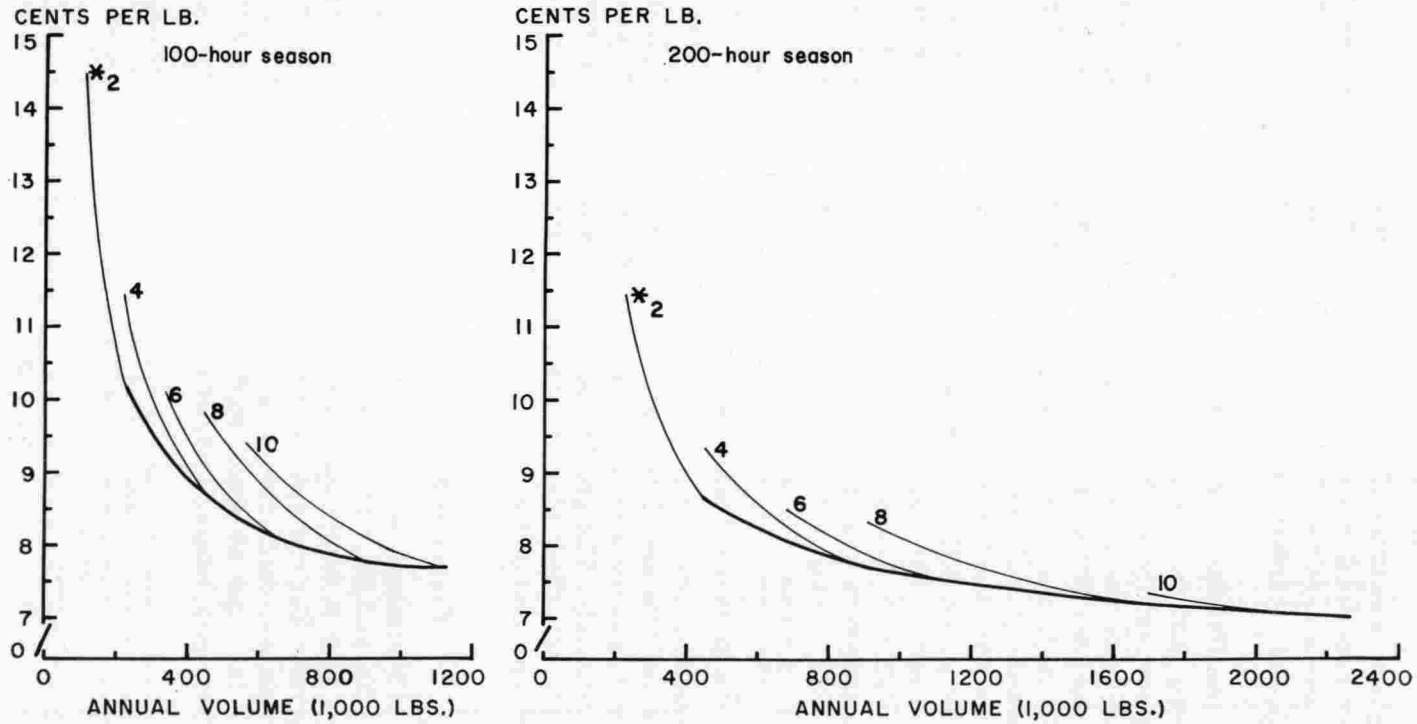

Figure 11. Relationship of plant size and volume to average total costs per pound for five model plants packaging in the 10-ounce carton, Tennessee, 1963.

Assumptions: Input, 2,000 pounds per hour per belt at 100 percent of capacity; sort out, 10 percent; operating season, 100 and 200 hours.
*The number on each curve indicates the capacity of the model plant in thousands of pounds per hour of operation.

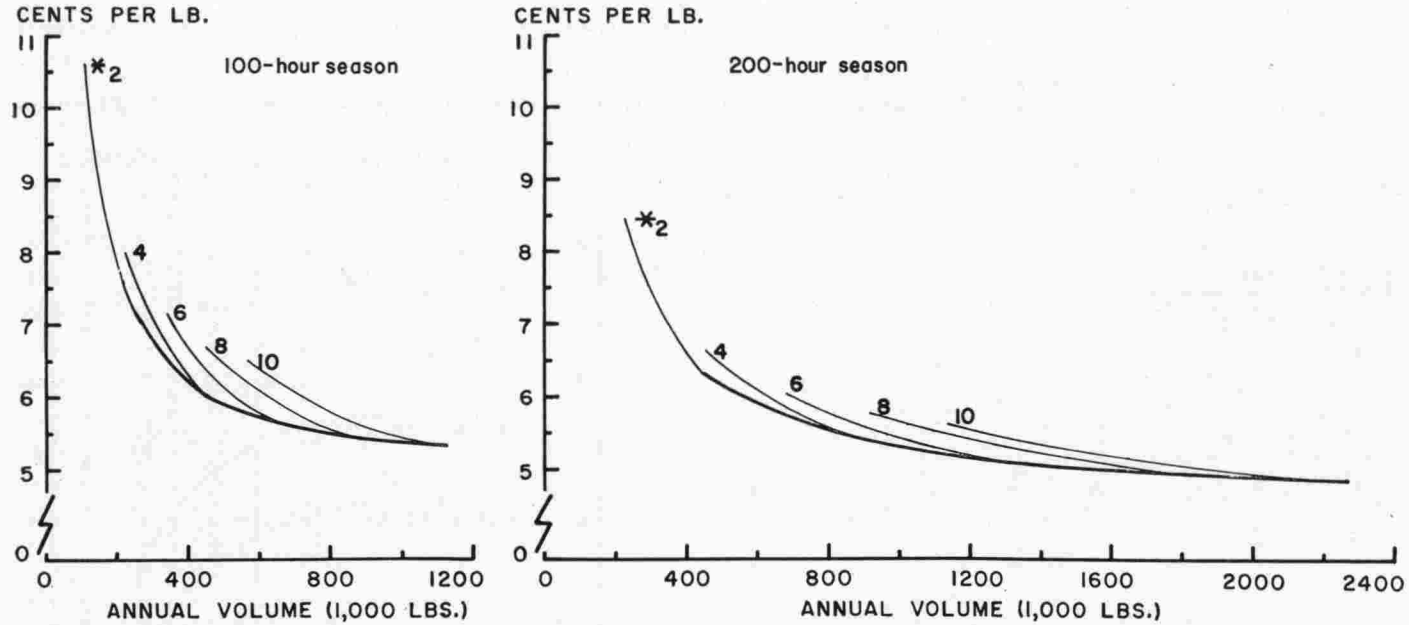

Figure 12. Relationship of plant size and volume to average total costs per pound for five model plants packaging in the 30-pound container, Tennessee, 1963.

Assumptions: Input, 2,000 pounds per hour per belt at 100 percent of capacity; sort out, 10 percent; operating season, 100 and 200 hours.

*The number on each curve indicates the capacity of the model plant in thousands of pounds per hour of operation.

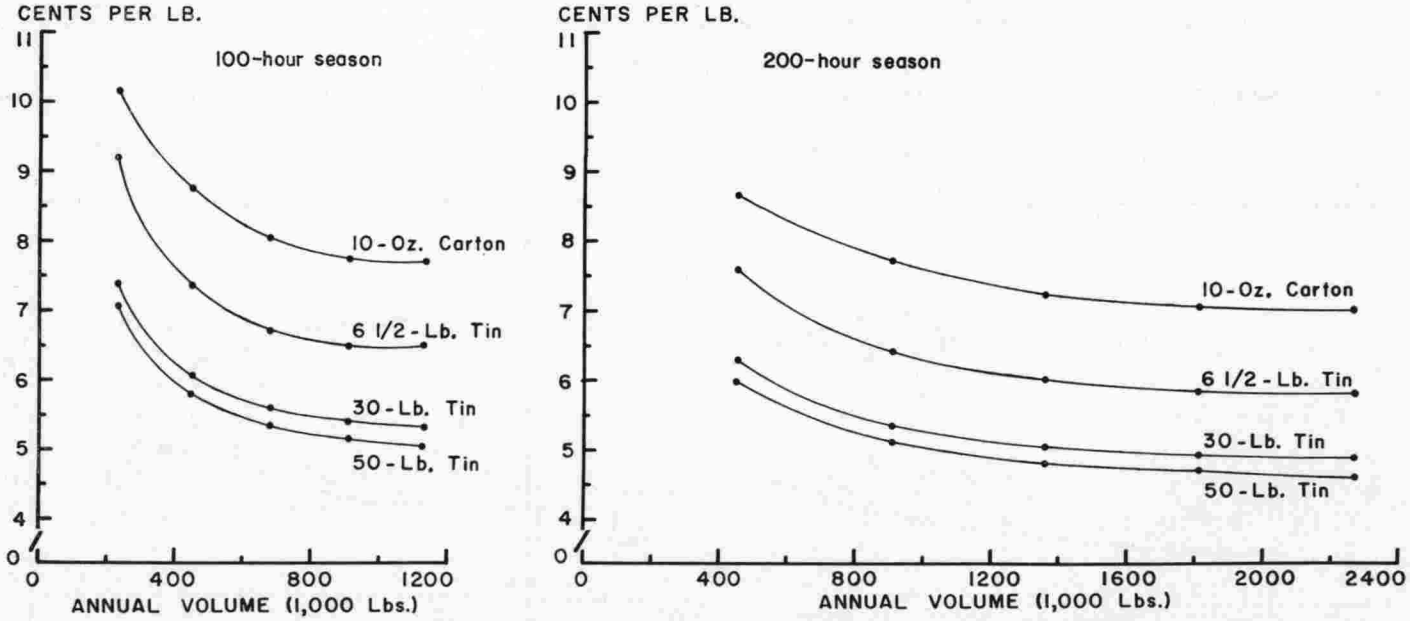

Figure 13. Relationship of containers packaged to average total costs per pound for five model plants operating at 100 percent of capacity, Tennessee, 1963.

Assumptions: Input, 2,000 pounds per hour per belt; sort out, 10 percent; operating season, 100 and 200 hours.

pound between the cost of the 10-ounce and 50-pound containers. When the same plant operates 200 hours, the difference in costs per pound between the 10-ounce carton and 50-pound tin is 2.69 cents. The chart also shows the relationship of plant size to average total unit costs when processing and packaging the product in different size containers. It is observed that the costs drop sharply from the 1-belt to the 2-belt plants, but these costs drop less sharply with the 3-, 4-, and 5-belt plants. Appendix Tables 12 and 13 show unit and dollar costs.

Length of Season

Figure 14 illustrates the relationship of the hours of operation per season on the average total cost per pound with the 10-ounce carton used as an example. Average total unit costs decrease sharply through 100 hours of operation. When the season is increased to 200 hours, the average costs become somewhat less. At volumes of 100,000 and 500,000 pounds, the processing and packaging costs are 13.18 and 9.09 cents per pound for a 50-hour

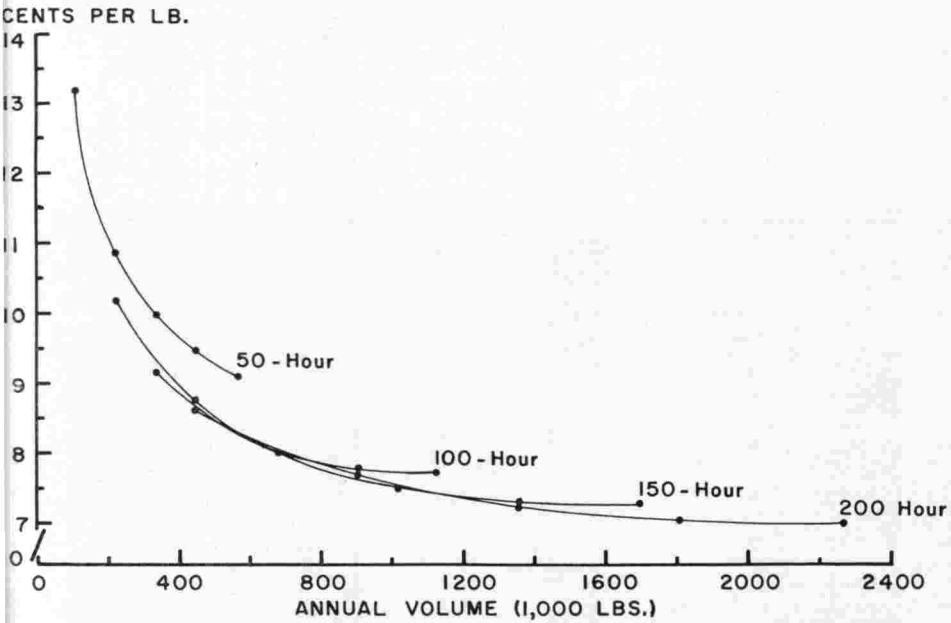

Figure 14. Relationship of length of season to average total costs per pound for five model plants operating at 100% of capacity and packaging in the 10-ounce carton, Tennessee, 1963.

Assumptions: Input, 2,000 pounds per hour per belt; sort out, 10 percent; operating season, 50, 100, 150, and 200 hours.

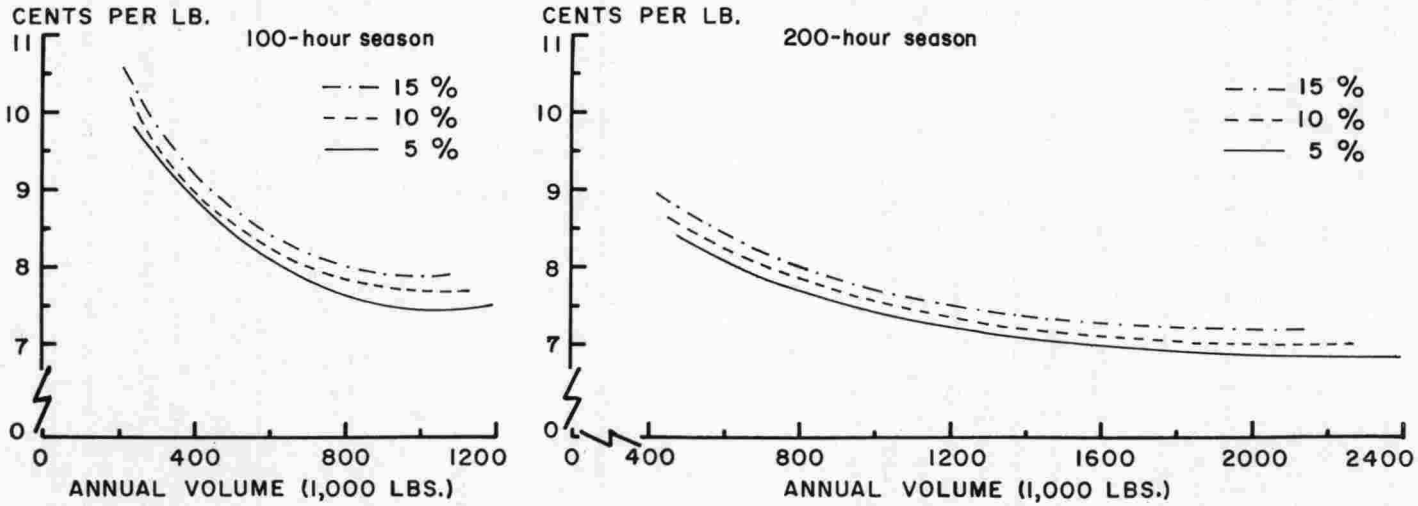

Figure 15. Relationship of percent of sort outs to average total costs per pound for five model plants operating at 100 percent of capacity and packaging in the 10-ounce carton, Tennessee, 1963.

Assumptions: Input, 2,000 pounds per hour per belt; sort out, 5, 10, and 15 percent; operating season, 100 and 200 hours.

season, while the costs for volumes of 400,000 and 2,300,000 are 8.67 and 7.02 cents per pound for a 200-hour season. Appendix Tables 14 and 15 show unit and dollar costs.

Amount of Sort Out

Figure 15 shows that the percent of culls removed from the inspection belt materially influences the costs. For a model plant with three inspection belts operating at full capacity for 100 hours and packing in the 10-ounce carton, the average cost per pound is 7.80, 8.04 and 8.30 cents for 5%, 10%, and 15% sort outs. When the above plant operates for 200 hours, there is a difference of 0.40 cent per unit between the 5% and 15% sort outs. As the percentage of sort out increases, the number of inspection line workers increases and the total pounds processed decreases.

For example, a plant with three inspection belts with a 200-hour season and operating at full capacity requires 30 inspection line workers if the sort out is at the 5% level; 36, at the 10% level; and 42, at the 15% level. The annual volumes processed would be 1,436, 1,361, and 1,285 thousand pounds, respectively. Appendix Tables 16 and 17 show unit and dollar costs.

Method of Dumping

Considerable savings are shown by changing from the conventional method of dumping strawberries. The usual method in

Figure 16. Dumping 2 quarts of strawberries simultaneously.

Tennessee processing plants is for workers to dump 2 quarts simultaneously into the shaker-washer (Figure 16). Where the "jig" method is used, the worker takes a 12-quart lug of strawberries from the adjacent stack, and places the lug upright on a frame made of small metal rods (Figure 17). Next, the frame and lug

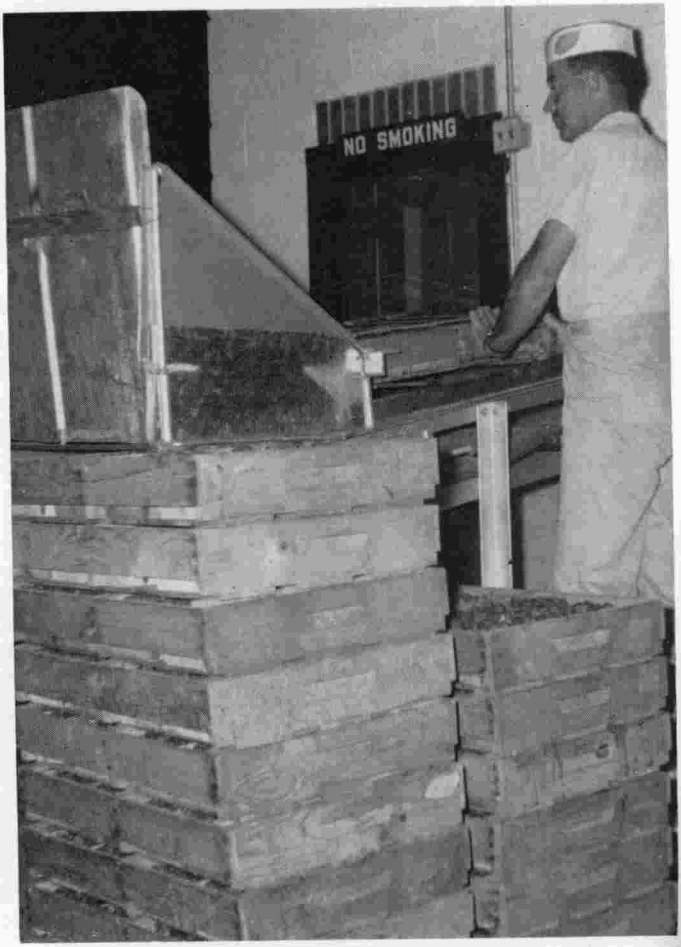

Figure 17. The first movement in dumping strawberries by the jig method.

are inverted over the diagonal dump frame which is made of steel rods (Figure 18). The strawberries fall on a conveyor belt that transports them into a shaker-washer.

The rate of dumping a 24-quart crate—2 quarts at one time—averages 58 seconds. The rate of dumping is governed by the quality of strawberries. When the percentage of sort out is high, more time is required by the sorters to remove them. The worker

who is dumping the strawberries adjusts his dumping speed to maintain an adequate flow of berries. Two workers are required per belt for dumping the berries. When the jig method (dumping 12 quarts at one time) is used, only one worker is required for dumping per belt. Table 12 shows the costs of dumping straw-

Figure 18. The second movement in dumping strawberries by the jig method.

berries by the conventional and jig methods in five model plants. The potential savings on dumping for a 2-belt and a 5-belt plant by the jig method over the conventional method (assuming a capacity of 2,000 pounds per hour with a 100-hour season) would be $182.97 and $457.43, respectively. If the 2-belt and 5-belt plants were operated for a 200-hour season, the potential savings would be $393.97 and $984.93 on dumping by the jig method over the conventional method (Table 12). Comparing operations of 100 and 200 hours for a 5-belt plant, Figure 19 shows that as the length of the season increases, the potential savings are more than doubled when using the jig method instead of the conventional method. The potential savings result from a reduction in the

Table 12. Costs of dumping strawberries by the conventional and jig methods in five model plants with 100- and 200-hour seasons, Tennessee, 1963

No. of inspection belts (2000-lb. capacity)	No. of crates or lugs required	Seasonal fixed charge[a]	No. of dump workers required[b]	100-hour season		200-hour season	
				Variable cost per season[c]	Total variable and fixed costs	Variable cost per season[c]	Total variable and fixed costs
			Conventional method				
1	1,000	$ 400.00	2	$ 211.00	$ 611.00	$ 422.00	$ 822.00
2	1,000	400.00	4	422.00	822.00	844.00	1,244.00
3	1,500	600.00	6	633.00	1,233.00	1,266.00	1,866.00
4	2,000	800.00	8	844.00	1,644.00	1,688.00	2,488.00
5	2,500	1,000.00	10	1,055.00	2,055.00	2,110.00	3,110.00
			Jig method				
1	2,000	418.71[d]	1	105.50	524.21	211.00	629.71
2	2,000	428.03	2	211.00	639.03	422.00	850.03
3	3,000	642.06	3	316.50	958.56	633.00	1,275.06
4	4,000	856.06	4	422.00	1,278.06	844.00	1,700.06
5	5,000	1,070.07	5	527.50	1,597.57	1,055.00	2,125.07

[a]Expected life of crates is 4 years; cups, 2 years. Lugs are estimated to have a life of 15 years. Crates are valued at 64¢ each; lugs, 82¢ each, cups, 0.15¢ each. The fixed charge includes fixed repair, 1.5%; insurance, 1.0%; interest on investment, 3.0%; property tax, 0.5%; and depreciation calculated according to estimated use life.

[b]Labor standards (pounds per hour): conventional method, 1,800 pounds per hour; jig method, 3,300 pounds per hour.

[c]Hourly wage, $1.00 plus 5.5% to cover payroll taxes.

[d]Includes charge for jig. The cost of one jig is $58.25 with an estimated life of 10 years. One jig is required for each inspection belt.

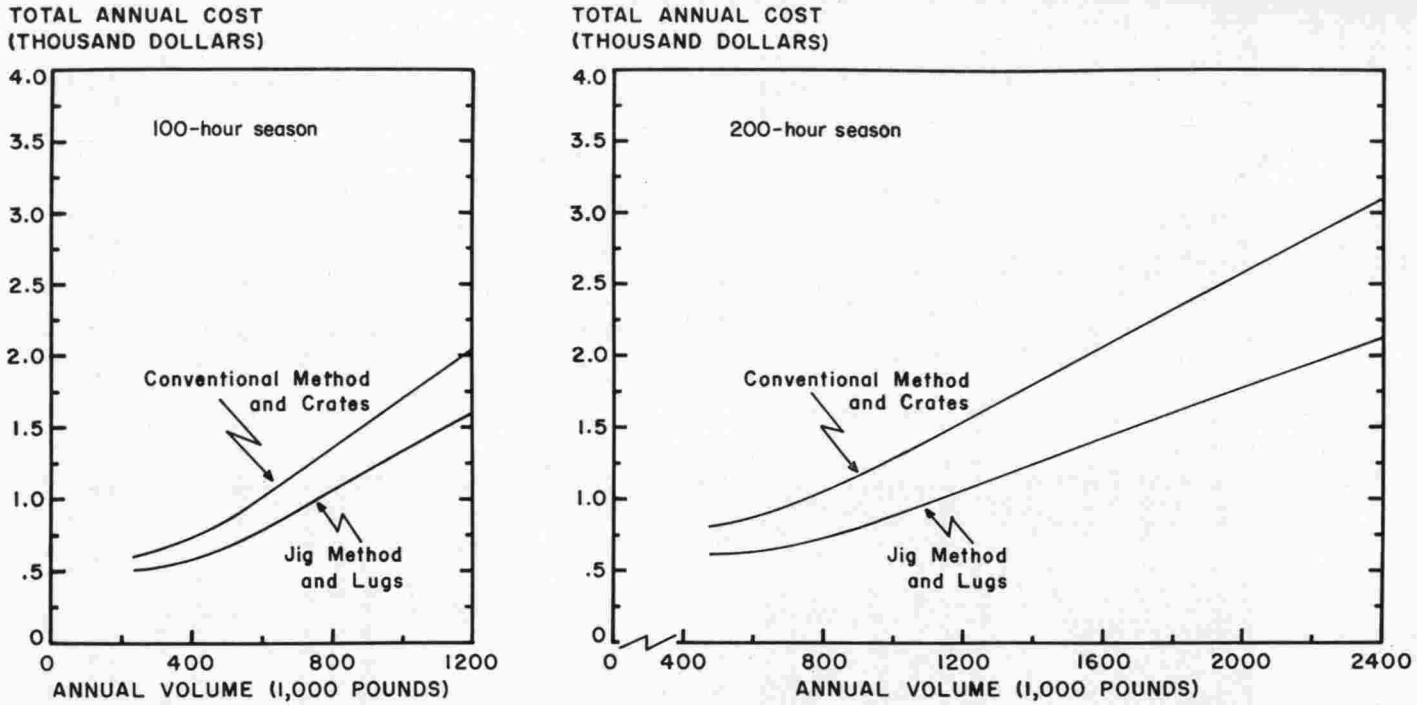

Figure 19. Relationship of dumping by the conventional and jig methods to costs when output is 2,000 pounds per hour per belt, operating 100 and 200 hours at full capacity, Tennessee, 1963.

amount of labor used. Mechanical crate dumps were more economical than manual handling in California when plants are operated 500 or more hours. It does not pay to install automatic dumps in other areas where seasons are less than 500 hours. Manual dumping costs less.[5]

Additional fixed charges may be incurred when 24-quart crates or 12-quart lugs are not returned to the plant by growers or truckers. Based upon the experience of actual plant operators, this could amount to as much as $350.00 per 1,000 24-quart crates or 2,000 12-quart lugs. Requiring a 50¢ deposit on each crate or lug will eliminate most of the losses from unreturned containers.

Casing Methods

There are three methods of casing the 10-ounce cartons and 6½-pound tins: manual, semi-mechanical, and mechanical. In the semi-mechanical method, the cases are filled manually and sealed automatically, and in the mechanical method the casing and sealing are performed by machines. The manual method is used in the five model plants (Table 13).

Table 13. Cost per pound of casing 10-ounce cartons for five model plants operating at full capacity with a 100-hour season and 10% sort out, Tennessee, 1963

No. of inspection belts	Annual pounds processed	No. of workers	Variable cost	Fixed cost	Total cost
				Cents	
1	226,800	3	0.14	0.04	0.18
2	453,600	7	0.16	0.04	0.20
3	680,400	9	0.14	0.02	0.16
4	907,200	11	0.13	0.03	0.16
5	1,134,000	13	0.12	0.02	0.14

The total seasonal costs for the three methods are about equal at low rates of input up to a 500-hour season, when it becomes more economical to use semi-mechanical and mechanical methods.[6]

In-Plant Transportation

The methods of in-plant transportation considered for the five model plants were hand truck, dolly, and fork truck. Approximately

[5]Dennis, C. C. and Reed, R. H., "Mechanical Crate Dumps Found Superior to Manual Handling in Strawberry Plants," **Quick Frozen Foods**, 19:205-6, July 1957.

[6]Dennis, C. C., "Mechanization of Carton-Casing, Carton-Sealing Effects Big Saving in Strawberry Plants, **Quick Frozen Foods**, August 1957, pp. 39-40.

14 lugs can be transported per trip by the hand truck and 42 lugs by the dolly or a fork truck (Figure 20). The fork truck is not economical for the five model plants because of the short season and low output.[7] The time required for operation of the dolly over

Figure 20. Hand truck (left) and dolly (right) used for transporting strawberries.

a specified distance is about the same as the time required for the hand truck. However, unless more berries are processed than one man can transport with the hand truck, there will not be any savings in using the dolly.

Investment in Buildings and Equipment

Buildings

The investment in buildings for the 1- through 5-belt plants was based on the minimum space requirements for each size plant. The enclosed building space requirements range from 2,645 to 11,546 square feet for the 1- through 5-belt plants. The cost range from $18,941 to $46,595 for the 1- to 5-belt plants (Table 14).

[7]Sammet, L. L., **In-Plant Transportation Costs as Related to Materials Handling Methods—Apple and Pear Packing**, California Agricultural Experiment Station, Mimeographed Report No. 142, January 1953, p. 19, estimates that the break-even point for a hand truck and fork truck is at 285 hours of operation per season with an input of 20,000 pounds per hour.

Table 14. Building space requirements, replacement costs, and annual fixed charges with respect to plant-input capacity for five model plants processing strawberries for freezing[a], Tennessee, 1963

Plant strawberry input capacity	Enclosed building area requirement[b]	Building replacement cost[c]	Annual building charges[d]
Lbs./hr.	Sq. ft.	Dollars	
2,000	2,645	18,941	1,591
4,000	4,870	25,854	2,172
6,000	7,096	32,768	2,753
8,000	9,321	39,682	3,333
10,000	11,546	46,595	3,914

[a]Dennis, C. C., **An Analysis of Costs of Processing Strawberries for Freezing**, University of California, Mimeographed Report No. 210, July 1958, p. 51.

[b]The equation for estimating the building space is given on page 15.

[c]The equation for estimating planning cost is given on p. 15.

[d]Based on the building replacement cost. The items included and rates are listed on p. 13.

Equipment

The costs of the equipment, for example, in a 1-belt plant would be $14,763.06 to cover costs of equipment needed irrespective of size of containers packed (Table 15). If the 10-ounce carton is packed, $7,345.00 of additional equipment would be needed, and $15,258.00 of additional equipment if the 6½-pound container is packed. If only the 30-pound container is packed, it would only be necessary to buy $535.00 of equipment in addition to the basic equipment ($14,763.06). The floor plan for a 3-belt model plant is shown in Figure 21.

COMPARISON OF COSTS AND EFFICIENCY IN EXISTING AND MODEL PLANTS

Considerable excess capacity was found in the strawberry processing plants studied. The plants should have enough capacity to process the crop when it is ready. Half of the plants operated at less than 75% of the potential capacity and 20% at less than 50% of potential capacity.

The degree to which the use of capacity affects the average total cost per pound depends to some extent on the size of the processing plant. For example, the cost spread between operating at 50% and 100% of capacity for a 1-belt, 200-hour season plant is 2.79 and 2.14 cents per pound for the 10-ounce carton and 30-pound

Table 15. Replacement costs and annual fixed charges of equipment for five model plants, Tennessee, 1963

No. of belts	Equipment needed for all sizes packed		Additional equipment for packing 10-ounce carton		Additional equipment for packing 6½-pound tin		Additional equipment for packing 30-pound tin	
	Replacement cost	Annual charge[a]	Replacement cost	Annual charge[a]	Replacement cost	Annual charge[a]	Replacement cost	Annual charge[a]
	Dollars							
1	14,763.06	2,332.63	7,345.00	1,909.59	15,258.00	2,386.24	535.00	74.44
2	17,844.26	2,777.65	12,005.00	3,449.04	15,258.00	2,386.24	535.00	74.44
3	22,170.46	3,464.31	12,590.00	3,523.17	15,258.00	2,386.24	1,070.00	148.88
4	26,245.91	4,022.04	18,225.00	5,216.10	15,258.00	2,386.24	1,070.00	148.88
5	30,377.11	4,769.43	18,735.00	5,280.71	29,316.00	4,620.43	1,070.00	148.88

[a]The items included and rates are listed on p. 13.

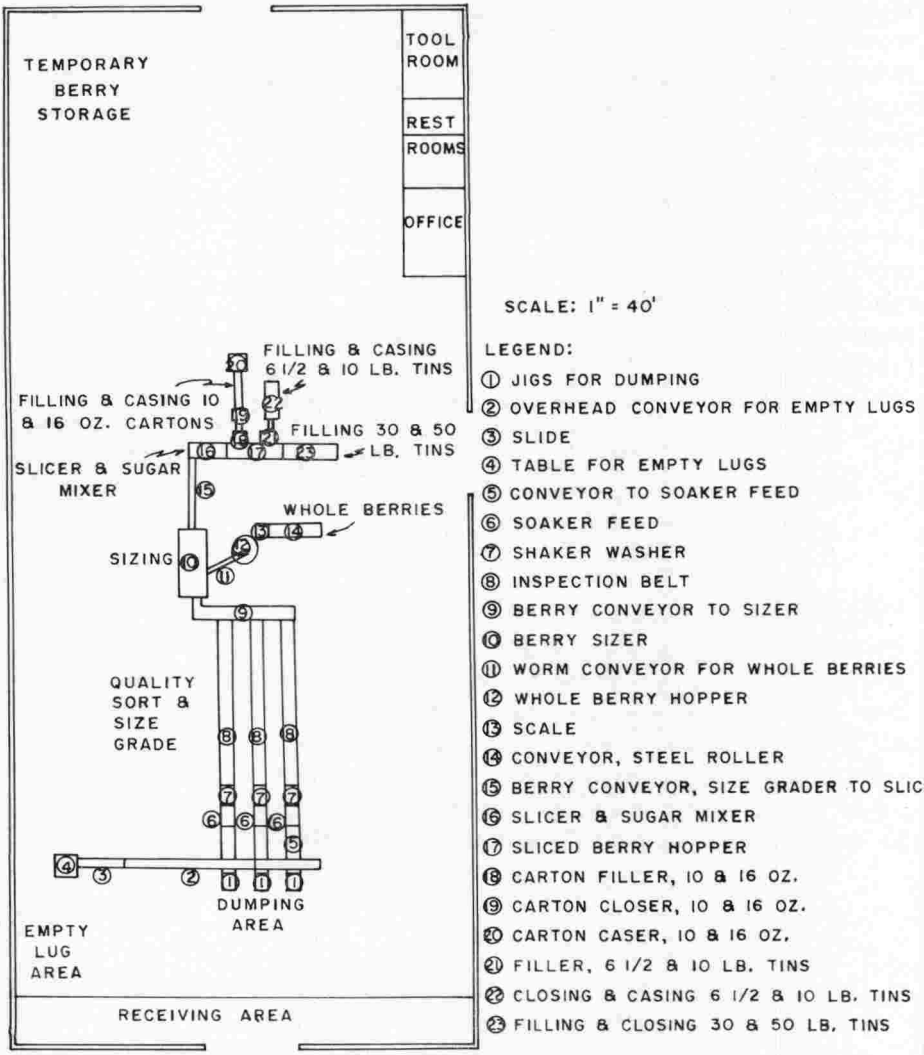

Figure 21. Floor plan for a model three-belt strawberry processing plant.

tin, respectively. For a 5-belt plant the difference is 1.01 cents per pound for the 10-ounce carton and 0.73 cent per pound for the 30-pound tin.

Costs per pound of processed product are appreciably lower in the model plants than in actual plants. For example, the costs of packaging 30-pound containers averaged 8.61 cents per pound in six plants with an average annual volume of 300,486 pounds.

if the same volume were processed in model plants, the savings would be 1.21 cents per pound or $3,636 per plant. If 1,263,300 pounds were packaged in 50-pound containers, the savings in the model plants would be 1.02 cents per pound, or $12,886 for a plant packing in the 50-pound countainer.

When strawberries were packaged in the 30-pound container, the output per man-hour in six existing plants was 83 pounds of processed product and is estimated to be 107 pounds of processed product in the model plant. When packaging was done in 50-pound containers in two existing plants, the output per man-hour was 168 pounds of processed product and is estimated to be 187 pounds of processed product in the model plant.

APPENDIX

Tables 1-17. Costs per pound and total dollar costs for processing strawberries.

Table 18. Labor production standards for jobs performed in five model plants processing strawberries for freezing.

Table 19. Personnel required to process strawberries at five model plants and operating at 100% capacity, 10% sort out.

Tables 20-22. Equipment for a model plant with one inspection belt packaging in the 10-ounce, 6½-, and 30-pound tins.

Table 23. Miscellaneous equipment.

Appendix Table 1. Variable costs of processing strawberries for 20 plants in Tennessee, 1959

Plant	Annual volume of strawberries processed	Variable costs						Total variable cost
		Sugar	Processing labor cost[a]	Container cost	Freezing and storage	Electricity and water	Transportation cost	
	Pounds				Dollars			
A	140,808	2,045	2,616	2,196	901	38	760	8,556
B	142,215	2,560	1,573	1,892	910	40	482	7,457
C	192,438	4,255	5,315	2,857	577	333	761	14,098
D	259,290	2,511	8,672	2,825	1,093	507	1,250	16,858
E	296,313	5,457	3,235	3,360	1,896	215	1,218	15,381
F	296,420	8,003	4,562	3,952	1,897	266	1,069	19,749
G	301,020	4,827	3,605	4,014	1,855	59	1,247	15,607
H	326,002	6,237	5,082	5,967	1,109	774	846	20,015
I	328,818	4,680	5,271	5,184	685	952	800	17,572
J	330,720	4,176	6,636	3,928	185	1,000	1,602	17,527
K	347,262	7,605	6,758	9,557	2,222	311	735	27,188
L	393,699	7,740	6,772	10,404	2,520	266	787	28,489
M	473,520	9,631	7,069	5,998	3,031	156	2,270	28,155
N	642,590	12,883	8,155	8,902	1,231	744	7,544	39,459
O	762,142	16,157	14,725	15,733	4,953	367	2,781	54,716
P	925,743	14,774	16,545	18,931	6,017	320	4,231	60,818
Q	1,034,300	27,926	10,482	11,991	6,620	364	4,315	61,698
R	1,114,900	26,083	7,362	12,487	7,135	445	1,122	54,634
S	1,235,090	25,043	18,616	28,822	1,109	1,475	2,320	77,385
T	1,411,700	37,666	12,073	15,811	9,035	500	1,414	76,499
Avg.	547,750	11,513	7,756	8,741	2,749	457	1,878	33,093

[a]Includes payroll taxes @ 5.5%.

Appendix Table 2. Fixed costs of processing strawberries for 20 plants in Tennesee, 1959

Plant	Annual volume of strawberries processed	Fixed Cost			Total fixed cost
		Plant equipment cost[a]	Building cost[b]	Admin. expenses & office supplies	
	Pounds		Dollars		
A	140,808	2,002	672	1,200	3,874
B	142,215	2,726	336	1,637	4,699
C	192,438	4,689	5,880	1,709	12,278
D	259,290	8,044	4,872	1,069	13,985
E	296,313	2,870	1,260	3,152	7,282
F	296,420	2,610	2,184	2,463	7,257
G	301,020	2,643	1,512	1,141	5,296
H	326,002	9,105	2,520	1,331	12,956
I	328,818	4,469	1,680	1,011	7,160
J	330,720	2,921	1,680	1,306	5,907
K	347,262	9,522	714	1,536	11,772
L	393,699	10,140	2,520	1,576	14,236
M	473,520	6,547	2,520	1,462	10,529
N	642,590	2,526	4,200	1,172	7,898
O	762,142	13,987	840	1,986	16,813
P	925,743	11,929	4,200	3,969	20,098
Q	1,034,300	7,002	2,100	2,519	11,621
R	1,114,900	3,588	2,100	2,689	8,377
S	1,235,090	17,776	8,400	3,270	29,446
T	1,411,700	6,034	2,520	2,613	11,167
Average	547,750	6,557	2,636	1,941	11,133
Pct. average is of total avg. fixed cost		58.9%	23.7%	17.4%	100.0%

[a]Based on installed cost. Includes fixed repair, 1.5%; insurance, 1.0%; interest on investment, 3.0%; property tax, 0.5%; and depreciation calculated according to estimated use life.

[b]Based on building replacement cost. The items included and rates are listed on p. 13.

Appendix Table 3. Total costs of processing strawberries in 20 Tennessee plants, 1959

Plant	Annual volume of strawberries processed	Total variable cost	Total fixed cost	Total cost	Total cost including raw strawberries
	Pounds			Dollars	
A	140,808	8,556	3,874	12,430	27,968
B	142,215	7,457	4,699	12,156	28,707
C	192,438	14,098	12,278	26,376	47,206
D	259,290	16,858	13,985	30,843	63,218
E	296,313	15,381	7,282	22,664	51,867
F	296,420	19,749	7,257	27,006	57,130
G	301,020	15,607	5,296	20,903	55,043
H	326,002	20,015	12,956	32,972	68,758
I	328,818	17,572	7,160	24,732	67,132
J	330,720	17,527	5,907	23,434	62,947
K	347,262	27,188	11,772	38,960	77,915
L	393,699	28,489	14,236	42,725	91,472
M	473,520	28,155	10,529	38,684	87,907
N	642,590	39,460	7,898	47,357	115,214
O	762,142	54,716	16,813	71,529	156,366
P	925,743	60,818	20,098	80,916	191,446
Q	1,034,300	61,698	11,620	73,318	182,923
R	1,114,900	54,634	8,377	63,011	176,018
S	1,235,090	77,385	29,447	106,832	244,203
T	1,411,700	76,499	11,167	87,666	231,540
Avg.	547,750	33,093	11,133	44,226	104,249

Appendix Table 4. Cost per pound of processing strawberries for a four-belt model plant packaging 10-ounce cartons with operating seasons of 100 and 200 hours and 10% sort out, Tennessee, 1963

Capacity utilized	Annual volume	Variable cost	Fixed cost	Total cost
Percent	Pounds		Cents	
		100-hour season		
50	453,600	6.67	3.17	9.84
75	680,400	6.42	2.12	8.54
100	907,200	6.34	1.59	7.93
		200-hour season		
50	907,200	6.62	1.68	8.30
75	1,360,800	6.38	1.12	7.50
100	1,814,400	6.31	0.84	7.15

Appendix Table 5. Total cost of processing strawberries for a four-belt model plant packing 10-ounce cartons with operating seasons of 100 and 200 hours and 10% sort out, Tennessee, 1963

Capacity utilized	Annual volume	Variable cost	Fixed cost	Total cost
Percent	Pounds		Dollars	
		100-hour season		
50	453,600	30,277	14,400	44,677
75	680,400	43,665	14,400	58,065
100	907,200	57,529	14,400	71,929
		200-hour season		
50	907,200	60,059	15,251	75,310
75	1,360,800	86,836	15,251	102,087
100	1,814,400	114,563	15,251	129,814

Appendix Table 6. Cost per pound of processing strawberries by capacity utilized for five model plants packaging 10-ounce cartons or 30-pound tins with a 200-hour season and 10% sort out, Tennessee, 1963

No. belts	Percent of plant capacity		
	50	75	100
		Cents	
		10-ounce cartons	
1	11.46	9.60	8.67
2	9.34	8.25	7.70
3	8.49	7.67	7.23
4	8.30	7.50	7.15
5	8.03	7.35	7.02
		30-pound tins	
1	8.43	7.00	6.29
2	6.63	5.79	5.37
3	6.03	5.38	5.07
4	5.74	5.22	4.95
5	5.60	5.11	4.87

Appendix Table 7. Total cost of processing strawberries by capacity utilized for five model plants packaging 10-ounce cartons or 30-pound tins with a 200-hour season and 10% sort out, Tennessee, 1963

No. belts	Percent of plant capacity		
	50	75	100
		Dollars	
		10-ounce cartons	
1	25,995	32,654	39,313
2	42,387	56,127	69,836
3	57,778	78,288	98,372
4	75,310	102,087	129,814
5	90,961	125,060	159,191
		30-pound tins	
1	19,132	23,825	28,518
2	30,050	39,437	48,792
3	41,051	54,820	69,007
4	52,106	71,020	89,830
5	63,520	86,946	110,406

Appendix Table 8. Cost per pound of processing strawberries for five model plants packaging 10-ounce cartons and operating for 100 and 200 hours with 10% sort out, Tennessee, 1963

No. belts	Capacity utilized — percent		
	100	75	50
		Cents	
		100-hour season	
1	10.18	11.60	14.47
2	8.75	9.65	11.45
3	8.04	8.74	10.11
4	7.93	8.53	9.84
5	7.71	8.27	9.40
		200-hour season	
1	8.67	9.60	11.46
2	7.70	8.25	9.34
3	7.23	7.67	8.49
4	7.15	7.50	8.30
5	7.02	7.35	8.03

Appendix Table 9. Total cost of processing strawberries for five model plants packaging 10-ounce cartons and operating for 100 and 200 hours with 10% sort out, Tennessee, 1963

No. belts	Capacity utilized — percent		
	100	75	50
		Dollars	
		100-hour season	
1	23,073	19,744	16,414
2	39,702	32,847	25,977
3	54,673	44,631	34,376
4	71,928	58,065	44,677
5	87,408	70,343	53,293
		200-hour season	
1	39,313	32,654	25,995
2	69,836	56,127	42,387
3	98,372	78,288	57,778
4	129,814	102,087	75,310
5	159,191	125,060	90,961

Appendix Table 10. Cost per pound of processing strawberries for five model plants packaging 30-pound tins and operating for 100 and 200 hours with 10% sort out, Tennessee, 1963

No. belts	Capacity utilized — percent		
	100	75	50
		Cents	
		100-hour season	
1	7.39	8.47	10.62
2	6.06	6.70	7.99
3	5.62	6.11	7.15
4	5.44	5.87	6.77
5	5.33	5.72	6.52
		200-hour season	
1	6.29	7.00	8.43
2	5.37	5.79	6.63
3	5.07	5.38	6.03
4	4.95	5.22	5.74
5	4.87	5.11	5.60

Appendix Table 11. Total cost of processing strawberries for five model plants packaging 30-pound tins and operating for 100 and 200 hours with 10% sort out, Tennessee, 1963

No. belts	Capacity utilized — percent		
	100	75	50
		Dollars	
		100-hour season	
1	16,744	14,397	12,050
2	27,477	22,800	18,106
3	38,275	31,182	24,297
4	49,369	39,964	30,718
5	60,407	48,677	36,964
		200-hour season	
1	28,518	23,825	19,132
2	48,792	39,437	30,050
3	69,007	54,820	41,051
4	89,830	71,020	52,106
5	110,406	86,946	63,520

Appendix Table 12. Cost per pound of processing strawberries in five model plants operating at full capacity with 10% sort out and seasons of 100 and 200 hours by size of container packed, Tennessee, 1963

Size of container packed	Number of inspection belts				
	1	2	3	4	5
			Cents		
			100-hour season		
10-ounce	10.18	8.75	8.04	7.93	7.71
6½-pound	9.20	7.37	6.73	6.49	6.49
30-pound	7.39	6.06	5.62	5.44	5.33
50-pound	7.08	5.80	5.36	5.18	5.07
			200-hour season		
10-ounce	8.67	7.70	7.23	7.15	7.02
6½-pound	7.59	6.43	6.01	5.86	5.83
30-pound	6.29	5.37	5.07	4.95	4.87
50-pound	5.98	5.11	4.81	4.69	4.61

Appendix Table 13. Total cost of processing strawberries in five model plants operating at full capacity with 10% sort out and seasons of 100 and 200 hours, by size of container packed, Tennessee, 1963

Size of container packed	Number of inspection belts				
	1	2	3	4	5
			Dollars		
			100-hour season		
10-ounce	23,073	39,702	54,673	71,928	87,408
6½-pound	20,863	33,413	45,823	58,815	73,601
30-pound	16,744	27,477	38,275	49,369	60,407
50-pound	16,049	26,299	36,507	47,012	57,460
			200-hour season		
10-ounce	39,313	69,836	98,372	129,814	159,191
6½-pound	34,433	58,321	81,833	106,454	132,260
30-pound	28,518	48,792	69,007	89,830	110,406
50-pound	27,129	46,435	65,471	85,115	104,512

Appendix Table 14. Cost per pound of processing strawberries for five model plants packaging 10-ounce cartons operating for 50, 100, 150, and 200 hours at full capacity with 10% sort out, Tennessee, 1963

No. belts	Volume processed	Variable cost	Fixed cost	Total cost
	Pounds		Cents	
		50-hour season		
1	113,400	7.10	6.08	13.18
2	226,800	6.65	4.22	10.87
3	340,200	6.44	3.21	9.65
4	453,600	6.40	3.08	9.48
5	567,000	6.37	2.72	9.09
		100-hour season		
1	226,800	6.97	3.21	10.18
2	453,600	6.56	2.19	8.75
3	680,400	6.38	1.66	8.04
4	907,200	6.34	1.59	7.93
5	1,134,000	6.31	1.40	7.71
		150-hour season		
1	340,200	6.93	2.24	9.17
2	680,400	6.53	1.51	8.04
3	1,020,600	6.36	1.14	7.50
4	1,360,800	6.32	1.09	7.41
5	1,701,000	6.29	0.96	7.25
		200-hour season		
1	453,600	6.91	1.76	8.67
2	907,200	6.52	1.18	7.70
3	1,360,800	6.35	0.88	7.23
4	1,814,400	6.31	0.84	7.15
5	2,268,000	6.28	0.74	7.02

Appendix Table 15. Total cost of processing strawberries for five model plants packaging 10-ounce cartons operating for 50, 100, 150, and 200 hours at full capacity with 10% sort out, Tennessee, 1963

No. belts	Volume processed	Total variable	Total fixed	Total cost
	Pounds		Dollars	
		50-hour season		
1	113,400	8,053	6,898	14,951
2	226,800	15,075	9,572	24,647
3	340,200	21,920	10,914	32,834
4	453,600	29,041	13,961	43,002
5	567,000	36,094	15,443	51,537
		100-hour season		
1	226,800	15,803	7,271	23,074
2	453,600	29,757	9,944	39,701
3	680,400	43,387	11,286	54,673
4	907,200	57,529	14,400	71,929
5	1,134,000	71,527	15,881	87,408
		150-hour season		
1	340,200	23,571	7,633	31,204
2	680,400	44,463	10,307	54,770
3	1,020,600	64,893	11,649	76,542
4	1,360,800	86,042	14,828	100,870
5	1,701,000	107,021	16,309	123,330
		200-hour season		
1	453,600	31,323	7,990	39,313
2	907,200	59,172	10,664	69,836
3	1,360,800	86,366	12,006	98,372
4	1,814,400	114,563	15,251	129,814
5	2,268,000	142,459	16,733	159,192

Appendix Table 16. Cost per pound of processing strawberries by percent of sort outs for five model plants packaging 10-ounce cartons and operating at full capacity with seasons of 100 and 200 hours, Tennessee, 1963

Percent of sort out	Number of inspection belts				
	1	2	3	4	5
			Cents		
			100-hour season		
15	10.56	9.06	8.30	8.19	7.92
10	10.18	8.75	8.04	7.93	7.71
5	9.83	8.58	7.80	7.69	7.49
			200-hour season		
15	8.97	7.94	7.44	7.37	7.19
10	8.67	7.70	7.23	7.15	7.02
5	8.40	7.48	7.04	6.97	6.84

Appendix Table 17. Total cost of processing strawberries by percent of sort out for five model plants packaging 10-ounce cartons and operating at full capacity with seasons of 100 and 200 hours, Tennessee, 1963

Percent of sort out	Number of inspection belts				
	1	2	3	4	5
			Dollars		
			100-hour season		
15	22,628	38,811	53,338	70,148	84,867
10	23,973	39,702	54,673	71,928	87,408
5	23,518	41,066	56,008	73,708	89,634
			200-hour season		
15	38,423	68,055	95,701	126,254	154,108
10	39,313	69,836	98,372	129,814	159,191
5	40,203	71,616	101,042	133,374	163,642

Appendix Table 18. Labor production standards for jobs performed in the five model plants processing strawberries for freezing, Tennessee, 1963

Job classification and description	Production standard Units per hour
Receive and weigh lugs	600 lugs
Stack and transport lugs to dumping point and remove empty lugs	350 lugs
Dump lugs with jig	190 lugs
Sort berries for quality (5% culls)	12 lugs
Sort berries for quality (10% culls)	10 lugs
Sort berries for quality (15% culls)	9 lugs
Supply sugar system (2 men)	2,000 pounds
10-ounce carton (24 cartons per case)	
Supply cartons	750 cases
Feed cartons to filler	185 cases
Place cartons on freezer trays	250 cases
Move trays to freezer and bring empty trays	242 cases
Move cartons from freezer to casing station	500 cases
Stencil and form cases	500 cases
Fill cases	160 cases
Stack cases and move to freezer	500 cases
6½-pound tin (6 tins per case)	
Supply tins and feed to filler	200 cases
Operate filler	250 cases
Stack tins and move to freezer	200 cases
Move tins from freezer to casing station	500 cases
Stencil and form cases	200 cases
Fill cases	120 cases
Stack cases and move to freezer	200 cases
30-pound tin	
Supply and stencil tins	325 tins
Fill and close tins	325 tins
Stack tins and move to freezer	250 tins
50-pound tin	
Supply and stencil tins	275 tins
Fill and close tins	275 tins
Stack tins and move to freezer	150 tins

Appendix Table 19. Personnel required to process strawberries at five model plants operating at 100% capacity, 10% sort out, Tennessee, 1963

Job classification	No. belts				
	1	2	3	4	5
	Employees				
Receive and weigh lugs	1	1	1	1	1
Stack and transport lugs to dumping point and remove empty lugs	1	1	1	2	2
Dump lugs with jig	1	2	3	4	5
Sort berries for quality	12	24	36	48	60
Supply sugar system	2	2	2	2	2
Total	17	30	43	57	70
10-ounce carton					
Supply cartons	1	1	1	1	2
Feed cartons to filler	1	2	3	4	5
Place cartons on freezer trays	1	2	2	3	4
Move trays to freezer and return empty trays	1	2	2	3	4
Move cartons from freezer to casing station	1[a]	1[b]	1	2[c]	2[d]
Stencil and form cases	1	1	1	2	2
Fill cases	1	2	3	4	5
Stack cases and move to freezer	1[a]	1[b]	1	1[c]	1[d]
Total	7	11	14	19	24
6½-pound tin					
Supply and feed tins to filler	1[e]	1[f]	1	2[g]	2[h]
Operate filler	1[e]	1[f]	1	1[g]	1[h]
Stack and move tins to freezer	1	1	1	2	2
Move tins from freezer to casing station	1[i]	1	1	2[l]	2
Stencil and form cases	1[j]	1[k]	1	2[m]	1[n]
Fill cases	2[j]	2[k]	2	2[m]	3[n]
Stack cases and move to freezer	1[i]	1	1	1[l]	1
Total	5	6	8	8	10
30-pound tin					
Supply and stencil tins	1[o]	1[p]	1	1	1[q]
Fill and close tins	1[o]	1[p]	1	1	2[q]
Stack and move tins to freezer	1	1	1	2	2
Total	2	2	3	4	4
50-pound tin					
Supply and stencil tins	1[r]	1[s]	1[t]	1[u]	1
Fill and close tins	1[r]	1[s]	1[t]	1[u]	1
Stack and move tins to freezer	1	1	1	2	2
Total	2	2	2	3	4

a-u The paired letters indicate that the worker(s) does both jobs.

Personnel tables for all other percentages of capacity and sort out are available from the Department of Agricultural Economics, University of Tennessee.

Appendix Table 20. Equipment for a model plant with one inspection belt packaging 10-ounce cartons

Quantity	Major equipment items	Replacement cost	Use life	Annual charge[a]
1	Jig	$ 58	10	$ 9
1	Dump stand	25	15	3
1	Conveyor, dumper to soaker feed	475	15	60
1	Soaker feed	470	10	75
1	Shaker washer	750	10	120
1	Inspection belt/sorting platform	1,200	15	152
1	Magnet	7	25	1
1	Dewatering belt	530	15	67
1	Worm conveyor	560	15	71
1	Sugar elevator	625	15	79
1	Sugar hopper	200	10	32
1	Slicer and sugar mixer	2,814	10	450
1	Vat feeder (holding tank)	1,200	15	152
1	10-oz. carton filler	4,010	10	642
1	Carton closer, 10-oz.	RENT		950
2	Conveyors	320	15	41
1	Scales, exact	190	15	24
50	Pallets	100	10	16
1	Case stapler (275 cases/hr.)	475	10	76
1	Case forming table	25	15	3
1	Glue stand	25	15	3
1	Empty lug conveyor	400	15	51
1	Empty lug slide	40	15	5
1	Empty lug table	40	15	5
1	Floor scale	794	15	101
2	Roller conveyors	150	15	19

[a]Includes fixed repair. The items included and rates are listed on p. 13.

Appendix Table 21. Equipment for a model plant with one inspection belt packing 6½-lb. tins

Quantity	Major equipment items	Replacement cost	Use life	Annual charge[a]
1	Jig	$ 58	10	$ 9
1	Dump stand	25	15	3
1	Conveyor, dumper to soaker feed	475	15	60
1	Soaker feed	470	10	75
1	Shaker washer	750	10	120
1	Inspection belt/sorting platform	1,200	15	152
1	Magnet	7	25	1
1	Dewatering belt	530	15	67
1	Worm conveyor (fruit elevator)	560	15	71
1	Sugar elevator	625	15	79
1	Sugar hopper	200	10	32
1	Slicer and sugar mixer	2,814	10	450
1	Vat feeder (holding tank)	1,200	15	152
1	6½-lb. tin filler (250 cases/hr.)	8,125	10	1,300
1	6½-lb. tin closer	5,005	10	801
1	Conveyor	75	15	10
50	Pallets	100	10	16
1	Case stapler	475	10	76
1	Case forming table	25	15	3
1	Glue stand	25	15	3
1	Empty lug conveyor	400	15	51
1	Empty lug slide	40	15	5
1	Empty lug table	40	15	5
1	Platform scale	253	15	32
1	Conveyor (steel roller)	75	15	10
1	Floor scale	794	15	101

[a]Includes fixed repair. The items included and rates are listed on p. 13.

Appendix Table 22. Equipment for a model plant with one inspection belt packing 30-lb. tins

Quantity	Major equipment items	Replacement cost	Use life	Annual charge[a]
1	Jig	$ 58	10	$ 9
1	Dump stand	25	15	3
1	Conveyor, dumper to soaker feed	475	15	60
1	Soaker feed	470	10	75
1	Shaker washer	750	10	120
1	Inspection belt/sorting platform	1,200	15	152
1	Magnet	7	25	1
1	Dewatering belt	530	15	67
1	Worm conveyor	560	15	71
1	Sugar elevator	625	15	79
1	Sugar hopper	200	10	32
1	Slicer and sugar mixer	2,814	10	450
1	Fill hopper 30-lb. tin	200	10	32
50	Pallets	100	10	16
1	Empty crate conveyor	400	15	51
1	Empty crate slide	40	15	5
1	Empty crate table	40	15	5
1	Conveyor (steel roller)	75	15	10
1	Platform scale, 50 lb. capacity	260	15	33
1	Floor scale, 2600 lb. capacity	794	15	101

[a]Includes fixed repair. The items included and rates are listed on p. 13.

Appendix Table 23. Miscellaneous equipment for a model plant with one inspection belt

Quantity	Miscellaneous equipment items	Replacement cost	Use life	Annual charge[a]
3	Chairs	$ 30	15	$ 4
2	24 in. fans	760	6	172
2	Gas heaters	350	12	50
2	Lockers, 19 unit	437	15	55
2	Fire extinguishers	23	12	3
1	Presto lite torch	14	5	4
1	Electric hand drill	80	10	13
1	Pipe threader, cutter, tap	50	10	8
1	Welder, arc, complete	395	12	57
1	Miscellaneous hand tools (set)	150	5	39
1	Sewage disposal	350	15	44
6	G. I. cans, 15 gal.	30	5	8
2	Drums, 55 gal.	10	10	2
2	Small cans	2	5	0
1	Bench vise	60	5	16
2	Dollies, hand operated	80	5	21
2,000	Lugs	1,640	15	208
24,000	Cups for lugs	360	2	202
1	Skil saw	60	15	8
1	Drill press	145	10	23
1	Bolt die set	30	15	4
Laboratory equipment:				
1	OHaus Harvard trip balance (ounce scale)	25	8	5
1	Blender	45	5	12
1	Sink, 66 in., stainless steel top	325	15	41
3	Hydrometer	8	5	2
2	Hydrometer jars	5	5	1
1	Microscope	99	15	13
6	Thermometers	13	5	3
6	Flat porcelain trays, 12 x 18	21	10	3
3	Howard mold counting chambers	30	5	8
1	Miscellaneous lab. supplies and glass ware	50	10	8

[a]Includes fixed repair. The items included and rates are listed on p. 13.

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